

Cactus Chemistry
By Species
2014
Light

**Assembled by
Keeper Trout
& friends**

Cactus Chemistry

By Species

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Previously published entitled

Distribution of the Alkaloids & Triterpenoids Reported in CACTACEAE; By Species (1997) and as

Trout's Notes #C-10 Cactus Chemistry Summary: By Species (1999 and later).

This version merges, updates, corrects and replaces all previous versions.

It is now section 2 of *Sacred Cacti* 4th edition Part C *Cactus Chemistry*

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Acquiring & processing the references needed for a comprehensive treatment has postponed the planned release date so dramatically that I have decided to make this version available while the final book takes shape. Due to the ongoing nature of research and this subject that book could be a never ending project to complete so the final book will be a compromise formed by time, life & literature access.

The intensely illustrated version that was the source for this same work can be found at:

<http://troutsnote.com/>

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Please do not use those links and I suggest deleting those files and downloading new ones. Most replacements are already online and the remaining are being worked on to enable their return.

kt Jan. 2018



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No one owns facts or factual data.

“ It is pertinent to mention that all of the *Trichocereus* species, which have been reported to contain alkaloids, grow in a rather limited geographical area confined to Argentina.”

DJERASSI *et al.* 1956 *JACS* 78: 2312-2315.

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Distribution of Alkaloids, Triterpenoids & other Compounds Reported in the CACTACEAE

Assembled & edited by Keeper Trout

It is important to understand that all alkaloid concentrations can be highly variable. This can be the result of many factors.

Genetics, environment, age, part sampled, weather, health, time of year or time of day, and whether the plants were wild or cultivated, have all been noted as factors potentially capable of influencing the alkaloid content and/or composition in plants.

Substantial variations can be encountered based on the variety, local form, age, growth stage and other factors.

An obvious but frequently overlooked fact is that analysis of a cactus can really only tell us about the actual material in hand undergoing analysis and can serve as no more than a probable guideline for what MIGHT be the case with another specimen within the same species.

Differences might simply be quantitative but are frequently found to be qualitative as well should enough samplings be performed.

The trend in the literature is a look at one sampling, sometimes using batched materials, and then move on to the next species. Those which have had in-depth workups performed for different collections and at different times of years suggest this should be undertaken for any species that has only one published analysis.

What should always be kept in mind when encountering any species where a single given alkaloid composition and concentration is stated this indicates that said species has only been analyzed that one single time.

Analysis involving different tissues within a single plant have consistently produced divergent results suggesting that distribution WITHIN a given specimen is also an avenue worthy of greater in-depth exploration. Mescaline users already utilize this unequal distribution by removing and ingesting only the outer portions of green tissue from the cactus *Trichocereus pachanoi* as, while wasteful of much of its contained alkaloid, it generates material that contains a greater percentage of mescaline by weight than would the intact plant. Sadly much of this work is not published and due to the current illegality of such practices (whether sacramental or recreational) will probably never be published in detail.

In many cases not enough variables are noted to understand the reported differences. We would suggest that detailed information about the actual source, the specific part or parts investigated (young or old tissues can produce quite different results as can different internal structures), the date and time of day they were collected and details about how they were processed PRIOR to investigation become regarded as vital information to include along with the normal procedural workup. The word "dried", as an example, can mean a number of things. For instance, freeze-dried material appears to give lower yields than does careful drying and standard extractions but whether this is the NORM remains to be evaluated.

Extraction approach can also generate differing results. Lengthy heating during Soxhlet extraction can cause changes compared to a room temperature soak being used. Similarly the use of acids during extraction, while valuable, can readily

hydrolyze or otherwise alter some components.

The concentrations given are as they were reported in the literature. Many were calculated as the final yield of highly purified and repeatedly recrystallized alkaloids and will therefore be low values.

Identification criteria can be found in the occurrence lists under individual alkaloid entries. (Previously released in an abridged form as C-9 Appendix A)

This supplemental listing is primarily of the alkaloids & triterpenoids reported from cacti although we have taken the liberty of including some additional compounds and reports indicating either that alkaloids were present but not identified or else that alkaloids seemed to be absent. Many fruit or flower pigments, carbohydrate, mucilage & polyphenolic studies were omitted.

In every case possible, the original research reports were used for the entries below but in a few instances we relied on second-hand listings when the primary source paper was unavailable. (Instances are indicated in the text.)

(%?) indicates both that the entry was from a second-hand listing and did not include a percentage.

Also included are notes of some errors appearing in the literature (an incomplete list). These are included simply to help the reader evaluate and resolve the conflicts they may find between this list and others. While making no note as to the source for any of these erroneous entries, they (and the reference that was cited) were included in hopes of reducing the number of errors being perpetuated in the future. We do not suggest people simply take us at our word over highly respected authorities and official databases; we do suggest that in these instances they look at the primary references given and determine the truth for themselves.

One point we would like to make concerning some of the disparities between various researchers is that AGURELL & coworkers specifically did not look for any quaternary amines and therefore would not have detected any even if present in their material.

It is also important to note that some workers used young cultivated material grown from seed while others used adult field collected specimens. The claim has been presented, without any indication of its basis, that analytical results are identical between these sets of samples but the available work as will be detailed within does not support that assertion beyond a rough qualitative generalization. Both have value for understanding the chemistry of the plants but in no case can the analysis of a given species or specimen be reliably extrapolated to indicate what will be found in anything other than what was analyzed on the day that it was analyzed.

Cacti can sometimes be highly variable in appearances. This work attempts to present multiple images of single species in habitat and grown under different situations or in multiple hands whenever possible. One clear advantage to this being a PDF is the elimination of concerns about minimizing cost through limiting the number of color photos that are included.

Cactus taxonomy and names in this work

Many species have been renamed multiple times; a partial list of synonyms or points of potential confusion is included.

Please see BACKEBERG, BRAVO, BRITTON & ROSE, ANDERSON, HUNT or the specific botanical authority listed for more nomenclatural or taxonomic details.

Some names have been changed so many times over the course of their analytical history that it can be difficult to locate comprehensive information about what has been published. The obscuring of analytical accounts by the proliferation of synonyms precluding effective indexing is an underappreciated problem. This is not limited to plants. My friend Jon Hanna pointed out a particularly amusing series of names changes. In a sweeping revision of Amphibia *Bufo alvarius* had its name changed to *Cranopsis alvaria* in 2006. Later in 2006 the name was changed again, by implication, to *Ollotis alvaria*. In 2008 it became *Incilius alvarius*. Incredibly the only one of its historical synonyms not resurrected in that process was *Phrynodis alvarius*. Few indexing services of publications can successfully manage to include all known synonyms of either plants or animals causing a fragmented access to the contents of scientific papers.

In many cases chemical work does not reflect the current name *en vogue*. We have often left names as encountered with efforts made only to reduce confusion. In this process we have employed what many may object to as outdated names.

This work is a compendium of published analytical accounts involving cacti rather than being a taxonomic treatment of cacti. Its just as likely that the following are presented however they were analyzed than with what is now their present accepted name.

Please be aware therefore that our use of one specific name over another does not necessarily indicate any agreement with or advocacy of that placement.

In a number of other cases older “splitter” synonyms were deliberately preserved to prevent lumping from obscuring some interesting analytical results.

A listing of synonyms is also incorporated so this should not cause any problems. Feedback is welcomed.

Some useful trivia

0.00X% indicates X milligrams per 100 grams. (i.e. 0.1% indicates 100 milligrams per 100 grams.)

0.01% by dry wt. is ~4.5 grams of alkaloid per 100 pounds dry wt. [i.e. 10 mg per 100 gm]

“5 to 25+ mg. per 100 grams of fresh” indicates approximately from ~0.01% to over 0.03% by wet wt.

Reported water content in some cacti has ranged from 62 to 95%. Around 90% water by weight is common.

Many entries based on bioassays of varieties of known active species were omitted from this work.

More details on those and many of the other species that are included in this work can be found in the pages of *Sacred Cacti Part A* and/or *Part B*

Aviso concerning the results of DJERASSI

It should be emphasized that most, if not all, of the triterpenoids investigated by DJERASSI (and other workers) were **primarily** artifacts of their isolation and analytical procedure. With only very few exceptions, it is not made clear if any of them actually exist in the plants and, if so, how much is there. In those few cases where it does appear that they actually may exist in the plant, it is as only a very small portion of the total triterpenoids recovered (The usual source for these triterpenoids & sterols was via acid hydrolysis of the corresponding glycosates.)

While it might therefore be debated as to whether these aglycones are really properly listed as cactus components, since they are products arising from the hydrolysis of the mixed saponin fraction, it was deemed important to include them as they appear to have valuable chemotaxonomic significance.

Another point concerns DJERASSI’s alkaloid investigations. Many species they reported as being devoid of alkaloids were later shown to contain alkaloids (sometimes in appreciable amounts). While not dismissing the possibility of individual variation between samples, we suspect their alkaloid screening technique played a significant role in at least some of the disparate results.

It was specifically flawed with regards to detecting mescaline, substances with similar solubilities or any neutral alkaloids.

DJERASSI’s primary criteria for detecting alkaloids:

- 1) The residue remaining from an initial ethanolic extract would form an alkaline solution when extracted with ether. [Ed.: Not all alkaloids are soluble in ether & not all alkaloids form alkaline solutions.]
- 2) Alkaloids could be isolated and obtained as crystalline material.
- 3) Positive Mayer test. (Apparently not used in many cases)

DJERASSI sometimes noted the presence of unidentified materials but in many cases there was obviously material present they did not elaborate on or investigate further.

DJERASSI repeatedly made the claim that alkaloids and triterpenoid glycosides are not found in the same plant. While this is obviously incorrect if made as a blanket statement when considering trace or low amounts, it might prove true that the presence of substantial amounts of either may preclude large amounts of the other simultaneously being present. A systematic overview and evaluation is needed before drawing any firm conclusions.

<http://sacredcacti.com>

TROUT'S NOTES

PDFs & books:

Sacred Cacti in its 4th edition!

<http://sacredcacti.com/>

San Pedro

<http://www.troutsnotes.com/pdf/SP.html>

Opening comments from *Sacred Cacti*

http://www.troutsnotes.com/pdf/SC3_A.pdf

Some Other Succulents

http://www.troutsnotes.com/pdf/SoS_2004_Trout.pdf

Cactus Chemistry By Species

<http://www.troutsnotes.com/pdf/C10.html>

This is the intensely illustrated version of the work you are reading.

The Cactus Alkaloids

<http://www.troutsnotes.com/pdf/C13.html>

formerly known as

Appendix A

Thanks to EROWID

The ayahuasca book is online with copyright free text
http://erowid.org/library/books_online/ayahuasca_apa/

Some Simple Tryptamines

<http://www.troutsnotes.com/pdf/SST.html>

The Genus *Desmodium*

http://www.troutsnotes.com/pdf/D2_2004_Trout.pdf

More information:

TROUT'S NOTES

<http://troutsnotes.com>

Highly recommended website:

CACTUS CONSERVATION INSTITUTE

<http://www.cactusconservation.org/>

LEGUMINOSAE

These 3 plants are included simply because they are, **so far**, the only reported occurrences appearing in the literature for simple mescaline derivatives & a number of peyote alkaloids outside of the CACTACEAE. **Be sure to read to the end.**

Leaves, petioles & tender stems; samples fresh frozen. Collected Zavala County, Texas

***Acacia berlandieri* BENTHAM**

Compound (all via gc-ms)	Spring ppm	Late fall ppm
Phenethylamine	991.3	1390.0
N-Methyl-phenethylamine	1702.7	3742.2
N,N-Dimethyl-phenethylamine	99.1	604.4
N,N,N-Trimethylphenethylammonium hydroxide*	nd	23.6
Amphetamine	3.1	10.1
Methamphetamine	20.1	11.5
N,N-Dimethyl- α -methyl-phenethylamine	45.6	229.7
<i>p</i> -Hydroxyamphetamine	8.0	7.3
<i>p</i> -Methoxyamphetamine	nd	35.7
Tyramine	367.2	1263.4
N-Methyltyramine	188.5	745.7
Hordenine	9.2	333.1
Candicine*	nd	35.1
Dopamine	3.6	25.3
N-Methyldopamine	1.9	10.8
N,N-Dimethyldopamine	nd	nd
3-Methoxytyramine	2.6	15.3
Mescaline	4.9	35.7
N-Methylmescaline	3.2	30.2
Trichocereine	nd	28.1
3,4,5-Trimethoxyphenethyl-N,N,N-trimethylammonium hydroxide*	nd	13.2
3,5-Dimethoxytyramine	2.7	43.4
3,4-Dimethoxy-5-hydroxyphenethylamine	11.4	40.9
β -Methoxy-3,4-dihydroxy-5-methoxy-phenethylamine	nd	30.2
3,4-Dimethoxy- α -methyl-5-hydroxy-phenethylamine	2.0	47.2
Nicotine	39.6	108.3
Nornicotine	19.2	72.5
Anhalamine	4.9	39.6
Anhalidine (N-Methylanhalamine)	2.9	40.9
Anhalonidine	2.7	46.8
Mimosine, methyl ester	10.6	24.2
3 α -Cumyl-1,3,4-oxadiazolidine-2,5-dione	308.4	420.9
Nortriptyline	19.8	71.5
Musk ambrette	26.5	27.3

CLEMENT *et al.* 1997

*Identity and amount present was inferred from the corresponding styrene

***Acacia rigidula* BENTHAM**

Compound (all via gc-ms)	Spring ppm	Late fall ppm
2-Cyclohexylethylamine	0.8	35.2
N-2-Cyclohexylethyl-N-methylamine	1.2	47.1
Phenethylamine	872.3	1135.7
N-Methylphenethylamine	2314.6	5264.8
N,N-Dimethylphenethylamine	123.6	724.5
Amphetamine	6.7	11.8
Methamphetamine	nd	12.4
N,N-Dimethyl- α -methylphenethylamine	57.6	394.2
<i>p</i> -Hydroxyamphetamine	2.1	6.9
<i>p</i> -Methoxyamphetamine	nd	15.7
Tyramine	459.1	1699.2
N-Methyltyramine	237.4	1237.6
Hordenine	6.4	533.8
Dopamine	8.9	36.1
N-Methyldopamine	0.5	8.2
N,N-Dimethyldopamine	11.2	44.6
3-Methoxytyramine	1.8	12.9
N-Methyl-3-methoxytyramine	3.4	28.4
3-Hydroxy-4-methoxy-phenethylamine	15.8	163.2
N-Methyl-3-hydroxy-4-methoxy-phenethylamine	19.2	184.7
3,4-Dimethoxyphenethylamine	1.3	6.5
N-Methyl-3,4-dimethoxyphenethylamine	7.6	28.3
3,4,5-Trihydroxyphenethylamine	1.6	12.4
N-Methyl-3,4,5-trihydroxyphenethylamine	0.3	1.9
Mescaline	3.4	27.5
N-Methylmescaline	1.8	35.3
Trichocereine	0.2	13.8
3,5-Dimethoxytyramine	1.6	21.6
3,4-Dimethoxy-5-hydroxyphenethylamine	15.6	57.1
β -Methoxy-3,4-dihydroxy-5-methoxyphenethylamine	4.6	22.1
3,4-Dimethoxy- α -methyl-5-hydroxy-phenethylamine	5.3	61.4
Nicotine	45.8	152.4
Nornicotine	23.4	84.3

Trouts Notes on Cactus Chemistry

***Acacia rigidula* BENTHAM continued**

Compound	ppm	ppm
Tryptamine	0.8	21.2
N-Methyltryptamine	4.6	54.9
N,N-Dimethyltryptamine	323.8	568.4
Anhalamine	9.6	48.7
Anhalidine (N-Methylanhalamine)		
	5.6	51.2
Anhalonidine	2.3	15.7
Peyophorine	3.8	43.4
Pipecolamide	872.8	978.2
<i>p</i> -Hydroxypipecolamide	241.6	353.1
1,4-Benzenediamine	104.8	129.6
4-Methyl-2-pyridinamine	341.5	567.3

CLEMENT *et al.* 1998

It was brought to my attention by Sasha Shulgin that there were some odd discrepancies in the accounts of Clement.

Despite repeated attempts to learn answers, apparently no one connected with authorship of this paper has been willing to respond to several professional researchers attempting to obtain clarification. Most glaring : not all the novel compounds that their paper claimed were synthesized as reference materials have a published synthesis (personal communication with Sasha).

More recent work, published in PAWAL *et al.* 2013, was unable to detect the presence of mescaline, mescaline derivatives or any of the purported amphetamines but it supported the prior analytical work by CAMP *et al.* All of the other novel results in Clement's accounts need a confirmation by someone or they should similarly be considered to be suspect.

A commentary with references is online at <http://sacredcacti.com/blog/acacia/>

***Alhagi pseudalhagi* (BIEBERSTEIN) DESVAUX**

Phenethylamine (0.0017%; 180 mg from 10.3 kg dry wt.)
N-Methylphenethylamine (0.0007%; 72 mg from 10.3 kg dry wt.)

N-Methylmescaline (8.7x10⁻⁵%; 9 mg from 10.3 kg dry wt.)

Hordenine (0.00037%; 38 mg from 10.3 kg dry wt.)
N-Methyltyramine (0.00011%; 11 mg from 10.3 kg dry wt.)
Coryneine (the N-trimethyl cation of Dopamine) [3,4-Dihydroxyphenethyltrimethyl ammonium (isolated as chloride/hydroxide)] (0.00027%; 28 mg from 10.3 kg dry wt.)
Salicifoline (the N-trimethyl cation of 3-methoxytyramine) [3-Methoxy-4-hydroxyphenethyltrimethylammonium (isolated as chloride)] (0.00012%; 12 mg from 10.3 kg dry wt.)

dl-Salsolidine (0.00041%; 42 mg from 10.3 kg dry wt.)

Choline (0.002%; 222 mg from 10.3 kg dry wt.)

Betaine (Traces detected)

All % listed reflect the amount of base isolated from air dried and milled **stems** (Varanasi, India)

The roots were said to contain “*essentially the same alkaloids but in different proportions*”

Details were not included.

GHOSAL *et al.* 1974

See also GHOSAL & SRIVASTAVA 1973a.

Unlike the two papers by Clement *et al.* there is no reason to doubt Ghosal's results. Shibnath Ghosal did quite meticulous work during his research career.

Despite the problems, or perhaps because of them, results of Clements deserve to be revisited using the specialized sample collection techniques they purported to have used.

It seems unlikely that amphetamines will be found but it is curious that one amphetamine (*p*-methoxy-amphetamine) has been reported from *Browningia candelaris*. Details and a reference are located under that species farther below.

The Cactus Species

Assembled by Keeper Trout & friends

***Acanthocereus pentagonus* (L.) BRITTON & ROSE**
(Now *Acanthocereus tetragonus* (L.) HUMMELINCK)
“organo”, “pitahaya”, “pitahaya morada”,
“pitahaya naranjadas”, “night-blooming cereus”,
“barb-wire cactus” POWELL & WEEDIN 2004 & STANDLEY
1924
See comments in **Activity Notes**

Anhalonium elongata See as *Ariocarpus trigonus*

Anhalonium jourdanianum LEWIN was determined to contain an unidentified but pharmacologically active alkaloid; LEWIN 1894b. It cannot be demonstrably linked to *Lophophora jourdaniana* HABERMANN. [See comment under] ANDERSON 1980

Anhalonium lewinii HENNINGS See as *Lophophora williamsii*
Anhalonium prismaticum LEMAIRE See as *Ariocarpus retusus*
Anhalonium williamsii RÜMLER See as *Lophophora diffusa*
Anhalonium williamsii (LEMAIRE) LEMAIRE See as *Lophophora diffusa* [See BRUHN & HOLMSTEDT 1974 for details]

Anisocereus foetidus (MACDOUGALL & MIRANDA) MARSHALL
See as *Pterocereus foetidus*
Anisocereus gaumeri (BRITTON & ROSE) BACKEBERG
See as *Pterocereus* (?) *gaumeri*

***Aporocactus flagelliformis* (L.) LEMAIRE**
“flor del cuerno”, “floricuerno”, “flor del látigo”, “hierba de la alferecía”, “junco”, “junquillo”, “cuerno”, “rat-tail cactus” Standley 1924: 917
Flowers contained Betanin (35.4% of total), Phyllocactin (59.8% of total) & an unidentified Betacyanin. PIATTELLI & IMPERATO 1969
See comments in **Activity Notes**

***Ariocarpus agavoides* (CASTAÑEDA) E.F.ANDERSON**
3,4-Dimethoxy-N-methylphenethylamine (trace)
N,N-Dimethyl-3-methoxytyramine (trace)
Hordenine (Over 50% of 1-10 mg of total alkaloids/ 100 gm. fresh.) BRUHN & BRUHN 1973

***Ariocarpus bravoanus* HERNANDEZ & ANDERSON**
Lacks published analysis.
See comments in **Activity Notes**.

***Ariocarpus bravoanus ssp. hintonii* (STUPPY & TAYLOR) ANDERSON & FITZ MAURICE**
Lacks published analysis.
See comments in **Activity Notes**.

Ariocarpus denegrii (FRIC) MARSHALL
See as *Obregonia denegrii*
Ariocarpus disciformis (DECANDOLLE) MARSHALL
See as *Strombocactus disciformis*

***Ariocarpus fissuratus* (ENGELMANN) K.SCHUMANN**
“chaute”, “chautle”, “peyote cimarrón”, “peyote” (said to be erroneous) STANDLEY 1924: 933
Hordenine (200 mg of sulfate from 1 kg dry) HEFFTER 1894b
N-Methyltyramine (%) DIAZ *et al.* 1977
See comments in the **Activity Notes**.

***Ariocarpus fissuratus var. fissuratus* (ROSE) MARSHALL**
3,4-Dimethoxy-N-methylphenethylamine (Major alkaloid. 0.004% dry wt.) NORQUIST & McLAUGHLIN 1970
Hordenine (0.006% by dry weight) McLAUGHLIN 1969
N-Methyltyramine (visual estimate of 10 mg from 1.92 kg dry) McLAUGHLIN 1969

Ariocarpus fissuratus var. hintonii see as *Ariocarpus bravoanus ssp. hintonii*

***Ariocarpus fissuratus var. lloydii* (ENGELMANN) SCHUMANN**
Hordenine (no quantification) McLAUGHLIN 1969
N-Methyltyramine (no quantification) McLAUGHLIN 1969

Ariocarpus furfuraceous see *Ariocarpus retusus* (most regard as *retusus var. furfuraceous*; lacks published analysis)

Ariocarpus hintonii see as *Ariocarpus bravoanus ssp. hintonii*

***Ariocarpus kotschoubeyanus* (LEMAIRE) SCHUMANN**
“pezuña de venado” (Nuevo León) STANDLEY 1924: 933
78% water by weight
Hordenine (0.059% dry wt.) NEAL *et al.* 1971b
N-Methyltyramine (0.015% dry wt.) NEAL *et al.* 1971b
Reported to contain Betalains as pigments.
WOHLPART & MABRY 1968 cited DREIDING 1961
See **Activity Notes** for additional comments.

***Ariocarpus retusus* SCHEIDWEILLER**
“chaute”, “chautle”, “peyote” (said to be an erroneous name) STANDLEY 1924: 933
86% water by weight. BRAGA & McLAUGHLIN 1969
3,4-Dimethoxy-N-methylphenethylamine (0.00047% dry wt.) NEAL & McLAUGHLIN 1970
Hordenine (0.02% dry wt.: 214 mg from 1.19 kg dry) BRAGA & McLAUGHLIN 1969
N-Methyl-4-methoxyphenethylamine (0.00045% by dry weight) NEAL & McLAUGHLIN 1970
N-Methyltyramine (0.0016% by dry weight, i.e. 18.5 mg from 1.19 kg.) BRAGA & McLAUGHLIN 1969
[NEAL & McLAUGHLIN 1970, did not report the latter compound.]
Reported with no detectable alkaloids in SMOLENSKI *et al.* 1973.
Retusin (a flavonoid) & β -Sitosterol were recovered by DOMINGUEZ *et al.* 1968. This was the first isolation of retusin (tetramethylated quercetrine); formerly known as a synthetic compound (GOMM & NIERENSTEIN 1931).
See **Activity Notes** for additional comments.

***Ariocarpus scaphiostriis* BOEDECKER**

(Originally misspelled *Ariocarpus scapharostriis*)
Hordenine (Major alkaloid of 4 in 0.012% total alkaloids)
N-Methyltyramine (no quantification)
3,4-Dimethoxy-N,N-dimethylphenethylamine (no quant.)
3,4-Dimethoxy-N-methylphenethylamine (no quant.)
BRUHN 1975b (Cultivated: California)

***Ariocarpus trigonus* (WEBER) SCHUMANN**

3,4-Dimethoxy-N-methylphenethylamine (0.007% dry)
Hordenine (Major alkaloid. 0.013% dry weight)
N-Methyltyramine (trace)

SPEIR *et al.* 1970

[Tyramine has been listed **in error**; the reference cited, SPEIR *et al.* 1970, did not report it from this species.]

Ariocarpus williamsii (LEMAIRE) VOSS

See as *Lophophora williamsii*

Armatocereus humilis (BRITTON & ROSE) BACKEBERG

See as *Lemaireocereus humilis*

Armatocereus laetus (HBK.) BACKEBERG

See as *Lemaireocereus laetus*

Oddly the entire genus *Astrophytum* lacks published analysis

***Astrophytum asterias* (ZUCCARINI) LEMAIRE**

“star cactus”, “peyote” (STANDLEY 1924: 955)

Unpublished analysis failed to show the presence of alkaloids
(Martin Terry 2005; personal communication)

***Astrophytum myriostigma* LEMAIRE**

“mitra” (San Luis Potosi), “birreta de obispo” (Coahuila)
“bonete”, “peyote cimarrón” (Durango) STANDLEY 1924:
955

Appears listed as containing unidentified alkaloid(s) but
either the entry included no reference (ex. SOULAIRE
1947) or else the reference that was cited (BROWN *et al.*
1968) did not mention the species.

See comments on the *Astrophytum* species in **Activity Notes**.

***Austrocylindropuntia cylindrica* LAMARCK**

[“*Opuntia cylindrica*” was **erroneously listed** as containing mescaline in the following reports: COCH FRUGONI 1956(?), CRUZ SÁNCHEZ 1948b, GUTIÉRREZ-NORIEGA & CRUZ SÁNCHEZ 1947, MARINI-BETTÒLO & COCH FRUGONI 1956, MARINI-BETTÒLO & COCH FRUGONI 1958 and, **ALMOST INCREDIBLY**, TURNER & HEYMAN 1960.

DER MARDEROSIAN 1966 indicated that “correspondence with the original author” verified that their material had indeed been misidentified. While it was not specifically stated; TURNER & HEYMAN were implied.

All of the above were apparently based on misidentified plants. (Actual identity was almost certainly *Trichocereus pachanoi* in all instances. It is demonstrably the case in CRUZ SÁNCHEZ 1948 where an unmistakable *T. pachanoi* photograph was included.

This is also discussed in more detail in **Part B; San Pedro]**

More recently *Opuntia cylindrica* reverted to an older synonym *Australocylindropuntia cylindrica*.

Authenticated *Opuntia cylindrica* was determined to contain no measurable alkaloid in AGURELL 1969b [Obtained via European commercial sources].

***Austrocylindropuntia exaltata* BERGER**

[Considered varietal to *Opuntia subulata* in HUNT 2006]

3,4-Dimethoxyphenethylamine (less than 0.01% dry wt.)

4-Hydroxy-3,5-dimethoxyphenethylamine (Less than 0.01% dry wt.) MA *et al.* 1986 (**OSTOLAZA #84284**)

***Austrocylindropuntia pachypus* K.SCHUMANN**

[sic as *Opuntia pachyypus*]

The claim for the presence of Mescaline was made by CAYCHO JIMENEZ 1977 (page 91) but no reference was cited and nothing was included to support his assertion.

***Austrocylindropuntia subulata* (MÜHLENPFORDT)**

ENGELMANN

3-Methoxytyramine (no quantification)

An unidentified alkaloid was also present.

MEYER *et al.* 1980

88% of the daily CO₂ uptake occurred through the leaves during the daytime but some occurred at night (under well watered conditions)

Nobel & Hartssock 1986

Aylostera pseudodeminuta (BACKEBERG) BACKEBERG

See as *Rebutia pseudodeminuta*

***Aztekium ritteri* (BÖDEKER) BÖDEKER**

(Plants greenhouse grown in Czechoslovakia)

N-Methyltyramine (0.0031%)

3-Methoxytyramine (Less than 0.0001%)

Hordenine (Less than 0.0001%)

N,N-Dimethyl-3,4-dimethoxyphenethylamine (0.0036%)

Mescaline (0.0009%)

Anhalidine (0.0008%)

Pellotine (0.0026%)

ŠTARHA 1994 (All % above are by fresh wt.)

***Azureocereus ayacuchensis* JOHNS**

Tyramine (0.135% by dry weight as HCl)

LEE *et al.* 1975 (cultivated in Arizona)

The genus *Azureocereus* needs analysis.

***Backebergia militaris* (ANDOT) BRAVO ex SANCHEZ**

MEJORADA

3-Methoxytyramine (0.02% dry wt.) PUMMANGURA & McLAUGHLIN 1981a [Collected in Michoacan, Mexico] [Also in PUMMANGURA *et al.* 1981b]; (Not identified by FERRIGNI *et al.* 1984.)

3,4-Dimethoxyphenethylamine (0.025% dry wt. [as HCl]) MATA & McLAUGHLIN 1980b; (Not identified FERRIGNI *et al.* 1984.)

Cactus Chemistry: By Species

3,4-Dimethoxy-N-methylphenethylamine (Detected: No quantification) FERRIGNI *et al.* 1984.

3,4-Dimethoxy-N,N-dimethylphenethylamine (0.0588% dry wt.) PUMMANGURA & McLAUGHLIN 1981a; (Trace: FERRIGNI *et al.* 1984.)

[3-Methoxyphenethylamine (**Error**. Based on typo in FERRIGNI *et al.* 1984.)]

[Phenethylamine (**Error**. Based on misreading of typo in FERRIGNI *et al.* 1984.)]

Also contains some isoquinolines [See Note]; (tetrahydro, dihydro and fully aromatic):

Heliamine (0.75% dry wt. [as HCl]) Mata & McLaughlin 1980b; 1.02% by dry wt. [as HCl]) PUMMANGURA & McLAUGHLIN 1981a; (Identified by ms/ms; but not mentioned in experimental account of isolations: FERRIGNI *et al.* 1984)

Lemaireocereine (0.034% by dry wt. [as HCl]) PUMMANGURA & McLAUGHLIN 1981a [Also by PUMMANGURA *et al.* 1981b]; (Not identified in ms/ms by FERRIGNI *et al.* 1984)

N-Methylheliamine (Identified by ms/ms; Detected in an impure residue) FERRIGNI *et al.* 1984

Dehydroheliamine (Identified by ms/ms; 0.07% by dry wt. isolated) FERRIGNI *et al.* 1984

Dehydrolemaireocereine (Identified by ms/ms; 0.006% by dry wt. isolated) FERRIGNI *et al.* 1984

Backebergine (Identified by ms/ms; 0.0126% by dry wt. isolated) FERRIGNI *et al.* 1984

Isobackebergine (Identified by ms/ms; 0.022% by dry wt. isolated) FERRIGNI *et al.* 1984

N-Methyllemaireocereine (possible presence; neither proven nor dismissed) FERRIGNI *et al.* 1984

[7,8-Dimethoxy-3,4-dihydroisoquinoline is a typographical **error** intending 7,8-Dimethoxy-3,4-dihydroisoquinoline (i.e. Dehydrolemaireocereine) FERRIGNI *et al.* 1984 was cited as the reference]

UNGER *et al.* 1980 evaluated this species using MIKES and reported detecting 3 alkaloids but it is unclear exactly which isomers they observed. One appeared to be N-Methylheliamine.

tlc examination showed the presence of alkaloids and the absence of triterpene glycosides: KIRCHER 1982

Kircher reported the same sterols as they had encountered in *L. schottii* and also what they thought was Lauric acid.

Lipid content determined to be 7% by dry weight: KIRCHER 1982

Backebergia Note: One other partially saturated THIQ was depicted in Ferrigni's line diagram key but appears to have been used as a synthetic intermediary and not isolated from the plant. It should be noted that besides having at least one typo in their key, the first two generic line diagrams are switched. [PEA ⇌ THIQ]

***Borzacactus sepium* (HBK) BRITTON & ROSE**

Flower contains Betanin, Phyllocactin, Isophyllocactin and traces of Isobetatin PIATTELLI & IMPERATO 1969

***Brasiliopuntia brasiliensis* (WILLDENOW) BERGER**

Positively identified in STUART 2003 as "*tchai*".

Mucilage comprised of Arabinose (26.2%), Galactose (49.8%), Galacturonic acid (6.1%), Rhamnose (9.4%) & Xylose (8.6%). MOYNA & DiFABIO 1978 (**MAM 1308**)

Popular ornamental purportedly used as an ayahuasca admixture and alone as a hallucinogenic. The claims were discredited by STUART 2003.

See more comments in the **Activity Notes**.

***Browningia candelaris* (MEYEN) BR. & R.**

In dried aerial parts:

0.0058% N-Acetyl-3,4-dimethoxyphenethylamine

0.0245% N,N-Dimethyl-3,4-dimethoxyphenethylamine

0.0327% N,N-Dimethyl-4-methoxyphenethylamine

0.0330% 4-Methoxyamphetamine

ECHVERRÍA & NEIMEYER 2012

Also see the interesting conjecture in OSTOLAZA 1987

The entire genus *Browningia* needs analysis.

Cactus grandiflora LINNAEUS See as *Selenicereus grandiflorus*

Carnegiea euphorbioides (HAW.) BACKEBERG

See as *Neobuxbaumia euphorbioides*

***Carnegiea gigantea* (ENGELMANN) BRITTON & ROSE**

AKA "*saguaro*", "*sahuaro*", "*suwarrow*", "*suwarro*",

"*suaharo*", "*suguarro*" STANDLEY 1924: 909

87-88% water by weight KIRCHER 1982

3,4-Dimethoxyphenethylamine ("less than" 0.00145%) BRUHN & LUNDSTRÖM 1976b (See Note A) & (trace) BRUHN *et al.* 1970

3-Methoxytyramine (trace) Bruhn *et al.* 1970 & (small amounts) BRUHN & LUNDSTRÖM 1976b

Dopamine (0.26%, as HCl, reported from young cultivated plants [Raised in the Netherlands]; not observed in their analysis of wild-collected material [Collected in Arizona]) BRUHN & LUNDSTRÖM 1976b. [Reported in cortical tissue (pulp) at 1%; Callus tissue and adjacent areas had higher dopamine concentrations than healthy tissue (See Note B): STEELINK *et al.* 1967 [Collected in Arizona]

[Tyramine, 3,4-DiMeO-5-OH-PEA and 3,5-DiMeO-4-OH-PEA have also been **erroneously** listed for this species but the claims are not supported by AGURELL 1969b (the reference that was cited).]

[Mescaline has been **erroneously** listed for this species. The claim is not supported by any of the references that were given. [i.e. AGURELL 1969b, KAPADIA & FAYEZ 1970 [See Note B] and MATA & McLAUGHLIN 1976.]

Carnegine Isolated (0.7% dry wt) & named by HEYL 1928. (0.575% yield by dry weight (as HCl) in ORDAZ *et al.* 1983.) Identified in BROWN *et al.* 1968; Reported present in decent amounts (70% of total alkaloid content) in BROWN *et al.* 1972b. [Presence also noted in HODGEKINS *et al.* 1967] Also by BRUHN *et al.* 1970, who, unlike BROWN, suggested presence in young plants but not in larger specimens. Unable to determine details due to procedural differences.

Also; 0.019% by fresh weight (2.9 grams of base from 15 kg fresh) BRUHN & LUNDSTRÖM 1976b [AGURELL *et al.* 1971a is also cited but is not presently available to us.] Isolated by SPÄTH 1929.

Gigantine (5-Hydroxycarnegine) (Identified) BROWN *et al.* 1968 [See Note C]; Only reported in substantial amounts during analysis of **wild** collected **adult** cacti and found to be higher in growing tips (see also BROWN *et al.* 1972b who found it composed 25-30% of the total alkaloid content in the whole

plant but 50% in the growing tip). [Said to comprise 30% of total alkaloid content in HODGEKINS *et al.* 1967] BRUHN & LUNDSTRÖM 1976b reported 0.0016% by fresh wt. (281.6 mg base from 15 kilos of fresh material) Not reported in greenhouse grown plants (BRUHN & LUNDSTRÖM 1976b); nor in young plants grown outdoors in Arizona (BRUHN *et al.* 1970).

Salsolidine (Norcarnegine) BRUHN *et al.* 1970 & BRUHN & LUNDSTRÖM 1976b reported salsolidine to be the major alkaloid (0.02% fresh wt.: 3.2 grams of base from 15 kg fresh), whereas BROWN *et al.* 1972b did not find salsolidine in any samples they tested. 0.47% yield by dry weight (as HCl) was reported in ORDAZ *et al.* 1983. [See also AGURELL *et al.* 1971a; See note above]

Arizonine (0.0036% by freshJ wt.; 1.1 grams of base from 15 kg fresh) BRUHN & LUNDSTRÖM 1976b [See also AGURELL *et al.* 1971a; See note above]

Dehydrosalsolidine (%) LUNDSTROM 1983 cited PUMMANGURA *et al.* (1983) *JJ. Nat. Prod.* (In press) [S. Pummangura, J.L. McLaughlin, D.V. Davies & R.G. Cooks] Not in 1983 or 1984 author index.

Heliamine (%) LUNDSTROM 1983 cited PUMMANGURA *et al.* 1983. (See note above)

Dehydroheliamine [0.0008% yield by dry weight (as HCl) was reported in ORDAZ *et al.* 1983.]

UNGER *et al.* 1980 evaluated this species using MIKES and reported detecting 4 (or 5?) quinolines. One was reported to be Salsolidine; another was either Carnegine or else isomeric with it. The exact isomeric identities of the rest was not clear to us. Two appeared to be trimethoxylated.

1-1.7% alkaloid (Carnegine and Gigantine) KIRCHER 1982

Glucaric acid (tlc by KRINGSTAD & NORDAL 1975)

Isocitric acid (tlc & glc by KRINGSTAD & NORDAL 1975)

Quinic acid (tlc & glc by KRINGSTAD & NORDAL 1975)

Vanillin, Syringaldehyde & *p*-Hydroxybenzaldehyde were found to be higher in healthy tissue than in callus tissue. A glycoside of 4-Hydroxybenzoic acid and Ferulic acid were reported as minor & trace components respectively.

3,4-Dihydroxybenzoic acid, Vanillic acid & *p*-Hydroxybenzoic acid found in callus tissue along with trace amounts of *p*-Coumaric acid & Ferulic acid. Quercetin was also observed at 0.1% of the total callus but was absent from the ribs themselves.

STEELINK *et al.* 1967

tlc examination showed the presence of alkaloids and the absence of triterpene glycosides: KIRCHER 1982
Lipid content determined to be 2.5% by dry weight.

0.1% sterols: Campesterol, Sitosterol and 1 unknown sterol. Unable to detect any sterol or triterpene glycosides. KIRCHER 1982

Carbohydrates in healthy cortical tissue were reported to be composed of Glucose, Galactose (31% of all saccharide constituents), Xylose & Arabinose.

Galactose was lacking from the wound tissue. STEELINK *et al.* 1968

Carnegiea Notes:

A: Concerning our math-work for BRUHN & LUNDSTRÖM 1976b:

15 kg of fresh cactus yielded 32 grams of alkaloids. 80% was nonphenolic and 20% was phenolic. When purifying these fractions they only used 1 gram of the nonphenolic and 0.5 grams of the phenolic fractions. The amounts listed in their account is what was obtained from these aliquots rather than totals.

For all compounds except dopamine the yields were calculated, by kt, as if they had used all of their product and then recalculated them in terms of their free bases (Alkaloids were obtained as the hydrochloride salts in all cases except for Arizonine)

B: We should note that while listing KAPADIA & FAYEZ 1970, they used the volume, and a page number, in KAPADIA *et al.* 1969.

C: The unusual substitution at the 5 position has also been observed in several other alkaloids found in *Pachycereus pringlei*, and *Pachycereus weberi*, as well as in *Pachycereus tehuan-tepecanas*. (Gigantine is also found in *Pachycereus pecten-aboriginum*.)

The question of whether any of the *Pachycereus* alkaloids are active as visionary compounds is an area overdue for evaluation. Preliminary evaluations depict them as rough and with a heavy body load yet some few people appear to like them. More study is clearly needed.

D: Dopamine concentrations were reported to increase with exposure to air or to ascorbic acid solutions.

In one case; a sample with 1.4% dopamine was taken. After 1 hour, a second sample, that was taken immediately next to the site of the first, showed 2.1%.

They also noted a high dopamine content in samples taken near the base (which always has a heavy callus layer).

See also comments in the Activity Notes.

Cephalocereus chrysacanthus (WEBER) BRITTON & ROSE.

See as *Pilocereus chrysacanthus*

Cephalocereus columna-trajani (KARW.) K.SCHUMANN

See as *Cephalocereus hoppenstedtii*

Cephalocereus euphorbioides (HAW.) BR & R.

See as *Neobuxbaumia euphorbioides*

Cephalocereus gaumeri BRITTON & ROSE is NOT synonymous with *Pterocereus* (?) *gaumeri*

Cephalocereus glaucescens (LABOURET) BORG

This species was reported to show no detectable alkaloids in the alkaloid screenings of SMOLENSKI *et al.* 1973.

Fruit contains Betanin (major), Phyllocactin and traces of Isophyllocactin & Isobetainin. PIATTELLI & IMPERATO 1969

Cephalocereus guerronis (BACK.) BUXB. See as *Pilocereus guerreronis*

Cephalocereus hoppenstedtii (A.WEB.) K.

SCHUMANN

No detectable alkaloids.

CHALET 1980a cited DOMINGUEZ *et al.* 1969

Cephalocereus leucocephalus (POSELGER) BRITTON & ROSE

"*napisora*" (PENNINGTON 1963: 155)

No detectable alkaloids in the alkaloid screenings of SMOLENSKI *et al.* 1973.

Cactus Chemistry: By Species

Fruit contains Betanin (major), Phyllocactin, Betanidin and traces of Isophyllocactin & Isobetatin.

PIATTELLI & IMPERATO 1969

See comments in **Activity Notes**.

Cephalocereus maxonii ROSE See as *Pilocereus maxonii*

***Cephalocereus melanostele* VAUPEL**

***Cephalocereus* sp. (?) PFEIFFER**

Claim purporting the presence of Mescaline is made by CAYCHO JIMENEZ 1977 (page 91) but he cites no reference and does not include anything that support the assertion.

***Cephalocereus nobilis* (HAWORTH) BRITTON & ROSE**

Fruit contains Betanin (major), Phyllocactin and traces of Isophyllocactin & Isobetatin. PIATTELLI & IMPERATO 1969

***Cephalocereus senilis* (HAWORTH) PFEIFFER**

No detectable alkaloids. AGURELL 1969b [Obtained via European commercial sources]. **NOT** synonym for *Mamillopsis senilis*.

Traces of unidentified triterpene(s) DJERASSI 1957 cited unpublished observations by DJERASSI & MARFEY

Cephalocereus tetetzo (A.WEB.) VAUPEL

See as *Neobuxbaumia tetetzo*

Cereus acranthus (K.SCHUMANN) VAUPEL

See as *Haageocereus* (*Weberbauerocereus*) *acranthus*

***Cereus aethiops* HAWORTH**

Candicine (%) Ruiz *et al.* 1973

Hordenine (%) RUIZ *et al.* 1973

Tyramine (%) RUIZ *et al.* 1973

***Cereus alacriportanus* PFEIFFER**

Hordenine. (Sole alkaloid 1-10 mg/ 100 gm of fresh plant) AGURELL 1969b [European commercial source]

***Cereus azureus* PARMENTIER**

No detectable alkaloids. AGURELL 1969b

[European commercial source]

Cereus caespitosus ENGELMANN & A. GRAY

= *Echinocereus reichenbachii* subs. *caespitosus*

See comments under *Echinocereus reichenbachii* in **Activity Notes**.

***Cereus comarapanus* CARDENAS**

Flower contains Isophyllocactin, Betanin, Phyllocactin & Isobetatin. PIATTELLI & IMPERATO 1969

Cereus coryne. See as *Stetsonia coryne*

Cactus divaricatus LAM. non KUNTZE = *Cereus divaricatus* (LAM.)

DE CAND. See as *Harrisia divaricata*.

See comment in **Activity Notes**.

Cereus fimbriatus See as *Lemaireocereus hystrix*

See comment in **Activity Notes**.

Cereus gummosus See as *Machaerocereus gummosus*

Cactus flagelliformis L. = *Cereus flagelliformis* (L.) MILL. See as *Aporocactus flagelliformis*

***Cereus forbesii* O.**

Tyramine (Over 50 mg/ 100 gm of fresh) AGURELL 1969b [European commercial source]

Cereus gigantens ENGELMANN. See as *Carnegiea gigantea*

Cereus giganteus ENGELMANN See as *Carnegiea gigantea*

Please note that, in the past, *Trichocereus pachanoi* has been sold (improperly) under the name *Cereus giganteus* and there is also a Karel Knize *nomen nudum* designated *Trichocereus giganteus* KNIZE n.n. There is also material in cultivation designated as *Trichocereus peruvianus* var. *giganteus* that is the same Knize *nomen nudum*.

***Cereus glaucus* SALM-DYCK**

Hordenine (1-10% of 1-10 mg total alkaloids/ 100 gm of fresh plant) AGURELL 1969b [European commercial sources]

Tyramine (Over 50% of 1-10 mg total alkaloids/ 100 gm of fresh) AGURELL 1969b

Cereus grandiflorus MILL. See as *Selenicereus grandiflorus*

***Cereus hirschtianus* K.SCHUMANN**

Citric acid (1.8% in stem juice)

HEGNAUER 1964 cited BERGSTRÖM 1934

***Cereus jamacaru* DECANDOLLE**

“mandacaru”

Tyramine (total 0.2% crude but only 0.02% was recovered as the HCl) BRUHN & LINDGREN 1976 [Obtained via the Kew]. (second to most abundant for Davet 2005)

N-Methyltyramine DAVET 2005 (major alkaloid in DAVET 2005)

Tyrosine DAVET 2005

Hordenine DAVET 2005

beta-Sitosterol DAVET 2005

[Caffeine (0.08-0.11%) was reported in the seeds by FREISE 1935 (1936?), and this was iterated in WILLAMAN & SCHUBERT 1961, but BRUHN & LINDGREN 1976, reported that they could detect NO caffeine in either the seeds or stems of this plant. FREISE apparently reported it in only some samples of seeds but neglected to note how he identified it. No xanthine derivative has ever been demonstrably isolated from **any** cacti despite his claim. BRUHN & LINDGREN 1976 reported no alkaloidal material in the seeds.]

[Hordenine appeared listed **in error** but more recently was reported. The reference cited initially, AGURELL 1969b, did not investigate this species. DAVET 2005 did.]

β-Sitosterol DJERASSI 1957 cited unpublished observations by DJERASSI & KAN

The name cactin was assigned to a methionine rich albumin isoated from the seeds of *Cereus jamaracu*. It was found to resemble a protein found in Brazil nuts.

ARAGÃO *et al.* 2000

Sultan had earlier used the name cactine for an uncharacterized alkaloid from *Selenicereus grandiflorus*.

The list of endophytes in BEZERRA et al. 2013 suggests that the potential for bioactivity is worth study.

Alkaloid production of callous tissue culture was studied by DE OLIVEIRA & MACHADO 2003

Reported to contain Betalains as pigments.

WOHLPART & MABRY 1968 cited DREIDING 1961

Cereus macrostibas (K.SCHUMANN) BERGER

See as *Neoraimondia macrostibas*

***Cereus peruvianus* (LINNAEUS) MILLER**

[See note on the next page.]

Hordenine (%) DE VRIES et al. 1971

Tyramine (trace) AGURELL 1969b [Obtained via European commercial sources]

Reported to contain Betalains as pigments.

WOHLPART & MABRY 1968 cited DREIDING 1961

Erroneously listed both as a mescaline containing plant and as a hallucinogen.

See comments in **Activity Notes**.

Mucilage polysaccharide - 1.6% of total weight of fresh plant.

Uronic acid content of polysaccharide: 44%

Rhamnose: arabinose, galactose (1:1:2)

MINDT et al. 1975

Cereus peruvianus is under intensive development for fruit production. The fruit is called *koubo* in Israel.

It "...can produce fruits 3-4 years after planting from seeds and 2-3 years after planting from cuttings. A 7-year-old plant can bear 60-80 kg of fruits annually."

NINIO et al. 2003

The color of the peel changes from green to violet in the early stages of ripening and then from violet to red at the end of the process. The first appearance of color begins near the perianth scar becoming complete violet color about a week later. As ripening continues, the color of the peel changes to red, which is usually followed by the cracking of the fruit.

All fresh wt.	Green	Purple	Red
Ethanol-insoluble polysaccharides	14 mg/g	4 mg/g	4 mg/g
Ethanol-soluble sugars	20 mg/g	~75 mg/g	110 mg/g

The main sugars that accumulated in the fruit pulp were Fructose and Glucose in a 1:1 ratio. Each one increased from 25 to 275 µmol/g fw during ripening.

Sucrose was present in low concentration (0-10 µmol/g fw) which did not change significantly during ripening.

The decrease in polysaccharide content is too low to account for the increases in soluble sugars so Ninio felt "it is likely that the observed accumulation of fructose and glucose during ripening is dependent on assimilated transport from the mother plant."

Ninio also found that fruits which were harvested at the green stage contained lower levels of soluble sugars than red fruits. Their conclusion:

"To obtain fruits of high quality with high sugar concentration, it is recommended to postpone fruit harvest as much as possible (before fruit cracks)."

Malic acid constituted 90% of the fruit's organic acids.

When the mature green fruit turned purple the content of malic acid decreased by half (from 50 to 25 µmol/g fresh weight) and remained constant for the rest of the ripening process.

Concentrations of citric, succinic, and oxalic acids were all lower than 4 µmol/g fw.

During ripening, the composition of the volatile components changed from being comprised of 2-Heptenal, (E,E)-2,4-Decadienal, (E,Z)-2,4-Decadienal, 2-Decenal & Benzoic acid at the mature green stage to being largely Linalool with smaller amounts of Epoxy linalool and 3,7-Dimethyl-1,5-octadiene-3,7-diol when violet, increasing dramatically when completely red. Those three compounds comprise 99% of the total volatiles in the ripe fruit.

Linalool reaches concentrations of 1.5-3.5 µg/g fresh weight in mature red fruits.

NINIO et al. 2003

The aroma of the fruit is the product of (S)-linalool and linalool derivatives.

The initial detection of linalool coincides with the development of the purple color and increases during ripening into a cracked red fruit. The highest values were found in fruit ripening in storage. These findings are in line with the reports that higher linalool levels accumulate in fruit ripening in storage compared to fruit ripening on the tree.

SITRIT et al. 2004 cited NINIO et al. 2003 & 2004.

S-(+)-Linalool was found to be the main volatile accumulating in the ripening fruit and was determined to occur in a remarkably high optical purity of 98%.

SITRIT et al. 2004

Note

Trichocereus macrogonus, *T. pachanoi*, *T. peruvianus*, *T. sp.* TJG & some material resembling what is known as *Trichocereus argentinensis* have all been improperly sold or published as photos in cactus books under this name. (As are other *Cereus* species)

Cactus Chemistry: By Species

Similarly "*Cereus*" sp. Peru 68.0235 at the Berkeley Botanical Gardens and the fat blue "*Cereus*" encountered mislabelled are both *Trichocereus*.

It appears probable that *Cereus arequipensis*, SOME of the material marked *Cereus argentinensis* (but NOT true *Cereus argentinensis*), *Cereus bolivianus* (No. 6231 in the NY Bot. Garden), some *Cereus colossus* (but NOT true *Cereus colosseus*), *Cereus hempelianus* BAUER, & *Cereus tephraacanthus bolivianus* WEBER, may prove to be active *Trichocereus* species once analyzed.

***Cereus peruvianus formae monstrosus* DeCANDOLLE**
Tyramine (over 50% of 10-50mg total alkaloids/ 100 gm of fresh plant) AGURELL 1969b [From European commercial source]

Cereus pilocereus is somehow a mistaken rendering referring to *Pilocereus Sargentianus* (i.e. *Lophocereus schottii*) that appears in some early medical literature (ex.: REMINGTON *et al.* 1918)

Cereus rosei WERDERMANN See as *Trichocereus peruvianus*

***Cereus* sp. MILLER**

Claim for the presence of Mescaline is made by CAYCHO JIMENEZ 1977 (page 91) but no reference was cited and he does not include anything to support his assertion.

***Cereus* sp.** (unidentified; Mexico) was reported to show detectable alkaloids in SMOLENSKI *et al.* 1973.

***Cereus speciosus* K.SCHUMANN**

Reported to contain Betalains as pigments.
WOHLPART & MABRY 1968 cited DREIDING 1961

***Cereus stenogonus* K.SCHUMANN**

Flower contains Betanin, Phyllocactin (30.4% of total), Isophyllocactin & Isobetainin. PIATTELLI & IMPERATO 1969

***Cereus stenogonus* K.SCHUMANN X *Heliaporus smithii* (PFEIFF.) ROWL.**

Flower contains Betanin, Phyllocactin (60.9% of total), Isophyllocactin & Isobetainin. PIATTELLI & IMPERATO 1969

***Cereus thouarsii* WEBER**

Reported to contain Betalains as pigments.
WOHLPART & MABRY 1968 cited DREIDING 1961

***Cereus validus* HAWORTH**

92.6% water by weight in March (fruiting)/ 88.1% in October (no fruit). (Argentina)
3-Nitrotyramine (0.19% dry wt.) NEME *et al.* 1977 & (0.19% dry wt. in branches) NIETO *et al.* 1982
Tyramine (0.023%: branches; 0.377%: green fruit; 0.382%: ripe fruit; All by dry wt.) NIETO *et al.* 1982
[2 unidentified bases reported in all samples; NIETO *et al.* 1982]

Choline (0.012%: branches; 0.029%: green fruit; 0.022%: ripe fruit; All by dry wt.) NIETO *et al.* 1982

***Chamaecereus silvestrii* (SPEG.) BR. & R.**

Reported to contain Betalains as pigments.
WOHLPART & MABRY 1968 cited DREIDING 1961
Weddellite was identified as druses.
Monje & Baran 2002

***Cleistocactus baumannii* (Lemaire) Lemaire**

Weddellite was identified as druses and crystal sand.
Monje & Baran 2002

***Cleistocactus jujuyensis* (BACKEBERG) BACKEBERG**

Flowers contains Betanin (major) & Phyllocactin PIATTELLI & IMPERATO 1969
Reported to contain Betalains as pigments.
WOHLPART & MABRY 1968 cited DREIDING 1961

***Cleistocactus parviflorus* (K.SCHUMANN) GOSSELIN**

Flower contains Betanin (major), Isophyllocactin, Betanidin & traces of Phyllocactin
PIATTELLI & IMPERATO 1969

***Cleistocactus smaragdiflorus* (WEBER) BRITTON & ROSE**

Flowers contains Betanin (minor) & Phyllocactin (major)
PIATTELLI & IMPERATO 1969

***Cleistocactus strausii* (HEESE) BACKEBERG**

Flower contains Phyllocactin, Isophyllocactin, Betanin & Isobetainin. PIATTELLI & IMPERATO 1969

The genus *Copiapoa* seemingly lacks analysis

***Corynopuntia clavata* (ENGELMANN) KNUTH**

N-Methyltyramine (Major base; 0.51%) VANDERVEEN *et al.* 1974 [collected near Albuquerque, NM. 3 collections made].
Also isolated in KELLER 1980
Tyramine (trace) VANDERVEEN *et al.* 1974
Hordenine (trace) VANDERVEEN *et al.* 1974.

***Corynopuntia emoryi* (ENGELMANN) GRIFFITH**

(Analyzed as *Opuntia standlyi* v. *standlyi*)
N-Methyltyramine (no quantification) MEYER *et al.* 1980
Tyramine (no quantification) MEYER *et al.* 1980

***Corynopuntia invicta* (BRANDEGEE) KNUTH**

Hordenine (%?)
N-Methyltyramine (no quantification)
Tyramine (no quantification)
MEYER *et al.* 1980

***Corynopuntia kunzei* (ROSE) GRIFFITH**

(Analyzed as *Opuntia stanlyi* v. *kunzei*)
N-Methyltyramine (0.05%) MEYER *et al.* 1980
Tyramine (no quantification) MEYER *et al.* 1980

***Corynopuntia schottii* ENGELMANN**

Hordenine (0.049% dry wt)
N-Methyltyramine (0.018%)
Tyramine (no quantification)
MEYER *et al.* 1980

[BROWN *et al.* 1968 found no detectable alkaloid in their sample of this species.]

***Coryphantha bumamma* (EHRENBERG) BRITTON & ROSE**

3,4-Dimethoxy-N-methylphenethylamine (trace)
Hordenine (Over 50% of 10- 50 mg of total alkaloids/ 100 grams of fresh plant.)
N-Methyl-4-methoxyphenethylamine (trace)
BRUHN *et al.* 1975b [Wild collected; Guerrero, Mexico]

***Coryphantha calipensis* H.BRAVO**

β -Methoxy-3,4-dimethoxy-N,N-dimethylphenethylamine (40 mg from 2.56 kg fresh) BRUHN & AGURELL 1974; (10-50% of over 50 mg of total alkaloids/ 100 grams fresh) BRUHN *et al.* 1975b [Wild collected; Puebla, Mexico].
 β -Methoxy-3,4-dimethoxy-N-methylphenethylamine [Calipamine] (210 mg from 2.56 kg fresh.) BRUHN & AGURELL 1974; (10-50% of over 50 mg of total alkaloids/ 100 grams fresh) BRUHN *et al.* 1975b
3,4-Dimethoxy-N-methylphenethylamine (trace) BRUHN & AGURELL 1974 & BRUHN *et al.* 1975b
Hordenine (trace) BRUHN *et al.* 1975b
N-Methyltyramine (trace) BRUHN *et al.* 1975b
Normacromerine (0.005% dry wt.) BRUHN & AGURELL 1974.
[N,N-DiMe-3,4-diMeO-PEA has also been listed in an alkaloid summary. One of the references given, BRUHN & AGURELL 1974, did not report this alkaloid. The other, BRUHN 1975a, is presently unavailable to us.]
[Macromerine has also been listed. The reference given, BRUHN 1975a, is presently unavailable to us.]
Isocitric acid (tlc, glc & gc-ms by KRINGSTAD & NORDAL 1975)

***Coryphantha compacta* (ENGELMANN) BRITTON & ROSE**
Needs an analysis. See **Activity Notes**

***Coryphantha cornifera* (DECAUDOLLE) LEMAIRE**

β -O-Methylsynephrine (no quantification)
3,4-Dimethoxy-N-methylphenethylamine (no quantification)
4-Methoxyphenethylamine (no quantification)
Hordenine (no quantification)
N-Methyltyramine (no quantification)
Synephrine (no quantification)
HORNEMAN *et al.* 1972
[Macromerine has been listed **in error**. The reference cited, HORNEMAN *et al.* 1972, did not report this alkaloid.]

***Coryphantha cornifera* var. *echinus* (ENGELMANN)**

L.BENSON

β -O-Methylsynephrine (no quantification)
3,4-Dimethoxy-N-methylphenethylamine (0.0007% dry wt.)
4-Methoxy- β -hydroxyphenethylamine (no quantification)
Hordenine (0.0006% dry wt.)
Macromerine (no quantification) [Macromerine also reported in HABERMANN 1974a (from ŠTARHA *nd*)]
N-Methyl-4-methoxyphenethylamine (0.0002% dry wt.)
N-Methyltyramine (0.0002% dry wt.)
Synephrine (no quantification)
HORNEMAN *et al.* 1972

***Coryphantha durangensis* (RÜNGE) BRITTON & ROSE**

3,4-Dimethoxy-N-methylphenethylamine (no quantification)
Hordenine (no quantification)
N-Methyltyramine (no quantification)
Synephrine (no quantification)
HORNEMAN *et al.* 1972

Coryphantha echinus

See as *Coryphantha cornifera* var. *echinus*

***Coryphantha elephantidens* LEMAIRE**

Macromerine (no quantification)
 β -O-Methylsynephrine (no quantification)
3,4-Dimethoxy-N-methylphenethylamine (no quantification)
Hordenine (no quantification)
N-Methyltyramine (no quantification)
Synephrine (no quantification)
HORNEMAN *et al.* 1972
[N-Me-4-MeO-PEA has been reported **in error**, the reference cited, HORNEMANN *et al.* 1972, did not report this alkaloid]

***Coryphantha greenwoodii* H.BRAVO**

β -Methoxy-3,4-dimethoxy-N,N-dimethylphenethylamine (10-50% of over 50 mg of total alkaloids/ 100 grams fresh) BRUHN *et al.* 1975b
 β -Methoxy-3,4-dimethoxy-N-methylphenethylamine (Calipamine) (10-50% of over 50 mg of total alkaloids/ 100 grams fresh) BRUHN *et al.* 1975b; (As (-)-form: 0.034% dry wt.) RANIERI *et al.* 1976
 β -O-Methylsynephrine (trace) BRUHN *et al.* 1975b and RANIERI *et al.* 1976
3,4-Dimethoxy-N,N-dimethylphenethylamine (trace) BRUHN *et al.* 1975
3,4-Dimethoxy-N-methylphenethylamine. (1-10% of over 50 mg of total alkaloids/ 100 grams fresh) BRUHN *et al.* 1975; (0.0095% by dry weight) RANIERI *et al.* 1976
3,4-Dimethoxy-N-formyl- β -hydroxy-N-methylphenethylamine SHULGIN & SHULGIN 1997
Coryphanthine (0.022%) MEYER *et al.* 1983 Also observed by DAVIS *et al.* 1983
Hordenine (trace) BRUHN *et al.* 1975
Normacromerine (0.043% dry wt.) RANIERI *et al.* 1976
O-Methylcandicine (no quantification) MEYER *et al.* 1983
Synephrine (trace) RANIERI *et al.* 1976

***Coryphantha macromeris* (ENGELMANN) LEMAIRE**

“Doña ana” “Big nipple cactus”

Macromerine (0.16% dry wt.) BROWN *et al.* 1972a [Also observed as the major alkaloid in BROWN *et al.* 1968] HODGEKINS *et al.* 1967 reported it to be the “main alkaloid”. Unidentified alkaloids were observed in BROWN *et al.* 1968

[All of the many listings, or mention, of other alkaloids reported from this species (including normacromerine) are apparently in error as they all cited references, (such as KELLER), that actually analyzed *Coryphantha macromeris* var. *runyonii* (*C. runyonii*). The equating of analytical reports for different varieties and the assumption that they could be viewed as generalized alkaloid profiles for the entire species, has lead to not a few unfortunate errors in the chemical literature; both in discussions and in tabular summaries.

Normacromerine would not be surprising but someone needs to report it based on an actual analysis.

Mescaline is an erroneous listing. BARCELOUX 2008 confusedly includes *Coryphantha macromeris* along with “several South American cactus species [that] contain mescaline”]

***Coryphantha macromeris* var. *runyonii* L.BENSON**

3,4-Dimethoxy-N-methylphenethylamine (trace) AGURELL 1969b [Obtained via European commercial sources]; (0.0006% fresh) KELLER *et al.* 1973.

Epinephrine (14.22 µg/gm fresh), KELLER 1978.

Hordenine (trace) AGURELL 1969b; (0.0004%) fresh) KELLER *et al.* 1973.

Macromerine (Major alkaloid. 0.07% dry wt.) BELOW *et al.* 1968; (major alkaloid- over 50% of over 50 mg total alkaloids/ 100 gm fresh) AGURELL 1969b; (0.0021% fresh) KELLER *et al.* 1973.

Metanephrine (0.0002% fresh) KELLER *et al.* 1973.

N-Formylnormacromerine [0.0077% fresh] KELLER *et al.* 1973; [0.19% dry wt.] KELLER & McLAUGHLIN 1972

N-Methyl-4-methoxyphenethylamine (0.0005% fresh) KELLER *et al.* 1973.

N-Methylmetanephrine (trace) KELLER *et al.* 1973.

N-Methyltyramine (0.0019% fresh wt) KELLER *et al.* 1973

Norepinephrine (5.54 µg/gm fresh) KELLER 1978.

Normacromerine [Major alkaloid. 0.0710% (fresh)] KELLER *et al.* 1973. [Also isolated in KELLER 1980] Conflicting assays; see Macromerine above in this entry.

Synephrine (0.0001% fresh wt) KELLER *et al.* 1973.

Tyramine (trace) AGURELL 1969b; (0.0001 fresh wt) KELLER *et al.* 1973

[N-Me-4-OH-tyramine appears in the literature erroneously. It is probably a typo meaning N-Me-4-MeO-PEA or N-Me-4-OH-PEA. (Tyramine IS 4-OH-PEA)]

***Coryphantha missouriensis* (SWEET) BRITTON & ROSE**

3,4-Dimethoxy-N-methylphenethylamine (trace)

Hordenine (0.39% dry wt.)

N-Methyltyramine (0.013% dry wt.)

Tyramine (trace)

PUMMANGURA *et al.* 1981

***Coryphantha ottonis* (PFEIFFER) LEMAIRE**

4-Methoxyphenethylamine (no quantification)

Hordenine (no quantification).

N-Methyltyramine (no quantification)

Synephrine (no quantification)

HORNEMAN *et al.* 1972

***Coryphantha palmeri* BRITTON & ROSE**

β-Sitosterol (0.003% dry wt)

Dotriacontane

Eicosanol

Galactose

Saccharose

Small amounts of an unsaturated triterpenol (a tetracyclic triterpenoid).

Small amounts of an unidentified alkaloid.

DOMINGUEZ *et al.* 1970

No detectable alkaloid. CHALET 1980a cited DOMINGUEZ *et al.* 1969

[Traces of Mescaline are seemingly implied to have been detected in this species but the account is unclear and does not specifically state it. GENNARO *et al.* 1996]

Needs additional analysis.

See comment & image in Activity Notes

***Coryphantha pectinata* (ENGELMANN) BRITTON & ROSE**

β-O-Methylsynephrine

3,4-Dimethoxy-N-methylphenethylamine

4-Methoxy-β-hydroxyphenethylamine

Hordenine

Macromerine

N-Methyl-4-methoxyphenethylamine

N-Methyltyramine

Synephrine

HORNEMAN *et al.* 1972 (no quantification)

***Coryphantha poselgeriana* (DIETRICH) BRITTON & ROSE**

4-Methoxyphenethylamine

Hordenine

N-Methyltyramine

Synephrine

HORNEMAN *et al.* 1972 (no quantification)

***Coryphantha radians* (DECANDOLLE) BRITTON & ROSE**

Hordenine (1-10% of over 1-10 mg of total alkaloids/ 100 grams fresh.) BRUHN *et al.* 1975 [Wild collected: Querétaro, Mexico].

N-Methyltyramine (Over 50% of 1-10 mg of total alkaloids/ 100 grams fresh) BRUHN *et al.* 1975

[Traces of Mescaline are seemingly implied to have been detected in this species but the account is unclear and does not specifically state it. GENNARO *et al.* 1996]

***Coryphantha ramosa* CUTAK**

β-O-Methylsynephrine (0.0015% dry wt. 1.9% of total alkaloid.) SATO *et al.* 1973.
Hordenine (0.73% in dry. 91.8% of total alkaloid.) SATO *et al.* 1973.
N-Methyl-4-methoxyphenethylamine (0.00092% dry wt.: 0.1% of total alkaloid.) SATO *et al.* 1973.
N-Methyltyramine (0.043% by dry weight. 5.5% of total alkaloid) SATO *et al.* 1973
Synephrine (0.0057% dry wt.) SATO *et al.* 1973.

Coryphantha runyonii BRITTON & ROSE See as *Coryphantha macromeris* var *runyonii*

***Coryphantha scolymoides* (SCHEIDWEILER) A. BERGER [excluded]**

Traces of Mescaline reported (between 4-12 µg/gm fresh)
GENNARO *et al.* 1996

Coryphantha tuberculosa

as *Escobaria tuberculosa* BRITTON & ROSE
Reported to contain druses of Weddellite.
RIVERA & SMITH 1979
(collected in the Marathon Basin, West Texas)

***Coryphantha vivipara* (NUTTALL) ENGELMANN**

Hordenine (Sole alkaloid present. 10-50 mg/ 100 grams of fresh plant.) BRUHN *et al.* 1975 [Cultivated: Switzerland]
CO₂ uptake occurred entirely at night through the stems (under well watered conditions).
Nobel & Hartsock 1986

***Coryphantha vivipara* (NUTTALL) BRITTON & ROSE var. *arizonica* (ENGELMANN) W.T.MARSHALL**

Hordenine (0.017% by dry weight) HOWE *et al.* 1977b
An unidentified quaternary alkaloid was reported by
BROWN *et al.* 1968

***Cylindropuntia acanthocarpa* ENGELMANN & BIGELOW**

3,4-Dimethoxyphenethylamine (around 0.01% dry wt.)
4-Hydroxy-3,5-dimethoxyphenethylamine (Less than 0.01% dry wt.)
Mescaline (0.01% dry wt. [ie 10 mg/ 100 gm dry wt])
Ma *et al.* 1986 (Analyzed **F. Zeylmaker #8320**)
[Hordenine has also been listed **in error**, this species is not included by TA SMITH 1977; the reference cited.]
[MEYER *et al.* 1980: traces of unidentified alkaloids]
Quercetin-3-rutinoside, Quercetin-3-glucoside and Kaempferol-3-glucoside (flavonoids) were reported in the flowers.
CLARK *et al.* 1980 [Collected east of Florence, AZ]

***Cylindropuntia echinocarpa* ENGELMANN & BIGELOW**

“silver cholla”

3,4-Dimethoxyphenethylamine (Around 0.01% dry wt.)
4-Hydroxy-3,5-dimethoxyphenethylamine (Around 0.01% dry wt.)
Mescaline (Around or less than 0.01% dry wt.)
MA *et al.* 1986 (F. ZEYLMAKER #8327 & 8328)
See comments in **Activity Notes**.

***Cylindropuntia fulgida* ENGELMANN**

Unidentified alkaloids reported by MEYER *et al.* 1980
Quercetin-3-rutinoside, Quercetin-3-glucoside and Kaempferol-3-glucoside (flavonoids) were reported in the flowers.
CLARK *et al.* 1980 [Collected east of Florence, Arizona]
Cholla gum was determined to contain Arabinose (51.6%), Galactose (31.7%), Galacturonic acid (11.2%), Rhamnose (2 or 3%) & Xylose (15.0%). (Gum degradation products were studied) PARIKH & JONES 1966. [SANDS & KLASS 1929 found: Arabinose (53.2%), Galactose (8.4%), Galacturonic acid (11.5%) & Rhamnose (5.5%) They did not detect Xylose; BROWN *et al.* 1949 reported *L*-Arabinose (6 parts), *D*-Galactose (3 parts), *D*-Galacturonic acid (1 part), *L*-Rhamnose (traces) & *D*-Xylose (2 parts)] See also
ANDERSON *et al.* 1925

***Cylindropuntia imbricata* HAWORTH**

3-Methoxytyramine (no quantification)
3,4-Dimethoxyphenethylamine (no quantification)
Mescaline (Not quantified)
Tyramine (no quantification)
Unidentified alkaloid also present.
MEYER *et al.* 1980
Reported to contain druses of Whewellite.
RIVERA & SMITH 1979
(collected on the campus of the University of Texas at Austin)

***Cylindropuntia kleiniae* DECANDOLLE**

N-Methyltyramine (no quantification)
Tyramine (no quantification)
MEYER *et al.* 1980

***Cylindropuntia leptocaulis* DC**

(AKA “*tasajillo*”)

Most often appearing in the literature as *Opuntia leptocaulis*.

Reported by Meyer et al. 1980 to contain traces of unidentified alkaloids.

It was reported to show no detectable alkaloids in the screenings of Smolenski et al. 1973.

Betacyanins reported as pigments.

Mabry et al. 1963

A number of compounds were isolated from *Chaetomium globosum*. This fungus was found inhabiting the rhizosphere of *Opuntia leptocaulis*.

Globosuxanthone A (a new dihydroxanthone)

Globosuxanthone B (a new tetrahydroxanthone)

Globosuxanthone C (a new xanthone)

Globosuxanthone D (a new xanthone)

2-Hydroxyvertixanthone

Chrysazin (anthraquinone)

1,3,6,8-Tetrahydroanthraquinone

WIJERATNE *et al.* 2006a

Five new isocoumarins were isolated from cultures of *Paraphaeosphaeria quadrisepitata*, a fungal strain living in association with *Opuntia leptocaulis*.

Paraphaeosphaerin A, B & C

and

Chaetochiversins A and B

Along with a new chroman-4-one, Aposphaerin C.

WIJERATNE *et al.* 2006b

See additional comments in the Activity Notes.

***Cylindropuntia ramosissima* (ENGELMANN) F.M. KNUTH**

3,4-Dimethoxyphenethylamine (less than 0.01% dry wt.)

MA *et al.* 1986 (F. ZEYLMAYER #8501)

***Cylindropuntia spinosior* (ENGELMANN) TOUMEY**

Tyramine (0.0018% dry wt.)

3-Methoxytyramine (0.0011% dry wt.)

3,4-Dimethoxyphenethylamine. (trace)

Mescaline (0.00004% dry wt.) [Initially detected by KRUGER *et al.* 1977] This is 40 µg per 100 grams of dried material.

PARDANANI *et al.* 1978

Quercetin-3-rutinoside, Quercetin-3-glucoside and Kaempferol-3-glucoside (flavonoids) were reported in the flowers.

CLARK *et al.* 1980 [Collected east of Florence, Arizona]

***Cylindropuntia versicolor* (ENGELMANN ex J.M. COULTER) F.M. KNUTH**

Hordenine (no quantification)

N-Methyltyramine (no quantification)

Tyramine (no quantification)

Unidentified alkaloids were also present.

MEYER *et al.* 1980

Chemical studies have been performed on *Aspergillus terreus*. This fungus was found inhabiting the rhizosphere of *Opuntia versicolor*.

Asterredione (a novel cyclopentenedione)

(+)-5(6)-Dihydro-6-methoxyterrecyclic acid A (a new terrecyclic acid A derivative)

(+)-5(6)-Dihydro-6-hydroxyterrecyclic acid A (a new terrecyclic acid A derivative)

(+)-Terrecyclic acid A

(-)-Quadrone

Betulinan A

Asterriquinone D

and

Asterriquinone C

WIJERATNE *et al.* 2003

See comments in Activity Notes.

***Cylindropuntia whipplei* (ENGELMANN & BIGELOW) F.M. KNUTH**

3,4-Dimethoxyphenethylamine (no quantification)

Unidentified alkaloids were also present.

MEYER *et al.* 1986

Cylindropuntia stanlyi ENGELMANN var. *kunzei* (ROSE) L. BENSON

See as *Corynopuntia kunzei*

Cylindropuntia stanlyi var. *stanlyi* ENGELMANN

See as *Corynopuntia emoryi*

***Denmoza rhodacantha* (SALM-DYCK) BRITTON & ROSE**

Candicine (%?) NIETO 1987

***Dolichothele baumii* (BOEDECKER) WERDERMANN & BUXBAUM**

Dolichotheline (an imidazole)

6 unidentified alkaloids (tentatively)

DINGERDISSEN & McLAUGHLIN 1973b

Dehydrogeosmin - Minor volatile in the floral scent.

Sesquiterpene alcohol 1 - Trace volatile in the floral scent.

Sesquiterpene alcohol 2 - Minor volatile in the floral scent.

SCHLUMBERGER *et al.* 2004 (in tepals; gc-ms)

***Dolichothele longimamma* (DeCANDOLLE) BRITTON & ROSE**

N-Methyl-4-methoxy-β-hydroxyphenethylamine (Longimammine: O-Methylsynephrine) (0.00037% dry wt.) RANIERI & McLAUGHLIN 1976. [Reported in RANIERI & McLAUGHLIN 1975b]

Normacromerine (0.012% dry wt.) RANIERI & McLAUGHLIN 1976. [Reported in RANIERI & McLAUGHLIN 1975b]

Synephrine (0.43% dry wt.) RANIERI & McLAUGHLIN 1976. [Reported in RANIERI & McLAUGHLIN 1975b]

Also contains a few tetrahydroisoquinolines (If you ever doubted there are chemists with a twisted sense of humor...)

Longimammosine [6-Hydroxy-2-methyl-THIQ] (0.0019% dry wt.) RANIERI & McLAUGHLIN 1976. [Reported in RANIERI & McLAUGHLIN 1975b]

Longimamidine [8-Hydroxy-2-methyl-THIQ] (0.0019% dry wt.) RANIERI & McLAUGHLIN 1976. [Reported in RANIERI & McLAUGHLIN 1975b]

Longimammatine [6-Methoxy-THIQ] (0.0028% dry wt.) RANIERI & McLAUGHLIN 1976. [Reported in RANIERI & McLAUGHLIN 1975b]

Longimammamine [4,8-Dihydroxy-2-methyl-THIQ] (0.0008% dry wt.) RANIERI & McLAUGHLIN 1976. [Reported in RANIERI & McLAUGHLIN 1975b] **Note: Do not confuse with Longimammine which is a phenethylamine.**

Ubine (no quantification) KRUGER *et al.* 1977; **NOT** reported in RANIERI & McLAUGHLIN 1976

And

Dolichotheline (An imidazole) (Identified) Dingerdisen & McLaughlin 1973b (Also noted "...large number of unusual compounds that were unidentified...")

Natural occurrence in the plant of lauric, myristic and other fatty acids esterified to the C-3 hydroxyl groups of assorted 12-Oleanene series triterpenes, including:

β -Amyrin, Erythrodiol, Longispinogenin, Methyloleanolate, Maniladiol, Oleanonate, Oleanolic aldehyde.

SPENCER *et al.* 1983

Dehydrogeosmin - Minor volatile in floral scent.

Sesquiterpene alcohol 1 - Minor volatile in floral scent.

Sesquiterpene alcohol 2 - Minor volatile in floral scent.

SCHLUMBERGER *et al.* 2004 (in tepals; gc-ms)

***Dolichothele melaleuca* (DIETRICH) BRITTON & ROSE**

Dolichotheline (an imidazole)

(Tentatively) 6 unidentified alkaloids

DINGERDISSEN & McLAUGHLIN 1973b

***Dolichothele sphaerica* (DIETR.) BRITTON & ROSE**

Phenethylamine (traces) KELLER 1982

β -O-Ethylsynephrine (0.0038% dry wt.) DINGERDISSEN & McLAUGHLIN 1973a. Recovered via preparative tlc but said to have been shown to be an extraction artifact of Synephrine. DINGERDISSEN & McLAUGHLIN 1973c

β -O-Methylsynephrine (0.0060% dry wt.) DINGERDISSEN & McLAUGHLIN 1973a. Recovered via preparative tlc: DINGERDISSEN & McLAUGHLIN 1973c

N-Methylphenethylamine (0.0411% by dry weight) DINGERDISSEN & McLAUGHLIN 1973a. Recovered via preparative tlc: DINGERDISSEN & McLAUGHLIN 1973c

N-Methyltyramine (0.0115% by dry weight) DINGERDISSEN & McLAUGHLIN 1973a. Recovered via preparative tlc: DINGERDISSEN & McLAUGHLIN 1973c. Also reported in KELLER 1982.

Synephrine (0.0033% dry wt.) DINGERDISSEN & McLAUGHLIN 1973a. Recovered via preparative tlc: DINGERDISSEN & McLAUGHLIN 1973c

Dolichotheline (N-Isovalerylhistamine) 0.7% by dry wt: (no mention of other alkaloids) ROSENBERG & PAUL 1969 & 1970; (0.65%: major alkaloid) DINGERDISSEN & McLAUGHLIN 1973b (reported presence of other, mainly trace, alkaloids). [0.65% also reported in DINGERDISSEN & McLAUGHLIN 1973a [Also said to be reported in HABERMANN 1974a (from ŠTARHA *nd*)] Detected in tlc in DINGERDISSEN & McLAUGHLIN 1973c.

***Dolichothele surculosa* (BOEDECKER) F.BUXBAUM**

Hordenine (0.178% dry wt.)

N-Methyltyramine.

N-Methylphenethylamine (0.25% by dry weight)

Synephrine (0.017% dr wt.)

The imidazole, Dolichotheline was also identified.

[An unidentified imidazole was also reported]

DINGERDISSEN & McLAUGHLIN 1973b

[DINGERDISSEN & McLAUGHLIN 1973a is also cited as a reference but they DID NOT analyze this species]

Reported to contain Betalains as pigments (as *Mammillaria surculosa*). WOHLPART & MABRY 1968 cited DREIDING 1961

Volatile components of the floral scent have been studied.

Dehydrogeosmin - Minor volatile in floral scent.

Sesquiterpene alcohol 1 - Trace volatile in floral scent.

Sesquiterpene alcohol 2 - Minor volatile in floral scent.

SCHLUMBERGER *et al.* 2004 (in tepals; gc-ms)

***Dolichothele uberiformis* (ZUCCARINI) BRITTON & ROSE**

3,4-Dimethoxy-N-methylphenethylamine (0.007% dry wt.)

Hordenine (trace) [Also in KRUGER *et al.* 1977]

N-Methyl-4-methoxyphenethylamine (0.004% dry wt.)

N-Methyltyramine (trace) [Also in KRUGER *et al.* 1977]

Normacromerine (0.068% dry wt.) Synephrine (0.12%+ dry wt.)

Ubine (N,N-diMe- β -OH-PEA) (Major alkaloid. 0.24% dry wt.)

(-)-Longimammine (0.016% dry wt)

Longimammatine (trace)

Uberine (5-MeO-7-OH-2-Me-THIQ) (0.002% dry wt) [Also in KRUGER *et al.* 1977]

RANIERI & McLAUGHLIN 1977.

Dolichotheline (an imidazole) DINGERDISSEN & McLAUGHLIN 1973b (Also noting a "...large number of unusual compounds that were unidentified...")

[AGURELL 1969b is cited as a reference by **DID NOT** analyze this species. WHEATON & STEWART 1970 also appears cited as a reference but **DOES NOT** mention this species.]

Longimammamine was reported in error. RANIERI & McLAUGHLIN 1977 did **NOT** observe this alkaloid.

See comments in **Activity Notes**.

Echinocactus arechavaletai SCHUMANN.

See as *Wiggensia arechavaletai*

Cactus Chemistry: By Species

Echinocactus caespitosus was reported to contain an unidentified alkaloid by BROWN *et al.* 1968

Echinocactus concinus MONVILLE. See as ***Notocactus concinus***

***Echinocactus grandis* ROSE**

β -Sitosterol (0.005% by dry wt)

Galactose, Rhamnose, traces of an aliphatic saturated tetrol & small amounts of a polyhydroxylated steroid. DOMINGUEZ *et al.* 1970

Reported to contain no detectable alkaloid. CHALET 1980a cited DOMINGUEZ *et al.* 1969

Synonym of *Echinocactus platyacanthus* LINK & OTTO according to HUNT 1999.

***Echinocactus horizonthalonius* LEMAIRE**

No detectable alkaloid. BROWN *et al.* 1968

Reported to contain druses of Weddellite. RIVERA & SMITH 1979. See comments on the **Biominerals** page.

Echinocactus hystrix HAW.

See as ***Lemaireocereus hystrix***

Echinocactus ingens PFEIFFER

See as ***Echinocactus platyacanthus***

Echinocactus lewinii K.SCHUMANN

See as ***Lophophora williamsii***

Echinocactus platyacanthus was reported to contain unidentified alkaloids. (from SOULAIRE 1947)

***Echinocactus polycephalus* ENGELMANN & BIGELOW** Mescaline was **NOT** observed at the levels they were capable of detecting. GENNARO *et al.* 1996

***Echinocactus polycephalus* ENGELMANN & BIGELOW var. *xeranthoides* COULTER**

BROWN *et al.* 1968 reported to contain unidentified alkaloid.

Echinocactus pruinosus O.

See as ***Lemaireocereus pruinosus***

Echinocactus ritteri BOD.

See as ***Aztekium ritteri***

***Echinocactus texensis* HOPF**

AKA the "Horse Crippler" or "Devil's Head" or "Viznaga"

Reported to contain unidentified quaternary alkaloid(s) by BROWN *et al.* 1968

***Echinocactus visnaga* HOOKER**

Appears in the literature for a report of an unidentified alkaloid.

Synonym of *Echinocactus platyacanthus* LINK & OTTO according to HUNT 1999.

Echinocactus williamsii LEMAIRE ex SALM-DYCK

See as ***Lophophora williamsii***

***Echinocereus acifer* (OTTO) LEMAIRE**

DOMINGUEZ *et al.* 1969 reported an unidentified alkaloid.

***Echinocereus blanckii* POSELGER ex RÜMLER**

Has 94% water by weight

N,N-Dimethylhistamine (0.016% by fresh wt/ 0.285% by dry wt. (as 2HCl))

3,4-Dimethoxyphenethylamine (0.0065 % by fresh wt/ 0.114% by dry wt. (as HCl) WAGNER & GREVEL 1982b

[N-Me-3,4-DiMeO-PEA has been listed **in error**. The reference, WAGNER & GREVEL 1982b, did not report this compound.]

Citric acid (7.6% in stem juice) HEGNAUER 1964 cited BERGSTRÖM 1934

Echinocactus polycephalus Mescaline **NOT** observable at the levels they were capable of detecting. GENNARO *et al.* 1996

***Echinocereus chloranthus* ENGELMANN**

BROWN *et al.* 1968 reported to contain unidentified alkaloid.

***Echinocereus cinerascens* (DECAUDOLLE) RÜMLER**

3,4-Dimethoxy-N,N-dimethylphenethylamine (0.01% fresh) BRUHN & SÁNCHEZ-MEJORADA 1977 [Wild collected: Hidalgo, Mexico].

3,4-Dimethoxy-N-methylphenethylamine (0.0002%; 1.95x10⁻⁴% fresh) BRUHN & SÁNCHEZ-MEJORADA 1977

Glucaric acid (tlc by KRINGSTAD & NORDAL 1975)

***Echinocereus enneacanthus* var. *stramineus* (ENGELMANN) L.BENSON**

"pitahaya" STANDLEY 1924

BROWN *et al.* 1968 reported to contain unidentified alkaloids. Contains large amounts of some form of Calcium oxalate. See a photo on the biomineral page in this work.

***Echinocereus merkerii* HILDM.**

3,4-Dimethoxy-N,N-dimethylphenethylamine (no quantification) AGURELL *et al.* 1969

3,4-Dimethoxy-N-methylphenethylamine (no quantification) AGURELL *et al.* 1969

3,4-Dimethoxyphenethylamine (no quantification)

AGURELL *et al.* 1969 and MCFARLANE & SLAYTOR 1972

3-Methoxytyramine (no quantification) AGURELL *et al.* 1969

Tyramine (no quantification) MCFARLANE & SLAYTOR 1972b

Hordenine (no quantification) AGURELL *et al.* 1969 and

MCFARLANE & SLAYTOR 1972b

Candicine (no details) SHULGIN & SHULGIN 1997

Salsoline (no quantification) AGURELL *et al.* 1969; (no details) SHULGIN & SHULGIN 1997

***Echinocereus pectinatus* (SCHEIDWEILER) ENGELMANN** has been listed **in error** as containing hordenine. AGURELL 1969b, the reference cited for the claim, did not examine this species.

***Echinocereus triglochidiatus* ENGELMANN**

var. *gurneyi* BENSON

Dihydroquercetin

Dihydroquercetin 7-O-glucoside

Dihydrokaempferol

Dihydrokaempferol 7-O-glucoside

Dihydromyricetin

Dihydromyricetin 7-O-glucoside
Quercetin 7-O-glucoside
Quercetin 3-O-glucoside
Quercetin 3-O-rhamnosylglucoside
Kaempferol 3-O-glucoside
Kaempferol 3-O-rhamnosylglucoside

Present in perianth parts; in particular the tepals. Epidermis & spines contained traces only. Absent from the cortex. MILLER & BOHM 1982. (Wild collected: Marathon, Texas)

***Echinocereus triglochidiatus* ENGELMANN
var. *neomexicanus* (STANDLEY) STANDLEY ex
W.T. MARSHALL**

N,N-Dimethylhistamine (no quantification; tlc) FERRIGNI *et al.* 1982.

***Echinocereus triglochidiatus* ENGELMANN**

var. *pauispinus* ENGELMANN ex W.T. MARSHALL

N,N-Dimethylhistamine (no quantification) MATA & McLAUGHLIN 1982 citing FERRIGNI & McLAUGHLIN 1981: unpublished results; (0.11% dry wt; isolation, tlc, mp, mmp, pmr) FERRIGNI *et al.* 1982.

Echinocereus triglochidiatus has been listed as containing 5-Methoxy-N,N-dimethylhistamine but there is no basis for that assertion. (This compound was nowhere mentioned in the reference cited: i.e. Bye 1979. It does not appear to have ever been reported in nature.)

This species has also had a report of 5-Methoxy-N,N-dimethyltryptamine or what was suspected to be 5-MeO-DMT (first mentioned as a possibility in Bye 1979, citing personal communication with JL McLaughlin, and later repeated as fact many other places.) Schultes & Hofmann 1979 & 1980 also mentioned the possibility that a tryptamine derivative may have been observed.

In some retellings the identity was inexplicably recreated as DMT.

This was never proven. More importantly, Ferrigni *et al.* made a comment that whatever indole(s) they observed was present in trace amounts and was unstable in their extraction procedure. Unknown(s) were suspected of being indolic due to reacting with Ehrlich's reagent and forming a blue chromophore in TLC.

Had unknown been DMT or 5-MeO-DMT, they would have been both stable and easily been recovered using their approach so, whatever the identity of their unidentified compound(s) turns out to be, it was decidedly **NEITHER** 5-MeO-DMT **NOR** DMT. They determined the main alkaloid present was dimethylhistamine.

Some imidazoles are reactive with Ehrlich's reagent but Dimethylhistamine is not, more investigation is needed.

To risk adding more confusion to the issue the plants being discussed are actually *E. coccineus* (tetraploid), **var. *pauispinus*** & **var. *gurneyii***, and not *E. triglochidiatus* (which is diploid) This is also true for part of *neomexicanus*, but I do not know which FERRIGNI used. See POWELL & WEEDIN 2004. See comments in the **Activity Notes**.

Echinocereus viridiflorus ENGELMANN var. *chloranthus* BACKEBERG See as *Echinocereus chloranthus*

***Echinofossulocactus multicostatus* (HILDM.) BR. & R.**
No detectable alkaloid.

CHALET 1980a cited DOMINGUEZ *et al.* 1969

Echinomastus dasyacanthus BRITTON & ROSE; See as *Neolloydia intertexta* var. *dasyacantha*

Echinomastus intertextus ENGELMANN var. *dasyacanthus* ENGELMANN See as *Neolloydia intertexta* var. *dasyacantha*

Echinopsis andalgalensis (WEBER) FRIEDRICH & ROWLEY
See as *Trichocereus andalgalensis*

Echinopsis bridgesii SD lacks an analysis

Echinopsis camarguensis (CARD.) FRIEDRICH & ROWLEY
See as *Trichocereus camarguensis*

Echinopsis candicans WEBER See as *Trichocereus candicans*

Echinopsis chiloensis (COLLA) FRIEDRICH & ROWLEY
See as *Trichocereus chilensis*

***Echinopsis eyriesii* (TURPIN) ZUCCARINI**

93.8% water by weight (pH of juice: 4.6-5)

HERRERO-DUCLOUX 1930a

Hordenine (10-50% of 1-10 mg total alkaloids/ 100 gm fresh) AGURELL 1969b [European commercial sources]

Small amounts of unidentified alkaloids were reported to be present by HERRERO-DUCLOUX 1930a.

SOULAIRE 1947 was of the opinion, that the photograph in Herrero-Ducloux showed an erroneous identification had been made and that Herrero-Ducloux had actually examined either *Echinopsis oxygona* or *E. multiplex*.

Echinopsis fulvilana (RITT.) FRIEDRICH & ROWLEY

See as *Trichocereus fulvilanus*

Echinopsis gigantea KNIZE n.n. (in Friedrich & Glaetzle 1983) =
Trichocereus giganteus HORT. KNIZE See in *San Pedro*

Echinopsis hybrid

Dehydrogeosmin - Minor volatile in floral scent.

Sesquiterpene alcohol 1 - Trace volatile in floral scent.

Sesquiterpene alcohol 2 - Minor volatile in floral scent.

SCHLUMBERGER *et al.* 2004 (in tepals; gc-ms)

Echinopsis huascha (WEB.) FRIEDRICH & ROWLEY

See as *Helianthocereus huascha*

Echinopsis kermesina (KRAINZ) KRAINZ

See analysis under *Pseudolobivia kermesina*

Echinopsis lamprochlora (WEBER) FRIEDRICH & GLAETZLE

See as *Trichocereus lamprochlorus*

Echinopsis lageniformis (FOERST.) FRIEDRICH & ROWLEY

See as *Trichocereus bridgesii*

Echinopsis macrogona (SALM-DYCK) FRIEDR. & ROWLEY

See as *Trichocereus macrogonus*

Echinopsis manguinii (BACKEBERG) FRIEDR. & ROWLEY

See as *Trichocereus manguinii*

Echinopsis mamilosa GUERKE

See potential analysis under *Pseudolobivia kermesina*.

HUNT recognizes these as synonyms but, even if true, it should not be taken for granted that the chemistry of synonyms are the same without some analytical work. Material recognized as *Echinopsis*

mamilosa should be analyzed and compared to that of material identified as *Echinopsis kermesina*.

***Echinopsis multiplex* (PFEIFFER) PFEIFFER & OTTO**

Showed antitumor & antineoplastic activity.

See **Activity Notes**.

This species presently appears to lack any published analysis.

***Echinopsis obrepanda* (SALM-DYCK) K. SCHUMANN**

Dehydrogeosmin - Trace volatile in floral scent.

trans-Nerolidol - Major volatile in floral scent.

Sesquiterpene alcohol 1 - Trace volatile in floral scent.

Sesquiterpene alcohol 2 - Trace volatile in floral scent.

SCHLUMBERGER *et al.* 2004 (in tepals; gc-ms)

Echinopsis pachanoi (BRITTON & ROSE) FRIEDRICH & ROWLEY

See as *Trichocereus pachanoi*

Echinopsis pasacana (WEBER) FRIEDRICH & ROWLEY

See as *Trichocereus pasacana*

Echinopsis peruviana (BRITTON & ROSE) FRIEDRICH & ROWLEY

See as *Trichocereus peruvianus*

Echinopsis peruviana spp. *puquiensis* (RAUH & BACKEBERG) OS-TOLAZA See as *Trichocereus puquiensis*

***Echinopsis rhodotricha* K. SCHUMANN**

Hordenine (Major alkaloid in the traces present)

Tyramine (10-50% of the traces of alkaloid present) AGURELL *et al.* 1971b [Commercial source: Netherlands]

[AGURELL 1969b reported no detectable alkaloid. European commercial sources]

Echinopsis schickendantzii WEBER

See as *Trichocereus schickendantzii*

Echinopsis scopulicola (RITTER) MOTTRAM

See as *Trichocereus scopulicola*

Echinopsis spachiana (LEMAIRE) FRIEDRICH & ROWLEY

See as *Trichocereus spachianus*

Echinopsis strigosa (SALM-DYCK) FRIEDRICH & ROWLEY

See as *Trichocereus strigosus*

Echinopsis taquimbalensis (CARDENAS) FRIEDRICH & ROWLEY

See as *Trichocereus taquimbalensis*

Echinopsis terscheckii (PARMENTIER) FRIEDRICH & ROWLEY

See as *Trichocereus terscheckii*

Echinopsis thelegonoides (SPEGAZZINI) FRIEDRICH & ROWLEY

See as *Trichocereus thelegonoides*

Echinopsis thelegona (WEBER) FRIEDRICH & ROWLEY

See as *Trichocereus thelegonus*

***Echinopsis triumphans* R. MEY** was reported to contain

Isocitric acid (tlc & glc by KRINGSTAD & NORDAL 1975)

***Echinopsis tubiflora* (PFEIFFER) ZUCCARINI**

24 ζ -Methylcholesterol (33.1% of total)

Sitosterol (66.9% of total)

SALT *et al.* 1987

Echinopsis valida MONV. See as *Trichocereus validus* but please be aware that 2 or 3 different plants are sometimes called *E. valida*.

***Epiphyllum* sp.**

Unsubstantiated and referenceless claim for the presence of mescaline is made by CAYCHO Jimenez 1977 (page 91). He does not include anything supporting his assertion.

Sterols isolated from leaves:

Avenasterol (8.4% of total)

24 ζ -Methylcholesterol (9.4% of total)

Stigmasterol (2.5% of total)

Sitosterol (75.5% of total)

24 ζ -Methylcholesterol (traces)

Sitostanol (4.2% of total)

SALT *et al.* 1987

Epiphyllum phyllanthoides (DC) SWEET

See as *Nopalxochia phyllanthoides*

***Epithelantha micromeris* (ENGELMANN) WEBER**

Tyramine (less than 0.001%) ŠTARHA 1995b; (0.0003%)

ŠTARHA 1994 [All of ŠTARHA's *Epithelantha* specimens were seed grown in Czechoslovakian greenhouses]

N-Methyltyramine (less than 0.001%) ŠTARHA 1995b; (0.0004%) ŠTARHA 1994

Hordenine (0.003%) ŠTARHA 1995b; (0.0026%) ŠTARHA 1994

3-Methoxytyramine (0.006%) ŠTARHA 1995b; (0.0059%) ŠTARHA 1994

3,4-Dimethoxyphenethylamine (0.440%) ŠTARHA 1995b [Note from Dr. ŠTARHA, rec'd. Jan. 1999 indicates this to be a typo intending 0.004% by fresh weight]; (0.0042%) ŠTARHA 1994

N-Methyl-3,4-dimethoxyphenethylamine (less than 0.001%) ŠTARHA 1995b; (0.0010%) ŠTARHA 1994 (All values above are % by fresh weight.)

[Both DOMINGUEZ *et al.* 1969 and McLAUGHLIN (unpublished) detected trace amounts of alkaloids.]

It should also be noted that WEST & McLAUGHLIN 1977 isolated and crystallized the following (as acid hydrolysis products of the corresponding saponins):

Epithelanthic acid ($\Delta^{9(11)}$ -12-oxo-oleane) (0.00008% dry wt)

Methylepithelanthate (a triterpene) (0.0004% dry wt)

Methylmachaerinate (a triterpene diol) (0.0003% dry wt)

(Thought to possibly be an artifact arising from machaeric acid)

Oleanolic acid (a triterpene) (0.58% (crude) dry wt)

β -Sitosterol (a sterol) (0.001% dry wt)

An unidentified triterpene lactone (0.0002% dry wt)

Methyl oleanate (as 5% of oleanolic acid content; thought to possibly be an artifact)

See **Activity Notes**.

The several varieties of this plant appear to lack analysis

***Eriocereus guelichii* (SPEZ.) BERG.**

Fruit contains Phyllocactin, Betanin, Isobetanin & Iso-phyllocactin. PIATTELLI & IMPERATO 1969

Eriocereus spp. This genus seriously needs some analysis.

Escobaria aguirreana (GLASS & FOSTER) TAYLOR

See as *Gymnocactus aguirreanus*

Escobaria missouriensis (SWEET) HUNT

See as *Coryphantha missouriensis*

Escobaria roseanus (BØDEKKER) TAYLOR

See as *Gymnocactus roseana* BUXBAUM

Escobaria tuberculosa

See as *Coryphantha tuberculosa*

Escobaria vivipara (NUTTALL) BUXBAUM

See as *Coryphantha vivipara*

***Escontria chiotilla* (WEBER) ROSE**

86.3% water by weight

4-Hydroxy-3,5-dimethoxyphenethylamine (Around 0.01% dry wt.) MA *et al.* 1986

Longispinogenin [0.29% yield; dry wt.]

Maniladiol [0.1% yield; dry wt.]

DJERASSI *et al.* 1956a [Collected at marker km 368 along Mexico City-Oaxaca Hwy, Puebla, Mexico]

Escontria gaumeri See as *Pterocereus gaumeri*

***Espostoa huanucensis* RITTER**

Hordenine (0.002% dry wt.)

N-Methyltyramine (0.002% by dry weight)

Tyramine (0.004% by dry weight)

MATA *et al.* 1976a [Also MATA *et al.* 1976b]

Unidentified trace alkaloid detected in MATA *et al.* 1976a.

***Espostoa lanata* (HBK) BR. & R.**

Reported to be alkaloid negative (based on Mayer's test showing no detectable alkaloid); also reported to lack triterpenes. DJERASSI *et al.* 1955b [Wild collected in Peru] [MATA & McLAUGHLIN 1976 also appears listed as a reference but they simply mentioned Djerassi's work.]

***Ferocactus acanthodes* (LEMAIRE) BRITTON & ROSE**

CO₂ uptake occurred entirely at night through the stems (under well watered conditions)

Nobel & Hartsock 1986

***Ferocactus hamatocanthus* (MUEHLENPFORDTII) BRITTON & ROSE**

No detectable alkaloids.

CHALET 1980a cited DOMINGUEZ *et al.* 1969

***Ferocactus latispinus* (HAWORTH) BRITTON & ROSE**

No detectable alkaloids in the screenings of FONG *et al.* 1972

***Ferocactus recurvus* (MILL.) BERG.**

No detectable alkaloids.

CHALET 1980a cited DOMINGUEZ *et al.* 1969

***Ferocactus stainesii* (ANDOT) BRITTON & ROSE var. *pringlei* (COULTER) BRITTON & ROSE**

Reported to contain unidentified alkaloid(s). CHALET 1980a cited DOMINGUEZ *et al.* 1969

***Ferocactus wislizeni* (ENGELMANN) BRITTON & ROSE**

Unidentified alkaloids indicated. BROWN *et al.* 1968

***Glandulicactus crassihamatus* (WEBER) MARSHALL**

Reported to contain unidentified alkaloid(s). CHALET 1980a cited DOMINGUEZ *et al.* 1969

***Grusonia bradtiana* (COULTER) BRITTON & ROSE**

Reported to contain unidentified alkaloid(s). CHALET 1980a cited DOMINGUEZ *et al.* 1969

Grusonia clavata (ENGELMANN) H.ROBINSON

see as *Corynopuntia clavata*

Grusonia emoryi (ENGELMANN) PINKAVA

see as *Corynopuntia stanlyi* var. *stanlyi*

Grusonia invicta (T.BRANDEGEE) E.F.ANDERSON

see as *Corynopuntia invicta*

Grusonia kunzei (ROSE) PINKAWA

see as *Corynopuntia stanlyi* var. *kunzei*

Grusonia schottii (ENGELMANN) H.ROBINSON

see as *Corynopuntia schottii*

***Gymnocactus aguirreanus* GLASS & FOSTER**

Hordenine (2.26% dry wt.)

N-Methyltyramine (trace)

N-Methylphenethylamine (trace)

WEST *et al.* 1974

***Gymnocactus beguinii* (WEBER) BACKEBERG**

Hordenine (trace)

N-Methyltyramine (trace)

N-Methylphenethylamine (trace)

WEST *et al.* 1974

Traces of Mescaline (between 4-12 µg/gm fresh) GENNA-RO *et al.* 1996

***Gymnocactus horripilus* (LEMAIRE) BACKEBERG**

Hordenine (trace)

N-Methylphenethylamine (0.17% dry weight)

WEST *et al.* 1974

***Gymnocactus knuthianus* (BOEDECKER) BACKEBERG**

N-Methylphenethylamine (trace) WEST *et al.* 1974

***Gymnocactus mandragora* (FRIC) BACKEBERG**

N-Methylphenethylamine (trace)

N-Methyltyramine (trace)

WEST *et al.* 1974.

***Gymnocactus roseanus* (BOEDECKER) GLASS & FOSTER**

Hordenine (2.39% dry wt.)

N-Methylphenethylamine (trace)

N-Methyltyramine (trace)

WEST *et al.* 1974

***Gymnocactus* sp. (thought to be a variety of *G. roseanus*)**

N-Methylphenethylamine (0.04% dry wt.)

Hordenine (1.89% dry wt.)

WEST *et al.* 1974 [Collected from El Chiflon, Mexico]

***Gymnocactus viereckii* (WERDERMANN) BACKEBERG**

N-Methylphenethylamine (trace) WEST *et al.* 1974

***Gymnocalycium achirasense* TILL & SCHATZL**

Tyramine (0.00159% [\pm 0.00008])

N-Methyltyramine (0.00045% [\pm 0.00006])

Hordenine (0.00129% [\pm 0.00006])

Mescaline (0.00007% [\pm 0.00001])

N-Methylmescaline (0.00013% [\pm 0.00001])

N,N-Dimethylmescaline (0.00025% [\pm 0.00002])

Anhalamine (0.00097% [\pm 0.00001])

ŠTARHA *et al.* 1998 (% by fresh weight)

ŠTARHA used cultivated plants; gc or gcms to identify.

***Gymnocalycium albispinum* BACKEBERG**

Tyramine (Between 0.0001-0.001%)

N-Methyltyramine (Less than 0.0001%)

Hordenine (Between 0.0001-0.001%)

Anhalinine (Less than 0.0001%)

O-Methylanhalonidine (Less than 0.0001%)

Anhalonidine (Less than 0.0001%)

Pellotine (Less than 0.0001%)

Anhalonine (Less than 0.0001%)

Lophophorine (Less than 0.0001%)

ŠTARHA *et al.* 1997 (% by fresh weight)

***Gymnocalycium andreae* (BÖD.) BACKEB. & F.M.KNUTH**

Betalains. WOHLPART & MABRY 1968 cited DREIDING 1961
trans- β -Ocimene - Minor volatile in floral scent, absent in some

Dehydrogeosmin - Minor volatile, major or absent in some; present in 73%, absent in 15%, questionable in 12%.

Heptadecene - Minor volatile, trace in some.

Bergamotene - Minor volatile.

β -Farnesene - Major volatile, trace or absent in some.

Sesquiterpene alcohol - Trace volatile, absent in some.

Alkane - Trace volatile, absent in some.

Eudesman-3,7-dien? - Minor volatile, absent in some.

trans-Nerolidol - Major volatile, trace or absent in some.

Alkene 1 - Minor volatile, trace in some.

Sesquiterpene alcohol 1 - Minor volatile, trace in some.

Sesquiterpene alcohol 2 - Minor volatile.

Alkene 2 - Minor volatile, absent in some.

Alkene 3 - Minor volatile, trace in some.

Highly variable among cultivated individuals. 19 of 20 showed floral scent dominated by either β -Farnesene or *trans*-Nerolidol; 1 specimen had Dehydrogeosmin as the largest peak.

Six wild specimens from Argentina had a uniform floral scent composed almost entirely of β -Farnesene.

SCHLUMBERGER *et al.* 2004 (in tepals; gc-ms)

***Gymnocalycium anisitsii* (K.SCHUMANN) BR. & R.**

Tyramine (less than 0.0001%)

Hordenine (approximately 0.001%)

N-Methylmescaline (less than 0.0001%)

Anhalinine (between 0.0001-0.001%)

Anhalidine (between 0.0001-0.001%)

Anhalonidine (less than 0.0001%)

ŠTARHA 1996 (% by fresh weight)

***Gymnocalycium asterium* ITO**

Tyramine (0.00089% [\pm 0.00013])

N-Methyltyramine (0.00012% [\pm 0.00004])

Hordenine (0.00105% [\pm 0.0001])

Mescaline (0.00013% [\pm 0.00002])

N-Methylmescaline (0.00031% [\pm 0.00004])

N,N-Dimethylmescaline (0.0005% [\pm 0.00004])

O-Methylanhalidine (0.00011% [\pm 0.00002])

Anhalidine (Trace)

Anhalamine (0.00054% [\pm 0.00002])

Anhalonidine (Trace)

Pellotine (Trace)

Anhalonine (Trace)

Lophophorine (Trace)

ŠTARHA *et al.* 1998 (% by fresh weight)

***Gymnocalycium baldianum* (SPEGAZZINI) SPEGAZZINI**

Tyramine (less than 0.0001%)

Hordenine (approximately 0.001%)

Mescaline (less than 0.0001%)

Anhalinine (less than 0.0001%)

Anhalidine (less than 0.0001%)

Anhalamine (less than 0.0001%)

Anhalonidine (less than 0.0001%)

Pellotine (less than 0.0001%)

Anhalonine (less than 0.0001%)

Lophophorine (less than 0.0001%)

ŠTARHA 1996 (% by fresh weight)

Reported to contain Betalains as pigments. WOHLPART & MABRY 1968 cited DREIDING 1961

***Gymnocalycium bayrianum* TILL**

Tyramine (between 0.0001-0.001%)

Hordenine (between 0.0001-0.001%)

N-Methyltyramine (less than 0.0001%)

Anhalinine (less than 0.0001%)

Anhalonidine (less than 0.0001%)

Pellotine (less than 0.0001%)

Anhalonine (between 0.0001-0.001%)

Lophophorine (less than 0.0001%)

ŠTARHA 1996 (% by fresh weight)

Gymnocalycium bodenbenderianum* ssp. *intertextum

Dehydrogeosmin - Major volatile in the flower scent.

Sesquiterpene alcohol 1 - Minor volatile in floral scent.

Sesquiterpene alcohol 2 - Major volatile in floral scent.

Scent emission from the apical half of tepal was dominated by Dehydrogeosmin and Sesquiterpene alcohol 1; basal half was dominated by β -Farnesene.

SCHLUMBERGER *et al.* 2004 (in tepals; gc-ms)

***Gymnocalycium boszingianum* SCHÜTZ**

Tyramine (between 0.0001-0.001%)
Hordenine (approximately 0.001%)
Anhalinine (between 0.0001-0.001%)
N-Methylmescaline (less than 0.0001%)
N-Methyltyramine (less than 0.0001%)
Anhalonidine (less than 0.0001%)
Pellotine (approximately 0.001%)
Anhalonine (less than 0.0001%)
Lophophorine (less than 0.0001%)
ŠTARHA 1996 (% by fresh weight)

***Gymnocalycium bruchii* (SPEGAZZINI) HOSSEUS**

trans-β-Ocimene - Minor volatile in floral scent.
Dehydrogeosmin - Major volatile, minor in some.
trans-Nerolidol - Major volatile, absent in some.
Sesquiterpene alcohol 1 - Minor volatile, trace in some.
Sesquiterpene alcohol 2 - Minor volatile, major in some.
SCHLUMBERGER *et al.* 2004 (in tepals; gc-ms)

***Gymnocalycium calochlorum* (BOEDECKER) Y. ITO**

Mescaline (between 0.0001-0.001%)
Tyramine (between 0.0001-0.001%)
N-Methyltyramine (less than 0.0001%)
Hordenine (approximately 0.001%)
N-Methylmescaline (less than 0.0001%)
Anhalinine (less than 0.0001%)
Anhalidine (less than 0.0001%)
Anhalamine (less than 0.0001%)
Anhalonidine (between 0.0001-0.001%)
Pellotine (less than 0.0001%)
ŠTARHA 1996 (% by fresh weight)

***Gymnocalycium cardenasianum* RITTER**

Tyramine (between 0.0001-0.001%)
N-Methyltyramine (less than 0.0001%)
Hordenine (between 0.0001-0.001%)
Anhalinine (less than 0.0001%)
Anhalonidine (less than 0.0001%)
Pellotine (less than 0.0001%)
ŠTARHA 1996 (% by fresh weight)

***Gymnocalycium carminanthum* BORTH & KOOP**

Tyramine (0.00007% [\pm 0.00003])
N-Methyltyramine (Trace)
Hordenine (0.00016% [\pm 0.00005])
Mescaline (0.00006% [\pm 0.00005])
N-Methylmescaline (Trace)
N,N-Dimethylmescaline (0.00008% [\pm 0.00002])
O-Methylanhalidine (0.00007% [\pm 0.00002])
Anhalamine (0.00088% [\pm 0.00003])
Anhalonidine (Trace)
ŠTARHA *et al.* 1998 (% by fresh weight)

***Gymnocalycium chubutense* SPEGAZZINI**

Tyramine (Between 0.0001-0.001%)
N-Methyltyramine (Between 0.0001-0.001%)
Hordenine (approximately 0.001%)

N-Methylmescaline (Between 0.0001-0.001%)
O-Methylanhalidine (Less than 0.0001%)
O-Methylanhalonidine (Less than 0.0001%)
Anhalonidine (Less than 0.0001%)
Pellotine (Between 0.0001-0.001%)
Anhalonine (Between 0.0001-0.001%)
Lophophorine (Between 0.0001-0.001%)
ŠTARHA *et al.* 1997 (% by fresh weight)

***Gymnocalycium comarapense* BACKEBERG**

Tyramine (Between 0.001-0.001%)
N-Methyltyramine (Less than 0.001%)
Hordenine (Less than 0.001%)
Mescaline (Less than 0.001%)
N-Methylmescaline (Less than 0.001%)
Anhalamine (Less than 0.001%)
Pellotine (Less than 0.001%)
ŠTARHA 1995 (% by fresh weight)

***Gymnocalycium curvispinum* FRIC**

Tyramine (between 0.0001-0.001%)
N-Methylmescaline (less than 0.0001%)
Hordenine (less than 0.0001%)
Anhalinine (between 0.0001-0.001%)
Anhalonidine (less than 0.0001%)
Pellotine (less than 0.0001%)
Anhalonine (less than 0.0001%)
ŠTARHA 1996 (% by fresh weight)

***Gymnocalycium delaetii* BACKEBERG**

Tyramine (less than 0.0001%)
N-Methyltyramine (less than 0.0001%)
Hordenine (approximately 0.001%)
N-Methylmescaline (less than 0.0001%)
Anhalinine (less than 0.0001%)
Anhalonidine (less than 0.0001%)
Pellotine (less than 0.0001%)
ŠTARHA 1996 (% by fresh weight)

***Gymnocalycium denudatum* (L.&O.) PFEIFF.**

Tyramine (0.00066% [\pm 0.00006])
N-Methyltyramine (0.00061% [\pm 0.00002])
Hordenine (0.00052% [\pm 0.00005])
Mescaline (Trace)
N-Methylmescaline (0.00008% [\pm 0.00001])
N,N-Dimethylmescaline (0.00073% [\pm 0.00005])
O-Methylanhalidine (0.00025% [\pm 0.00003])
Anhalinine (0.00006% [\pm 0.00002])
O-Methylanhalonidine (0.0001% [\pm 0.00002])
Anhalidine (Trace)
Anhalamine (0.00048% [\pm 0.00002])
Anhalonidine (Trace)
ŠTARHA *et al.* 1998 (% by fresh weight)

***Gymnocalycium eytianum* CÁRDENAS**

Weddellite was identified as druses.
MONJE & BARAN 2002

***Gymnocalycium fleischerianum* BACKEBERG**

Tyramine (0.0001-0.001% dry wt.)
 N-Methyltyramine (0.001% dry wt.)
 Hordenine (0.0001-0.001% dry wt.)
Mescaline (0.0001-0.001% dry wt.)
 N-Methylmescaline (0.0001-0.001% dry wt.)
 N,N-Dimethylmescaline (0.0001-0.001% dry wt.)
 Anhalamine (0.0001-0.001% dry wt.)
 Anhalonidine (0.00001-0.0001% dry wt.)
 ŠTARHA 2001c did not include a citation for his information. (*G. fleischerianum* is included only in the table on page 91 and not in the by species breakdown)

***Gymnocalycium friedrichii* PAZ.**

Tyramine (between 0.0001-0.001%)
 Hordenine (less than 0.0001%)
 ŠTARHA 1996 (% by fresh weight)

***Gymnocalycium gibbosum* (HAWORTH) PFEIFFER**

92.1% water by weight (pH of juice: 4.6-5.0) HERRERO-DUCLOUX 1930b
 Tyramine (Less than 0.0001%) ŠTARHA *et al.* 1997
 N-Methyltyramine (approximately 0.001%) ŠTARHA *et al.* 1997
 Hordenine (approximately 0.001%) ŠTARHA *et al.* 1997
Mescaline (unquantified and tentatively identified. Colorless birefringent crystals, n 1.544, mp 160-162° were claimed to show the “reactions of mescaline”) HERRERO-DUCLOUX 1930b. **Not** observed by ŠTARHA *et al.* 1997.
 N-Methylmescaline (Between 0.0001-0.001%) ŠTARHA *et al.* 1997
 N,N-Dimethylmescaline (Less than 0.0001%) ŠTARHA *et al.* 1997
 O-Methylanhalidine (approximately 0.001%) ŠTARHA *et al.* 1997
 Anhalinine (approximately 0.001%) ŠTARHA *et al.* 1997
 O-Methylanhalonidine (approximately 0.001%) ŠTARHA *et al.* 1997
 Anhalidine (Between 0.0001-0.001%) ŠTARHA *et al.* 1997
 Anhalamine No quantification (or accurate identification) attempted; HERRERO-DUCLOUX 1930b [Our source was RETI; CA gives this as Anhalonine. We presently lack the primary paper.] (approximately 0.001%) ŠTARHA *et al.* 1997
 Anhalonidine (Less than 0.0001%) ŠTARHA *et al.* 1997
 Pellotine (Between 0.0001-0.001%) ŠTARHA *et al.* 1997
 Anhalonine (Between 0.0001-0.001%) ŠTARHA *et al.* 1997
 Lophophorine No quantification (or accurate identification) attempted; HERRERO-DUCLOUX 1930b (Between 0.0001-0.001%) ŠTARHA *et al.* 1997
 [All of ŠTARHA’s values are % by fresh wt]

***Gymnocalycium horridispinum* FRANK**

Mescaline (between 0.0001-0.001%)
 Tyramine (approximately 0.001%)
 N-Methyltyramine (less than 0.0001%)
 Hordenine (approximately 0.001%)
 N-Methylmescaline (less than 0.0001%)
 Anhalinine (less than 0.0001%)
 Pellotine (less than 0.0001%)
 ŠTARHA 1996 (% by fresh weight)

***Gymnocalycium leeanum* (HOOKER) BR. & R.**

Anhalonine (Unconfirmed) HERRERO-DUCLOUX 1930b
Not observed by DEVRIES *et al.* 1971
 Hordenine (%) DEVRIES *et al.* 1971
 Lophophorine (Unconfirmed) HERRERO-DUCLOUX 1930b
Not observed by DEVRIES *et al.* 1971
Mescaline (Unconfirmed) HERRERO-DUCLOUX 1930b
Not observed by DEVRIES *et al.* 1971
 N-Methyltyramine (?) DEVRIES *et al.* 1971
 Tyramine (0.00583%) DEVRIES *et al.* 1971

***Gymnocalycium marsoneri* (FRIC) ITO**

Tyramine (Less than 0.0001%)
 N-Methyltyramine (Less than 0.0001%)
 Hordenine (Approximately 0.001%)
 N-Methylmescaline (Between 0.0001-0.001%)
 ŠTARHA *et al.* 1997 (% by fresh weight)

***Gymnocalycium mazanense* BACKEBERG**

N-Methyltyramine (Less than 0.0001%)
 Tyramine (Between 0.0001-0.001%)
 Hordenine (Approximately 0.001%)
 ŠTARHA 1996 (% by fresh weight)

***Gymnocalycium megalothales* (SENCKE) BRITTON & ROSE**

Tyramine (Approximately 0.001%)
 Hordenine (Between 0.0001-0.001%)
 N-Methyltyramine (Less than 0.0001%)
 Anhalinine (Less than 0.0001%)
 Anhalonidine (Less than 0.0001%)
 ŠTARHA 1996 (% by fresh weight)

***Gymnocalycium mesopotamicum* KIESSLING**

Tyramine (Trace)
 N-Methyltyramine (Trace)
 Hordenine (Trace)
Mescaline (Trace)
 N-Methylmescaline (Trace)
 N,N-Dimethylmescaline (0.00279% [\pm 0.0005])
 Anhalamine (0.0019% [\pm 0.00028])
 Anhalonidine (0.00005% [\pm 0.00003])
 ŠTARHA *et al.* 1998 (% by fresh weight)

***Gymnocalycium mihanovichii* (FRIC & GÜRKE) BRITTON & ROSE**

Hordenine (less than 0.0001%)
 Tyramine (between 0.0001-0.001%)
 ŠTARHA 1996 (% by fresh weight)
 Reported to contain Betalains as pigments. WOHLPART & MABRY 1968 cited DREIDING 1961

***Gymnocalycium monvillei* (LEMAIRE) BRITTON & ROSE**

Tyramine (Between 0.0001-0.001%)
 N-Methyltyramine (Between 0.0001-0.001%)
 Hordenine (Approximately 0.001%)

Mescaline (Less than 0.0001%)
N-Methylmescaline (Less than 0.0001%)
N,N-Dimethylmescaline (Less than 0.0001%)
O-Methylanhalidine (Less than 0.0001%)
Anhalinine (Less than 0.0001%)
O-Methylanhalonidine (Less than 0.0001%)
Anhalidine (Less than 0.0001%)
Anhalamine (Less than 0.0001%)
Anhalonidine (Between 0.0001-0.001%)
Pellotine (Between 0.0001-0.001%)
Anhalonine (Between 0.0001-0.001%)
Lophophorine (Less than 0.0001%)
ŠTARHA *et al.* 1997 (% by fresh weight)
Dehydrogeosmin - Major volatile in floral scent, minor or absent in some.
Sesquiterpene alcohol 1 - Minor volatile, trace in some.
Sesquiterpene alcohol 2 - Minor volatile.
Dehydrogeosmin present in 85% of their samples, absent in 5%, questionable in 10%.
SCHLUMBERGER *et al.* 2004 (in tepals; gc-ms)

***Gymnocalycium moserianum* SCHUTZ**

Tyramine (0.00077% [\pm 0.0001])
N-Methyltyramine (0.0001% [\pm 0.00003])
Hordenine (0.00011% [\pm 0.00003])
Mescaline (0.00007% [\pm 0.00001])
N-Methylmescaline (0.00151% [\pm 0.00015])
N,N-Dimethylmescaline (0.00071% [\pm 0.00006])
O-Methylanhalidine (0.00007% [\pm 0.00001])
Anhalinine (0.00007% [\pm 0.00001])
O-Methylanhalonidine (0.00007% [\pm 0.00001])
Anhalidine (0.00007% [\pm 0.00001])
Anhalamine (0.00215% [\pm 0.00014])
Anhalonidine (0.00014% [\pm 0.00003])
Pellotine (0.00012% [\pm 0.00003])
Anhalonine (Trace)
Lophophorine (Trace)
ŠTARHA *et al.* 1998 (% by fresh weight)

***Gymnocalycium multiflorum* (HOOKER) BR. & R.**

HERRERO-DUCLOUX 1932a reported the recovery of small quantities of a 'mescaline-like' alkaloid but did not identify it. This species is now considered *G. monvillei*.

***Gymnocalycium netrelianum* BRITTON & ROSE**

Tyramine (Less than 0.001%)
Hordenine (Between 0.0001-0.001%)
Mescaline (Between 0.0001-0.001%)
N-Methylmescaline (Less than 0.001%)
Pellotine (Less than 0.001%)
ŠTARHA 1995a (% by fresh weight)

***Gymnocalycium nigriareolatum* BACKEBERG**

Tyramine (0.00047% [\pm 0.00005])
N-Methyltyramine (0.00008% [\pm 0.00002])
Hordenine (0.0014% [\pm 0.00006])
Mescaline (0.00006% [\pm 0.00002])
N-Methylmescaline (0.00006% [\pm 0.00001])

N,N-Dimethylmescaline (0.00009% [\pm 0.00002])
O-Methylanhalidine (0.00012% [\pm 0.00006])
Anhalamine (0.00019% [\pm 0.00004])
Anhalonidine (0.00008% [\pm 0.00002])
ŠTARHA *et al.* 1998 (% by fresh weight)

***Gymnocalycium oenanthemum* BACKEBERG**

Tyramine (Between 0.0001-0.001%)
N-Methyltyramine (Less than 0.0001%)
Hordenine (approximately 0.001%)
Mescaline (Less than 0.0001%)
N-Methylmescaline (Less than 0.0001%)
N,N-Dimethylmescaline (Less than 0.0001%)
O-Methylanhalidine (Less than 0.0001%)
O-Methylanhalonidine (Less than 0.0001%)
Anhalidine (Less than 0.0001%)
Anhalamine (Less than 0.0001%)
Anhalonidine (Between 0.0001-0.001%)
Pellotine (Between 0.0001-0.001%)
Anhalonine (Less than 0.0001%)
Lophophorine (Less than 0.0001%)
ŠTARHA *et al.* 1997 (% by fresh weight)

***Gymnocalycium paraguayense* SCHUTZ**

Tyramine (0.00047% [\pm 0.00004])
N-Methyltyramine (0.00104% [\pm 0.00014])
Hordenine (0.00043% [\pm 0.00008])
Mescaline (0.00011% [\pm 0.00006])
N-Methylmescaline (0.00041% [\pm 0.0001])
N,N-Dimethylmescaline (0.00427% [\pm 0.00032])
Anhalamine (0.00505% [\pm 0.0005])
Anhalonidine (0.00017% [\pm 0.00006])
ŠTARHA *et al.* 1998 (% by fresh weight)

***Gymnocalycium pflanzii* (VAUPEL) WERDERMANN**

Tyramine (approximately 0.001%)
Hordenine (between 0.0001-0.001%)
N-Methyltyramine (less than 0.0001%)
N-Methylmescaline (less than 0.0001%)
Anhalinine (less than 0.0001%)
Anhalamine (less than 0.0001%)
Anhalonidine (less than 0.0001%)
Pellotine (between 0.0001-0.001%)
Anhalonine (between 0.0001-0.001%)
Lophophorine (between 0.0001-0.001%)
ŠTARHA 1996 (% by fresh weight)

***Gymnocalycium platense* (SPEGAZZINI) BRITTON & ROSE**

Weddellite was identified as druses.
MONJE & BARAN 2002

***Gymnocalycium pungens* FLEISCHER**

Hordenine (approximately 0.001%)
Tyramine (between 0.0001-0.001%)
ŠTARHA 1996 (% by fresh weight)

***Gymnocalycium quehlianum* (HAAGE) BERG.**

Tyramine (Between 0.0001-0.001%)
 N-Methyltyramine (Between 0.0001-0.001%)
 Hordenine (approximately 0.001%)
Mescaline (Less than 0.0001%)
 N-Methylmescaline (Less than 0.0001%)
 N,N-Dimethylmescaline (Less than 0.0001%)
 Anhalinine (Less than 0.0001%)
 O-Methylanhalonidine (Between 0.0001-0.001%)
 Anhalonidine (Less than 0.0001%)
 Pellotine (Less than 0.0001%)
 Anhalonine (Less than 0.0001%)
 Lophophorine (Less than 0.0001%)
 ŠTARHA *et al.* 1997 (% by fresh weight)

***Gymnocalycium ragonessii* CAST.**

Tyramine (0.00009% [\pm 0.00002])
 N-Methyltyramine (0.00005% [\pm 0.00001])
 Hordenine (0.0035% [\pm 0.00014])
Mescaline (Trace)
 N-Methylmescaline (Trace)
 N,N-Dimethylmescaline (Trace)
 O-Methylanhalonidine (0.00048% [\pm 0.00003])
 Anhalinine (0.00109% [\pm 0.00018])
 O-Methylanhalonidine (0.00007% [\pm 0.00001])
 Anhalonidine (0.00006% [\pm 0.00001])
 Anhalonidine (Trace)
 Pellotine (Trace)
 ŠTARHA *et al.* 1998 (% by fresh weight)

***Gymnocalycium riojense* FRIČ ex H.TILL & W.TILL**

Tyramine
 0.001% dry wt.
 ŠTARHA 2001c cited ŠTARHA 2001a
 Not observed.
 ŠTARHA 2002
 N-Methyltyramine
 0.00001-0.0001% dry wt.
 ŠTARHA 2001c cited ŠTARHA 2001a
 Less than 0.0001% fresh wt.
 ŠTARHA 2002
 Hordenine
 0.001% dry wt.
 ŠTARHA 2001c cited ŠTARHA 2001a
 Not observed.
 ŠTARHA 2002
 Mescaline
 0.00001-0.0001% dry wt.
 ŠTARHA 2001c cited ŠTARHA 2001a
 Less than 0.0001% fresh wt.
 ŠTARHA 2002
 N-Methylmescaline
 0.00001-0.0001% dry wt.
 ŠTARHA 2001c cited ŠTARHA 2001a
 Less than 0.0001% fresh wt.
 ŠTARHA 2002

Anhalinine
 0.00001-0.0001% dry wt.
 ŠTARHA 2001c cited ŠTARHA 2001a
 Less than 0.0001% fresh wt.
 ŠTARHA 2002
 O-Methylanhalonidine
 0.00001-0.0001% dry wt.
 ŠTARHA 2001c cited ŠTARHA 2001a
 Less than 0.0001% fresh wt.
 ŠTARHA 2002
 Pellotine
 0.00001-0.0001% dry wt.
 ŠTARHA 2001c cited ŠTARHA 2001a
 Less than 0.0001% fresh wt.
 ŠTARHA 2002
 Anhalonidine
 0.00001-0.0001% dry wt.
 ŠTARHA 2001c cited ŠTARHA 2001a
 Less than 0.0001% fresh wt.
 ŠTARHA 2002

***Gymnocalycium riojense* FRIČ ex H.TILL & W.TILL
 ssp. *kozelskianum* SCHÜTZ ex H.TILL & W.TILL**

Tyramine
 0.002% fresh wt.
 N-Methyltyramine
 Less than 0.0001% fresh wt.
 Hordenine
 0.004% fresh wt.
 Mescaline
 Less than 0.0001% fresh wt.
 N-Methylmescaline
 Less than 0.0001% fresh wt.
 Anhalinine
 Less than 0.0001% fresh wt.
 O-Methylanhalonidine
 Less than 0.0001% fresh wt.
 Pellotine
 Less than 0.0001% fresh wt.
 Anhalonidine
 Less than 0.0001% fresh wt.
 ŠTARHA 2002

***Gymnocalycium riojense* FRIČ ex H.TILL & W.TILL
 ssp. *paucispinum* BACKEBERG ex H.TILL & W.TILL**

Tyramine
 0.002% fresh wt.
 N-Methyltyramine
 less than 0.0001% fresh wt.
 Hordenine
 0.004% fresh wt.
 Mescaline
 less than 0.0001% fresh wt.
 N-Methylmescaline
 less than 0.0001% fresh wt.

Anhalinine
less than 0.0001% fresh wt.
O-Methylanhalonidine
less than 0.0001% fresh wt.
Pellotine
less than 0.0001% fresh wt.
Anhalonidine
less than 0.0001% fresh wt.
ŠTARHA 2002

***Gymnocalycium riograndense* CARDENAS**

Tyramine (Between 0.0001-0.001%)
N-Methyltyramine (Less than 0.001%)
Hordenine (Less than 0.001%)
Mescaline (Between 0.0001-0.001%)
N-Methylmescaline (Less than 0.001%)
Anhalinine (Less than 0.001%)
Anhalidine (Less than 0.001%)
Anhalonidine (Less than 0.001%)
Pellotine (Less than 0.001%)
Anhalonine (Less than 0.001%)
Lophophorine (Less than 0.001%)
ŠTARHA 1995a (% by fresh weight)

***Gymnocalycium saglionae* (CELS) BRITTON & ROSE**

Tyramine (0.027% dry wt.) NIETO *et al.* 1982.
Also; Less than 0.001% [fresh wt] in ŠTARHA 1995a
Hordenine (0.008% dry wt.) NIETO *et al.* 1982.
Also; Less than 0.001% [fresh wt] in ŠTARHA 1995a
Anhalidine (Less than 0.001%) ŠTARHA 1995a
Anhalonidine (Between 0.0001-0.001%) ŠTARHA 1995a
Pellotine (Less than 0.001%) ŠTARHA 1995a
Anhalonine (Less than 0.001%) ŠTARHA 1995a
Lophophorine (Less than 0.001%) ŠTARHA 1995a
Candicine (0.041% dry wt.) NIETO *et al.* 1982.
[3 unidentified bases reported; NIETO *et al.* 1982]

***Gymnocalycium schickendantzii* (WEBER) BRITTON & ROSE**

Tyramine (approximately 0.001%)
N-Methyltyramine (between 0.0001-0.001%)
Hordenine (approximately 0.001%) ŠTARHA 1996; Also
(%?) RUIZ *et al.* 1973
Anhalinine (between 0.0001-0.001%)
Anhalidine (less than 0.0001%)
Anhalamine (less than 0.0001%)
Pellotine (less than 0.0001%)
Anhalonine (less than 0.0001%)
Lophophorine (less than 0.0001%)
All above by ŠTARHA 1996 (% by fresh weight)
Candicine (%?) RUIZ *et al.* 1973

***Gymnocalycium stellatum* SPEGAZZINI**

Tyramine (Between 0.0001-0.001%)
N-Methyltyramine (Less than 0.0001%)
Hordenine (approximately 0.001%)
Mescaline (Less than 0.0001%)

N-Methylmescaline (Between 0.0001-0.001%)
N,N-Dimethylmescaline (Less than 0.0001%)
Anhalinine (Between 0.0001-0.001%)
O-Methylanhalonidine (Less than 0.0001%)
Anhalamine (Less than 0.0001%)
Anhalonidine (Between 0.0001-0.001%)
Pellotine (Between 0.0001-0.001%)
Anhalonine (Between 0.0001-0.001%)
Lophophorine (Less than 0.0001%)
ŠTARHA *et al.* 1997 (% by fresh weight)

***Gymnocalycium strigianum* JEGGLE**

Tyramine (Less than 0.001%)
Hordenine (Less than 0.001%)
Mescaline (“readily apparent” at around 0.001%)
N-Methylmescaline (“readily apparent” at around 0.001%)
Anhalinine (Less than 0.001%)
Anhalidine (Less than 0.001%)
Anhalamine (“readily apparent” at around 0.001%)
Anhalonidine (Less than 0.001%)
Pellotine (“readily apparent” at around 0.001%)
Anhalonine (Less than 0.001%)
Lophophorine (Less than 0.001%)
ŠTARHA 1995a (% by fresh weight)

***Gymnocalycium tillianum* RAUSCH**

Tyramine (Less than 0.001%)
N-Methyltyramine (Less than 0.001%)
Hordenine (Between 0.0001-0.001%)
Anhalinine (Between 0.0001-0.001%)
Anhalidine (Less than 0.001%)
Anhalonidine (Less than 0.001%)
Pellotine (Between 0.0001-0.001%)
ŠTARHA 1995a (% by fresh weight)

***Gymnocalycium triacanthum* BACKEBERG**

Tyramine (Trace)
N-Methyltyramine (0.00005% [\pm 0.00001])
Hordenine (0.00054% [\pm 0.00004])
Mescaline (Trace)
N-Methylmescaline (Trace)
N,N-Dimethylmescaline (Trace)
O-Methylanhalidine (0.00015% [\pm 0.00001])
Anhalinine (0.00014% [\pm 0.00001])
Anhalidine (Trace)
Anhalonidine (0.0006% [\pm 0.00001])
ŠTARHA *et al.* 1998 (% by fresh weight)

According to HUNT 1999, *Gymnocalycium triacanthum* was lumped into *Gymnocalycium riogense* FRIČ ex H.TILL & W.TILL.

HUNT 2006 mentions that TILL & TILL recognized four subspecies within *G. riogense* with three varieties within each of three of the four.

HUNT 2006 also notes that *G. riogense* has more recently been absorbed into *Gymnocalycium bodenbenderianum* (BGR.) HILL.

See also the synonym list of Ulrich CREUTZBERG 2010 and Creutzberg's great informational website.

***Gymnocalycium uebelmannianum* RAUSCH**

Tyramine (Between 0.0001-0.001%)
N-Methyltyramine (Between 0.0001-0.001%)
Hordenine (Between 0.0001-0.001%)
Mescaline (Between 0.0001-0.001%)
N-Methylmescaline (Less than 0.0001%)
N,N-Dimethylmescaline (Less than 0.0001%)
O-Methylanhalidine (Less than 0.0001%)
Anhalinine (Between 0.0001-0.001%)
O-Methylanhalonidine (Between 0.0001-0.001%)
Anhalidine (Less than 0.0001%)
Anhalamine (Between 0.0001-0.001%)
Anhalonidine (Between 0.0001-0.001%)
Pellotine (Between 0.0001-0.001%)
Anhalonine (Less than 0.0001%)
Lophophorine (Less than 0.0001%)
ŠTARHA *et al.* 1997 (% by fresh weight)

***Gymnocalycium valnicekianum* JAJÓ**

Tyramine (Between 0.0001-0.001%)
N-Methyltyramine (Less than 0.001%)
Hordenine ("readily apparent" at around 0.001%)
Mescaline (Less than 0.001%)
Anhalinine (Less than 0.001%)
Anhalonidine (Between 0.0001-0.001%)
Pellotine (Less than 0.001%)
Anhalonine (Less than 0.001%)
Lophophorine (Less than 0.001%)
ŠTARHA 1995a (% by fresh weight)

***Gymnocalycium vatteri* BUINING**

Mescaline (between 0.0001-0.001%)
Tyramine (approximately 0.001%)
N-Methyltyramine (between 0.0001-0.001%)
Hordenine (approximately 0.001%)
N-Methylmescaline (between 0.0001-0.001%)
Anhalinine (approximately 0.001%)
Anhalidine (less than 0.0001%)
Anhalonidine (between 0.0001-0.001%)
Pellotine (between 0.0001-0.001%)
Anhalonine (less than 0.0001%)
Lophophorine (less than 0.0001%)
ŠTARHA 1996 (% by fresh weight)

***Haageocereus acranthus* (VPL.) BACKEBERG**

Flower contains Phyllocactin, Isophyllocactin, Betanin & Isobetatin. PIATTELLI & IMPERATO 1969
Claim for the presence of mescaline is made by CAYCHO 1977 (page 91 as *Cereus acranthus* VAUPEL) but no reference was cited and he does not include anything to support his assertion.
See comment in **Activity Notes**.

Hamatocactus hamatocanthus (MÜHLENPF.) BORG See as *Fero-cactus hamatocanthus*

***Hariota salicornioides* DC**

Citric acid (5.2% in stem juice)
HEGNAUER 1964 cited BERGSTRÖM 1934
Reported to contain Betalains as pigments. WOHLPART & MABRY 1968 cited DREIDING 1961

***Harrisia adscendens* (GÜRKE) BR. & R.**
"rabo de raposa "

Unconfirmed report of caffeine (0.12-0.2%) in the seeds.
HEGNAUER 1964 & MATA & McLAUGHLIN 1982 cite FREISE 1935.
As was mentioned elsewhere here, Freise's reports of caffeine from cactus seeds have never been confirmed by anyone.

Haseltonia columna-trajani (KARW.) BACKEBERG
See as *Cephalocereus hoppenstedtii*

Heliabravoa chende (GOSSELIN) BACKEBERG
See as *Polaskia chende*

Helianthocereus andalgalensis (WEBER) BACKEBERG
See as *Trichocereus andalgalensis*
Helianthocereus atacamensis (PHIL.) BACKEBERG
See as *Trichocereus atacamensis*
Helianthocereus huascha (WEBER) BACKEBERG
See as *Trichocereus huascha*
Helianthocereus pasacana (WEBER) BACKEBERG.
See as *Trichocereus pasacana*
Helianthocereus poco (BACKEBERG) BACKEBERG
See as *Trichocereus poco*
Helianthocereus speciosus (CAVAN.) BR. & R.
See as *Cereus speciosus*

Hertrichocereus beneckeii (EHRENBERG) BACKEBERG
See as *Stenocereus beneckeii*

Homalocephala texensis BRITTON & ROSE
See as *Echinocactus texensis*

***Hylocereus costaricensis* (WEBER) BRITTON & ROSE**

Total betacyanin
Phyllocactin was present at several times the betanin content.
Total 0.39 ± 0.041 mg/g in fruit pulp.
Betanin ($17.9 \pm 1.4\%$ of total)
Phyllocactin ($63.9 \pm 4.1\%$ of total)
Hylocerenin ($6.4 \pm 0.72\%$ of total)
Isobetatin ($2.8 \pm 0.32\%$ of total)
Isophyllocactin ($7.4 \pm 0.66\%$ of total)
Isohylocerenin ($1.0 \pm 0.15\%$ of total)
(% = relative percent of total peak in HPLC)
WYBRANIEC & MIZRAHI 2002

Hylocereus costaricensis* X *purpusii

Fruit contained:
Betanidin 5-O-β-sophoroside
Betanin & Isobetatin
2'-Apiosyl-betanin & 2'-Apiosyl-isobetatin
Phyllocactin & Isophyllocactin

4'-Malonyl-betanin & 4'-Malonyl-isobetanin
Hylocerenin & Isohylocerenin
2'-Apiosyl-phyllolactin & 2'-Apiosyl-isophyllolactin
Peel contained
Same and additionally
5''-O-E-Feruloyl-2'-apiosylbetanin
5''-O-E-Feruloyl-2'-apiosylisobetanin
5''-O-E-Sinapoyl-2'-apiosylbetanin
5''-O-E-Sinapoyl-2'-apiosylisobetanin
5''-O-E-Feruloyl-2'-apiosylphyllolactin
5''-O-E-Feruloyl-2'-apiosylisophyllolactin
WYBRANIEC *et al.* 2007 (hplc)

Hylocereus hybrid 1 (Hylocereus undatus (whiteflesh) X sp. 487)

Total 0.28 ± 0.024 mg/g in fruit pulp.
Betanin ($76.2 \pm 5.7\%$ of total)
Phylloactin ($12.0 \pm 1.0\%$ of total)
Hylocerenin ($1.3 \pm 0.12\%$ of total)
Isobetanin ($9.6 \pm 0.79\%$ of total)
Isophyllolactin ($0.7 \pm 0.09\%$ of total)
Isohylocerenin ($0.2 \pm 0.03\%$ of total)
(% = relative percent of total peak in HPLC)
WYBRANIEC & MIZRAHI 2002

Hylocereus Hybrid 35 (Hylocereus sp. 487 X polyrhizus)

Total 0.33 ± 0.031 mg/g in fruit pulp.
Betanin ($60.6 \pm 4.2\%$ of total)
Phylloactin ($19.5 \pm 1.9\%$ of total)
Hylocerenin ($4.1 \pm 0.34\%$ of total)
Isobetanin ($13.6 \pm 1.3\%$ of total)
Isophyllolactin ($1.9 \pm 0.17\%$ of total)
Isohylocerenin ($0.2 \pm 0.04\%$ of total)
(% = relative percent of total peak in HPLC)
WYBRANIEC & MIZRAHI 2002

Hylocereus Hybrid 95 (Hylocereus polyrhizus X sp. 487)

Total 0.30 ± 0.023 mg/g in fruit pulp.
Betanin ($57.9 \pm 3.8\%$ of total)
Phylloactin ($19.7 \pm 1.5\%$ of total)
Hylocerenin ($3.6 \pm 0.44\%$ of total)
Isobetanin ($11.3 \pm 1.1\%$ of total)
Isophyllolactin ($6.4 \pm 0.53\%$ of total)
Isohylocerenin ($1.0 \pm 0.11\%$ of total)
(% = relative percent of total peak in HPLC)
WYBRANIEC & MIZRAHI 2002

Hylocereus ocamponis (SALM-DYCK) BR. & R.

Fruit contained:
Betanidin 5-O- β -sophoroside
 γ -Aminobutyric acid
Betaxanthin
Indicaxanthin
Betanin & Isobetanin
2'-Apiosyl-betanin & 2'-Apiosyl-isobetanin
Phylloactin & Isophyllolactin
4'-Malonyl-betanin & 4'-Malonyl-isobetanin
Hylocerenin & Isohylocerenin

2'-Apiosyl-phyllolactin & 2'-Apiosyl-isophyllolactin
Peel contained the same and additionally
5''-O-E-Feruloyl-2'-apiosylbetanin
5''-O-E-Feruloyl-2'-apiosylisobetanin
5''-O-E-Sinapoyl-2'-apiosylbetanin
5''-O-E-Sinapoyl-2'-apiosylisobetanin
5''-O-E-Feruloyl-2'-apiosylphyllolactin
5''-O-E-Feruloyl-2'-apiosylisophyllolactin
WYBRANIEC *et al.* 2007 (hplc)

Hylocereus polyrhizus (WEBER) BRITTON & ROSE

(now *Hylocereus monacanthus* (LEMAIRE) BRITTON & ROSE

"pitaya" Commercial fruit in Israel.
Total 0.28 ± 0.019 mg/g in fruit pulp.
Betanin ($18.9 \pm 1.3\%$ of total)
Phylloactin ($36.1 \pm 2.2\%$ of total)
Hylocerenin ($11.7 \pm 1.1\%$ of total)
Isobetanin ($7.2 \pm 0.55\%$ of total)
Isophyllolactin ($19.2 \pm 1.5\%$ of total)
Isohylocerenin ($5.8 \pm 0.32\%$ of total)
(% = relative percent of total peak in HPLC)
WYBRANIEC & MIZRAHI 2002

Fruit pulp was reported to contain:

Betanin
Phylloactin (= 6'-O-malonylbetanin)
Betanidin 5-O-[6'-O-(3''-hydroxy-3''-methyl-glutaryl)- β -D-glucopyranoside] (New compound named Hylocerenin.)
Isobetanidin 5-O-[6'-O-(3''-hydroxy-3''-methyl-glutaryl)- β -D-glucopyranoside] (New compound Isohylocerenin)
Isobetanin
Isophyllolactin
(electrospray MS/MS, HPLC, and NMR)
WYBRANIEC *et al.* 2001

Fruit contained:

Betanidin 5-O- β -sophoroside
Betanin & Isobetanin
2'-Apiosyl-betanin & 2'-Apiosyl-isobetanin
Phylloactin & Isophyllolactin
4'-Malonyl-betanin & 4'-Malonyl-isobetanin
Hylocerenin & Isohylocerenin
2'-Apiosyl-phyllolactin & 2'-Apiosyl-isophyllolactin
Peel contained the same and additionally
5''-O-E-Feruloyl-2'-apiosylbetanin
5''-O-E-Feruloyl-2'-apiosylisobetanin
5''-O-E-Sinapoyl-2'-apiosylbetanin
5''-O-E-Sinapoyl-2'-apiosylisobetanin
5''-O-E-Feruloyl-2'-apiosylphyllolactin
5''-O-E-Feruloyl-2'-apiosylisophyllolactin
WYBRANIEC *et al.* 2007 (hplc)

Hylocereus polyrhizus X undatus

Fruit contained:
Betanidin 5-O- β -sophoroside
Betanin & Isobetanin

2'-Apiosyl-betanin & 2'-Apiosyl-isobetanin
Phyllocactin & Isophyllocactin
4'-Malonyl-betanin & 4'-Malonyl-isobetanin
Hylocerenin & Isohylocerenin
2'-Apiosyl-phyllocactin & 2'-Apiosyl-isophyllocactin
Peel contained the same and additionally
5''-O-E-Feruloyl-2'-apiosylbetanin
5''-O-E-Feruloyl-2'-apiosylisobetanin
5''-O-E-Sinapoyl-2'-apiosylbetanin
5''-O-E-Sinapoyl-2'-apiosylisobetanin
5''-O-E-Feruloyl-2'-apiosylphyllocactin
5''-O-E-Feruloyl-2'-apiosylisophyllocactin
WYBRANIEC *et al.* 2007 (hplc)

***Hylocereus purpusii* (WEINGART) BRITTON & ROSE**

Lupeone & Lupeol (In a 4:1 ratio in the surface wax)
[Grown in Germany]
WOLLENWEBER & DÖRR 1995

Total 0.23 ± 0.018 mg/g in fruit pulp.
Betanin ($66.9 \pm 4.1\%$ of total)
Phyllocactin ($21.3 \pm 1.4\%$ of total)
Hylocerenin ($2.0 \pm 0.18\%$ of total)
Isobetanin ($7.2 \pm 0.73\%$ of total)
Isophyllocactin ($2.4 \pm 0.17\%$ of total)
Isohylocerenin ($0.1 \pm 0.03\%$ of total)
(% = relative percent of total peak in HPLC)
WYBRANIEC & MIZRAHI 2002

Fruit contained:
Betanidin 5-O- β -sophoroside
Betanin & Isobetanin
2'-Apiosyl-betanin & 2'-Apiosyl-isobetanin
Phyllocactin & Isophyllocactin
4'-Malonyl-betanin & 4'-Malonyl-isobetanin
Hylocerenin & Isohylocerenin
2'-Apiosyl-phyllocactin & 2'-Apiosyl-isophyllocactin
contained the same and additionally
5''-O-E-Feruloyl-2'-apiosylbetanin
5''-O-E-Feruloyl-2'-apiosylisobetanin
5''-O-E-Sinapoyl-2'-apiosylbetanin
5''-O-E-Sinapoyl-2'-apiosylisobetanin
5''-O-E-Feruloyl-2'-apiosylphyllocactin
5''-O-E-Feruloyl-2'-apiosylisophyllocactin
WYBRANIEC *et al.* 2007 (hplc)

***Hylocereus* sp. 487**

Total 0.30 ± 0.023 mg/g in fruit pulp.
Betanin ($57.2 \pm 4.2\%$ of total)
Phyllocactin ($34.2 \pm 2.1\%$ of total)
Hylocerenin ($1.5 \pm 0.11\%$ of total)
Isobetanin ($3.4 \pm 0.41\%$ of total)
Isophyllocactin ($2.0 \pm 0.18\%$ of total)
Isohylocerenin ($0.2 \pm 0.04\%$ of total)
(% = relative percent of total peak in HPLC)
WYBRANIEC & MIZRAHI 2002

***Hylocereus undatus* (HAWORTH) BRITTON & ROSE**
"pitahaya" (Jalisco, Yucatan, Costa Rica, El Salvador, Puerto Rico), "pitahaya orejona" (Oaxaca), "tasajo" (Durango)
"junco", "juco tapatio", "chacoub", "zacoub" (Yucatan)
"caliz" (Philippines) STANDLEY 1924: 913

From leaves:
Cholesterol (traces)
24 ζ -Methylcholesterol (18.5% of total)
Stigmasterol (8.3% of total)
Sitosterol (73.2% of total)
SALT *et al.* 1987

Total 0.29 ± 0.027 mg/g in redfleshed fruit pulp.
Betanin ($61.2 \pm 4.3\%$ of total)
Phyllocactin ($28.0 \pm 2.1\%$ of total)
Hylocerenin ($2.2 \pm 0.17\%$ of total)
Isobetanin ($6.0 \pm 0.51\%$ of total)
Isophyllocactin ($1.9 \pm 0.17\%$ of total)
Isohylocerenin ($0.6 \pm 0.07\%$ of total)
(% = relative percent of total peak in HPLC)
WYBRANIEC & MIZRAHI 2002

Fruit contained:
Betanidin 5-O- β -sophoroside
Betanin & Isobetanin
2'-Apiosyl-betanin & 2'-Apiosyl-isobetanin
Phyllocactin & Isophyllocactin
4'-Malonyl-betanin & 4'-Malonyl-isobetanin
Hylocerenin & Isohylocerenin
2'-Apiosyl-phyllocactin & 2'-Apiosyl-isophyllocactin
Peel contained the same and additionally
5''-O-E-Feruloyl-2'-apiosylbetanin
5''-O-E-Feruloyl-2'-apiosylisobetanin
5''-O-E-Sinapoyl-2'-apiosylbetanin
5''-O-E-Sinapoyl-2'-apiosylisobetanin
5''-O-E-Feruloyl-2'-apiosylphyllocactin
5''-O-E-Feruloyl-2'-apiosylisophyllocactin
WYBRANIEC *et al.* 2007 (hplc)
Flowers reported to contain:
isorhamnetin,
isorhamnetin 3-O- β -D-glucopyranoside
isorhamnetin 3-O- α -L-rhamopyranosyl-(1 \rightarrow 6)- β -D-galactopyranoside.
isorhamnetin 3-O- β -D-rutinoside
kaempferol
kaempferol 3-O- α -L-arabinofuranoside
kaempferol 3-O- β -D-galactopyranoside
...kaempferol 3-O- β -D-glucopyranoside
kaempferol 3-O- α -L-rhamopyranosyl-(1 \rightarrow 6)- β -D-galactopyranoside
kaempferol 3-O- β -D-rutinoside
quercetin
quercetin 3-O- β -D-galactopyranoside
quercetin 3-O- β -D-glucopyranoside
YI *et al.* 2011
WU *et al.* 2011 added three glycosides they named -
Undatusides A-C.
See comments in **Activity Notes**.

***Islaya minor* BACKEBERG (T)**

Phenethylamine (no quantification)
Tyramine (no quantification)
N-Methyltyramine (no quantification)
Hordenine (no quantification)
3-Methoxytyramine (no quantification)
3,4-Dimethoxyphenethylamine (0.0038% dry wt.)
Mescaline (0.0017% dry wt.)
Corypalline (7-Hydroxy-6-methoxy-2-methyl-tetrahydroisoquinoline)
Pellotine (no quantification)
DOETSCH *et al.* 1980

Isolatocereus dumortieri (SCHEIDW.) BACKEBERG

See as *Lemaireocereus dumortieri*

***Lemaireocereus aragonii* (WEBER) BRITTON & ROSE**

This is now *Stenocereus aragonii*
91.3% water by weight
Thought to contain an Amyrin mixture but never fully investigated due to insufficient material.
No ether soluble alkaloids.
DJERASSI *et al.* 1955b [Wild collected; Costa Rica]

Lemaireocereus beneckeii (EHRENBERG) BERGER See as *Stenocereus beneckeii*

Lemaireocereus chende (GOSSELIN) BRITTON & ROSE

See as *Polaskia chende*

Lemaireocereus chichipe (GOSSELIN) BRITTON & ROSE

See as *Polaskia chichipe*

***Lemaireocereus deficiens* (O. & DIETR.) BR. & R.**

No saponins or terpenes. HEGNAUER 1964
Traces of unidentified terpene(s). DJERASSI 1957 cited unpublished observations by DJERASSI & MITSCHER

***Lemaireocereus dumortieri* BRITTON & ROSE**

This is now *Stenocereus dumortieri*.
Dumortierigenin (A triterpene lactone)
0.21% by dry wt.
No detectable alkaloid.
DJERASSI *et al.* 1954b
[Wild collected; Hildago, Mexico]

Two triterpene saponinins,
Dumortierigenin
Pachanol D (new triterpene saponin with a new skeletal type. They named it pachanane)
KINOSHITA *et al.* 1998

Dumortierinoside A (a new triterpenoid saponin) i.e. Dumortierigenin 3-O- α -L-rhamnosyl-(1 \rightarrow 2)- β -D-glucopyranosyl-(1 \rightarrow 2)- β -D-glucuronopyranoside
KINOSHITA *et al.* 2000

Three new triterpenoid saponins
(as *Isolatocereus dumortieri* BACKEBERG)
Dumortierinoside A methyl ester
Pachanoside I1 (aglycon was pachanol I; new pachanane-type triterpene skeleton.)
Pachanoside D1 (aglycon was pachanol D)
KAKUTA *et al.* 2012

Lemaireocereus eruca BRITTON & ROSE

See as *Stenocereus eruca*

Lemaireocereus euphorbioides (HAW.) WERD.

See as *Neobuxbaumia euphorbioides*

***Lemaireocereus griseus* (HAWORTH) BRITTON & ROSE**

“Cardon dato”, “Mexican organ pipe”, “dagger cactus”, “pitaya”, “pitayo de mayo”, “yato” (Netherland Antilles)
“No alkaloids”
Erythrodiol (0.58% dry wt.)
Longispinogenin (0.82% dry wt.)
Oleanolic acid (Isolated via acetate methyl ester as 2% dry wt.)
Betulin (Isolated via the acetate methyl ester as 4% dry wt.)
Unidentified lactone 0.12% [Thought identical with material from *L. hystrix*; i.e. “*hystrix lactone*”]
DJERASSI *et al.* 1956a [Venezuela]

Lemaireocereus gummosus BRITTON & ROSE

See as *Machaerocereus gummosus*

***Lemaireocereus hollianus* (WEB.) BRITTON & ROSE**

This is now *Pachycereus hollianus*.
“baboso”
86.5% water by weight. DJERASSI *et al.* 1956a
No alkaloids present. UNGER *et al.* 1980
Yielded only small amounts of a nonpolar substance that they believed was “probably similar” to the “aromatic” [?] alcohol they encountered with *T. chiloensis* and *T. cuzcoensis*. No triterpenes detected.
DJERASSI *et al.* 1956a [Collected on Tehuacán-Puebla road 7 km from Zapotitlán, Mexico]

***Lemaireocereus humilis* BRITTON & ROSE**

This is now *Stenocereus humilis*.
No saponins or terpenes. HEGNAUER 1964
Traces of unidentified terpene(s).
DJERASSI 1957 cited unpublished observations by DJERASSI & MITSCHER

***Lemaireocereus hystrix* (HAW.) BRITTON & ROSE**

79.7% water by weight
Unidentified neutral triterpene lactone (“*hystrix lactone*”; possibly isomeric with thurberogenin) [0.025% by dry wt]
Erythrodiol [0.067% by dry wt]
Oleanolic acid [(crude) 0.95% by dry wt]

Longispinogenin [0.17% by dry wt]
Betulinic acid (0.025% by dry wt) [isolated via its methyl ester])

No detectable alkaloid.

DJERASSI & LIPPMAN 1954 [Collected in Mona district, Jamaica] Noted an almost identical qualitative composition as *L. longispinus*

See **Activity Endnote** for a more recent curiosity.

***Lemaireocereus laetus* BRITTON & ROSE**

This is now *Armatocereus laetus*

82.3% water by weight

[Concluded it was almost devoid of alkaloids or triterpenes. (Unable to resolve and separate. No ether soluble alkaloids. Much unidentified oily material (all neutral)]

DJERASSI *et al.* 1955b [Wild collected; Peru].

This species needs an analysis. E. Wade DAVIS purportedly encountered it being used on a local basis as a *T. pachanoi* substitute

See **Activity Notes** for more comments.

***Lemaireocereus longispinus* BRITTON & ROSE**

This is now *Stenocereus eichlamii*.

81.5% water by weight

Alkaloid devoid.

“Rich source” of triterpenoid glycosides.

Erythrodiol [0.33% by dry wt]

Oleanolic acid [(crude) 2.76% by dry wt]

Longispinogenin [0.4% by dry wt]

DJERASSI *et al.* 1953c [Guatemala; cultivated specimen from Guatemala City]

See comments in the **Activity Notes**.

Lemaireocereus marginatus (DC) BERG. See as *Pachycereus marginatus*

***Lemaireocereus matucanense*.**

Hunt 2006: “doubtfully distinct from *Armatocereus laetus*”

See additional comments in the **Activity Notes**.

Lemaireocereus mixtecensis (PURPUS) BRITTON & ROSE See as *Polaskia chichipe*

***Lemaireocereus montanus* BRITTON & ROSE**

This is now *Stenocereus montanus*.

“pithaya” [sp?]

Oleanolic acid

Queretaroic acid

β-Sitosterol

DJERASSI 1957 cited unpublished observations by

DJERASSI & KAN

***Lemaireocereus pruinosus* (OTTO) BRITTON & ROSE**

AKA “Pitayo”

89% water by weight. DJERASSI *et al.* 1955b

Reported to show no detectable alkaloids in the screenings of FONG *et al.* 1972

Unidentified alkaloids detected by BROWN *et al.* 1968

Oleanolic acid (an acidic triterpene; single component: 0.2% fresh wt/ 1.8% dry)

DJERASSI *et al.* 1955b [Cultivated: California]

First analyzed by L.H. Liu (unpublished observation from DJERASSI’s lab) according to DJERASSI & LIPPMAN 1954.

This is now *Stenocereus pruinosus*.

***Lemaireocereus queretaroensis* (WEBER) SAFFORD**

“pitahaya” STANDLEY 1924: 900

Queretaroic acid (A dihydroxy triterpene acid) No isolation details included.

DJERASSI *et al.* 1955a. Also in DJERASSI *et al.* 1956b.

Oleanolic acid DJERASSI *et al.* 1956b

See comments in **Activity Notes**.

***Lemaireocereus quevedonis* G. ORTEGA**

This is now *Stenocereus quevedonis*.

87.2% water by weight

“hystrix lactone” (~0.4% yield dry wt)

Longispinogenin (1.42% yield dry wt.)

Oleanolic acid

Betulinic acid

DJERASSI *et al.* 1956a [Collected near Acapulco, Mexico]

***Lemaireocereus thurberi* (ENGELMANN) BRITTON & ROSE**

This is now *Stenocereus thurberi*.

“Pitahaya dulce” or “Organ pipe” or “Pitahaya” STANDLEY 1924

84.9% water by weight DJERASSI *et al.* 1953a [KIRSCHER 1972 reported 85%; KIRSCHER 1982 reported 77-80%]

No alkaloids- Based on negative Mayer test DJERASSI *et al.* 1953a [Collected: Sonora, Mexico]

tlc examination showed the absence of alkaloids and the strong presence of triterpene glycosides: KIRSCHER 1982

Oleanolic acid (an acidic sapogenin) 1.8% dry wt. DJERASSI *et al.* 1953a (Also reported in KIRSCHER 1977)

Thurberogenin (a neutral triterpenoid lactone: first reported occurrence) 0.46% dry wt. DJERASSI *et al.* 1953a. (This paper was the first report of triterpenes in cacti) (It was also reported in KIRSCHER 1977 & in JOLAD & STEELINK 1969)

Queretaroic acid (No details) GIBSON & HORAK 1978 cited H.W. KIRSCHER (unpublished data); (Also reported in KIRSCHER 1972)

Thurberin (a pentacyclic triterpene; a lupenediol) JOLAD & STEELINK 1969 See comment under **Calenduladiol** below

Betulin JOLAD & STEELINK 1969
Calenduladiol (A triterpene diol; Δ-20,30-lupen-3β,12β -diol) Shown to be identical with Thurberin. KASPRZYK *et al.* 1970 [Previously isolated from the Composite *Calendula officinales* (Marigold) by KASPRZYK & PYREK 1968]

KIRSCHER 1980 isolated the following (See also in KIRSCHER 1982):

Lupeol

Betulin

Betulinic aldehyde

Methyl betulinic

Calenduladiol

Longispinogenin

Lupenetriol (Lup-20(29)-en-3 β ,16 β ,28-triol)
Oleanolic aldehyde
Methyl oleanolate
(3 β ,6 α Sterol diols were isolated as 2.6% of dry wt. KIRCHER 1980)

The following 5 sterol diols were isolated and identified in KIRCHER & BIRD 1982. (No concentrations included)
Cyclostenol (14 α -Methyl-9,19-cyclo-5 α -cholestan-3 β ,6 α -diol)
Stenocereol (14 α -Methyl-5 α -cholesta-8,24-dien-3 β ,6 α -diol)
Macdougallin (14 α -Methyl-5 α -cholest-8-en-3 β ,6 α -diol)
Thurberol (5 α -Cholesta-8,14-dien-3 β ,6 α -diol)
Peniocerol (5 α -Cholest-8(9)-en-3 β ,6 α -diol)
Lipids determined to compose 10-17% of the dry weight (comprised of neutral Oleanene and Lupene mono-, di- and triols, 0.07% Phytosterols [Cholesterol, Campesterol & Sitosterol] and a large proportion of Dihydroxysterols.) KIRCHER & BIRD 1982 cited BIRD 1974.

Lipid content determined to be 11% by dry weight: KIRCHER 1982
See comments in **Activity Notes**.

Lemaireocereus treleasei BR. & R.
See as *Stenocereus treleasei*
Lemaireocereus weberi (COULTER) BR. & R.
See as *Pachycereus weberi*

Leocereus bahiensis BR. & R.
Unconfirmed report of caffeine (0.10-0.35%) in seeds.
HEGNAUER 1964 & MATA & McLAUGHLIN 1982 cited FREISE 1935.

Lepidocoryphantha macromeris (ENGELMANN) BACKEBERG See as *Coryphantha macromeris*
Lepidocoryphantha runyonii (BRITTON & ROSE) BACKEBERG See as *Coryphantha macromeris* var. *runyonii*

Leuchtenbergia principis HOOKER
Reported to contain unidentified alkaloid(s). CHALET 1980a cited DOMINGUEZ *et al.* 1969
See comments in **Activity Notes**.

Lobivia allegriana BACKEBERG
Hordenine (trace) FOLLAS *et al.* 1977.
N-Methyltyramine (trace) FOLLAS *et al.* 1977.
Tyramine (trace) FOLLAS *et al.* 1977

Lobivia andalgalensis (WEBER) BR. & R. **IS NOT** *Trichocereus andalgalensis* Probably is synonymous with *Trichocereus huascha* See Ritter 1980.

Lobivia aurea (BRITTON & ROSE) BACKEBERG
Hordenine (trace) FOLLAS *et al.* 1977.
N-Methyltyramine (trace) FOLLAS *et al.* 1977
Tyramine (trace) FOLLAS *et al.* 1977.

Lobivia backebergii (WERDERMANN) BACKEBERG
Hordenine (0.011% dry wt.) FOLLAS *et al.* 1977.
N-Methyltyramine (0.0008% dry wt.) FOLLAS *et al.* 1977.
Tyramine (trace) FOLLAS *et al.* 1977

Lobivia binghamiana BACKEBERG
Hordenine (0.004% dry wt.) FOLLAS *et al.* 1977.
N-Methyltyramine (0.0003% dry wt.) FOLLAS *et al.* 1977.
Tyramine (trace) FOLLAS *et al.* 1977

Lobivia chlorogona WESSN.
Reported to contain Betalains as pigments.
WOHLPART & MABRY 1968 cited DREIDING 1961

Lobivia famatimensis (SPEG.) BR. & R.
Reported to contain Betalains as pigments.
WOHLPART & MABRY 1968 cited DREIDING 1961

Lobivia formosa (PFEIFFER) DODDS
Candicine (0.268% [column chromatography] & 0.242% [via precipitation of picrate] All dry wt)
NIETO *et al.* 1982

Lobivia huashua (WEBER) W.T.MARSHALL = *Lobivia huascha*
Lobivia huascha (WEBER) W.T.MARSHALL See as *Helianthocereus huascha*

Lobivia pentlandii (HOOKER) BRITTON & ROSE
Hordenine (0.012% dry wt.) FOLLAS *et al.* 1977.
N-Methyltyramine (trace) FOLLAS *et al.* 1977.
Tyramine (trace) FOLLAS *et al.* 1977

Lophocereus australis (K.BRANDEGEE) BORG
[Considered a local variant of *L. schottii* by some; *Lophocereus schottii* var. *Australis*]
92% water (inaccurate due to prior removal of core)
Pilocereine [(crude) 0.5% by dry wt; 0.27% yield after purification]
DJERASSI *et al.* 1954c
Lophenol (a sterol) present both free and esterified. DJERASSI 1957 cited unpublished analysis by DJERASSI, MARFEY & LIU

Lophocereus gatesii M.E.JONES
91% water by weight
Pilocereine (0.5% by dry wt)
[Unidentified alkaloids present]
DJERASSI *et al.* 1954c
[AGURELL 1969b also appears listed as a reference but only mentions pilocereine. Did not analyze this species.]
Lophenol (a sterol) present both free and esterified. DJERASSI 1957 cited unpublished analysis by DJERASSI, MARFEY & LIU

Lophocereus mieckleyanus (WGT.) BACKEBERG
See as *Lophocereus schottii* forma *mieckleyanus*
Lophocereus sargentianus (ORCUTT) BRITTON & ROSE
See as *Lophocereus schottii*

***Lophocereus schottii* (ENGELMANN) BRITTON & ROSE**
 “sinita”, “senita”, “cina”, “zina” (Sonora) “garambullo”, “hombre viejo”, “cabeza de viejo”, “pitahaya barbona” (Baja) STANDLEY 1924

91.29% & 92.25% water by weight reported by HEYL 1901.
 (KIRCHER 1969 found it to range from 80-90%; KIRCHER 1982 listed it with 81% water by weight)

3.7% total alkaloid isolated according to HEGNAUER 1964
 [See Note A]

Pilocerine (novel cactus alkaloid) DJERASSI *et al.* 1958c;
 (0.5% yield by dry wt: DJERASSI *et al.* 1953b) (Observed in tlc WEST *et al.* 1975); (Noted as present: O'DONOVAN & HORAN 1968 & 1969 & O'DONOVAN *et al.* 1971); (Not extracted but pharmacologically evaluated by POWELL & CHEN 1956) WANI *et al.* 1980 recovered 0.016% [HEYL 190 isolated 5.8% (amorphous) & named Pilocerine.]

Lophocerine 0.19% by dry wt. DJERASSI *et al.* 1958c;
 (Observed in tlc: WEST *et al.* 1975); (Noted as present: O'DONOVAN & BARRY 1974, O'DONOVAN & HORAN 1968 & 1969 & O'DONOVAN *et al.* 1971)

Piloceredine 1.456% by dry wt. DJERASSI *et al.* 1958c.

Unidentified alkaloids ((Observed in tlc WEST *et al.* 1975)
 [Lophocine was reported by WANI *et al.* 1980 at 0.004% dry weight but it is believed to be an artifact]

[AGURELL 1969b is cited as a reference but only mentions a previous report of pilocerine and lophocerine and did not analyze this species. LUNDSTROM 1971 is also cited; he mentions lophocerine but did not analyze this species. DINGERDISSEN & McLAUGHLIN 1973b also appears listed as a reference but does not mention this species]

[UNGER *et al.* 1980 reported the presence of two alkaloids using MIKES. Both were presented as dimethoxylated THIQU. They suggested the identities as N-Methylheliamine and another THIQU that was either isomeric or identical with Heliamine, Lemaireocereine or Uberine. This report needs confirmation. Unless MIKES fails entirely for the 1-Isobutyl-substituted THIQU, their results stand in direct and complete conflict with the rest of the work published for this species.]

Reported to be devoid of glycosides in DJERASSI *et al.* 1958a
n-Octyl-alcohol (0.9%) DJERASSI *et al.* 1958b

Lupeol (0.02% via its acetate) DJERASSI *et al.* 1958b [Was also reported in KIRCHER 1969 & CAMPBELL & KIRCHER 1980. Noted to be isolated from neutral nonglycosidic fraction DJERASSI 1957 cited unpublished analysis by DJERASSI, MILLS, KRAKOWER, LIU & LEMIN]

Lophenol (a neutral alcohol; 4 α -Methyl- Δ^7 -cholesten-3 β -ol [AKA 4 α -Methyl-5 α -cholest-7-en-3 β -ol]) (0.23% dry wt.) DJERASSI *et al.* 1958b [Also isolated in DJERASSI *et al.* 1958a & KIRCHER 1969 (the latter finding it higher in older stems and in the cortex than in the epidermis) & reported in KIRCHER & HEED 1970 & CAMPBELL & KIRCHER 1980. Present both free and esterified DJERASSI 1957 cited unpublished analysis by DJERASSI, MILLS, KRAKOWER, LIU & LEMIN]

Schottenol (Δ^7 -Ergosten-3 β -ol [AKA Δ^7 -Stigmasten-3 β -ol and 5 α -Stigmast-7-en-3 β -ol]) (0.13%) DJERASSI *et al.* 1958b [Also reported by KIRCHER 1969 & KIRCHER & HEED 1970 & CAMPBELL & KIRCHER 1980]

In addition, the following sterols were later reported:
 Lathosterol (5 α -Cholest-7-en-3 β -ol)

5 α -Campest-7-en-3 β -ol

α -Spinasterol (5 α -Stigmasta-7,22*E*-dien-3 β -ol)

5 α -Cholesta-8,14-dien-3 β -ol [First isolation from plants]

Locoreol (4 α -Methylcholesta-8,14-dien-3 β -ol) [First isolation from plants]

24-Methylenelophenol (4 α -Methyl-5 α -ergosta-7,24(28)-dien-3 β -ol)

CAMPBELL & KIRCHER 1980

Palmitic acid, Oleic acid, Linoleic acid and Linolenic acid were the main fatty acids in all specimens tested. KIRCHER 1969

***Lophocereus schottii* notes:**

A: There appears to be a typo in one of these papers. DJERASSI *et al.* 1953b determined that the majority of this was in the green epidermis (6.7% crude alkaloid); a minor portion in the cortex (1.1% crude alkaloid) and almost no alkaloid in the core & pith (0.2% crude alkaloid).

See comment in **Activity Notes**.

Lophocereus schottii* var. *schottii and

Lophocereus schottii* var. *tenuis

Determined to have no significant differences in their overall phytochemistry.

[Differences however were seen when comparing mature stems with young stems on a single plant or when comparing the non-alkaloidal chemistry of the cortex and epidermis.]

The young stems contained higher proportions of phenolic alkaloids despite having lower alkaloid levels overall.

L. schottii* variety *schottii* *tenuis

Phenolic alkaloid fraction: % are dry weight

Young stem	0.4%	0.5%
Mature stem	0.7%	0.6%

Total alkaloid fraction:

Young stem	1.1%	1.2%
Mature stem	8.7%	9.1%

KIRCHER 1969

tlc examination showed the strong presence of alkaloids and the absence of triterpene glycosides.

In general, younger stems contained more Linolenic acid than mature stems.

Lipid content determined to be 6-7% by dry weight:
 KIRCHER 1982

***Lophocereus schottii* forma *mieckleyanus* G.LINDSEY**

Pilocerine (0.005% yield by dry wt)

Lophocerine (Observed)

Unidentified alkaloids

WEST *et al.* 1975 [WEST *et al.* commented that this form proved to be quantitatively the richest in alkaloids but this claim is directly in conflict with their experimental details]

***Lophocereus schottii* (ENGEL.) BR. & R. forma *monstrosus* GATES**

AKA “Totem pole cactus”

Pilocerine (0.01% yield by dry wt)

Lophocereine (Observed)

Unidentified alkaloids

WEST *et al.* 1975

Lophocereus schottii (ENGEL.) BR. & R. var. *Australis* (K.BRAND.)
BORG See as *Lophocereus australis*

***Lophophora diffusa* (CROIZAT) H.BRAVO**

0.9% total alkaloid (whole plants; dry wt) 98% phenolic.
BRUHN & HOLMSTEDT 1974

Tyramine 0.1% of total alkaloid: ŠTARHA 1997 [Cultivated material: **GR 1086**]

N-Methyltyramine 0.1% of total alkaloid: ŠTARHA 1997

Hordenine (trace) BRUHN & HOLMSTEDT 1974; 0.5% of total alkaloid [from ŠTARHA 1997]; (In contrast to TODD 1969 who had not observed it in tlc.)

Mescaline (As traces or absent entirely.) Traces in tops & roots (tlc) TODD 1969; Minor base: HABERMANN 1977, 1978a & 1978b (from ANDERSON 1980 & ŠTARHA *nd*); 0.018% (± 0.012) HABERMANN 1978a (from ŠTARHA 1997); 0.003% by dry weight (isolated): SINISCALCO 1983 [See Note A]; **1.2% of total alkaloid**: ŠTARHA 1997; (Not observed by BRUHN & HOLMSTEDT 1974.)

N-Methylmescaline (traces) BRUHN & HOLMSTEDT 1974; 0.1% of total alkaloid: ŠTARHA 1997

Anhalinine 0.6% of total alkaloid [from ŠTARHA 1997] (Not detected; TODD 1969 [Wild material: collected Queretaro, Mexico])

O-Methylanhalidine 0.7% of total alkaloid: ŠTARHA 1997 [See Note B]

Anhalamine (no quantification [tlc]- in tops only, not in roots) TODD 1969; 5% of total alkaloid. ŠTARHA 1997

Anhalidine (trace) BRUHN & HOLMSTEDT 1974; 0.1% of total alkaloid. ŠTARHA 1997

Anhalonidine (trace) BRUHN & HOLMSTEDT 1974; (tlc showed in tops & roots: TODD 1969); 3.8% of total alkaloid. ŠTARHA 1997

Anhalonine 0.1% of total alkaloid. ŠTARHA 1997 (Not detected; TODD 1969)

Lophophorine (no quantification, [tlc] present in tops & roots: TODD 1969); 0.1% of total alkaloid ŠTARHA 1997

O-Methylpellotine (trace) BRUHN & AGURELL 1975.

Pellotine (0.75-0.89% [fresh wt]) HEFFTER 1894b. [Also observed as the major base by HABERMANN 1977, 1978a & 1978b (from ANDERSON 1980 & ŠTARHA *nd*); 2.105% (± 0.108) HABERMANN 1978a (from ŠTARHA 1997); (TODD 1969 reported it to be the major alkaloid but did not quantify); **86.2% of total alkaloid**: ŠTARHA 1997

[Ed.:? Please note that ŠTARHA (in GRYM) 1997 cited ŠTARHA & KUCHYNA 1996 but some included entries are not in ŠTARHA & KUCHYNA 1996. They may refer to otherwise unpublished material but we lack details; most likely due to our lack of understanding of Czechoslovakian.]

Glucaric acid (tlc by KRINGSTAD & NORDAL 1975)

Quinic acid (tlc, glc & gc-ms by KRINGSTAD & NORDAL 1975)

***L. diffusa* Notes:**

A: Analyzed as *L. echinata*. This is an incorrect designation for *L. diffusa* that is not uncommonly, but unfortunately, encountered in European collections.

THIS BEGAN WHEN CROIZAT described *L. echinata* as being from Texas and then went on to describe *L. diffusa* as *L. echinata* var. *diffusa*.

L. echinata (*L. williamsii* var. *echinata*) is most commonly used for the greyish, larger & higher alkaloid material found in southern Trans-Pecos Texas and southward into Coahuila. It is probably synonymous with the Coahuilan material NOW being called *L. decipiens* by some European cactophiles.

B: Possible error on our part. ŠTARHA 1997 lists this as O-Methylanhalinine which we *assumed* is a typo (as a compound cannot exist with this name)

***Lophophora diffusa* var. *koehresii* RÍHA**

[See Note A]

(Wild-collected in Mexico) Sample was 2.4 gm dry (Total alkaloid concentration not included)

Tyramine (0.04% [± 0.01] of the total alkaloid content) ŠTARHA & KUCHYNA 1996; [0.1% of total alkaloid: ŠTARHA 1997]

N-Methyltyramine (Trace of the total alkaloid content) ŠTARHA & KUCHYNA 1996; [0.1% of total alkaloid: ŠTARHA 1997]

Hordenine (0.37% [± 0.05] of the total alkaloid content) ŠTARHA & KUCHYNA 1996; [0.4% of total alkaloid; ŠTARHA 1997]

N-Methyl-3,4-dimethoxyphenethylamine (0.01% [± 0.01] of the total alkaloid content) ŠTARHA & KUCHYNA 1996

Mescaline (**1.32% [± 0.35] of the total alkaloid content**) ŠTARHA & KUCHYNA 1996; [1.3% of total alkaloid: ŠTARHA 1997]

N-Methylmescaline (0.07% [± 0.02] of the total alkaloid content) ŠTARHA & KUCHYNA 1996; [0.1% of total alkaloid: ŠTARHA 1997]

3,5-Dimethoxy-4-hydroxyphenethylamine (0.10% [± 0.02] of the total alkaloid content) ŠTARHA & KUCHYNA 1996

O-Methylanhalidine (0.07% [± 0.01] of the total alkaloid content) ŠTARHA & KUCHYNA 1996; [? 0.8% of total alkaloid: ŠTARHA 1997] [See Note B]

Anhalinine (0.44% [± 0.07] of the total alkaloid content) ŠTARHA & KUCHYNA 1996; [0.5% of total alkaloid: ŠTARHA 1997] [See Note C]

O-Methylpellotine (Trace of the total alkaloid content) ŠTARHA & KUCHYNA 1996; [0.1% of total alkaloid: ŠTARHA 1997]

Anhalidine (Trace of the total alkaloid content) ŠTARHA & KUCHYNA 1996; [0.1% of total alkaloid: ŠTARHA 1997]

Anhalamine (4.74% [± 0.32] of the total alkaloid content) ŠTARHA & KUCHYNA 1996; [4.7% of total alkaloid: ŠTARHA 1997]

Anhalonidine (3.45% [± 0.82] of the total alkaloid content) ŠTARHA & KUCHYNA 1996; [3.5% of total alkaloid: ŠTARHA 1997]

Pellotine (**88.39% [± 2.12] of the total alkaloid content**) ŠTARHA & KUCHYNA 1996; [88.4% of total alkaloid: ŠTARHA 1997]

Anhalonine (0.12% [\pm 0.02] of the total alkaloid content) ŠTARHA & KUCHYNA 1996; [0.1% of total alkaloid: ŠTARHA 1997]

Lophophorine (Trace of the total alkaloid content) ŠTARHA & KUCHYNA 1996; [0.1% of total alkaloid: ŠTARHA 1997]

***L. diffusa* var *Koehresii* Notes:**

A: Also described as *Lophophora williamsii* var. *koehresii* (RÍHA) GRYM. See GRYM 1997.

B: Possible error. ŠTARHA 1997 lists as O-Methylanhalanine See comment in earlier footnote

C: In ŠTARHA & KUCHYNA 1996 this appears as a typo (anhalamine is listed twice). We based our assignment on a comparison of the gc value with those in Starha's other papers.

***Lophophora fricii* HABERMANN**

“*Ginkangyoku*”

[See Note A]

Pellotine (Major) HABERMANN 1978a (From ŠTARHA *n.d.*); ANDERSON 1980 cited HABERMANN 1977 & HABERMANN 1978a; [1.819% (\pm 0.212) (from ŠTARHA 1997 citing HABERMANN 1978a)]; **(65.2% & 65.5% of total alkaloid [See Note B] [ŠTARHA 1997 cited ŠTARHA & KUCHYNA 1996])**

Mescaline (Minor) HABERMANN 1978a (From ŠTARHA *n.d.*); ANDERSON 1980 cited HABERMANN 1977 & HABERMANN 1978a; [0.014% (\pm 0.009) (from ŠTARHA 1997 citing HABERMANN 1978a)]; **(0.9% & 1.1% of total alkaloid ŠTARHA 1997);**

Tyramine (0.1% & 0.1% of total alkaloid ŠTARHA 1997)

N-Methyltyramine (0.1% & 0.1% of total alkaloid ŠTARHA 1997)

Hordenine (0.3% & 0.4% of total alkaloid ŠTARHA 1997)

N-Methylmescaline (0.1% & 0.1% of total alkaloid ŠTARHA 1997)

Anhalanine (2.7% & 2.2% of total alkaloid ŠTARHA 1997)

O-Methylanhalidine (?) (2.3% & 1.9% of total alkaloid ŠTARHA 1997) **[See Note C]**

Anhalidine (1.0% & 1.0% of total alkaloid ŠTARHA 1997)

Anhalamine (0.2% & 0.7% of total alkaloid ŠTARHA 1997)

Anhalonidine (25.9% & 24.9% of total alkaloid ŠTARHA 1997)

Anhalonine (0.2% & 0.2% of total alkaloid ŠTARHA 1997)

Lophophorine (0.1% & 0.1% of total alkaloid ŠTARHA 1997)

Ed.:? Please note that ŠTARHA (in GRYM) 1997 only cited ŠTARHA & KUCHYNA 1996 but some entries are not in our copy of ŠTARHA & KUCHYNA 1996. They may refer to otherwise unpublished material but we lack details.

***L. fricii* Notes:**

A: Published in HABERMANN 1974b & 1975a..

Specific name is not widely accepted and needs more work to clarify its status and placement.

B: The 2 figures refer respectively to **GR 1086 & PR 3293**; both were cultivated

C: Possible error. ŠTARHA 1997 lists this as O-Methylanhalanine. See comment in earlier footnote.

See comments in **Activity Notes**.

Details from both Aragane and Sasaki papers still need to be inserted as finding nothing in this species. They also assigned a mistaken identification of *Lophophora williamsii* var. *decipiens* despite obtaining them as **Ginkangyoku**. Those particular specimens that were reported to contain no mescaline should have been listed as *Lophophora fricii*.

***Lophophora jourdaniana* HABERMANN**

[Note A]

Mescaline (Major) HABERMANN 1978a (From ŠTARHA *n.d.*); ANDERSON 1980 cited HABERMANN 1977 & 1978a; [0.690% (\pm 0.105) ŠTARHA 1997 cited HABERMANN 1978a **(See Note B)**]; **(31% of total alkaloid ŠTARHA 1997);** See comments in **Activity Notes**.

Pellotine (Minor) HABERMANN 1978a (From ŠTARHA *n.d.*); ANDERSON 1980 cited HABERMANN 1977 & HABERMANN 1978a; [0.710% (\pm 0.089) HABERMANN 1978a (from ŠTARHA 1997) **(See Note C)**]; **(17.8% of total alkaloid ŠTARHA 1997)**

Tyramine (0.6% of total alkaloid ŠTARHA 1997)

N-Methyltyramine (0.5% of total alkaloid ŠTARHA 1997)

Hordenine (2.9% of total alkaloid ŠTARHA 1997)

N-Methylmescaline (3.2% of total alkaloid ŠTARHA 1997)

Anhalanine (0.6% of total alkaloid ŠTARHA 1997)

O-Methylanhalidine (?) (0.8% of total alkaloid ŠTARHA 1997) **[See Note D]**

Anhalidine (3.1% of total alkaloid ŠTARHA 1997)

Anhalamine (1.7% of total alkaloid ŠTARHA 1997)

Anhalonidine (20.1% of total alkaloid ŠTARHA 1997)

Anhalonine (1.1% of total alkaloid ŠTARHA 1997)

Lophophorine (1.4% of total alkaloid ŠTARHA 1997)

Ed.:? Please note that ŠTARHA 1997 only cited ŠTARHA & KUCHYNA 1996 but some entries are not in our copy of ŠTARHA & KUCHYNA 1996. They may refer to otherwise unpublished research but we lack details. The values refer to work performed with material cultivated in Germany

***L. jourdaniana* Notes:**

A: Published in HABERMANN 1975a & 1975b
The use of the specific name “*jourdaniana*” is potentially misleading (and should be rejected as invalid) as it was previously used, including for horticultural offerings (initially ‘*jourdaniana*’ appeared as a specific name in an old Pierre Rebut catalog) and had already been published in several vague and unclear accounts (as *Anhalonium jourdanianum* LEWIN, *Echinocactus jourdaniana* REBUT ex MAASS, *Echinocactus lewinii* (HEN.) SCHUM. var. *jourdaniana* MICHAELIS & *Lophophora jourdaniana* KREUZ)

None of these can be linked with Habermann's with any degree of certainty.

Habermann's assignment referred to a rose-violet flower color appearing in European imported & cultivated plants (arising from within lots of material identified as *L. williamsii*), while his actual description (and type) was based on a Mexican plant purchased from K.H. Uhlig (as *L. williamsii*) that he felt looked like the same material as was already in European collections, and thus this name, as Habermann described it, cannot be reliably extrapolated to include any of the earlier material referred to by the same name.

Lophophora jourdaniana is not widely accepted and was rejected by Anderson. See ANDERSON 1980.

The presence of readily visible persistent spines in the available horticultural material may support a separate varietal status or at least indicates this “*species*” needs additional investigation and, if specific status is warranted, a legitimate name assignment.

B: There appears to be some discrepancy as this is not the major alkaloid with regards to the pellotine present.

C: There appears to be some discrepancy as this is not a minor alkaloid with regards to the mescaline present.

D: Possible error. ŠTARHA 1997 lists this as O-Methylanhalinine. See comment in earlier footnote.

LEWIN 1894 commented that Hildman isolated an alkaloid in 1889.

Lophophora lutea is another invalid name. It was given by Croizat to material that was said to be yellow in flower, hair and body color. Presently it is used for yellow flowering specimens of *L. diffusa* as are known in cultivation in European collections.

See more comments in *Sacred Cacti Part A*

Lophophora sp. var. *Viesca* (Vieska), Mex.

(Wild-collected in Mexico) Sample was 7.6 gm dry (Total alkaloid concentration not included)

Tyramine (0.03% [\pm 0.01] of the total alkaloid content) ŠTARHA & KUCHYNA 1996; (0.1% of total alkaloid ŠTARHA 1997)

N-Methyltyramine (0.08% [\pm 0.01] of the total alkaloid content) ŠTARHA & KUCHYNA 1996; (0.1% of total alkaloid ŠTARHA 1997)

Hordenine (6.47% [\pm 0.29] of the total alkaloid content) ŠTARHA & KUCHYNA 1996; (6.5% of total alkaloid ŠTARHA 1997)

N,N-Dimethyl-3-methoxy-4-hydroxyphenethylamine (0.02% [\pm 0.01] of total alkaloid content) ŠTARHA & KUCHYNA 1996

N-Methyl-3,4-dimethoxyphenethylamine (0.04% [\pm 0.01] of the total alkaloid content) ŠTARHA & KUCHYNA 1996

Mescaline (**1.01% [\pm 0.25] of the total alkaloid content**) ŠTARHA & KUCHYNA 1996; (1.0% of total alkaloid ŠTARHA 1997)

N-Methylmescaline (0.09% [\pm 0.01] of the total alkaloid content) ŠTARHA & KUCHYNA 1996; (0.1% of total alkaloid ŠTARHA 1997)

3,5-Dimethoxy-4-hydroxyphenethylamine (0.77% [\pm 0.09] of the total alkaloid content) ŠTARHA & KUCHYNA 1996

O-Methylanhalidine (0.07% [\pm 0.01] of the total alkaloid content) ŠTARHA & KUCHYNA 1996 [**See Note A**]; (0.9% of total alkaloid ŠTARHA 1997)

Anhalinine (0.45% [\pm 0.06] of the total alkaloid content) ŠTARHA & KUCHYNA 1996; (0.5% of total alkaloid ŠTARHA 1997) [**See Note B**]

O-Methylpellotine (Trace of the total alkaloid content) ŠTARHA & KUCHYNA 1996

Anhalidine (0.14% [\pm 0.01] of the total alkaloid content) ŠTARHA & KUCHYNA 1996; (0.1% of total alkaloid ŠTARHA 1997)

Anhalamine (6.94% [\pm 0.30] of the total alkaloid content) ŠTARHA & KUCHYNA 1996; (6.9% of total alkaloid ŠTARHA 1997)

Anhalonidine (5.32% [\pm 0.32] of the total alkaloid content) ŠTARHA & KUCHYNA 1996; (5.2% of total alkaloid ŠTARHA 1997)

Pellotine (**76.28% [\pm 1.92] of the total alkaloid content**) ŠTARHA & KUCHYNA 1996; (76.3% of total alkaloid ŠTARHA 1997)

Anhalonine (0.10% [\pm 0.02] of the total alkaloid content) ŠTARHA & KUCHYNA 1996; (0.1% of total alkaloid ŠTARHA 1997)

Lophophorine (0.08% [\pm 0.02] of the total alkaloid content) ŠTARHA & KUCHYNA 1996; (0.1% of total alkaloid ŠTARHA 1997)

A: Possible error. ŠTARHA 1997 lists this as O-Methylanhalinine. See comment in earlier footnote.

B: In ŠTARHA & KUCHYNA 1996 this appears as a typo (anhalamine is listed twice). The listed identity was inferred from their GC.

Lophophora williamsii (LEMAIRE) COULTER

AKA *Peyote* and many other names

89% water by weight.

Total alkaloid reported: 8.41% in dried “buttons”; 0.47% in fresh whole plants; 0.2% in fresh roots and 0.93% in fresh tops.

BRUHN & HOLMSTEDT 1974.

82.5% of the alkaloid total in tops and 75.2% in roots: ANONYMOUS 1959 cited ROUHIER 1927a.

1,2-Dimethyl-6,7-dimethoxy-8-hydroxy-3,4-dihydroisoquinolinium inner salt (0.00008% fresh wt.)

2-Methyl-6,7-dimethoxy-8-hydroxy-3,4-dihydroisoquinolinium inner salt (0.001% fresh wt.)

1-Methyl-6,7-dimethoxy-8-hydroxy-3,4-dihydroisoquinoline (0.0001% fresh weight)

6,7-dimethoxy-8-hydroxy-3,4-dihydroisoquinoline (0.0008% fresh weight)

FUJITA *et al.* 1972 (above 4 as *L. williamsii* var. *caespitosa*).

3,4-Dihydroxy-5-methoxyphenethylamine (trace) LUNDSTRÖM 1971a

3,4-Dimethoxy-N-methylphenethylamine (trace) LUNDSTRÖM 1971a.

3,4-Dimethoxyphenethylamine (trace) LUNDSTRÖM & AGURELL 1968 and LUNDSTRÖM 1971a. [ŠTARHA *nd cf* HABERMANN 1978b]

[3,4,5-trimethoxyphenylalanine [i.e. (3,4,5-Trimethoxyphenethyl)glycine] reported **in error** (Used only as reference material- Did not observe in plant). See SETHI *et al.* 1973. Please note that N-[3,4,5-Trimethoxyphenethyl]-glycine and N-[3,4,5-Trimethoxyphenethyl]-alanine are synonyms for Mescaloxalic acid and Mescaloruvic acid (respectively); See KAPADIA & HUSSAIN 1972a.]

3-Hydroxy-4,5-dimethoxyphenethylamine [AKA 5-OH-3,4-diMeO-PEA or **3-Demethylmescaline**] (5% of total alkaloid: AGURELL & LUNDSTRÖM 1968); (1-5% of total alkaloid content in fresh material: LUNDSTRÖM & AGURELL 1971b) Also (identified) by KAPADIA *et al.* 1969 and AGURELL & LUNDSTRÖM 1968

3-Methoxytyramine (trace) LUNDSTRÖM 1971a

- Anhalamine (0.1-0.7% dry wt. has been reported) SPÄTH & BECKE 1935b and LUNDSTRÖM 1971b. [Also in HABERMANN 1974a (from ŠTARHA *nd*)] [8% of total alkaloid content: LUNDSTRÖM 1971b]
- Anhalidine (trace) (0.001% dry wt.) SPÄTH & BECKE 1935b; (0.16% dry wt. i.e. 2% of 8% total alkaloid content) LUNDSTRÖM 1971b
- Anhalinine (0.01% dry wt.) SPÄTH & BECKE 1935b; (0.04% dry wt.) [0.5% of total alkaloid content: LUNDSTRÖM 1971b]
- Anhalonidine (1.12% dry wt.) [14% of total alkaloid content: LUNDSTRÖM 1971b] [ŠTARHA *nd cf.* HABERMANN 1974a]
- Anhalonine (0.24% dry wt.) [3% of total alkaloid content: LUNDSTRÖM 1971b]
- Anhalotine (0.0003% dry wt. KAPADIA *et al.* 1968 [Candicine. (Presence is unconfirmed and questionable. Detection by McLAUGHLIN & PAUL 1966 relied entirely on tlc. All other workers were unable to detect it. Ex.: See KAPADIA *et al.* 1968 & DAVIS *et al.* 1983)]
- Choline (0.005% dry wt.) KAPADIA *et al.* 1968
- Dopamine (trace) LUNDSTRÖM 1971a.
- Epinine (trace) LUNDSTRÖM 1971a.
- Holdenine (0.6-0.7% dry wt.) LUNDSTRÖM 1971b; (0.008% dry wt.) McLAUGHLIN & PAUL 1966; TODD 1969 found it **only in roots** (tlc). [Also in HABERMANN 1978b (from ŠTARHA *nd*)]
[8% of total alkaloid content: LUNDSTRÖM 1971b]
- Isoanhalamine (trace) LUNDSTRÖM 1972
- Isoanhalidine (trace) LUNDSTRÖM 1972 & 1971b
- Isoanhalonidine (trace) LUNDSTRÖM 1972
- Isopellotine (0.04% dry weight) [0.5% of total alkaloid content: LUNDSTRÖM 1971b]
- Lophophorine (0.4% dry wt.) LUNDSTRÖM 1971b; (0.5% dry wt.) HEFFTER 1898b. [Also in HABERMANN 1974a (from ŠTARHA *nd*)] [5% of total alkaloid content: LUNDSTRÖM 1971b] (Appeared to be the major alkaloid in 2 varieties of summer collected plants: TODD 1969)
- Lophotine (0.0002% dry weight) KAPADIA *et al.* 1968
- Mescaline ([0.10-]0.9-6.0[-6.3%] dry wt. has been reported [See Note A] [ANONYMOUS 1959, HEFFTER 1896a, LUNDSTRÖM 1971b, MARTIN & ALEXANDER 1968 & SINISCALCO 1983]; ANDERSON 1980 cited KELSEY 1959 (0.9%), BERGMAN 1971 (1.5%), FISCHER 1958 (3%), HEFFTER 1896a (4.6-5.6 %[-6.3%]); 2.4-2.7 % dry (~400 mg. per 16 grams of dried cactus) OTT 1993 citing BRUHN & HOLMSTEDT 1974 and LUNDSTRÖM 1971b; [CROSBY & McLAUGHLIN 1973 stated peyote can reach 6% mescaline but rarely exceeds 1% (dry wt.)]; [Tops>>Roots; TODD 1969 (See Note B)] ; SINISCALCO 1983 reported the isolation of 0.10% (well irrigated), 0.93% (grafted) and up to 2.74% dry weight (after 6 months of dry conditions) from plants cultivated in Italy; 0.1 to 0.2% by fresh weight is common; Friends with extraction experience found fresh Texas plants to average 0.2% mescaline content during 1970s; 75-125 mg of HCl was recovered from 70-140 gm plants greenhouse grown in northern Europe. LUNDSTRÖM & AGURELL 1971b (This approaches 0.1% by fresh weight) [Also in HABERMANN 1978a & 1978b (from ŠTARHA *nd*)] [30% of total alkaloid content: LUNDSTRÖM 1971b]; 0.255% by fresh weight (2.55 mg/gm fresh: average of two specimens; estimated using HPLC) They also reported an average of 1.75% by dry weight. (Ed.: Note the obvious discrepancy) [Container grown in Italy] GENNARO *et al.* 1996;
- [As *L. williamsii* var. *typica* CROIZAT: 0.709% (\pm 0.032) dry wt. HABERMANN 1978a (from ŠTARHA 1997)] Starr Co.: 2.77%; Jim Hogg Co: 3.2%; Val Verde Co: 3.5%; Presidio Co: 3.52%. (Averaged % by dry weight.) HULSEY *et al.* 2011. 3.80% mature crowns, 2.01% small regrowth crowns. (Jim Hogg Co. - Averaged % by dry weight.) KALAM *et al.* 2012 & 2013. 1.82-5.50% in crown tissue, 0.125-0.376% in subterranean stem tissue, and 0.0147-0.0520% in root tissue. (Starr Co.; Analyzed individually. All % by dry wt.) KLEIN *et al.* 2013.
- Mescaline citrimide (trace) KAPADIA *et al.* 1970
- Mescaline isocitrimide lactone (trace) KAPADIA *et al.* 1970
- Mescaline maleimide (trace) KAPADIA & FALES 1968
- Mescaline malimide (trace) KAPADIA & FALES 1968
- Mescaline succinamide (trace) KAPADIA & HIGHT 1968
- Mescaloruvic acid (trace) KAPADIA & HUSSAIN 1972
- Mescalotam (trace) KAPADIA & FALES 1968
- Mescaloxyllic acid (trace) KAPADIA & HUSSAIN 1972
- N,N-Dimethyl-3-hydroxy-4,5-dimethoxyphenethylamine (0.04% dry weight i.e. 0.5% of 8% total alkaloid content) LUNDSTRÖM 1971c. [0.5% of total alkaloid content: LUNDSTRÖM 1971b]
- N,N-Dimethyl-3-methoxytyramine (trace) LUNDSTRÖM 1971a. [0.5-2% of total alkaloid content: LUNDSTRÖM 1971b]
- N-Acetyl-3-hydroxy-4,5-dimethoxyphenethylamine (trace) KAPADIA & FALES 1968
- N-Acetylanhalamine (trace) KAPADIA & FALES 1968
- N-Acetylanhalonine (trace) KAPADIA & FALES 1968
- N-Acetylmescaline (trace) SPÄTH & BRUCK 1938 and KAPADIA & FALES 1968
- N-Formyl-3-hydroxy-4,5-dimethoxyphenethylamine (trace) KAPADIA & FALES 1968
- N-Formyl-O-methylanhalonidine (trace) KAPADIA & FALES 1968
- N-Formylanhalamine (trace) KAPADIA & FALES 1968
- N-Formylanhalinine (trace) KAPADIA & FALES 1968
- N-Formylanhalonidine (trace) KAPADIA & FALES 1968
- N-Formylanhalonine (trace) KAPADIA & FALES 1968
- N-Formylmescaline (trace) KAPADIA & FALES 1968
- N-Methyl-3-hydroxy-4,5-dimethoxyphenethylamine (trace) LUNDSTRÖM 1971c
- N-Methyl-3-methoxytyramine (trace) LUNDSTRÖM 1971a. [$<$ 0.5% of total alkaloid content: LUNDSTRÖM 1971b]
- N-Methylmescaline (0.24% dry wt.) [3% of total alkaloid] LUNDSTRÖM 1971b. See also SPÄTH & BRUCK 1937.
- N-Methyltyramine (0.012% dry wt.) McLAUGHLIN & PAUL 1966. (trace) LUNDSTRÖM 1971a.

O-Methyl-anhalonidine (0.04% dry wt.) [$<0.5\%$ of total alkaloid content] LUNDSTRÖM 1971b
[O-Methylpellotine (**Probable** erroneous listing. We cannot locate any primary or substantiating source.)]
O-Methylpeyoruvic acid (trace) KAPADIA *et al.* 1973.
O-Methylpeyoxylic acid (trace) KAPADIA *et al.* 1973.
Pellotine (1.36% dry weight) LUNDSTRÖM 1971b
[Also (%) HABERMANN 1974a, 1978a & 1978b (from ŠTARHA *nd*)]
[**17% of total alkaloid content:** LUNDSTRÖM 1971]
[As *L. williamsii* var. *typica*: 0.296% (± 0.065) HABERMANN 1978a (from ŠTARHA in GRYM 1997)]
Peyoglunol (trace) KAPADIA *et al.* 1970
Peyoglutam (trace) KAPADIA & FALES 1968
Peyonine (trace) KAPADIA & HIGHT 1968
Peyophorine (trace) KAPADIA & FALES 1968; (0.04% dry wt.) LUNDSTRÖM 1971b. [0.5% of total alkaloid content: LUNDSTRÖM 1971b]
Peyoruvic acid (trace) KAPADIA *et al.* 1970
Peyotine (0.00015% dry wt.) KAPADIA *et al.* 1968
Peoxylic acid (trace) KAPADIA *et al.* 1970
[Serotonin (a tryptamine) was thought to be observed (but was neither isolated nor the identity actually proven); via ion-interaction HPLC: GENNARO *et al.* 1996]
Tyramine (0.001% dry wt.) McLAUGHLIN & PAUL 1966; (trace) LUNDSTRÖM 1971a. [Also in HABERMANN 1978b (from ŠTARHA *nd*)]

BRUHN *et al.* 2008 reported Lophophine, 3,4-Methylene-dioxyphenethylamine (Homopiperonylamine), and N,N-Dimethyl-3,4-methylenedioxyphenethylamine (Lobivine) as new minor alkaloids both this species and in San Pedro. This paper and these three alkaloid identifications need to be viewed with serious reservations. See comments in **Activity Notes**.

Glucaric acid (tlc by KRINGSTAD & NORDAL 1975)

Oxalate druses are present in abundance.
Rouhier 1927

***L. williamsii* notes:**

A: Note that this is 63X from min to max.

Peyote plants, collected from the wild in the late 19th century, have been reported that were 63 times stronger than other peyote plants, cultivated and well watered.

B: TODD 1969 presented an interesting tlc assessment of two distinct populations of *L. williamsii*.

His Coahuilan specimens were far more potent than those collected in San Luis Potosí lending support to the claim that the Coahuilan populations are a higher alkaloid form, designated by most as *L. echinata* or *L. williamsii* var. *echinata*.

***Lophophora williamsii* var. *caespitosa* Y.Ito n.n.**

[Varietal name is wisely rejected by most authorities as simply being a multi-headed form that normal growth can take. See ANDERSON or BENSON. Bottom image is a normal wild caespitose plant.]

Mescaline 0.701% (± 0.085) [dry wt?]

Pellotine 0.300% (± 0.095) [dry wt?]

HABERMANN 1978a (from ŠTARHA in GRYM 1997)]

Another analysis of this variety was published (in Japanese) by FUJITA *et al.* 1972. In this paper they reported the four new alkaloids listed under *L. williamsii* above (first 4 on our list) and also Pellotine (0.01%), Anhalidine (0.005%), Anhalonidine (0.001%), Anhalamine (detected), & Lophophorine (detected); All % by fresh wt. They apparently did not detect ANY mescaline (a caespitose *diffusa*?) but we have some distrust of our translator's accuracy so mention this with reservations. They analyzed plants grown in Japan. And apparently named one of their new compounds, Peyotine. SHULGIN & SHULGIN 1997 have pointed out that this is certain to cause confusion at some point down the road due to its use for another compound entirely.

***Lophophora williamsii* var. *decipiens* CROIZAT**

[Varietal name is wisely rejected by most authorities.

CROIZAT's designated type specimen was a **drawing** (in BRITTON & ROSE 1922), made from a photograph taken of a peyote plant, obtained via France, with no collection or locality information available. His description was further based on a plant furnished to him with no origin information. It was apparently identified as synonymous with the drawing based on it lacking ribs, instead being basally tubercled, and having more prominent flowers. He claims *decipiens* possesses flowers that "*freely reaches out of the top of the plant*". See ANDERSON and/or BENSON and/or BRAVO.

Modern attempts to describe the Coahuilan material by this name seem to lack published descriptions that can be demonstrably linked to the type. It is said to have an ashen grey color, light pink flowers and expressing tubercles rather than ribs (the latter form is not infrequently observable as individuals within large populations of normal *L. diffusa*, *L. fricii* and *L. williamsii*) These features (ashen grey coloration, a tuberculate appearance and pink or reddish flowers) can actually be considered to be fairly common for *fricii*. In fact Koehres & some others logically recognize their "*decipiens*" as *L. fricii* var. *decipiens*.

So far as we can determine the purported synonymy is based entirely on inferences from a couple of points of simple morphology and supposition based on reported geographical distribution rather than proof. There is no doubt *fricii* expressed this form though.

The novel characteristics (including an unusually high number of seeds in the fruit) that are now mentioned in the newer description of var. *decipiens* were NEVER mentioned by Croizat. It MAY eventually be proven to be synonymous but this is presently still in need of proof.

Croizat's ENTIRE Latin diagnosis: "Culta pusilla ca. 5-6 cm. lata. Costis primum ca. 1.1, subtus in tuberculis conicus solutis. Flore roseo, in anthesi tubo elongato primo intuitu peculiari."

Due to its prior usage, *decipiens* is AT BEST an invalid name.

It is also possible that this material could be synonymous with that referred to by US authors as *Lophophora echinata* or *Lophophora williamsii* var. *echinata* (a good amount of which does form ribs). Be aware that in Europe material labeled *L. echinata* is often *L. diffusa*]

Mescaline 0.724% (± 0.092) [dry wt?]

Pellotine 0.288% (± 0.066) [dry wt?]

HABERMANN 1978a (from ŠTARHA in GRYM 1997)]

***Lophophora williamsii* var. *pentagona* CROIZAT**

[Varietal name is wisely rejected by most authorities as simply being a 5-ribbed form that normal growth can take and it can be found occurring in any *Lophophora* species. It is not even correct to describe it as a proper form since it is typically transitory. It is common in juveniles but does infrequently persist into adulthood.

See ANDERSON or BENSON]

Mescaline 0.714% (\pm 0.049) [dry wt?]

Pellotine 0.296% (\pm 0.065)[dry wt?]

HABERMANN 1978a (from ŠTARHA in GRYM 1997)]

Machaerocereus eruca (BRANDEGEE) BRITTON & ROSE

See as *Stenocereus eruca*

***Machaerocereus gummosus* (ENGELMANN) BR. & R.**

89.5% (DJERASSI) & 74.09% (HEYL 1901) water by weight [KIRCHER 1982 reported 80% water by weight]

Gummosogenin (a new triterpene; Δ^{12} -18 β -oleanene-3 β ,16 β -diol-28-al) 0.76% dry weight; 0.08% fresh weight.

DJERASSI *et al.* 1954d. First report was DJERASSI *et al.* 1953c citing future publ. [Also in DJERASSI *et al.* 1954a & 1955b.] Longispinogenin (Reported in DJERASSI *et al.* 1954a.)

Machaeric acid [21-Keto-oleanolic acid; first isolation] 0.125% dry wt. (Isolated via its Methyl ester) DJERASSI *et al.* 1955b

Machaerinic acid (a 21-hydroxy-oleanolic acid) Traces. DJERASSI & LIPPMAN 1955. [Also in 1954]

HEYL 1901 isolated a hemolytic principle from *Machaerocereus gummosus* and believed it responsible for its activity as a traditional fish poison. He named it Cereinic acid but it was apparently never actually characterized. HEYL reported the dried plant material to have a total saponin content of 24%.

tlc examination showed the absence of alkaloids and the strong presence of triterpene glycosides: KIRCHER 1982

Lipid content 6.5% by dry weight: KIRCHER 1982

See comment in **Activity Notes**.

***Maihuenia poeppigii* (Pfeiffer) Schumann**

All CO₂ uptake occurred entirely during the day through the stems (under well watered conditions)

Maihueniopsis darwinii (HENSLOW) RITTER

See as *Opuntia hickenii*

Mamillopsis senilis (LODDIGES) WEBER ex BR. & R.

= *Mammillaria senilis* LODDIGES ex SALM-DYCK

AKA “Cabeza de viejo”.

ROSE 1899 calls it the “Sacred Cactus”

No analysis reported

ROSE 1899 suggested this may be an active species based on the fearful reluctance of a Tarahumara to assist Nelson while collecting this cactus [and the respectful treatment they applied to the spot where said cacti was harvested.]

See comments in the **Activity Notes**

Mammillaria aselliformis W.WATSON

See as *Pelecypora aselliformis*

***Mammillaria centricirra* LEMAIRE**

Fruit contains Phyllocactin (63.9% of total), Betanin (26.2% of total), Isophyllocactin & Isobetanin. PIATTELLI & IMPERATO 1969

The betacyanin Mammillarinin (Betanidin 5-O-(6'-O-malonyl)-beta-sophoroside) was identified as a fruit pigment. WYBRANIEC & NOWAK-WYDRA 2007

Listed as containing unidentified alkaloid(s) but either the entry included no reference or else the reference that was cited (BROWN *et al.* 1968) did not mention the species.

***Mammillaria coronata* Scheidweiler**

A new betacyanin (Betanidin 5-O-(6'-O-malonyl)-beta-sophoroside) was reported and named Mammillarinin.

WYBRANIEC & NOWAK-WYDRA 2007

***Mammillaria craigii* LINDSAY** Needs an analysis.

See comments in the **Activity Notes**

Mammillaria crinita DC

See as *Mammillaria wildii* (?)

Mammillaria dactylithele LABOURET

See as *Coryphantha macromeris*

***Mammillaria dioica* K.Brandegee**

CO₂ uptake occurred entirely at night through the stems (under well watered conditions)

NOBEL & HARTSOCK 1986

Mammillaria disciformis DC See as *Strombocactus disciformis*

***Mammillaria donatii* Berge ex Schumann**

A new betacyanin (Betanidin 5-O-(6'-O-malonyl)-beta-sophoroside) was reported and named Mammillarinin.

WYBRANIEC & NOWAK-WYDRA 2007

***Mammillaria elongata* DECANDOLLE**

β -O-Methylsynephrine (trace)

Hordenine (0.0005% dry wt.)

N-Methyltyramine (trace)

Synephrine (0.0009% dry wt.)

Tyramine (trace)

WEST & McLAUGHLIN 1973

***Mammillaria elongata* DECANDOLLE var.**

***rufrocrocea* K.SCHUMANN**

Reported to contain Kaempferol & Quercetin (Flavonols)

RICHARDSON 1978 (based on acid hydrolysis)

***Mammillaria gracilis* PFEIFFER**

Structures of protein linked N-glycans in different

tissues of this cactus was studied by BALEN *et al.* 2006

BALEN *et al.* 2007 looked on how environmental factors influenced their structure.

***Mammillaria grahamii* ENGELMANN** Needs an analysis
***Mammillaria grahamii* ENGELMANN var. *olivae* (ORCUTT)**
L.BENSON Needs an analysis
See comments in the **Activity Notes**.

***Mammillaria gummifera* Engelmann**
A new betacyanin was reported; named Mammillarinin (Betanidin 5-O-(6'-O-malonyl)- β -sophoroside).
WYBRANIEC & NOWAK-WYDRA 2007

***Mammillaria hidalgensis* J.PURPUS**
Reported to contain Betalains as pigments. WOHLPART & MABRY 1968 cited DREIDING 1961

***Mammillaria heyderi* MUEHLENPFORDT**
3,4-Dimethoxy-N-methylphenethylamine (Over 50% of the 10-50 mg of total alkaloid/ 100 grams fresh) BRUHN & BRUHN 1973 (Also mentioned in BRUHN 1973)
Reported to contain Betalains as pigments. WOHLPART & MABRY 1968 cited WOHLPART 1967
Reports of ethnopharmacological use appear to be **in error**.
See **Activity Notes** for more details.

***Mammillaria infernillensis* CRAIG**
A new betacyanin (Betanidin 5-O-(6'-O-malonyl)- β -sophoroside) was reported and named Mammillarinin.
WYBRANIEC & NOWAK-WYDRA 2007

***Mammillaria karwinskiana* MARTIUS**
A new betacyanin (Betanidin 5-O-(6'-O-malonyl)- β -sophoroside) was reported and named Mammillarinin.
WYBRANIEC & NOWAK-WYDRA 2007

***Mammillaria krameri* MÜHLENPFORDT**
A new betacyanin (betanidin 5-O-(6'-O-malonyl)- β -sophoroside) was reported and named mammillarinin.
WYBRANIEC & NOWAK-WYDRA 2007

***Mammillaria lenta* K.BRANDEGEE**
Reported to contain unidentified alkaloid(s).
CHALET 1980a cited DOMINGUEZ *et al.* 1969

Mammillaria lewinii KARSTEN See as *Lophophora williamsii*
Mammillaria longimamma DECANDOLLE See as *Dolichothele longimamma*
Mammillaria longimamma sphaerica K.BRANDEGEE See as *Dolichothele sphaerica*
Mammillaria longimamma uberiformis SCHUMANN See as *Dolichothele uberiformis*
Mammillaria macromeris ENGELMANN See as *Coryphantha macromeris*

***Mammillaria magnimamma* HAWORTH**
Unidentified alkaloid(s) reported. HEFFTER 1898a
Fruit contains Phyllocactin (65.2% of total), Betanin (34.8% of total) and traces of Isophyllocactin & Isobetatin.
PIATTELLI & IMPERATO 1969

A new betacyanin (betanidin 5-O-(6'-O-malonyl)- β -sophoroside) was reported and named mammillarinin.
WYBRANIEC & NOWAK-WYDRA 2007

***Mammillaria magnimamma* var. *divergens* HAWORTH**
Fruit contains Phyllocactin (80.0% of total), Betanin (10.2% of total), Isobetatin (9.8% of total) and traces of Isophyllocactin. PIATTELLI & IMPERATO 1969

***Mammillaria meiacantha* BRITTON & ROSE**
Positive Mayer's test. GC showed one alkaloid present but it was not identified. BRUHN & BRUHN 1973.
An unidentified alkaloid was reported by BROWN *et al.* 1968.

Mammillaria melaleuca KARWINSKY ex SALM-DYCK See as *Dolichothele melaleuca*

***Mammillaria melanocentra* POSELGER**
Acetovanillone (Apocynine) (0.11367% dry wt.)
Mammillarol (a partially characterized triterpenoid) (0.0069% dry wt.)
ACI-9 (A new steroid) (0.0043% dry wt.)
DOMINGUEZ & PUGLIESE 1967 [Collected Nuevo Leon, Mexico. Analyzed under synonym *Mammillaria runyonii* (BR. & R.) BÖD.]
This particular paper by Dominguez is in reference to *Mammillaria melanocentra* rather than to *Coryphantha runyonii* as is sometimes presented in alkaloid listings.
Confusion on synonymy is not just easy but easy to locate.

Nomenclatural synonyms:

Mammillaria melanocentra POSELGER var. *runyonii* (BRITTON & ROSE) R.T.CRAIG in the *Mammillaria* Handbook 65. 1945

= *Mammillaria runyonii* BOED. Mammillarien-Vergleichs-Schlüssel 52. 1933

= *Mammillaria runyonii* (BRITTON & ROSE) BOED.

= *Neomammillaria runyonii* BRITTON & ROSE; BRITTON & ROSE Cactaceae 4: 81. 1923 [24 Dec 1923]

There are many references to *Mammillaria runyonii* BRITTON & ROSE being a synonym for *Coryphantha runyonii*. Including some authoritative databases.

Often this is given as *Coryphantha runyonii* (BRITTON & ROSE) CORY which was published In: *Rhodora* 38(455): 407. 1936.

***Coryphantha runyonii* BRITTON & ROSE:**

Coryphantha macromeris subsp. *runyonii* (BRITTON & ROSE) N.P. TAYLOR

Coryphantha macromeris var. *runyonii* (BRITTON & ROSE) L.D. BENSON

Lepidocoryphantha runyonii (BRITTON & ROSE) BACKEBERG.

Incredibly, Britton & Rose 1923 actually used "runyonii" for two different new species; both of which were discovered by Runyon. However, neither one was as *Mammillaria runyonii*. Hence Cory's use of *Mammillaria runyonii* in 1936 to refer to Britton &

Rose's *Coryphantha runyonii* and Boedekker's use of *Mammillaria runyonii* in 1933 to refer to *Mammillaria melanocentra* (Britton & Rose's *Neomammillaria runyonii*) has resulted in some persistent confusion.

***Mammillaria microcarpa* ENGELMANN**

3,4-Dimethoxyphenethylamine (0.0015% (\pm 0.0006) in chlorophyllous tubercles, 0.0035% (\pm 0.0027) in cortex tissue, 0.0007% (\pm 0.0002) in vascular tissue and 0.0008% (\pm 0.0004) in the root.) KNOX *et al.* 1983. [KNOX & CLARK 1986 found it to be present in only 64% of their samples.] Hordenine (0.0017% by dry weight) HOWE *et al.* 1977; (0.0035% (\pm 0.0017) in chlorophyllous tubercles, 0.017% (\pm 0.0053) in cortex tissue, 0.019% (\pm 0.012) in vascular tissue and 0.036% (\pm 0.023) in the root.) KNOX *et al.* 1983. [KNOX & CLARK 1986 found it to be present in 95% of their samples]

N-Methyltyramine (0.0019% dry wt.) HOWE *et al.* 1977; (0.0094% (\pm 0.0028) in chlorophyllous tubercles, 0.025% (\pm 0.006) in cortex tissue, 0.014% (\pm 0.0073) in vascular tissue and 0.014% (\pm 0.0023) in the root.) KNOX *et al.* 1983. [KNOX & CLARK 1986 found it to be present in all of their samples]

Tyramine 0.0064% (\pm 0.0033) in chlorophyllous tubercles, 0.014% (\pm 0.0099) in cortex tissue, 0.004% (\pm 0.0028) in vascular tissue and 0.0029% (\pm 0.0017) in the root.) KNOX *et al.* 1983. [KNOX & CLARK 1986 found it to be present in all of their samples]

[KNOX & CLARK 1986 looked at 129 individuals from 15 Arizona populations. The occurrences of particular alkaloids showed no clear associations with the geographical distribution.]

Mammillaria microcarpa is considered variously either synonymous with *Mammillaria grahamii* or a variety of it. Toss a coin.

For sake of aiding keyword searches we kept them separate.

***Mammillaria multiceps* SALM-DYCK**

Reported to contain unidentified alkaloid(s). CHALET 1980a cited DOMINGUEZ *et al.* 1969

***Mammillaria neumanniana* LEMAIRE**

Fruit contains Phyllocactin (50.2% of total), Betanin (30.9% of total), Isophyllocactin (18.9% of total) and traces of Isobetainin. PIATTELLI & IMPERATO 1969

***Mammillaria pilcayensis* BRAVO**

Seed coats reported to contain guaiacyl/syringyl lignins. CHEN *et al.* 2012

***Mammillaria pusilla* (DC) SWEET**

Reported to contain Betalains as pigments. WOHLPART & MABRY 1968 cited DREIDING 1961

***Mammillaria rhodantha* LINK & OTTO**

Reported to contain Betalains as pigments. WOHLPART & MABRY 1968 cited DREIDING 1961

***Mammillaria roseo-alba* BOEDECKER**

A new betacyanin (Betanidin 5-O-(6'-O-malonyl)- β -sophoroside) was reported and named Mammillarinin.

WYBRANIEC & NOWAK-WYDRA 2007

Mammillaria runyonii (BRITTON & ROSE) BOEDECKER

See as *Mammillaria melanocentra*

Mammillaria runyonii (BRITTON & ROSE) BOEDECKER **IS NOT** synonymous with *Mammillaria runyonii* CORY

Mammillaria runyonii CORY

See as *Coryphantha macromeris* var. *runyonii*

Mammillaria runyonii HORT

See as *Coryphantha macromeris* var. *runyonii*

***Mammillaria saffordii* (BR. & R.) BRAVO**

Reported to have no detectable alkaloids in DINGERDISSEN & McLAUGHLIN 1973b

Mammillaria senilis is not the same plant as *Mamillopsis senilis* but the equating of them appears in the literature. (ex.: BYE 1979, p 35)

***Mammillaria seitziana* MARTIUS**

Fruit contains Phyllocactin (60.1% of total), Betanin (24.9% of total), Isobetainin (15.0% of total) and traces of Isophyllocactin. PIATTELLI & IMPERATO 1969

Mammillaria setigera

Betalains as pigments. WOHLPART & MABRY 1968 cf DREIDING 1961

Mammillaria sphaerica DIETRICH ex POSELGER See as *Dolichothele sphaerica*

***Mammillaria tetrancistra* ENGELMANN**

Hordenine (0.0038% (\pm 0.0023) in chlorophyllous tubercles, 0.013% (\pm 0.0027) in cortex tissue, 0.026% (\pm 0.017) in vascular tissue and 0.047% (\pm 0.03) in the root.) KNOX *et al.* 1983

N-Methyltyramine (0.012% (\pm 0.0034) in chlorophyllous tubercles, 0.06% (\pm 0.017) in cortex tissue, 0.022% (\pm 0.004) in vascular tissue and 0.0094% (\pm 0.0028) in the root.) KNOX *et al.* 1983 (Wild collected: Arizona)

Mammillaria uberiformis ZUCCARINI ex PFEIFFER

See as *Dolichothele uberiformis*

Mammillaria wildii A.DIETRICH had 1 unidentified alkaloid reported [C₁₃H₁₃NO₃] RÄTSCH 1998 cited LÜTHY 1995.

Mammillaria williamsii COULTER See as *Lophophora williamsii*

***Mammillaria woodsii* R.T.CRAIG**

Reported to contain Betalains as pigments. WOHLPART & MABRY 1968 cited DREIDING 1961

***Mammillaria zeilmanniana* BÖD.**

Reported to contain Betalains as pigments. WOHLPART & MABRY 1968 cited DREIDING 1961

***Mammillaria zuccariniana* MARTIUS**

Fruit contains Phyllocactin (45.2% of total), Betanin (25.3% of total), Isophyllocactin (19.6% of total) & Isobetanin (9.9% of total). PIATTELLI & IMPERATO 1969

Marginatocereus marginatus (DC) BACKEBERG

See as *Pachycereus marginatus*

Marshallocereus aragonii (WEB.) BACKEBERG

See as *Lemaireocereus aragonii*

Marshallocereus thurberi (ENGELMANN) BACKEBERG

See as *Lemaireocereus thurberi*

Matucana madisoniorum is **erroneously** rumored to contain mescaline.

Analysis of it could detect no alkaloid (unpublished GC-MS by Shulgin; personal communication)

See additional comments in **Activity Notes**.

Melocactus bellavistensis has been purported to have use.

It needs study and an analysis.

See additional comments in **Activity Notes**.

***Melocactus delessertianus* LEMAIRE**

Tyramine (no quantification) DOETSCH *et al.* 1980

***Melocactus maxonii* (ROSE) GÜRKE**

3,4-Dimethoxyphenethylamine (less than 0.01% dry wt.)

MA *et al.* 1986

4-Hydroxy-3,5-dimethoxyphenethylamine (Around 0.01% dry wt.)[?] MA *et al.* 1986 (Commercial: CA)

Tyramine (no quantification) DOETSCH *et al.* 1980

***Melocactus obtusipetalis* LEMAIRE**

Seed coats reported to contain a homopolymer of cafeyl alcohol as C-lignins. CHEN *et al.* 2012

***Melocactus peruvianus* VAUPEL**

Reported to contain Betalains as pigments. WOHLPART & MABRY 1968 cited DREIDING 1961

CAYCHO JIMENEZ 1977 (page 91) asserted that it contains Mescaline but did not offer any supportive reference.

See additional comments in the **Activity Notes**.

***Monvillea spegazzinii* (A.WEBER) BRITTON & ROSE**

Reported to contain Betalains as pigments.

WOHLPART & MABRY 1968 cited DREIDING 1961

***Myrtillocactus cochal* (ORC.) BRITTON & ROSE**

“cochal” STANDLEY 1924: 911

92.6% water by weight [SANDOVAL *et al.* 1957 found that 70% water weight was lost when drying 7 days at 35°C.]

Cochalic acid (A triterpene acid; 16-*epi*-echinocystic acid) 0.56% dry wt. DJERASSI *et al.* 1955c and DJERASSI & THOMAS 1954; (1.25% by dry wt DJERASSI *et al.* 1957 [a portion of this was via its methyl ether])

Chichipecogenin (A triterpene) 2.47% by dry wt: DJERASSI *et al.* 1957; 0.83% by dry wt: SANDOVAL *et al.* 1957 [Collected near Tehuacán, Puebla]

Myrtillogenic acid (A β -Amyrin-type terpene: 3 β , 16 β , 28-trihydroxy- Δ^{12} -oleanen-29-oic acid [DJERASSI & MONSIMER 1957]) (0.19% dry wt. via the methyl ether) DJERASSI *et al.* 1957. [Cultivated: Corona, California]

Longispinogenin (0.157% dry wt) DJERASSI *et al.* 1957

Oleanolic acid (via the methyl ether) SANDOVAL *et al.* 1957
DJERASSI 1957 presents almost the same list but omits oleanolic acid; citing unpublished observations by DJERASSI, MONSIMER & THOMAS

***Myrtillocactus eichlamii* BRITTON & ROSE**

Cochalic acid (0.37% by dry wt via the methyl ether)

Chichipecogenin (?This is listed in their discussion in the text but does not appear in the experimental account)

Myrtillogenic acid (0.028% dry wt. via the methyl ether)

Longispinogenin (0.83% dry wt)

Oleanolic acid (0.16% dry wt. via the methyl ether)

β -Sitosterol (detected)

Maniladiol (0.14% dry wt)\

DJERASSI *et al.* 1957 [Collected near Guatemala City] citing unpublished observations by DJERASSI & BURSTEIN

***Myrtillocactus geometrizans* (VONMARTIUS) CONSOLE**

“garambullo” or “padre nuestro” or “blue myrtle” or “billberry cactus”

[Mescaline was apparently reported **in error**. Weak presence [0.30% by dry weight] was only isolated from plants previously used as grafting stocks for *L. williamsii*. However, directly in conflict with his experimental account, SINISCALCO also includes a closing comment that suggests one of his controls contained mescaline. SINISCALCO 1983]

[Alkaloids were only detected in one of the preliminary screenings of this species by FONG *et al.* 1972. All other tests indicated no alkaloid. All were from Mexico.]

Cochalic acid (0.25% by dry wt via the methyl ether)

Chichipecogenin (0.62% by dry wt via the methyl ether)

Myrtillogenic acid (0.14% dry wt. via the methyl ether)

Longispinogenin (0.0025% dry wt)

No detectable alkaloid.

DJERASSI *et al.* 1957 [Material was collected at km 205 of Mexico-Laredo Hwy]

DJERASSI 1957 cited unpublished observations by DJERASSI, LIPPMAN & MONSIMER

Chichipecogenin, Peniocerol, Macdougallin were reported from an extract of plant and roots.

CÉSPEDES *et al.* 2005

A study of the flavor of the “*berrycactus*” decided that nine volatile compounds were the most important components:

Furfural,

5-Methyl-2-furancarboxaldehyde,

2(5H)-Furanone,

5-Acetoxymethyl-2-furaldehyde,

2-Cyclohexen-1-ol,

Octanoic acid ethyl ester,

Decanoic acid ethyl ester,

Octanoic acid,
Phenylethyl alcohol.
VAZQUEZ-CRUZ *et al.* 2012

See comments in **Activity Notes**.

Myrtillocactus geometrizans var. *grandiareolatus* (BRAVO) BACKEBERG See as *Myrtillocactus grandiareolatus*. Hunt 1999 considers this to be synonymous with *Myrtillocactus geometrizans*

***Myrtillocactus grandiareolatus* BRAVO**

[See BRAVO 1932]

Chichipecogenin (nearly 1% by dry wt)
Oleanolic acid (0.2% dry wt. via the methyl ether)
DJERASSI *et al.* 1957 [Collected near Zapotitlán, Mexico]
DJERASSI 1957 cited unpublished observations by ESTRADA & MANJARREZ

***Myrtillocactus schenckii* (PURPUS) BR. & R.**

AKA “vichishovo” or “garambullo”
Stellatogenin (0.052% by dry wt)
Oleanolic acid (0.136% dry wt. via the methyl ether)
DJERASSI *et al.* 1957 [Collected in Oaxaca, Mexico]
DJERASSI 1957 cited unpublished observations by MANJARREZ

***Neobuxbaumia euphorbioides* (HAW.) BUXB.**

Reported to show no detectable alkaloids (with MIKES)
in UNGER *et al.* 1980

Neobuxbaumia multiareolata* (E.Y. DAWSON) BRAVO *et al.

Salsolidine, Anhalidine and Arizonine in trace amounts.
FLORES ORTIZ *et al.* 2003 (gc-ms)

***Neobuxbaumia scoparia* (POSELGER) BACKEBERG**

Salsolidine, Anhalidine and Arizonine in trace amounts.
FLORES ORTIZ *et al.* 2003 (gc-ms)

***Neobuxbaumia tetetzo* (WEBER ex COULTER)**

BACKEBERG

No detectable alkaloids.
CHALET 1980a cited DOMINGUEZ *et al.* 1969 (analyzed as *Cephalocereus tetetzo* (A.WEBER) VAUPEL)
Salsolidine, Anhalidine and Arizonine in trace amounts.
FLORES ORTIZ *et al.* 2003 (gc-ms)

Neogomesia agavioides CASTAÑEDA. See as *Ariocarpus agavioides*

***Neolloydia intertextus* (ENGELMANN) KIMNACH**

[as *Echinomastus intertextus* ENGELMANN]

Reported to contain druses of Weddellite.
These druses appeared to be comprised of symmetrical tetragonal crystals that were piled onto one another.
They were found to possess a ¹³C/¹²C ratio that was 1%

higher than the ratio of its environmental atmosphere (the ratio was also richer than was found within woody tissues).
The cortex of older regions within the stem was found to contain up to 50% of its dry weight as the oxalate.

RIVERA & SMITH 1979
(Collected in Paradise Canyon, West Texas)

***Neolloydia intertexta* var. *dasyacantha* (ENGELMANN) L.BENSON**

Reported to contain a single unidentified alkaloid when harvested in Spring and no alkaloid when harvested in the Fall.
BROWN *et al.* 1968.

Neolloydia odorata was reported to show no detectable alkaloids. CHALET 1980a cited DOMINGUEZ *et al.* 1969

Neomammillaria anything. See under *Mammillaria*
Neomammillaria runyonii BRITTON & ROSE See as *Mammillaria melanocentra* [Not a synonym for *Coryphantha runyonii*]

Neoporteria ebenacantha

Betalain pigments. WOHLPART & MABRY 1968 cited DREIDING 1961
We are unclear if this was *Neoporteria ebenacantha* (HORT. non MONV.) Y.ITO or *Neoporteria ebenacantha* (MONV.) BERG.

***Neoraimondia arequipensis* var. *roseiflora* (WERDERMANN & BACKEBERG) RAUH**

3,4-Dimethoxyphenethylamine (less than 0.01% dry wt.)
4-Hydroxy-3,5-dimethoxyphenethylamine (Less than 0.01% dry wt.)
MA *et al.* 1986 (Collected by OSTOLAZA #85055)

***Neoraimondia macrostibas* (SCHUMANN) BRITTON & ROSE**

86% water by weight
“no alkaloid”
A basic, partially crystalline material was obtained. It showed multiple components: all unidentified; ethanol soluble & ether insoluble. Also noted was a gummy ‘non-glycosidic’ neutral material and substantial amounts of an unidentified neutral material (oily or amorphous)
[No saponins or terpenes observed]
DJERASSI *et al.* 1955b [Wild collected; Peru]
This species is in need of further analysis.
See more comments in **Part B San Pedro**

***Nopalea cochenillifera* (L.) SALM-DYCK**

Mucilage polysaccharide was 0.48% of total weight of the fresh plant.
Uronic acid content of polysaccharide: 20%
Rhamnose, arabinose, galactose, xylose (1:4.7:2.1:1.8)
MINDT *et al.* 1975

See comments in **Activity Endnotes**.

***Nopalxochia ackermannii* (HAWORTH) F.M.KNUTH**
Appears listed as containing an unidentified alkaloid but either the entry included no reference or else the reference that was cited (BROWN *et al.* 1968) did not mention the species. The intended reference was likely HEFFTER 1898; who included no additional information.

According to HORTUS, the plants propagated under this name are actually a hybrid of this species with a *Heliocereus*

***Nopalxochia phyllanthoides* (DC) BR. & R.**

Reported to contain Betalains as pigments.

WOHLPART & MABRY 1968 cited DREIDING 1961.

Betacyanin first reported by Kryz.

PIATTELLI 1981 cited KRYZ 1919 & KRYZ 1920.

The genus *Nopalxochia* is now lumped into *Disocactus* along with some former members of *Epiphyllum*, *Phyllocactus* and *Heliocereus*.

Normanbokea pseudopectinata (BACKEBERG) KLADIWA & BUXBAUM.
See as *Pelecophora pseudopectinata*

The former *Notocactus* are now in the genus *Parodia*.

***Notocactus concinnus* (MONVILLE) BERGER**

Mucilage determined to be comprised of Arabinose

(22.0%), Galactose (42.7%), Galacturonic acid (14.1%),
Rhamnose (7.6%) & Xylose (13.7%).

MOYNA & DiFABIO 1978 (Analyzed MAM 1219)

***Notocactus mammulosus* (LEMAIRE) A.BERGER**

Hunt lists as *Notocactus mammulosus* (LEMAIRE) BACKEBERG

Reported to contain Betalains as pigments.

WOHLPART & MABRY 1968 cited DREIDING 1961

***Notocactus ottonis* (LEMAIRE)**

BERGER ex BACKEBERG & KNUTH

Hordenine (%) DEVRIES *et al.* 1971

[N-Me-3,4-DiMeO-PEA has been listed in error. It is not supported by the reference that was cited: SMITH 1977.]

Reported to contain Betalains as pigments.

WOHLPART & MABRY 1968 cited DREIDING 1961

***Nyctocereus guatemalensis* BRITTON & ROSE**

Devoid of glycosides

DJERASSI *et al.* 1953c [Guatemala; cultivated Guatemala City]
Most members of this genus, including this species, have been transferred elsewhere. (In this case to *Peniocereus* and absorbed into *Peniocereus hirschtianus* (SCHUMANN) HUNT)

The work of Arias *et al.* 2005 indicates that *Nyctocereus* should be preserved only as a monotypic genus (*N. serpentinus*).

***Obregonia denegrii* FRIC**

Hordenine (0.002% dry wt.) NEAL *et al.* 1971a; (1-10% of 1-10 mg total alkaloids/ 100 gm. fresh.) BRUHN & BRUHN 1973.

N-Methyltyramine (0.0002% dry wt.) NEAL *et al.* 1971a; (trace) BRUHN & BRUHN 1973.

Tyramine. (Over 50% of 1-10 mg of total alkaloids/ 100 gm. of fresh) BRUHN & BRUHN 1973 [All 3 reported in HABERMANN 1974a (from ŠTARHA nd)]
Quinic acid (tlc & glc by KRINGSTAD & NORDAL 1975)
β-Sitosterol (tentative ID) DOMINGUEZ *et al.* 1969
ANDERSON 1967 & DOMINGUEZ *et al.* 1969 reported unidentified alkaloids.

Opuntia

More detailed entries for the mescaline containing species can be found in Part A of Sacred Cacti.

***Opuntia basilaris* ENGELMANN & BIGELOW**

Also appears spelled *basilaria*. We went with BENSON 1982.

4-Hydroxy-3,5-dimethoxyphenethylamine (Less than 0.01%)

Mescaline (0.01% dry wt.) [ie 100 mg/ 1 kg. dry wt]

MA *et al.* 1986 (Analyzed F. ZEYLMAYER #8504)

***Opuntia bergeriana* WEBER**

Fruit contains Betanin (major), Isobetanin, Betanidin and traces of Phyllocactin & Isophyllocactin:
PIATTELLI & IMPERATO 1969

Betanin in fruit (biosynthetic study) MILLER *et al.* 1968

Flower contains betacyanins: Betanin (major) & Isobetanin.

PIATTELLI & MINALE 1964b

***Opuntia bigelovii* ENGELMANN (Analyzed F.ZEYLMAYER #8508)**

Reported by MA *et al.* 1986 to contain no detectable alkaloid.

***Opuntia boldinghii* BRITTON & ROSE**

Fatty acids composition of seed oil (relative percents).

Linoleic acid 67.2±0.1%

Oleic acid 18.0±0.1%

Palmitic acid 10.4±0.1%

Stearic acid 3.0±0.1%

Palmitoleic acid 0.5±0.1%

Linolenic acid 0.3±0.1%

Arachidic acid 0.3±0.1%

Gadoleic acid 0.4±0.1%

GARCÍA PANTALEÓN *et al.* 2009

Fruits shown to contain betalains by VILORIA-MATOS *et al.* 2002. Proximate analyses was performed on fruits and on cladodes by MORENO-ALVAREZ *et al.* 2003 & 2006. [from GARCÍA PANTALEÓN *et al.* 2009]

***Opuntia brasiliensis* (WILLDENOW) HAWORTH**

See as *Brasiliopuntia brasiliensis*

***Opuntia bradtiana* (COULTER) K. BRANDEGEE**

see as *Grusonia bradtiana*

***Opuntia clavata* ENGELMANN**

see as *Corynopuntia clavata*

***Opuntia chlorotica* ENGELMANN & BIGELOW**

Quercetin-3-glucoside, Quercetin-3-rutinoside, Iso-rhamnetin-3-glucoside, Isorhamnetin-3-rutinoside, Isorhamnetin-3-rhamnosylgalactoside, and

Cactus Chemistry: By Species

Kaempferol 3-galactoside (all flavonoids) in flowers.
CLARK & PARFITT 1980

***Opuntia comondensis* (COULTER) BRITTON & ROSE**

Cholesterol (4.4% of total)
24 ζ -Methylcholesterol (8.8% of total)
Sitosterol (86.7% of total)
SALT *et al.* 1987

***Opuntia curvispina* GRIFFITHS**

Quercetin-3-glucoside, Quercetin-3-rutinoside, Iso-rhamnetin-3-glucoside, Isorhamnetin-3-rutinoside, Iso-rhamnetin-3-rhamnosylgalactoside, and Kaempferol 3-galactoside (all flavonoids) in flowers.
CLARK & PARFITT 1980
This name is considered unresolved.

***Opuntia decumbens* SALM-DYCK**

Fruit determined to contain betalains. FISCHER & DREIDING 1972 & MILLER *et al.* 1968 (Both studied the biosynthesis of Betanin)

***Opuntia dejecta* SALM-DYCK**

Fruit contains Betanin (major), Isobetanin and traces of Phyllocactin. PIATTELLI & IMPERATO 1969

***Opuntia diademata* LEMAIRE**

Citric acid (3.0% in stem juice)
HEGNAUER 1964 cited BERGSTRÖM 1934

Opuntia dillenii HAWORTH See as *Opuntia stricta* var. *dillenii*

***Opuntia ellisiana* GRIFFITHS**

Crystalline material isolated from the stems shows a very complex mineral composition that includes:
Whewellite (monohydrated calcium oxalate)
Opal (SiO₂)
Calcite (CaCO₃)
Glushinskite (dihydrated Magnesium oxalate).
Monje & Baran 2005

***Opuntia engelmannii* SALM-DYCK**

Flower contains Betanin (major), and an unidentified Betacyanin.
Fruit contains Betanin (major), Phyllocactin & Isobetanin.
PIATTELLI & IMPERATO 1969
Reported to contain druses of Whewellite.
RIVERA & SMITH 1979
(collected on the campus of the University of Texas at Austin)

***Opuntia elatior* MILL.**

β -Sitosterol
Opuntiol (0.05% dry wt) (2-Hydroxymethyl-4-methoxy- α -pyrone)
GANGUL *et al.* 1965 (Collected in India)

Narcissin (a flavone) was found in the flowers.
SHABBIR & ZAMAN 1968

***Opuntia erinacea* ENGELMANN & BIGELOW var. *hystricina* (ENGELMANN & BIGELOW) L.BENSON**

Reported by MEYER *et al.* 1980 to contain traces of unidentified alkaloids.

***Opuntia ficus-indica* (LINNAEUS) MILLER**

Pads determined to contain 87.4% (young) and 85.4% (mature) water by weight. KIRCHER 1982
Mescaline (% not given)
N-Methyltyramine (% not given)
Tyramine (% not given)
Four additional unidentified bases present as trace amounts.
EL-MOGHAZY *et al.* 1982 (Material growing in Egypt.)
Unidentified lactone-forming acid (tlc by KRINGSTAD & NORDAL 1975)

In cladodes:

Glucose and Galacturonic acid were found to be the primary sugars
Kaempferol and Isorhamnetin glycosides (as glucosides and rhamnosides) were also detected.
Calcium oxalate crystals were present in large amounts.
Reported no observable antimicrobial activity.
MANDALARI *et al.* 2009

Myrcene, Limonene & γ -Terpinene (terpenes: small amounts in the *de Castilla* variety fruit) FLATH & TAKAHASHI 1978. [Also reported the presence of other volatile compounds in the fruit including many alcohols, aldehydes, ketones, esters & hydrocarbons such as Toluene & Methylcyclohexane]

β -Sitosterol DAWIDER & FAYEZ 1961; (0.04% dry wt. in flowers) ARCOLEO 1966

var. **saboten** (leaf & stem): 2 triterpenoids and eight flavonoids.

(6S,9S)-3-oxo-ceionol-[3-*D*-glucopyranoside
Corchoionoside C

(+)-Dihydrokaempferol (Aromadendrin)

(+)-Dihydroquercetin (Taxifolin)

Eriodictyol

Kaempferol

Kaempferol 3-methyl ether

Narcissin

Quercetin

Quercetin 3-methyl ether

LEE *et al.* 2003

Flowers were found to contain the flavonoids: Penduletin, Luteolin, Kaempferol, Quercetin, Quercitrin & Rutin
EL-MOGHAZY *et al.* 1982

Mucilage was determined to be comprised of D-Glucose, D-Galactose, L-Arabinose, D-Xylose, L-Rhamnose and D-Galacturonic and D-Glucuronic acids.

EL-MOGHAZY *et al.* 1982

free Lauric acid, Myristic acid, Palmitic acid, Stearic acid and Oleic acid & also the esters of Myristic, Palmitic, Stearic, and Oleic acids. ARCOLEO 1966

Reported to contain Betalains as pigments. WOHLPART & MABRY 1968 cited PIATTELLI & MINALE 1964

Fruit contains betacyanins: Betanin (major) & Isobetanin. PIATTELLI & MINALE 1964

Indicaxanthin (a betaxanthin) was reported in mature fruit (orange - yellow variety) by IMPELLIZZERI & PIATTELLI 1972 (Also in PIATTELLI *et al.* 1964a & 1964b)

Indicaxanthin & Betanin in fruit. MINALE *et al.* 1965

tlc examination showed a small amount of unidentified alkaloid and the absence of triterpene glycosides: KIRCHER 1982

Lipid content determined to be 2.5% by dry weight: KIRCHER 1982

Isorhamnetin was found in the hydrosylate of flower pigments. ARCOLEO *et al.* 1961.

Fruit was found to contain Maleic, Malonic, Malic, Succinic, Tartaric, Oxalic & Ascorbic acids. Ascorbic acid content determined to be 0.094% by fresh weight.

EL-MOGHAZY *et al.* 1982

Malic acid, Citric acid, Piscidic acid, Piscidic acid monoethyl ester (0.0433%), Piscidic acid diethyl ester (0.0333%) and several other nonvolatile acids in fruit. NORDAL *et al.* 1966.

1 - Methylcitrate, 1, 3 - Dimethylcitrate, Trimethylcitrate & 1-Methylmalate were isolated from the fruit of *Opuntia ficus-indica* var. *saboten* 'Makino':

HAN *et al.* 2001

Betalain distribution for three Sicilian cultivars of *Opuntia ficus indica* was studied by Butera .

These cultivars differ by producing either yellow, red, or white fruits due to the combination of two betalains, namely betanin (purple-red) and indicaxanthin (yellow-orange)

They found that the yellow cultivar exhibited the highest amount of betalains, followed by the red and white ones.

White fruit:

Indicaxanthin comprised about 99% of the betalains.

Also found polyphenolic pigments.

Yellow fruit:

The ratio of betanin to indicaxanthin was 1:8 (w:w)

Also found polyphenolic pigments.

Red fruit:

The ratio of betanin to indicaxanthin was 2:1 (w:w)

Found that polyphenol pigments were negligible components.

BUTERA *et al.* 2002

Eight flavonoids were isolated from the stems and fruits of *Opuntia ficus-indica* var. *saboten*:

Kaempferol

Quercetin

Kaempferol 3-methyl ether

Quercetin 3-methyl ether

Narcissin

(+)-Dihydrokaempferol (Aromadendrin)

(+)-Dihydroquercetin (Taxifolin)

Eriodictyol

along with two terpenoids:

(6S,9S)-3-Oxo- α -ionol- β -D-glucopyranoside

Corchoionoside C

LEE *et al.* 2003

DOK-GO *et al.* 2003 reported:

Quercetin

(+)-Dihydroquercetin

Quercetin 3-methyl ether

These flavonoids were isolated from the ethyl acetate fractions of an extract of the fruits and stems of *Opuntia ficus-indica* var. *saboten* .

	Pulp	Skin	Seeds
Glucose	35%	21%	–
Fructose	29%	–	–
Protein	5.1%	8.3%	11.8%
Starch	yes	yes	yes
Cellulose	14.4%	29.1%	45.1% (in fibers)
Calcium	–	2.09%	–
Potassium	–	3.4%	–

EL-KOSSORI *et al.* 1998. (All as dry weight)

Fruit sugars were found to include D-Glucose, D-Galactose, L-Arabinose, Fructose, & D-Glucuronic and D-Galacturonic acids prior to hydrolysis and showed D-Xylose, L-Rhyrcose (? - I cannot locate this name) & L-Rhamnose after hydrolysis.

EL-MOGHAZY *et al.* 1982.

El-Moghazy mentioned that AWAD *et al.* 1970 & HARALAMBS 1979 had reported Galactose, Arabinose, Xylose, Rhamnose and Galacturonic acid.

de Castilla fruit showed pH 4.85-6.3 .

Citric acid was reported at levels of 0.084-0.12% according to FLATH & TAKAHASHI 1976

Fruit juice of Sicilian cultivars of *Opuntia ficus indica*:

pH 6.4-6.5

Sugar content of 11-12% (mainly glucose and fructose)

L-ascorbic acid content of 31-38 mg/100 grams.

Manganese(II) (1.7-2.9 ppm)

Iron(III) (0.6-1.2 ppm)

Zinc(II) (0.3-0.4 ppm)

The metal ions appeared to be present mainly in the skin of the fruit or were "trapped" inside of the pulp.

GURRIERI *et al.* 2000

Linoleic acid was determined to be the major fatty acid in the seed oil (61.01%), with Oleic (25.52%) and Palmitic (12.23%) acids. Myristic, Stearic and Arachidonic acids were also present in low concentrations.

ÖZCAN & AL JUHAIMI 2011

Cactus Chemistry: By Species

Similar results were reported for oil extracted from *Opuntia ficus-indica* seeds. The oil constituted 13.6% of the whole seed. 16% saturated fatty acid, with a linoleic acid content of 63.66% followed by oleic 18.34%, palmitic 12.84% and stearic acid 2.81%. EL FINTI *et al.* 2013

See comments in **Activity Notes**.

Fruit fragrance has been studied:

“In cactus pear, R-(–)-linalool is present in an enantiomeric excess of 36%.”

SITRIT *et al.* 2004 cited WECKERLE *et al.* 2001

E-2-hexenal, 1-hexanol, E-2-hexen-1-ol, E-2-nonenol and E,Z-2,6-nonadienol are considered to be responsible for the melon-like character.

WECKERLE *et al.* 2001

Also, reported by Wu *et al.* 2008:

Aspergiketal (A new spiroketal)

Physcion

Asterric acid

All three of which were isolated from a culture broth of *Aspergillus terreus* (An endophytic fungus found associated with the stems of *Opuntia ficus-indica*)

Volatile compounds identified in the fruit of *Opuntia ficus indica* by HRGC-MS

Methyl butanoate	Methyl 2-methyl-butanoate
2-Methyl-3-buten-2-ol	Hexanal
3-Pentanol	1-Butanol
1-Pentene-3-ol	3-Pentene-2-ol
Z-3-Hexenal	1, 8-Cineol
E-2-Hexenal	2-Pentylfuran
3-Methyl-3-butene-1-ol	1-Pentanol
Methyl 3-hexenoate	Hexyl acetate
Acetoin	E-2-Pentene-1-ol
E-2-Heptenal	Z-2-Pentene-1-ol
E-2-Hexenyl acetate	1-Hexanol
E-3-Hexen-1-ol	Z-3-Hexen-1-ol
Nonanal	Methyl 2-(methylthio)-acetate
E-2-Hexen-1-ol	Z-2-Hexen-1-ol
E-2-Octenal	Acetic acid
1-Octene-3-ol	1-Heptanol
Methyl 3-hydroxybutanoate	E,E-2,4-Heptadienal
E-2-Hepten-1-ol	Linalool
1-Nonene-3-ol	1-Octanol
E, Z-2, 6-Nonadienal	Methyl benzoate
E-2-Octen-1-ol	1-Nonanol
2-Methylbutanoic acid	γ-Nonalactone
E-2-Nonenol	Methyl salicylate
E, Z-2,6-Nonadienol	1-Phenylethanol
Hexanoic acid	Geraniol
Benzyl alcohol	Perillalcohol
Octanoic acid	γ-Nonalactone
Methyl cinnamate	γ-Decalactone
Nonanoic acid	Decanoic acid
γ-Dodecalactone	Dodecanoic acid

WECKERLE *et al.* 2001

Compound	Enantiomeric ratio	
	R	S
1-Phenylethanol	74%	26%
Linalool	68%	32%
Methyl 2-methylbutanoate	2%	98%
Methyl 3-hydroxybutanoate	73%	27%
γ-Nonalactone	35%	65%
γ-Decalactone	79%	21%
γ-Dodecalactone	99.5%	0.5%

WECKERLE *et al.* 2001

CO₂ uptake occurred entirely at night through the stems (under well watered conditions while leafless).
NOBEL & HARTSOCK 1986

Opuntia glomerata See as *Opuntia articulata*.

***Opuntia guatemalensis* BRITTON & ROSE**

Fruit contains Betanin (major), and an unidentified Betacyanin. PIATTELLI & IMPERATO 1969

***Opuntia hickenii* BRITTON & ROSE**

Candicine (%) NIETO 1987

***Opuntia humifusa* RAFINESQUE-SCHMALTZ**

No detectable alkaloid reported by MEYER *et al.* 1980

Lutein (A carotenoid: Xanthophyll), Carotene & possibly Rhodoxanthin (in pads). ROMARIZ 1946. Quercetin was reported from the pads.

See comments in **Activity Notes**.

CHO *et al.* 2006

(Wild collected in New Jersey)

Cholesterol (5.0% of total)

24 ζ -Methylcholesterol (8.0% of total)

Sitosterol (87.0% of total)

SALT *et al.* 1987

***Opuntia leuchotricha* DC**

Reported to contain Isorhamnetin, Quercetin & Kaempferol (Flavonols) RICHARDSON 1978 (based on acid hydrolysis)

***Opuntia lindheimeri* ENGELMANN**

MEYER *et al.* 1980 reported to contain unidentified alkaloids. Reported to contain Betacyanins as pigments. MABRY *et al.* 1963

Isorhamnetin 3-rutinoside, Isorhamnetin 3-rhamnosylgalactoside, Quercetin, and Isorhamnetin 3-galactoside (all flavonoids) in flowers. CLARK & PARFITT 1980

Hyperin (Quercetin-3-galactoside), Narcissin (Isorhamnetin-3-rutinoside), Isorhamnetin-3-galactoside, Isorhamnetin-3-rhamnogalactoside (flavonol glycosides; pigments from flowers) RÖSLER *et al.* 1966

Del Weniger 1984 related an amusing tale concerning this species. Apparently Engelmann based this species' description on the pads of one species and the fruit of another. When discovering his error he corrected the description to being partly *O. engelmannii* and partly what he thought was a hybrid. The latter became *O. leptocarpa* "so there is nothing left to be *O. lindheimeri*"

***Opuntia littoralis* (ENGELMANN) COCKERELL
var. *littoralis***

Quercetin-3-glucoside, Quercetin-3-rutinoside, Isorhamnetin-3-glucoside, Isorhamnetin-3-rutinoside, Isorhamnetin-3-rhamnosylgalactoside, and Kaempferol 3-galactoside (all flavonoids) in flowers. CLARK & PARFITT 1980

***Opuntia littoralis* (ENGELMANN) COCKERELL
var. *martiniana* (L.BENSON) L.BENSON**

Quercetin-3-glucoside, Quercetin-3-rutinoside, Isorhamnetin-3-glucoside, Isorhamnetin-3-rutinoside, Isorhamnetin-3-rhamnosylgalactoside, and Kaempferol 3-galactoside (all flavonoids) in flowers. CLARK & PARFITT 1980

***Opuntia longispina* Haworth**

Whewellite was identified as druses.

MONJE & BARAN 2002

***Opuntia macrocentra* ENGELMANN**

MEYER *et al.* 1980 reported as containing unidentified alkaloids.

Reported to contain Betalains as pigments. WOHLPART & MABRY 1968 cited WOHLPART 1967

(as *Opuntia violaceae*) Flavonol production in was found to be largely reduced when grown in the absence of UV rather than in sunlight. BERGER *et al.* 2007.

***Opuntia maldonadensis* ARECHAVELETA**

Hordenine (%) DEVRIES *et al.* 1971

***Opuntia matudae* SCHEINVAR cv. Cuaresmeño
"Xoconostle"**

Gallic, Vanillic, 4-Hydroxybenzoic acids, Catechin, Epicatechin, and Vanillin were detected in the soluble phenolic fractions of the fruit.

GUZMÁN-MALDONADO *et al.* 2010

Opuntia megacantha

Most view as a spiny wild *Opuntia ficus-indica*.

See comments in **Activity Notes**.

***Opuntia microdasys* (LEHMANN) PFEIFFER**

Whewellite was identified as druses.

MONJE & BARAN 2002

***Opuntia monacantha* HAWORTH**

Flower contains Betanin (major), and Isobetanin.

Fruit contains Betanin (30.2% of total), Isobetanin (24.8% of total), an unidentified Betacyanin, Betanidin and Isobetanidin. PIATTELLI & IMPERATO 1969

Mucilage polysaccharide - 0.53% of total weight of fresh plant.

Uronic acid content of polysaccharide: 25%

Rhamnose: arabinose, galactose, xylose (1:3:3.5:1.5)

MINDT *et al.* 1975

***Opuntia penicilligera* SPEGAZZINI**

Whewellite was identified as druses.

MONJE & BARAN 2002

Opuntia pachypus K.SCHUMANN see as *Austrocylindropuntia pachypus*

***Opuntia paraguayensis* K.SCHUMANN**

Fruit contains Betanin (major), Isobetanin, and Phyllocactin.
PIATTELLI & IMPERATO 1969

***Opuntia phaeacantha* ENGELMANN** was reported by MEYER *et al.* 1980 to contain unidentified alkaloids.

***Opuntia phaeacantha* ENGELMANN var. *discata* (GRIFFITHS) L.BENSON & WALKINGTON and var. *major* ENGELMANN**

Quercetin-3-glucoside, Quercetin-3-rutinoside, Isorhamnetin-3-glucoside, Isorhamnetin-3-rutinoside, Isorhamnetin-3-rhamnosylgalactoside, and Kaempferol 3-galactoside (all flavonoids) in flowers. CLARK & PARFITT 1980

***Opuntia pilifera* WEBER** was reported to contain no detectable alkaloids in the screenings of FONG *et al.* 1972

***Opuntia polyacantha* HAWORTH**

Approximately 90% water by weight.

Opuntiol (0.007% dry wt) (an α -pyrone: See *O. elatior*)

Positive Mayer's test for alkaloids but none identified.

TELANG 1973 [Collected at Drumheller, Alberta, Canada]

Fruit contains Betanin (major), Isobetanin & Betanidin.
PIATTELLI & IMPERATO 1969

***Opuntia ritteri* BERGER**

Fruit contains Betanin (major), Isobetanin and Phyllocactin.
PIATTELLI & IMPERATO 1969

***Opuntia robusta* WENDL.**

Reported to contain Isorhamnetin, Quercetin & Kaempferol (Flavonols) RICHARDSON 1978 (based on acid hydrolysis)

***Opuntia* spp. hybrids**

Variable amounts of Quercetin-3-rutinoside, Quercetin-3-glucoside and Kaempferol-3-glucoside (flavonoids) were comparatively reported in the flowers of 6 hybrids (and 3 species). CLARK *et al.* 1980 [Collected east of Florence, Arizona]

***Opuntia streptacantha* LEMAIRE**

Fruit contains Betanin (major), Isobetanin, Phyllocactin & Isophyllocactin PIATTELLI & IMPERATO 1969
See comment in **Activity Notes**.

***Opuntia stricta* (HAW.) HAW. (var. ?)** was reported by MEYER *et al.* 1980 to contain unidentified alkaloids.

“*Opuntia stricta*” extract. Stable as a natural food pigment.

Was suggested to be a good commercial choice due to betanin concentrations and low pH.

CASTELLAR *et al.* 2006.

CASTELLAR *et al.* 2003 had reported 80 mg betanin /100 g fresh fruit.

***Opuntia stricta* (HAW.) HAW. var. *dillenii* (KER-GAWLER) L.BENSON**

Unidentified alkaloids reported by MEYER *et al.* 1980.

Malic acid & Succinic acid. MEYER & McLAUGHLIN 1982 cited HAJANARVIS 1964.

Arabinogalactan (a polysaccharide composed of L-Arabinose & D-Galactose 1:3) isolated from dried fruit in 0.5% yield. SRIVASTAVA & PANDE 1974

Known as Xian Ren Zhang in Chinese.

Qiu isolated (from aqueous ethanolic extract of fresh stems):

Opuntiol (0.0032%)

p-Hydroxybenzoic acid (0.0023%)

L-(–)-Malic acid (0.00019%)

Opuntioside I (0.078%) [an α -pyrone]

3,3'-Dimethylquercetin (0.00019%)

Ferulic acid (0.00053%)

4-Ethoxyl-6-hydroxymethyl- α -pyrone (0.00013%)

1-Heptanecanol (0.0019%)

Vanillic acid (0.00035%)

Isorhamnetin-3-O-rutinoside (0.0070%)

Rutin (0.00014%)

Kaempferol 7-O- β -D-glucopyranosyl-(1 \rightarrow 4)- β -D-glucopyranoside (0.0001%) [a flavonol glycoside]

3-O-Methyl quercetin 7-O- β -D-glucopyranoside (0.00015%)

Kaempferol 7-O- β -D-glucopyranoside (0.00019%)

Manghaslin (0.003%)

Ethyl 3,4-dihydroxybenzoate (0.00014%)

3,4-Dihydroxybenzoic acid (0.00041%)

(all % as dry weights)

Plant material was harvested in Hainan, China

QIU *et al.* 2002

Earlier (in 2000) Qiu had isolated:

Quercetin

3-O-Methyl quercetin

Kaempferol

Kaempferide

Isorhamnetin

β -Sitosterol

(from QIU *et al.* 2002 citing QIU *et al.* 2000)

Opuntisterol [(24R)-24-ethyl-5 β -cholest-9-ene-6 β ,12 α -diol] (a novel C29-5 β -sterol)

Opuntisteroside [(24R)-24-ethyl-6 β -[(β -D-glucopyranosyl)oxy]-5 β -cholest-9-ene-12 α -ol] (a novel C29-5 β -sterol)

β -Sitosterol

Taraxerol

Friedelin

Methyl linoleate

7-Oxositosterol
6 β -Hydroxystigmast-4-ene-3-one
Daucosterol
Methyl eucomate
Eucomic acid

JIANG *et al.* 2006
Isolated from stems collected in Guizhou Province, China.

Isorhamnetin-3-O-galactoside
Isorhamnetin-3-O-glucoside
Orientin (Luteolin 8-C-glucoside)
Quercetin-3-O-rhamnoside (Quercetrin)
Vitexin (Apigenin 8-C-glucoside)

GUPTA *et al.* 202
Isolated from stems growing in India.

Flavonoid glycosides isolated from the combined flowers,
fruit & stems were identified as :

Kaempferol 3-O- α -arabinoside
Isorhamnetin-3-O-glucoside
Isorhamnetin-3-O-rutinoside

AHMED *et al.* 2005
Material was harvested in Egypt.

Compound	pulp	peel	seed
	mg/100gm		
Betanin	18.2 \pm 1.8	15.7 \pm 1.8	nd
Isobetanin	19.1 \pm 0.1	19.2 \pm 1.0	nd
Ascorbic acid	15.1 \pm 0.6	1.2 \pm 0.1	nd
Catechin	22.7 \pm 0.7	18.0 \pm 0.2	35.6 \pm 3.7
<i>p</i> -Coumaric acid	nd	0.6 \pm 0.0	2.2 \pm 0.1
Epicatechin	10.9 \pm 0.2	17.1 \pm 0.1	31.8 \pm 1.1
Ferulic acid	nd	4.0 \pm 0.1	10.2 \pm 1.2
Gallic acid	2.7 \pm 0.03	4.0 \pm 0.6	2.6 \pm 0.1
Quercetin	nd	4.6 \pm 0.1	33.5 \pm 1.6
Rutin	nd	nd	0.3 \pm 0.0
Sinapinic acid	nd	nd	26.8 \pm 1.4
nd = below detection limits			

CHANG *et al.* 2008

Opuntia tomentella BERGER

Fruit contains Betanin (major), Isobetanin, Phyllocactin
and traces of Isophyllocactin PIATTELLI & IMPERATO 1969

Opuntia tomentosa SALM-DYCK

Citric acid (1.2% in stem juice)
HEGNAUER 1964 cited BERGSTRÖM 1934

Fruit contains Betanin (major), Isobetanin, Phyllocactin
and traces of Isophyllocactin PIATTELLI & IMPERATO 1969

Opuntia violacea ENGELMANN var. *macrocentra* (ENGELMANN) L.BEN-
SON See as *Opuntia macrocentra* ENGELMANN

Opuntia vulgaris MILLER

Hordenine (%) DEVRIES *et al.* 1971

Opuntin B (new alkaloid)

4-Hydroxyproline

Tyrosine

JIANG *et al.* 2003

β -Sitosterol (used whole plant) ANJANEYULU *et al.* 1965.

Ascorbic acid & Dehydroascorbic acid.

MEYER & McLAUGHLIN 1982 cited GIRAL & ALVAREZ
1943.

Friedelin (0.01% dry wt.), Friedelan-3 α -ol (0.001% dry
wt.), Taraxerone (0.0025% dry wt.) & Taraxerol (0.005%
dry wt.): (triterpenoids). CHATTERJEE *et al.* 1976.

Fruit contains betacyanins: Betanin (major) & Isobetanin.
PIATTELLI & MINALE 1964

Reported to show the presence of waxy materials and
some sort of a rubber in the studies of DE GRAFFE 1896.

HOBSCHEITE 1929

See comment in **Activity Notes**.

Opuntia wilcoxii

Flavonol production in was found to be largely reduced
when grown in the absence of UV rather than in sunlight.

BERGER *et al.* 2007

Pachycereus calvas (WATSON) BRITTON & ROSE

See as *Pachycereus pringlei*

Pachycereus chrysomallus (LEMAIRE) BRITTON & ROSE

Traces of unidentified triterpene(s). DJERASSI 1957 cited
unpublished observations by DJERASSI & MARFEY

Pachycereus gaumeri BRITTON & ROSE

See as *Pterocereus* (?) *gaumeri*

Pachycereus gigas (BACKEBERG) BACKEBERG

See as *Pachycereus weberi*

Pachycereus grandis ROSE

Glucaric acid (a lactone-forming acid) (tlc)

Isocitric acid (a lactone-forming acid) (tlc & glc)

KRINGSTAD & NORDAL 1975

Pachycereus hollianus (WEBER) BUXBAUM

See as *Lemaireocereus hollianus*

Pachycereus marginatus (DECANDOLLE) BRITTON & ROSE

AKA "órgano"

Pilocereine Over 0.076% [fresh wt] (Additional alkaloid
was obtained but it is unclear how much was pilocereine
and what was unidentified material) DJERASSI *et al.* 1954c
[Collected from wild: State of Hidalgo, Mexico]
[AGURELL 1969b also appears listed as a reference. He mentioned
this species in passing but did not analyze it.]

Lophocereine was reported in mass fragmentography by
LINDGREN *et al.* 1971 [DJERASSI *et al.* 1954c, also appears listed
as a reference but did not report this alkaloid.]

Unidentified alkaloids also present. DJERASSI *et al.* 1954c (DJERASSI reported no detectable triterpenes)
Isocitric acid (tlc & glc by KRINGSTAD & NORDAL 1975)
Quinic acid (tlc & glc by KRINGSTAD & NORDAL 1975)
[UNGER *et al.* 1980 reported the presence of Salsolidine and N-Methylheliamine but their conclusion needs questioning. A similar discrepancy exists for *L. schottii*. See comments under its entry.]
[Cereine, Pachycereine and Ochoterene were reported by ROCA 1930. DJERASSI *et al.* 1954c felt all three names should be removed from the literature due to their lack of characterization. See more details in ROCA 1931 & 1932]

***Pachycereus pecten-aboriginum* (DC) BRITTON & ROSE**

Notice the discrepancies between the published accounts. Additional work is needed to adequately explain the details.
3,4-Dimethoxyphenethylamine (trace) BRUHN & LINDGREN 1976 [Material from Michoacán, Mexico].
3-Hydroxy-4-methoxyphenethylamine (1-10% of 1-10 mg of total alkaloid/ 100 gm fresh) AGURELL *et al.* 1971b; [Obtained via commercial sources in Germany & the Netherlands]; STROMBOM & BRUHN 1978 could not detect this alkaloid; nor did BRUHN & LUNDSTRÖM 1976b [Both used material collected from wild: Michoacán, Mexico].
3-Methoxytyramine (detected) STROMBOM & BRUHN 1978 [Sole phenethylamine they reported (major alkaloid in the phenolic fraction).]
Arizonine (detected) STROMBOM & BRUHN 1978
Carnegine [HEYL 1928 isolated and named Pectenine (*pectenin*); it was shown by SPATH & KUFFNER 1929 to be identical to Carnegine] (However, AGURELL *et al.* 1971b & BRUHN & LINDGREN 1976 & STROMBOM & BRUHN 1978 could NOT detect carnegine.) [Possibly detected by UNGER *et al.* 1980 but MIKES does not differentiate between aromatic isomers.]
Heliamine (Minor: 22 mg from 4.3 kg fresh [as HCl]) STROMBOM & BRUHN 1978
Isosalsoline (detected) STROMBOM & BRUHN 1978
Salsoline (detected) STROMBOM & BRUHN 1978
Salsolidine (Major alkaloid: (at 282 mg from 4.3 kg fresh) by BRUHN & LINDGREN 1976 & by STROMBOM & BRUHN 1978 [UNGER *et al.* 1980 DID NOT detect Salsolidine (using MIKES)]
AGURELL *et al.* 1971b noted that other alkaloids were present but reserved presenting details for a later paper that we have not been able to locate (citing it as “KAPADIA & AGURELL”)
Quinic acid (tlc & glc by KRINGSTAD & NORDAL 1975)

UNGER *et al.* 1980 reported N-Methylheliamine, Weberidine & N-Methylpachycereine using MIKES. They also reported 4 other isoquinoline alkaloids but it is unclear which isomers were actually detected.

***Pachycereus pringlei* (S.WATS) BR. & R.**

AKA “*sagusa*” or the “*elephant cactus*”
This species is most commonly called “*cardon*” (a name that is also used for many other Cereoids)
3,4-Dimethoxyphenethylamine (gc-ms) [“*not yet rigidly proven*”]

Carnegine (gc-ms)
N-Methylheliamine (gc-ms)
CROCKETT & SHULGIN 1999 (Personal communication; unpublished findings)
N-Methylmescaline (gc-ms) SHULGIN 2001 (personal conversation)
Heliamine (0.017% by dry wt)
Lemaireocereine (Detected)
Tehuanine (0.05% dry wt.)
Weberine (Detected)
MATA & McLAUGHLIN 1980d
Tehuanine-N-oxide (0.014% yield by dry wt.) PUMMANGURA *et al.* 1982b
Glucaric acid (tlc by KRINGSTAD & NORDAL 1975)
Isocitric acid (tlc & glc by KRINGSTAD & NORDAL 1975)
[UNGER *et al.* 1980 reported 5, possibly 6, quinoline alkaloids. Two were identified, as N-Methylheliamine and Weberidine, but we could not determine the isomeric identities of the others. All by MIKES.]
See comments in **Activity Notes**.

Pachycereus queretaroensis (WEBER) BRITTON & ROSE See as ***Lemaireocereus queretaroensis***
Pachycereus schottii (ENGELMANN) HUNT See as ***Lophocereus schottii***

***Pachycereus* sp.** (unidentified; collected in Mexico) was reported to show a very strong preliminary alkaloid screening but only gave positive results in the confirmatory tests for quaternary alkaloids. SMOLENSKI *et al.* 1972

***Pachycereus tehuatepecanus* T.MACDOUGALL & H.BRAVO**

[BACKEBERG considered this species to be synonymous with *Pachycereus pecten-aboriginum*.]
Tepenine (no details)
Tehuanine (no details)
LUNDSTROM 1983 & MATA & McLAUGHLIN 1980d cited WEISENBORN (personal communication 1978: Unpublished data). KAPADIA *et al.* 1970c mentions that J. WEISENBORN (at Squibb) first presented this in a discussion during the 5th Ann. Meeting of the American Society of Pharmacognosy June 22-25, 1964 (Pittsburgh, PA) and that it was planned for publication submission. It evidently never was.

Pachycereus tetetzo (A.WEB.) OCHOT. See as ***Cephalocereus tetetzo***
Pachycereus thurberi BRITTON & ROSE See as ***Lemaireocereus thurberi***

***Pachycereus weberi* (COULTER) BACKEBERG**

AKA “*candelabro*” & “*cardon*”
Anhalidine (no quantification) ROUSH *et al.* 1985
Anhalonidine (0.01% dry wt.) DJERASSI *et al.* 1954c. (traces)
MATA & McLAUGHLIN 1980c; (NOT observed by ROUSH *et al.* 1985)
O-Methylpellotine (no quantification) ROUSH *et al.* 1985; UNGER *et al.* 1980
Pellotine (0.0005% dry wt.) MATA & McLAUGHLIN 1980c; (no quantification) ROUSH *et al.* 1985.

5,6,7-TriMeO-THIQ (Nortehuanine) (0.0095% [as HCl] dry wt.) MATA & McLAUGHLIN 1980c; (no quantification) ROUSH *et al.* 1985

7,8-DiMeO-THIQ (Lemaireocereine) (0.003% [HCl] dry wt.) MATA & McLAUGHLIN 1980c; (no quantification) ROUSH *et al.* 1985 [PUMMANGURA & McLAUGHLIN 1981a used this species as the source of their reference material for Lemaireocereine]

7-MeO-THIQ (Weberidine) (0.00024% dry wt.) MATA & McLAUGHLIN 1980c; (no quantif.) ROUSH *et al.* 1985

6,7-Dimethoxy-THIQ (Heliamine) (0.0155% dry wt.; also 0.05% [all HCl]) MATA & McLAUGHLIN 1980c; (no quantification) ROUSH *et al.* 1985

Backebergine (no quantification) ROUSH *et al.* 1985

Carnegine (no quantification) ROUSH *et al.* 1985

Dehydroheliamine (no quantification) ROUSH *et al.* 1985

Dehydrolemaireocereine (no quantif.) ROUSH *et al.* 1985

Dehydronortehuanine (no quantification) ROUSH *et al.* 1985

Dehydropachycereine (no quantif.) ROUSH *et al.* 1985

Dehydrosalsolidine (no quantification) ROUSH *et al.* 1985

Dehydronorweberine (no quantif.) ROUSH *et al.* 1985

Isobackebergine (no quantification) ROUSH *et al.* 1985

Isonortehuanine (no quantification) ROUSH *et al.* 1985

Isopachycereine (no quantification) ROUSH *et al.* 1985

Salsolidine (detected with MIKES) UNGER *et al.* 1980

Isosalsolidine (no quantification) ROUSH *et al.* 1985

Isonorweberine (no quantification) ROUSH *et al.* 1985

Norweberine (no quantification) ROUSH *et al.* 1985

2-Methyl-6,7-dimethoxy-THIQ (N-Methylheliamine: O-Methylcorypalline) [Detected by MIKES UNGER *et al.* 1980] (0.0012% [HCl] dry wt.) MATA & McLAUGHLIN 1980c; (no quantification) ROUSH *et al.* 1985

N-Methylpachycereine (no quantif.) ROUSH *et al.* 1985

Pachycereine (no quantification) ROUSH *et al.* 1985

2-Methyl-5,6,7-triMeO-THIQ (Tehuanine) (0.105% & 0.1% [HCl] dry wt.) MATA & McLAUGHLIN 1980c; (no quantification) ROUSH *et al.* 1985; Detected with MIKES (?) UNGER *et al.* 1980

2-Methyl-5,6,7,8-tetraMeO-THIQ (Weberine) (0.0012 [HCl] dry wt.) MATA & McLAUGHLIN 1980c; (no quantification) ROUSH *et al.* 1985; Detected with MIKES UNGER *et al.* 1980

Four other THIQs were reported by ROUSH *et al.* 1985 but they were uncertain of the positions of the methoxy groups on the aromatic ring due to the identification by MIKES. Similarly, for the same reason, it does not appear possible to assign precise isomeric identity to several of the THIQs reported in UNGER *et al.* 1980 (2 appeared to be O-Methylanhalonidine and O-Methylpellotine but we cannot state this with certainty).

Pachycereus weberi was reported to show positive results in the alkaloid screenings of FONG *et al.* 1972

[3-OH-4-MeO-PEA is listed in error, the reference cited, SMITH 1977, does not mention this species.]

Djerassi *et al.* reported no detectable triterpenes.

Lemairin (0.018% yield by dry wt.) (a glucoside) MATA & McLAUGHLIN 1980a

Glucaric acid (tlc by KRINGSTAD & NORDAL 1975)

Isocitric acid (tlc & glc by KRINGSTAD & NORDAL 1975)

Parodia mutabilis BACKEBERG

Betalain pigments. WOHLPART & MABRY 1968 cited DREIDING 1961.

Parodia procera RITTER

Volatile compounds in floral scent have been studied.

Dehydrogeosmin - Minor volatile in floral scent.

Sesquiterpene alcohol 1 - Trace volatile in floral scent.

Sesquiterpene alcohol 2 - Minor volatile in floral scent.

SCHLUMBERGER *et al.* 2004 (in tepals; gc-ms)

Parodia sanguiniflora BACKEBERG

Betalain pigments. WOHLPART & MABRY 1968 cited DREIDING 1961.

Parodia stuemeri (WERDERMANN) BACKEBERG

Betalain pigments. WOHLPART & MABRY 1968 cited DREIDING 1961.

Parodia tuberculosa CÁRDENAS

Dehydrogeosmin - Major volatile in floral scent.

Sesquiterpene alcohol 1 - Trace volatile in floral scent.

Sesquiterpene alcohol 2 - Minor volatile in floral scent.

SCHLUMBERGER *et al.* 2004 (in tepals; gc-ms)

Pelecyphora aselliformis EHRENBERG

“peyote”, “peyotillo” STANDLEY 1924: 973

62% water by weight. NEAL *et al.* 1972 [300 dried plants weighed 5.5 kg]

Tyramine (Less than 0.0001% [fresh wt]) ŠTARHA 1994 [Seed grown in Czechoslovakian greenhouses]

N-Methyltyramine (0.0002% [fresh wt]) ŠTARHA 1994

Hordenine (10-50% of the 1-10 mg of total alkaloids/ 100 grams fresh) AGURELL *et al.* 1971b [Obtained via commercial source in the Netherlands]; (10-50% of 10-50 mg of total alkaloids/ 100 gm. fresh. Not major alkaloid.) BRUHN & BRUHN 1973; (Major alkaloid. 0.00063% dry wt.) NEAL *et al.* 1972; (0.0007% [fresh wt]) ŠTARHA 1994

3,4-Dimethoxyphenethylamine (trace) NEAL *et al.* 1972; (0.0002% [fresh wt]) ŠTARHA 1994

N-Methyl-3,4-dimethoxyphenethylamine (trace) NEAL *et al.* 1972

N,N-Dimethyl-3-hydroxy-4,5-dimethoxy-phenethylamine (0.00018% dry wt.: Minor alkaloid) NEAL *et al.* 1972; (10-50% of 10-50 mg of total alkaloids/ 100 gm.fresh: Major alkaloid) BRUHN & BRUHN 1973.

Mescaline (Less than 0.00002% dry wt.) NEAL *et al.* 1972 [Plants obtained commercially. Not indicated if field collected or seed grown]; (0.003% dry wt.) SINISCALCO 1983 [Plants was cultivated in Italy]; (Less than 0.0001% [fresh wt]) ŠTARHA 1994. Not observed by other workers (including AGURELL *et al.* 1971b [Material cultivated in Europe] & BRUHN & BRUHN 1973 [Material was field collected in Mexico]).

N-Methylmescaline (trace) NEAL *et al.* 1972

Anhalidine (0.000067% dry wt.) NEAL *et al.* 1972; (10-50% of 1-10 mg total alkaloids per 100 grams of [fresh wt]) AGURELL *et al.* 1971b & BRUHN & BRUHN 1973; (Less than 0.0001% [fresh wt]) ŠTARHA 1994

Pellotine (0.000009% dry wt.) NEAL *et al.* 1972; (Less than 0.0001% [fresh wt]) ŠTARHA 1994

[PEA, N-Me-PEA, 4-MeO-PEA and N-Me-4-MeO-PEA have been **erroneously** listed for *Pelecyphora aselliformis*. The cited reference, NEAL *et al.* 1972, ran these 4 alkaloids as their dansyl-derivatives using pure reference compounds. They were **NOT** found in the plant.]

Unidentified alkaloids reported by REKO 1928.

Quinic acid (tlc & glc by KRINGSTAD & NORDAL 1975)

Pelecyphora pseudopectinata BACKEBERG

See as *Turbinicarpus pseudopectinatus*

***Peniocereus fosterianus* CUTAK**

Chichipegenin (a triterpene) (in stem)

Peniocerol (1% by dry wt. in root) (a sterol: cholest-8-en-3 β ,6 α -diol)

DJERASSI *et al.* 1961 [From State of Colima, Mexico]

Peniocereus greggii* & *Peniocereus striatus

See comment under **Activity Notes**.

***Pereskia aculeata* MILLER**

“*grosellero*” (Cuba), “*Barbados gooseberry*”,

“*Spanish Gooseberry*” STANDLEY 1924

Tyramine (no quantification) DOETSCH *et al.* 1980

Citric acid (2.3% in stem juice) HEGNAUER 1964 cited BERGSTRÖM 1934

Betalains. WOHLPART & MABRY 1968 cited DREIDING 1961.

All CO₂ uptake occurred during the day through the stems (under well watered conditions) NOBEL & HARTSOCK 1986

Cholesterol (2.5% of total sterols)

24 ζ -Methylcholesterol (18.7% of total sterols)

Stigmasterol (6.3% of total sterols)

Sitosterol (72.5% of total sterols)

SALT *et al.* 1987

***Pereskia autumnalis* (EICHLAM) ROSE**

Phenethylamine (no quantification)

Tyramine (no quantification)

DOETSCH *et al.* 1980

***Pereskia bleo* DC**

Reported to contain Quercetin & Kaempferol (Flavonols)

RICHARDSON 1978 (based on acid hydrolysis)

***Pereskia corrugata* CUTAK**

Tyramine (no quantification)

3,4-Dimethoxyphenethylamine (0.0009%)

3-Methoxytyramine (no quantification)

Mescaline (0.0005% dry wt.)

DOETSCH *et al.* 1980

***Pereskia cubensis* BRITTON & ROSE**

Tyramine (no quantification) DOETSCH *et al.* 1980

***Pereskia godseffiana* (SANDWITH) KNUTH**

Tyramine (no quantification) DOETSCH *et al.* 1980

***Pereskia grandiflora* HORT.**

Tyramine (no quantification)

β -Hydroxymescaline (no quantification)

DOETSCH *et al.* 1980

Betalamic acid in flowers. PIATTELLI 1981 cited CHANG *et al.* 1974 but this reference is incorrect as they only investigated *Portulaca grandiflora*.

[A number of color forms and F1 hybrids have been surveyed for betalains. PIATTELLI 1981 cited OOTANI & HAGIWARA 1969. This reference has not been located but it too may also be suspect]

***Pereskia grandifolia* HAWORTH**

Tyramine (no quantification)

3-Methoxytyramine (no quantification)

4-Methoxy- β -hydroxyphenethylamine (no quantification)

DOETSCH *et al.* 1980

Flowers contains Betanin (major), and an unidentified Betacyanin. Also traces of Isobetanin & Phyllocactin PIATTELLI & IMPERATO 1969 [As *Rhodocactus grandifolius* (HAW.) KNUTH].

Reported to contain Quercetin & Kaempferol (Flavonols)

RICHARDSON 1978 (based on acid hydrolysis)

All CO₂ uptake occurred entirely during the day through the leaves (under well watered conditions)

NOBEL & HARTSOCK 1986

Pereskia grandifolia fruit reported to contain a saponin of oleanolic acid. Methyl oleanolate was found to be the sapogenin with D - Glucose and D - Glucuronic acid as the sugars. SAHU *et al.* 1974

***Pereskia pititache* (KARWINSKY) BRITTON & ROSE**

Phenethylamine (no quantification)

Tyramine (no quantification)

DOETSCH *et al.* 1980

***Pereskia tampicana* WEBER**

Phenethylamine (no quantification)

Tyramine (no quantification)

3,4-Dimethoxyphenethylamine (0.0025%)

4-Methoxy- β -hydroxyphenethylamine (no quantification)

Mescaline (0.0013% dry wt.)

DOETSCH *et al.* 1980

[3-MeO- β -hydroxy-PEA has been listed **in error**. The cited reference, DOETSCH *et al.* 1980, did not report this compound.]

***Pereskopsis chapistle* (WEBER) BRITTON & ROSE**

“*chapiztli*” STANDLEY 1924

Phenethylamine (no quantification)

Tyramine (no quantification)

4-Methoxy- β -hydroxyphenethylamine (no quantification)

3-Methoxytyramine (no quantification)

DOETSCH *et al.* 1980

***Pereskopsis porteri* (BRANDEGEE) BRITTON & ROSE**

“*alcajer*” (Baja California) STANDLEY 1924

Reported to contain Kaempferol (a Flavonol)

RICHARDSON 1978 (based on acid hydrolysis)

88% of the CO₂ uptake occurred during the day through the leaves (under well watered conditions)
NOBEL & HARTSOCK 1986

***Pereskiaopsis scandens* BRITTON & ROSE**

Tyramine (no quantification)
3,4-Dimethoxyphenethylamine (0.0029%)
Mescaline (0.0022% dry wt.)
DOETSCH *et al.* 1980

Phyllocactus ackermannii Link See as *Nopalxochia ackermannii*

Phyllocactus hybridus

Flower contains betacyanins: Betanin (major), Isobetanin, Phyllocactin & Isophyllocactin. PIATTELLI & MINALE 1964a & 1964b (Also MINALE *et al.* 1966 [Collected near Naples, Italy])

***Pilocereus chrysacanthus* WEBER**

N-Methyl-3,4-dimethoxyphenethylamine (Major alkaloid. 0.006% fresh) BRUHN & SÁNCHEZ-MEJORADA 1977 [Wild collected; Puebla, Mexico]
Reported as showing no detectable alkaloids in the screenings of FONG *et al.* 1972
Quinic acid (tlc, glc & gc-ms by KRINGSTAD & NORDAL 1975)

Pilocereus chrysomallus LEMAIRE See as *Backebergia militaris*
Pilocereus euphorbioides (HAW.) RÜMLER See as *Neobuxbaumia euphorbioides*
Pilocereus gaumeri (BR. & R.) KNUTH is NOT synonymous with *Pterocereus (?) gaumeri*
Pilocereus giganteus RÜMLER See as *Carnegiea gigantea*
Pilocereus glaucescens LABOURET See as *Cephalocereus glaucescens*

***Pilocereus gounellei* (WEBER) BYLES & ROWLEY**
“alastrado”

Unconfirmed report of caffeine (0.15-0.22%) in its seeds.
HEGNAUER 1964 & MATA & McLAUGHLIN 1982 cited FREISE 1935. This alkaloid identification is highly questionable.

***Pilocereus guerreronis* (BACKEBERG) BYLES & ROWLEY**

N-Methyl-3,4-dimethoxyphenethylamine (~0.042% (~60% of 0.07% total alkaloid) [fresh wt] Recovered 0.012%.)
N,N-Dimethyl-3,4-dimethoxyphenethylamine (approximately 0.025% fresh wt. (~35% of 0.07% total alkaloid) Recovered 0.0044% as pure compound.)
O-Methylcorypalline (i.e. N-Methylheliamine) (trace)
LINDGREN & BRUHN 1976 [Wild collected; Guerrero, Mexico]

Pilocereus leucocephalus POSELGER See as *Cephalocereus leucocephalus*

***Pilocereus maxonii* (ROSE) KNUTH**

Tyramine (trace)
N-Methyltyramine (trace)
N-Methyl-3-methoxytyramine (0.002% dry wt.)

N,N-Dimethyl-3-methoxytyramine (0.004% dry wt.)
3,4-Dimethoxyphenethylamine (trace)
N-Methyl-3,4-dimethoxyphenethylamine (trace)
PUMMANGURA *et al.* 1977.

Pilocereus nobilis HAWORTH See as *Cephalocereus nobilis*
Pilocereus pasacana WEBER See as *Trichocereus pasacana*
Pilocereus sargentianus ORCUTT See as *Lophocereus schottii*
Pilocereus schottii (ENGELMANN) LEMAIRE See as *Lophocereus schottii*
Pilocereus schottii LEMAIRE See as *Lophocereus schottii*
Pilocereus senilis (HAW.) PFEIFFER See as *Cephalocereus senilis*
Pilocereus thurberi RÜMLER See as *Lemaireocereus thurberi*

Pilosocereus chrysacanthus (WEBER) BYLES & ROWLEY See as *Pilocereus chrysacanthus*
Pilosocereus gaumeri (BR. & R.) BACKEBERG is NOT synonymous with *Pterocereus (?) gaumeri*
Pilosocereus glaucescens (LAB.) BYLES & ROWLEY See as *Cephalocereus glaucescens*
Pilosocereus guerronis (BACKEBERG.) BYLES & ROWLEY See as *Pilocereus guerreronis*
Pilosocereus leucocephalus (POSELGER) BYLES & ROWLEY See as *Cephalocereus leucocephalus*
Pilosocereus maxonii (ROSE) BYLES & ROWLEY See as *Pilocereus maxonii*
Pilosocereus nobilis (HAW.) BRITTON & ROSE See as *Cephalocereus nobilis*

***Polaskia chende* (GOSSELIN) GIBSON & HORAK**

“chende”, “chente”, “chinoa” STANDLEY 1924: 899
3,4-Dimethoxyphenethylamine (less than or around 0.01% dry wt.) MA *et al.* 1986
4-Hydroxy-3,5-dimethoxyphenethylamine (Around 0.01% dry wt.) MA *et al.* 1986
Mescaline (Around or less than 0.01%.) MA *et al.* 1986
Oleanolic acid
Oleanolic aldehyde
Erythrodil
SHAMMA & ROSENSTOCK 1959 (didn't include starting weight)
Strongly positive in alkaloid screening of FONG *et al.* 1972
Oleanolic acid & Chichiopenin were reported to be present.
GIBSON & HORAK 1978 cited BRAVO & COX 1958

***Polaskia chichi* (GOSSELIN) BACKEBERG**

“chichi”, “chichi” STANDLEY 1924: 898
69.8% water by wt.
Reported no detectable alkaloids.
Oleanolic acid (as 0.008% dry wt via its methyl ester)
Chichiopenin (a triterpene & tetrol) (0.083% dry wt.)
SANDOVAL *et al.* 1957 [Wild collected; Puebla, Mexico]
Longispinogenin GIBSON & HORAK 1978 cited DJERASSI 1957

***Pseudolobivia kermesina* KRAINZ**

Tyramine (0.0002% dry wt.)
3,4-Dimethoxyphenethylamine (trace)
FOLLAS *et al.* 1977

***Pterocereus foetidus* Th.MACDOUGALL & F.MIRANDA**

3,4-Dimethoxyphenethylamine (around 0.01% dry wt.)
4-Hydroxy-3,5-dimethoxyphenethylamine (Less than 0.01% dry wt.)
MA *et al.* 1986

***Pterocereus (?) gaumeri* (BRITTON & ROSE)**

Th.MACDOUGALL & F.MIRANDA

[Given by MACDOUGALL & MIRANDA as a provisional name]
3,4-Dimethoxyphenethylamine (less than or around 0.01% dry wt.) MA *et al.* 1986
4-Hydroxy-3,5-dimethoxyphenethylamine (Around or less than 0.01% dry wt.) MA *et al.* 1986
Mescaline (Less than 0.01%) MA *et al.* 1986
Pterocereine [a unique glucosylated cactus THIQ] (0.062% by dry wt) MOHAMED *et al.* 1979
Also reported to contain the tetrahydroisoquinoline Deglucopterocereine. (yield of 0.164% dry wt) MOHAMED *et al.* 1979 [This compound appears to be potentially pharmacologically active but lacks any published evaluation. It is formed via acid hydrolysis of Pterocereine so it is probable that at least part (and perhaps all) of their product was an extraction artifact.]
Unidentified alkaloids reported to present. MOHAMED *et al.* 1979
Deglucopterocereine-N-oxide (0.038% yield by dry wt.) PUMMANGURA *et al.* 1982b

***Puna clavarioides* (PFEIFFER)**

Whewellite was identified as druses.
MONJE & BARAN 2002

***Pyrrhocactus strausianus* (SCHUMANN) BACKEBERG**

Weddellite was identified as druses, prisms & crystal sand.
MONJE & BARAN 2002

***Quiabentia chacoensis* BACKEBERG**

Reported to contain Quercetin (a Flavonol)
RICHARDSON 1978 (based on acid hydrolysis)
88% of the daily CO₂ uptake occurred through the leaves during the daytime but some occurred at night (under well watered conditions)
NOBEL & HARTSOCK 1986

Rauhocereus riosaniensis BACKEBERG needs an analysis.

Rathbunia alamosensis (COULTER) BRITTON & ROSE See as *Stenocereus alamoensis*

***Rebutia arenacea* CÁRDENAS**

Dehydrogeosmin - Major volatile in floral scent.
Sesquiterpene alcohol 1 - Minor volatile in floral scent.
Sesquiterpene alcohol 2 - Minor volatile in floral scent.
SCHLUMBERGER *et al.* 2004 (in tepals; gc-ms)

***Rebutia fabrisii* RAUSCH**

Emission rates varied up to 12-fold between individuals
Dehydrogeosmin - Major volatile in floral scent.
Sesquiterpene alcohol 1 - Minor volatile in floral scent.
SCHLUMBERGER *et al.* 2004 (in tepals; gc-ms)

***Rebutia krainziana* W.KESSELRING**

Betalain pigments. WOHLPART & MABRY 1968 cited DREIDING 1961.

***Rebutia margarethae* RAUSCH**

Weddellite was identified as druses.
MONJE & BARAN 2002

***Rebutia marsoneri* WERDERMANN**

Betalain pigments. WOHLPART & MABRY 1968 cited DREIDING 1961.
Dehydrogeosmin - Major volatile in floral scent.
Sesquiterpene alcohol 1 - Minor volatile in floral scent.
Sesquiterpene alcohol 2 - Minor volatile in floral scent.
SCHLUMBERGER *et al.* 2004 (in tepals; gc-ms)

***Rebutia miniscula* K.SCHUMANN**

Betalain pigments. WOHLPART & MABRY 1968 cited DREIDING 1961.

***Rebutia pseudodeminuta* BACKEBERG**

AKA "Wallflower-crown"
Betalain pigments. WOHLPART & MABRY 1968 cited DREIDING 1961.

***Rebutia senilis* BACKEBERG**

AKA "Fire-crown cactus"
Betalain pigments. WOHLPART & MABRY 1968 cited DREIDING 1961.

Rhipsalis baccifera (JS MUELLER) STEARN is listed as containing unidentified alkaloid(s) by SHULGIN & SHULGIN but no reference was included.

***Rhipsalis capilliformis* WEBER**

Citric acid (3.5% in stem juice) HEGNAUER 1964 cited BERGSTRÖM 1934

***Rhipsalis cassytha* GAERTNER**

Citric acid (2.2% in stem juice) HEGNAUER 1964 cited BERGSTRÖM 1934
Listed as containing unidentified alkaloid(s) by SHULGIN & SHULGIN but no reference was included.
See comment in **Activity Notes**.

***Rhipsalis conferta* SALM-DYCK**

See comment in **Activity Notes**.

***Rhipsalis gaertneria* var. MACKOY**

Citric acid (2.9% in stem juice)
HEGNAUER 1964 cited BERGSTRÖM 1934

***Rhipsalis juengeri* BARTHOLOTT & N.P.TAYLOR**

(% = Relative percent of total)

10-Methylundecan-2-one (36.0%)
 Undecan-2-one (26.95%)
 Unidentified: possibly Methyl undecenone (12.3%)
 8-Methylnonan-2-one (1.918%)
 Linalool (1.86%)
 Styrene (2.4%)
 Heptan-2-one (1.2%)
 6-Methylheptan-2-one (0.4%)
 9-Methyldecanal (0.217%)
 Nonanal (0.2%)
 Nonanone-2 (0.86%)
 2-Undecanol (0.53%)
 8-Methylnonanol (0.494%)
 Benzaldehyde (0.352%)
 6-Methylhept-5-en-2-one (0.19%)
 Hexadecane (0.133%)
 Decanal (0.12%)
 Tetradecane (0.115%)
 Octan-2-one (0.1%)
 Benzyl acetone (0.097%)
 Octanal (0.072%)
 Benzyl acetate (0.067%)
 Benzyl alcohol (0.064%)
 Oct-1-en-3-ol (0.059%)
 Tridecan-2-one (0.48%)
 7-Methyloctan-2-one (0.035%)
 Octanol (0.035%)
 Dodecane (0.034%)
 Naphthalene (0.03%)
 Decan-2-one (0.023%)
trans-Anethole (trace)
 α -Cedrene (trace)
 Coumarin (trace)
p-Cymene (trace)
 Limonene (trace)
 3-Methylbut-2-enyl acetate (trace)
 Methyl decanoate (trace)
 Methyl salicylate (trace)
 Phenoxyethanol (trace)
 α -Pinene (trace)
 α -Selinene (trace)
 SCHLUMBERGER *et al.* 2006

***Rhipsalis mesembryanthemoides* STANDL.**

Mesembryanthemoidigenic acid (0.36%) (A dihydroxy triterpene acid) TURSCH *et al.* 1965 [Collected in the State of Guanabara, Brazil]

***Rhipsalis paradoxa* SALM-DYCK**

Citric acid (2.3% in stem juice) HEGNAUER 1964 cited BERGSTRÖM 1934

***Rhipsalis regnellii* LINDB.**

Citric acid (4.5% in stem juice) HEGNAUER 1964 cited BERGSTRÖM 1934

***Rhipsalis rhombea* PFEIFFER**

Citric acid (1.6% in stem juice) HEGNAUER 1964 cf. BERGSTRÖM 1934

***Rhipsalis teres* (VELLOZO) STEUDEL**

Appears listed as containing unidentified alkaloid(s) but either the entry included no reference or else the reference that was cited (BROWN *et al.* 1968) did not mention the species.

***Rhipsalis virgata* WEBER**

Citric acid (1.8% in stem juice) HEGNAUER 1964 cf. BERGSTRÖM 1934

***Rhipsalis warmingiana* K. SCHUMANN**

Citric acid (3.1% in stem juice) HEGNAUER 1964 cf. BERGSTRÖM 1934

Listed as containing unidentified alkaloid(s) by SHULGIN & SHULGIN but no reference was included.

Rhodocactus spp. See as *Pereskia* spp.

Ritterocereus griseus (HAWORTH) BACKEBERG

See as *Lemaireocereus griseus*

Ritterocereus hystrix (HAWORTH) BACKEBERG

See as *Lemaireocereus hystrix*

Ritterocereus montanus (BRITTON & ROSE) BACKEBERG

See as *Stenocereus montanus*

Ritterocereus pruinosus (OTTO) BACKEBERG

See as *Lemaireocereus pruinosus*

Ritterocereus queretaroensis (WEBER) BACKEBERG

See as *Lemaireocereus queretaroensis*

Ritterocereus weberi (COULTER) BACKEBERG

See as *Pachycereus weberi*

Rooksbya euphorbioides (HAWORTH) BACKEBERG

See as *Neobuxbaumia euphorbioides*

Roseocactus fissuratus See as *Ariocarpus fissuratus*

Roseocereus tephacanthus (LAB.) BACKEBERG = *Trichocereus tephacanthus* No analysis reported but one seems needed.

***Schlumbergera bridgesii* (LEMAIRE) LOFGREN**

Cholesterol (traces)

Avenasterol (8.5% of total)

24 ζ -Methylcholesterol (10.2% of total)

Sitosterol (81.3% of total)

SALT *et al.* 1987

Listed as containing unidentified alkaloid(s) by SHULGIN & SHULGIN but no reference was included.

***Schlumbergera russelliana* (HOOKER) BRITTON & ROSE**

Listed as containing unidentified alkaloid(s) but either the entry included no reference or else the reference that was cited (BROWN *et al.* 1968) did not mention the species.

***Schlumbergera truncata* (HAWORTH) MORAN**

Analyzed as *Zygocactus truncatus* (HAWORTH) SCHUMANN "Christmas Cactus"

Report of "Unknown amine" in WHEATON & STEWART 1970. Citric acid (1.3% in stem juice) HEGNAUER 1964 cf. BERGSTRÖM 1934.

[It was found to contain no Isocitric acid by SODESTROM 1962.]
Reported to contain Betalains as pigments. WOHLPART & MABRY 1968 cited DREIDING 1961.
Also caffeic acid. AARDVARK 2006 cf. SCHULTES & RAFFAUF 1990

***Schlumbergera x buckleyi* (T. MOORE) TJADEN**
“Christmas cactus”

The betalains:
Betamic acid
Betanidin 5-O-(2'-O-β-D-apiofuranosyl-6'-O-malonyl)-β-D-glucopyranoside
Betanidin 5-O-[(5'-O-E-feruloyl)-2'-O-β-D-apiofuranosyl-6'-O-malonyl]-β-D-glucopyranoside
Betanin
Phyllocactin (6'-O-Malonylbetanin)
Isophyllocactin
Iso-2'-apiosyl-betanin
Vulgaxanthin I
and 7 others were detected in the flowers.
KOBAYASHI *et al.* 2000
William Buckley produced this hybrid in the late 1840s between *S. russelliana* and *S. truncata*.

KOBAYASHI *et al.* 2000 made the comment that the pigments of *Schlumbergera truncata*'s petals showed “almost the same betalain pattern as that of *Schlumbergera x buckleyi* petals”.
Kobayashi did not include any actual details.

***Selenicereus coniflorus* (WEINGART) BRITTON & ROSE**

See comment in **Activity Notes**.

***Selenicereus grandiflorus* (LINNAEUS) BRITTON & ROSE**

“gigante” (Durango), “organillo” (Tamaulipas) STANDLEY 1924
Tyramine (0.3% dry wt.) WAGNER & GREVEL 1982a
Hordenine (0.001% dry wt.) PETERSHOFFER-HALBMEYER *et al.* 1982
[N-methyltyramine appears to be an **erroneous** entry in the literature. EAMP 1999. See comments in **Activity Notes**.]
Unidentified alkaloid(s) reported in BROWN *et al.* 1968 (3 major and 4 minor alkaloids; one of which had a MW of 330+-25.)
[An uncharacterized alkaloid named Cactine was previously reported by SULTAN 1891]
Unidentified alkaloid(s) reported in Brown *et al.* 1968
[An uncharacterized alkaloid named Cactine was previously reported by SULTAN 1891]
Claims of digitalis-like cardioactive glycosides, appearing in the literature, are ALL unsupported errors.
See additional comments in **Activity Notes**.
Reported to contain Betalains as pigments. WOHLPART & MABRY 1968 cited DREIDING 1961.

Flavonol-3-glycoside, and two glycosides of Isorhamnetin (Isorhamnetin-3-β-galactoside AKA Cacticin: 0.02% dry wt. & Isorhamnetin-3-β-rutinoside AKA Narcissin & Lycorine: 0.05% dry wt.) were isolated from flowers by HÖRHAMMER *et al.* 1966.

***Selenicereus pteranthus* (L.K. & O.) BR. & R.**

Hordenine (0.002% dry wt.) PETERSHOFFER-HALBMEYER *et al.* 1982

Soehrensia bruchii (Br. & R.) BACKEBERG see as *Trichocereus bruchii*

***Solisia pectinata* (B.STEIN.) BRITTON & ROSE**

N-Methyltyramine (10-50% of 10-50 mg of total alkaloids/ 100 gm. fresh.)
Hordenine (Over 50% of 10-50 mg of total alkaloids/ 100 gm. fresh.)
BRUHN & BRUHN 1973

Solisia pseudopectinata BACKEBERG
See as *Pelecypora pseudopectinata*

Stenocactus multicostatus (HILDMANN) A.BERGER
See as *Echinofossulocactus multicostatus*

***Stenocereus alamosensis* (COULTER) A.GIBSON & HORAK**

AKA “cina” or “sina”
Interestingly, this analysis suggests that this species might be better grouped with the species we have listed under *Lemaireocereus*.
Oleanolic acid was reported to be present. GIBSON & HORAK 1978 cited BIRD 1974
Gummoside A methyl ester
Gummoside A
KAKUTA *et al.* 2012
KIRCHER 1982 lists Longispinogenin as being present in higher concentrations than in *Machaereocereus gummosus* and the sterol diols being lower. Gummosogenin, Machaeric acid and Machaerinic acid also present but no details included.
tlc examination showed no detectable alkaloids and the very strong presence of triterpene glycosides: KIRCHER 1982
Lipid content was 5.6% by dry weight: KIRCHER 1982
See comment in **Activity Notes**.

***Stenocereus beneckeii* (EHRENBERG) BUXBAUM**

3,4-Dimethoxyphenethylamine (less than or around 0.01% dry wt.) MA *et al.* 1986 (HBG 32973)
4-Hydroxy-3,5-dimethoxyphenethylamine (Around 0.01% dry wt.) MA *et al.* 1986
Mescaline (Less than 0.01%.) MA *et al.* 1986
Queretaroic acid (A dihydroxy triterpene acid; in hydrolyzed saponin) No isolation details included. DJERASSI *et al.* 1955a. [Also isolated by DJERASSI *et al.* 1956b]
Lupenone (wax component) (0.12% by dry wt) KINOSHITA *et al.* 1992 (Also by WOLLENWEBER & DÖRR 1995)

Lupeol (wax component) (0.04% by dry wt) KINOSHITA *et al.* 1992 (Also by WOLLENWEBER & DÖRR 1995)
 Oleanolic acid (detected; in hydrolyzed saponin) DJERASSI *et al.* 1956b
 β -Amyrin (In the surface wax; in a 1:1:3 ratio with Lupeol & Lupeone) [Grown in Germany] WOLLENWEBER & DÖRR 1995

Stenocereus chende (GOSSELIN) BYLES & ROWLEY

See as *Polaskia chende*

Stenocereus chichipe (GOSSELIN) BYLES & ROWLEY

See as *Polaskia chichipe*

Stenocereus dumortieri (SCHEIDW.) BUXBAUM

See as *Lemaireocereus dumortieri*

***Stenocereus eruca* (BRANDEGEE) GIBSON & HORAK**

“chirinola”, “chirinole”, “chilenola” STANDLEY 1924:

3,4-Dimethoxyphenethylamine (less than 0.01% dry wt.)

MA *et al.* 1986 (Baja, Mexico; AC Gibson 3625)

4-Hydroxy-3,5-dimethoxyphenethylamine (Around 0.01% dry wt.) [?] MA *et al.* 1986

Mescaline (Less than 0.01% [?]) MA *et al.* 1986

Stellatogenin (a triterpene) 0.07% [fresh wt] (3.1 gm from 4.5 kg [fresh wt]) DJERASSI *et al.* 1955b

Betulinic acid (a triterpene) (Identified as present via the methyl ester) DJERASSI *et al.* 1955b.

Other compounds appeared to be present: DJERASSI *et al.* 1955b.

(Analysis has usually been as *Machaerocereus eruca*)

Two lectins (MEA I and MEA II) were isolated and partially characterized. They were the first lectins to be isolated from cacti.

ZENTENO *et al.* 1988

Zenteno described the purified lectins as being “glycoproteins containing 36% (MEA_I) and 24% (MEA_{II}) of total carbohydrate, respectively. They do not contain sialic acid, but are rich in glucose, galactose, L-rhamnose and xylose; in addition, mannose is present as well as some L-arabinose in MEA I.”

Betulinic acid

Machaerogenin (new) 111 mg from 67.8 g dry

Oleanolic acid

Stellatogenin

Thurberogenin

KOYAMA *et al.* 1993 (aerial parts)

A germanicane derivative:

3 α ,19R-dihydroxygermanican-28-oic acid (They named Machaeroceric acid.)

Three new lupane derivatives:

21-Ketobetulinic acid

16 α -Hydroxybetulinic acid

22 α -Hydroxystellatogenin

Four new triterpenes,

Morolic acid

Queretaroic acid

27-Desoxyphillyrigenin

Treasegenic acid (3 α -hydroxytaraxastan-28,20 α -olide) and four known triterpenes

Betulinic acid

Oleanolic acid

Stellatogenin

Thurberogenin

YE *et al.* 1998

Oleanolic acid

Thurberogenin

Queretaroic acid

Treasegenic acid

Machaerogenin

Morolic acid

Machaeroceric acid

21-Ketobetulinic acid

16 β -Hydroxybetulinic acid

22 β -Hydroxystellatogenin

Desoxyphillyrigenin

Stellatogenin

Betulinic acid

YANG *et al.* 1998

Two new triterpene saponins:

3-O- β -D-xylopyranosyl-(1 \rightarrow 2)- β -D-glucopyranosyl-(1 \rightarrow 2)- β -D-glucuronopyranosyl stellatogenin (They named it Stellatocide B.)

3-O- α -L-rhamnopyranosyl-(1 \rightarrow 2)-[α -L-rhamnopyranosyl-(1 \rightarrow 3)]- β -D-glucuronopyranosyl betulinic acid 28-O- α -L-rhamnopyranosyl ester (They named it Erucasaponin A.)

OKAZAKI *et al.* 2007

Stellatocide C, D & E

Stellatocide B methyl ester

Stellatocide C methyl ester

Thurberside A

Phillyriside A

Treaseside A

KAKUTA *et al.* 2012 (all new triterpene saponins)

See comments in **Activity Notes**.

Stenocereus griseus (HAWORTH) BUXBAUM See as *Lemaireocereus griseus*

Stenocereus gummosus (BRANDEGEE) A. GIBSON & HORAK See as *Machaerocereus gummosus*

Stenocereus hystrix (HAWORTH) BUXBAUM See as *Lemaireocereus hystrix*

Stenocereus longispinus (BR. & R.) BUXBAUM See as *Pachycereus marginatus*

Stenocereus marginatus (DECANDOLLE) BUXBAUM See as *Pachycereus marginatus*

Stenocereus montanus (BRITTON & ROSE) BUXBAUM See as *Lemaireocereus montanus*

Stenocereus pruinosus (OTTO) BUXBAUM See as *Lemaireocereus pruinosus*

Stenocereus queretaroensis (WEBER) BUXBAUM See as *Lemaireocereus queretaroensis*

Stenocereus quevedonis (G. ORTEGA) BUXBAUM See as *Lemaireocereus quevedonis*

***Stenocereus stellatus* (PFEIFFER) RICCOBONO**

“tuna”, “joconostle” STANDLEY 1924: 899

87.4% water by weight DJERASSI *et al.* 1955b

3,4-Dimethoxyphenethylamine (around 0.01% dry wt.)

4-Hydroxy-3,5-dimethoxyphenethylamine (around 0.01% dry wt.)

Mescaline (0.01% dry wt.) MA *et al.* 1986 (HBG 34963)

Stellatogenin (a neutral triterpene lactone (80% of neutral fraction); first isolation but not clear if *S. eruca* or *S. stellatus* was first) (2.2% by dry weight) [In another experiment in same paper they obtained 1.7% (crude)] Also in KOYAMA *et al.* 1993

Thurberogenin 15% of neutral fraction [DJERASSI 1957 thought this might be an artifact] Also in KOYAMA *et al.* 1993

Oleanolic acid (0.009% by dry wt) (Isolated via the methyl ester) [Also in KOYAMA *et al.* 1993]

Betulinic acid (0.376% by dry wt) (Isolated via the methyl ester)

DJERASSI *et al.* 1955b [Collected: Mexico] Also KOYAMA *et al.* 1993

16- β -Hydroxystellatogenin (new) 24 mg from 52.9 gm dry.

Machaerogenin (new) 31 mg from 52.9 gm dry.

KOYAMA *et al.* 1993 (aerial parts)

Stellatogenin 3-O- α -L-rhamnopyranosyl-(1 \rightarrow 4)- α -L-rhamno-pyranosyl-(1 \rightarrow 2)- β -D-glucuronopyranoside (They named it Stellatoside) 0.01% in cultivated plants and 0.22% in wild ones (dry weight).

Oleanolic acid 3-O- α -L-rhamnopyranosyl(1 \rightarrow 3)- β -D-glucuronopyranosyl 28-O--D-glucopyranoside (0.10% in cultivated plants and 0.02% in wild ones).

IMAI *et al.* 2006

Species was reported as containing triterpenoid saponins but devoid of alkaloid; according to DJERASSI & LIPPMAN 1954 & DJERASSI *et al.* 1954c; citing L.H. Liu (unpublished observation from DJERASSI's lab)

Flower contains Betanin, Phyllocactin, Isobetanin, 2 unidentified Betacyanins & traces of Isophyllocactin. PIATTELLI & IMPERATO 1969

Stenocereus thurberi (ENGELMANN) BACKEBERG

See as *Lemaireocereus thurberi*

Stenocereus thurberi (ENGELMANN) BUXBAUM

See as *Lemaireocereus thurberi*

***Stenocereus treleasei* (BRITTON & ROSE) BACKEBERG**

“tunillo” Standley 1924: 899

82.6% water by weight

3,4-Dimethoxyphenethylamine (around 0.01% dry wt.)

4-Hydroxy-3,5-dimethoxyphenethylamine (Around 0.01% dry wt.)

Mescaline (0.01% dry wt.) MA *et al.* 1986

Stellatogenin 0.64% dry wt. [Also observed in DJERASSI & MILLS 1958]

Thurberogenin 0.02% dry wt. [DJERASSI 1957 thought this might be an artifact]

Oleanolic acid 0.1% (via its methyl ester) [Also observed in DJERASSI & MILLS 1958]

Would not rule out possibility of traces of Betulinic acid.

DJERASSI *et al.* 1956a [Collected in Oaxaca, Mexico].

Treleasogenic acid (a triterpene) DJERASSI & MILLS 1958

Oxallobetulin was also listed in DJERASSI 1957 who thought this might be an artifact.

Stenocereus weberi (COULTER) RICCOBONO. See as *Pachycereus weberi*

Stenocereus weberi (COULTER) BUXBAUM See as *Pachycereus weberi*

***Stetsonia coryne* (SALM-DYCK) BRITTON & ROSE**

Tyramine (10-50% of 1-10 mg of total alkaloids/ 100 grams fresh)

N-Methyltyramine (1-10% of 1-10 mg of total alkaloids/ 100 grams fresh).

3-Methoxytyramine (Over 50% of the 1-10mg of total alkaloids/ 100 grams fresh)

3,4-Dimethoxyphenethylamine (trace)

Mescaline (0.1-1.0 mg. per 100 grams fresh.)

Anhalonidine (trace)

Anhalidine (trace)

AGURELL *et al.* 1971b [Obtained via commercial sources in Germany & the Netherlands] (Did not analyze for 4° amines such as coryneine.)

Coryneine (1% dry wt.) RETI *et al.* 1935 [Collected from the wild in Argentina]

[Oxycandicine is simply a synonym for Coryneine.]

***Strombocactus disciformis* (DC) BR. & R.**

Reported to contain Isocitric acid (tlc & glc by KRINGSTAD & NORDAL 1975)

***Tephrocactus articulata* (PFEIFFER) HUNT**

Whewellite was identified as druses.

MONJE & BARAN 2002 [Examined as *Tephrocactus articulatus* and separately as *Tephrocactus glomeratus*]

***Tephrocactus aurantiaca* LINDLEY**

Hordenine (%) DeVRIES *et al.* 1971

Mucilage determined to be comprised of Arabinose (30.8%), Galactose (38.3%), Galacturonic acid (6.6%), Rhamnose (10.3%) & Xylose (14.0%). MOYNA & DiFABIO 1978 (Analyzed MAM 1307)

***Tephrocactus soehrensii* BRITTON & ROSE**

Reported to contain Betalains as pigments.

WOHLPART & MABRY 1968 cited DREIDING 1961.

***Thelocactus bicolor* (GALEOTTI) BRITTON & ROSE**

AKA *Glory of Texas*

Reported to contain unidentified alkaloids. CHALET 1980a cited DOMINGUEZ *et al.* 1969

Itesmol (a steroid; 0.15% dry wt.) DOMINGUEZ *et al.* 1968

Eisacol (a triterpenoid) DOMINGUEZ *et al.* 1968

Two unidentified components. DOMINGUEZ *et al.* 1968
Reported to contain Betalains as pigments. WOHLPART &
MABRY 1968 cited DREIDING 1961.

Thelocactus pseudopectinatus (BACKEBERG) ANDERSON & BOKE See
as *Pelecyphora pseudopectinata*

***Thelocactus* spp.** A number of *Thelocactus* species were said
to have been found devoid of alkaloid but their specific
identities were not included. WEST *et al.* 1974

Two names appeared that seem to have created a divergent mess involving the name “*bicolor*”.

TERÁN & BERLANDIER, 1832 published *Cactus bicolor* (now
Thelocactus setispinus) This appears to be what Johnson
decided to name *Hamatocactus bicolor* despite what many
other authors seem to make of it. (Benson called this *Ferocactus setispinus*.)

Galeotti ex Pfeiff. 1848 published *Echinocactus bicolor*
(now *Thelocactus bicolor*) Taylor called it *Ferocactus bicolor*
in 1979.

I am not sure how Anderson or Hunt merged I.M. Johnson's
bicolor with *Thelocactus bicolor*'s history. It is listed as
renaming Galeotti ex Pfeiffer's plant but according to others
Johnson renamed Terán & Berland's plant (*setispinus*).

The declarations of synonymy go much farther in terms
of apparent errors in both directions with *T. bicolor* descriptions
being lumped with *setispina* being declared a synonym while
others have TERÁN & BERLANDIER included with *bicolor* while
preserving *setispina* on its own. Its totally schizoid.

***Thelocactus bicolor* subsp. *bicolor* :**

Echinocactus bicolor GALEOTTI EX PFEIFFER, 1848
Echinocactus bicolor var. *pottsii* SALM-DYCK, 1850
Echinocactus bicolor var. *schottii* ENGELMANN, 1856
Echinocactus bicolor var. *tricolor* K. SCHUMANN, 1898
Echinocactus wagnerianus A. BERGER, 1929
Ferocactus bicolor (GALEOTTI EX PFEIFFER) N.P. TAYLOR, 1979
Thelocactus bicolor subsp. *commodus* (R. HAAS) DOWELD, 1999
Thelocactus bicolor subsp. *zwakii* CHVASTÉK & HALDA, 2000
Thelocactus bicolor var. *commodus* R. HAAS, 1988
Thelocactus bicolor var. *pottsii* (SALM-DYCK) BACKEBERG, 1961
Thelocactus bicolor var. *schottii* (ENGELMANN) KRAINZ, 1961
Thelocactus bicolor var. *tricolor* (K. SCHUMANN) Y. ITO, 1952
Thelocactus bicolor var. *wagnerianus* (A. BERGER) KRAINZ, 1961
Thelocactus schottii (ENGELMANN) KLADIWA & FITTKAU, 1975
Thelocactus wagnerianus A. BERGER, 1929

***Thelocactus setispinus*:**

Cactus bicolor TERÁN & BERLANDIER, 1832
Echinocactus hamatus MUEHLENPFORDT, 1848
Echinocactus muehlenpfordtii FENNEL, 1847
Echinocactus setispinus ENGELMANN, 1845
Echinocactus setispinus var. *cachetianus* LABOURET, 1853
Echinocactus setispinus var. *hamatus* (MUEHLENPFORDT) ENGELMANN, 1850
Echinocactus setispinus var. *mierensis* K. SCHUMANN, 1898
Echinocactus setispinus var. *orcuttii*
Echinocactus setispinus var. *setaceus* ENGELMANN, 1850
Ferocactus setispinus (ENGELM.) L.D. BENSON, 1969
Hamatocactus bicolor (TERÁN & BERLANDIER) I.M. JOHNSTON, 1924
Hamatocactus setispinus (ENGELMANN) BRITTON & ROSE, 1922
Hamatocactus setispinus var. *hamatus* (MUEHLENPFORDT) BORG, 1937
Thelocactus setispinus (ENGELMANN) E.F. ANDERSON, 1987
Thelocactus setispinus var. *cachetianus* (LABOURET) PILBEAM, 1996
Thelocactus setispinus var. *hamatus* (MUEHLENPFORDT) PILBEAM 1996
Thelocactus setispinus var. *mierensis* (K. SCHUMANN) PILBEAM 1996
Thelocactus setispinus var. *muehlenpfordtii* (FENNEL) PILBEAM 1996
Thelocactus setispinus var. *orcuttii* (K. SCHUMANN) PILBEAM 1996

***Trichocereus andalgalensis* (WEBER) KREUZINGER**

Hordenine (%) NIETO 1987

Candicine (%) NIETO 1987

Great confusion exists in horticulture concerning this plant.
Several combinations have been made under this name involving
at least two separate plants. See Ritter for a discussion.

***Trichocereus argentinensis* n.n. HORT. B.RESSLER**

A stout *peruvianoid-macrogonoid* said to reach up to 8-9-(10?)
inches in diameter. Initially mislabeled *Cereus argentinensis*, it is
assumed to have originated in northern Argentina.

In pictures it looks very bluish-blushed (See Ressler's website)
and interestingly similar to what is pictured on page 41 in INNES &
GLASS 1991 mislabeled *Cereus peruvianus* with its origin given as
Argentina! Roberto Kiesling, in correspondence, insists that nothing
like this occurs in Argentina and the origin information is mistaken.

Needs an analysis and taxonomic study.

Also see an authentic *Cereus argentinensis* in INNES & GLASS 1991

***Trichocereus atacamensis* (PHILIPPI) MARSHALL**

(San Pedro de Atacama, Chile)

Needs an analysis.

See comment in **Activity Notes**.

***Trichocereus bridgesii* (SALM-DYCK) BRITTON & ROSE**

AKA *San Pedro* & *achuma* (Bolivia)

Tyramine (1-10% of over 50 mg total alkaloids/ 100 gm of fresh)

3-Methoxytyramine (1-10% of over 50 mg total alkaloids/ 100 gm fresh)

3,4-Dimethoxyphenethylamine (1-10% of over 50 mg total alkaloids/ 100 gm fresh)

[3,4-diMeO-5-OH-PEA and 3,5-diMeO-4-OH-PEA are also listed in error for *T. bridgesii*. The reference cited, AGURELL 1969b, did not report either compound.]

Mescaline (Over 25 mg. per 100 grams fresh.)

AGURELL 1969b [Obtained via European commercial sources] 0.56% (dry green outer tissues) SERRANO 2008 (Wild harvested; La Paz, Bolivia)

0.18% (dry outer green tissues) OGUNBEDEDE 2009 (Bob Gillette commercial nursery stock in California)

[All forms & varieties of this species are said to contain levels of mescaline ranging from nearly inactive to potent: Conversations with friends, DAVIS 1983, DAVIS 1997, DAVIS 1999 & also the 1998 *Entheogen Review* 7 (3): 70-71.]

See additional comments in **Activity Endnotes**.

Bridgesigenin A (a triterpene: 0.0378% dry wt.)

Bridgesigenin B (a triterpene: 0.00657% by dry wt)

Both triterpenes by KINOSHITA *et al.* 1992 [Both triterpenes arose via acid hydrolysis of the saponin fraction]

Reported to contain Kaempferol & Quercetin (Flavonols)

RICHARDSON 1978 (based on acid hydrolysis)

The degree of sliminess for *T. bridgesii* is claimed by growers to range from extreme to almost lacking.

***Trichocereus* sp. W. BAKER 5452** was collected by Julio Cruz at Murillo, Jayuri Province, Bolivia, on 20 March, 1983.

The original herbarium vouchers were submitted as *Trichocereus pachanoi* but it is clearly a *bridgesii*.

Presence of Mescaline was proven both through human bioassays and unpublished analysis (ANONYMOUS sources; personal communications.)

Purported to have indigenous use but that claim lacks details or a reference.

Lacking a published analysis.

The monstrose forms of *T. bridgesii* have been purported to be especially active in human bioassays.

OGUNBEDEDE 2010 analyzed the short jointed monstrose form and determined it to contain only 0.48% mescaline in the dried outer green tissues.

***Trichocereus bruchii* (BRITTON & ROSE) RITTER**

Flower contains Betanin (major), Phyllocactin, Isobetainin, Isophyllocactin & an unidentified Betacyanin.

PIATTELLI & IMPERATO 1969

***Trichocereus camaraguensis* CARDENAS**

Tyramine (trace)

N-Methyltyramine (trace)

3-Methoxytyramine (trace)

3,4-Dimethoxyphenethylamine (trace)

AGURELL 1969b [European commercial sources]

***Trichocereus candicans* (GILL.) BRITTON & ROSE**

Tyramine (trace) MATA *et al.* 1976a. Also reported in MATA *et al.* 1976b

N-Methyltyramine (0.004% by dry weight) MATA *et al.* 1976a; Also isolated in MATA *et al.* 1976b. Not observed by AGURELL 1969b

Hordenine (over 50% of over 50 mg total alkaloids/ 100 gm fresh) AGURELL 1969b [Obtained via European commercial sources]; (Variable from 0.5 to 5%) RETI 1950; also CASTRILLÓN 1950 & RETI 1933.

Candicine (Variable. 0.5 to 5%) RETI 1950 also RETI 1933 and CASTRILLÓN 1950

2 unidentified trace alkaloids detected MATA *et al.* 1976

***Trichocereus cephalomacrostibas* RAUH & BACKEBERG**

Needs an analysis (Also called a *Haageocereus*. Now it is considered to be a *Weberbauerocereus*)

This was purported to contain mescaline by Caycho Jimenez but no reference was included with the claim.

See comments in the **Activity Notes**.

***Trichocereus chalaensis* RAUH & BACKEBERG**

Needs an analysis

See images in the San Pedro book.

Trichocereus chiloensis (COLLA) BR. & R. See as *Trichocereus chilensis*

***Trichocereus chilensis* (COLLA) BRITTON & ROSE**

AKA *buisco*

Candicine (trace) CORTES *et al.* 1972

“no triterpenes or alkaloids” “essentially devoid of alkaloids”

β-Sitosterol

Unidentified material believed to be a straight chain alcohol [mp 82-82.5° [α]_D -11°] (also described in this paper as a long chain aliphatic alcohol and an aromatic alcohol.) It was thought to resemble *n*-Nonacosan-10-ol but mmp was depressed.

DJERASSI *et al.* 1956a [Material from Chile]

β-O-Palmityl longispinogenin (Olean-12-ene-3β,16β,28-triol-3-palmitate) in 1% yield. MORALES & McLAUGHLIN 1989 (Collected in Chile)

[AGURELL 1969b (Obtained via European commercial sources) reported it devoid of alkaloids but specifically did not look for quaternary amines like Candicine]

***Trichocereus courantii* (K.SCHUMANN) BACKEBERG**

Tyramine (trace)

3,4-Dimethoxyphenethylamine (1-10% of 1-10 mg of total alkaloids/ 100 grams fresh)

3-Methoxytyramine (1-10% of the 10-50 mg of total alkaloids/ 100 grams fresh)

N-Methyl-3-methoxytyramine (10-50% of 10-50 mg of total alkaloids/ 100 grams fresh)

N-Methyltyramine (Over 50% of 10-50 mg of total alkaloids/ 100 grams fresh)

AGURELL *et al.* 1971b [Obtained via commercial source in the Netherlands]

[The **typo** 2-Methoxytyramine has been published.]

***Trichocereus crassicostata* RITTER**

Needs an analysis & taxonomic study

***Trichocereus cuzcoensis* BRITTON & ROSE**

Common names: “*Giganton*” and “*Jahuackollai*”

Tyramine (trace) AGURELL *et al.* 1971b

3-Methoxytyramine (Over 50% of the over 50 mg of total alkaloids/ 100 grams fresh) AGURELL *et al.* 1971b

3-Hydroxy-4,5-dimethoxyphenethylamine (trace) AGURELL *et al.* 1971b [Obtained via commercial source in Germany] and LINDGREN *et al.* 1971

Mescaline (0.5-5 mg. per 100 grams fresh) AGURELL *et al.* 1971b. [Also identified by LINDGREN *et al.* 1971]

0.0% Cotaruse, Arequipa

0.0% Huaytampo, Cuzco

0.0% Huacarpay, Cuzco

0.0% Capacmarca, Cuzco

SERRANO 2008 (All were wild collections)

[4-MeO-PEA appears listed in error. The claim is not supported by any of the references cited.]

“no triterpenes or alkaloids” [Ran with a second procedure and reported traces of non-phenolic basic material]

DJERASSI *et al.* 1956a [Material from Cuzco, Peru]

β-Sitosterol (a sterol) DJERASSI *et al.* 1956a

Unidentified alcohol that was also reported in *T. chiloensis* (see under). DJERASSI *et al.* 1956a

See also *T. peruvianus* var. *cuzcoensis* (under *T. peruvianoids*) which appears to be simply an undescribed synonym for *T. cuzcoensis*. They ALL appear to have originated with Karel Knize who has offered “*peruvianus* var. *Cuzco* KK340” & “*peruvianus* var. *cuzcoensis* KK340”

***Trichocereus fulvilanus* RITTER**

Tyramine (10-50% of over 50 mg of total alkaloids/ 100 grams fresh)

N-Methyltyramine (10-50% of over 50 mg of total alkaloids/ 100 grams fresh)

Mescaline (trace)

AGURELL *et al.* 1971b [Commercial German source]

BACKEBERG 1959 viewed this as possibly synonymous with *T. deserticolus* but, based on seed coat morphology, FRIEDRICH & GLAETZLE 1983 considered the two to be separate species. Hunt sided with Backeberg. See **Part B San Pedro**

Trichocereus grandiflorus

This appears presented as a DMT container in both the underground literature and on the Internet. This arose from a preliminary report by Sasha Shulgin that he had observed what he suspected was DMT in GC-MS. He was unable to duplicate his observation but, upon flowering, discovered that he had used a yellow flowered form rather than the red-flowered one used in his initial analysis. It is unclear whether this was the cause for the disparate results or if a contaminated GC-MS was the culprit. Sasha suspects the latter.

All of the various forms of plants known in horticulture within and around this name are in need of further investigation; both as chemical investigation and taxonomic study. (Masochists only need apply.)

See comments on synonyms under *T. huascha*

Trichocereus grandiflorus* (red-flowered) see *Trichocereus huascha

There have been anecdotal reports of activity from material called *Trichocereus grandiflorus*. While purely speculative, perhaps the mislabeled material depicted on page 78 of **Part B San Pedro** might provide one suggestion as to a possible source for this rumor? Of course the issue of what is meant by “active” should be the first point to be clarified.

***Trichocereus huanucoensis* H. JOHNSON**

[Ex: UC Botanical Gardens (H. Johnson; Peru 56.1153; also in the Huntington as **HBG18568**. Released into horticulture by Johnson as *T. huanucoensis* and by HBG as **HBG18562**.]

Needs an analysis. One human bioassay using 500 gm fresh wt of 1 version of the horticultural material sold under this name reported a stimulant but not hallucinogenic action. ANONYMOUS 2000 It has conflicting bioassay reports with at least one claiming the presence of mescaline. ANONYMOUS

It should be emphasized that there appears to be 3 distinct versions in botanical gardens bearing this name and at least one additional offering in horticulture. The source for the material at both the Huntington & Berkeley Botanical Gardens was Harry Johnson, Sr., of Paramount California (better known as the source for the Paramount hybrids).

Harry Johnson, Sr. field collected the seeds in Peru (in 1956) so a possibility exists that the seeds produced F1 hybrids.

See **Part B San Pedro** for images

***Trichocereus huascha* (WEBER) BRITTON & ROSE**

Hordenine (Sole alkaloid. 10-50 mg/ 100 gm of fresh plant)

AGURELL 1969b [Obtained via European commercial sources]; (trace) FOLLAS *et al.* 1977 [FOLLAS analyzed as *Lobivia huashua* (WEBER) W.T. MARSHALL.]

N-Methyltyramine (trace) FOLLAS *et al.* 1977

Tyramine (trace) FOLLAS *et al.* 1977

Note on *T. huascha*:

In partial contrast to Ritter, Hunt considers the following to be synonyms of *Echinopsis huascha* (WEBER) FRIEDRICH & ROWLEY (and this summation ignores all purely horticultural and ill-defined material such as the orange flowered “*grandis*”)

Chamaecereus grandiflorus (BRITTON & ROSE) FRIC

***Echinopsis huascha* (WEBER) FRIEDRICH & ROWLEY** This is the name most commonly accepted at the present time.

Echinopsis lobivioides BACKEBERG

Echinopsis pecheretiana (BACKEBERG) FRIEDRICH & ROWLEY [In horticulture this has lemon-yellow flowers]

Echinopsis rowleyi (FRIEDRICH) KIESLING

Helianthocereus andalgalensis (WEBER) BACKEBERG

Helianthocereus grandiflorus (BRITTON & ROSE) BACKEBERG

Helianthocereus huascha (WEBER) BACKEBERG

Helianthocereus hyalacanthus (SPEGAZZINI) BACKEBERG

Helianthocereus pecheretianus BACKEBERG

Lobivia andalgalensis (WEBER ex SCHUMANN) BRITTON & ROSE (See photos under *T. andalgalensis* and under *T. grandiflora*)

Lobivia grandiflora BRITTON & ROSE

Lobivia huascha (WEBER) W.T. MARSHALL

Lobivia hyalacantha SPEGAZZINI

Lobivia purpureominiata RITTER

Pseudolobivia lobivioides (BACKEBERG) BACKEBERG ex KRAINZ

Trichocereus andalgalensis HOSSEUS

Trichocereus catamarcensis RITTER

Trichocereus grandiflorus BACKEBERG

Trichocereus huascha (WEBER) BRITTON & ROSE

Trichocereus lobivioides GRAESER & RITTER ex RITTER

Trichocereus rowleyi FRIEDRICH

Friedrich & Glaetzle 1983 kept *huascha* and *rowleyi* separate based on their seed-coat morphology.

(Note also that we disregard much of this; pending the location of some sort of published research or clarifications. Ideally this would take the form of a Monograph for the supergenus *Echinopsis*.)

Also be aware that any *Trichocereus lobivioides grandiflorus* is likely to be a hybrid. These are commercially available in red and other colorful flowers.

T. huascha, as available in horticulture, is offered in both a yellow and red flowered form.

***Trichocereus knuthianus* BACKEBERG**

Tyramine (10-50% of 10-50 mg of total alkaloids/ 100 grams fresh)

3-Methoxytyramine (10-50% of 10-50 mg of total alkaloids/ 100 grams fresh)

AGURELL *et al.* 1971b [Obtained via commercial source in the Netherlands]

This species needs additional analysis. Some of the material bearing this label is reported to be hallucinogenically active.

At least part of the commercial material available under this name is something else. The latter is sometimes referred to as *T. peruvianus* var. *knuthianus* which appears to lack any published description.

See also *T. peruvianus* v. *knuthianus* also (under *T. peruvianoids*) It is unclear but likely that this is only an undescribed synonym for *T. knuthianus* -- more study of the chemistry is needed.

***Trichocereus lamprochlorus* (LEMAIRE) BACKEBERG**

Hordenine (over 50% of 10-50 mg total alkaloids/ 100 gm fresh) AGURELL 1969b [Obtained via European commercial sources]

Candicine (trace) RETI 1933, RETI & ARNOLT 1935 & RETI 1950

***Trichocereus macrogonus* (SALM-DYCK) RICCOBONO**

Tyramine (1-10% of 10-50 mg total alkaloids/ 100 gm of fresh) AGURELL 1969b

3-Methoxytyramine (1-10 % of 10-50 mg total alkaloids/ 100 gm fresh.) AGURELL 1969b

3,4-Dimethoxyphenethylamine (1-10% of 10-50 mg total alkaloids/ 100 gm fresh) AGURELL 1969b [Obtained via European commercial sources]

Mescaline (5-25 mg. per 100 grams fresh.) AGURELL 1969b [Human bioassays suggest that this value might be low for many specimens. Conversations with friends & the 1998 *Entheogen Review* 7 (3): 71. MANY horticultural offerings appear to be quite potent while others are demonstrably weak. It is unclear how much of this is strain related and how much reflects variability within a given strain. Great confusion, or at least disagreement, apparently exists concerning what is and what is not this species.] [3,4-diMeO-5-OH-PEA and 3,5-diMeO-4-OH-PEA are also listed, in error, for this species. The reference cited, AGURELL 1969b, did not report either compound.]

No mucilage studies have been located thusfar but it should be noted that some strains are exceedingly slimy and other much less so.

Amazingly, Albesiano & Kiesling merged *T. macrogonus* and *T. peruvianus* as *T. macrogona* subsp. *macrogona*. ♪

A number of triterpene saponins have been reported.

Pachanol A (the hydrolyzed sapogenin) by TAKIZAWA *et al* 1993

Bridgesides A1, C1, C2, D1, D2, E1 & E2 (oleanane type)

Pachanosides C1, E1, F1 and G1 (pachanane type)

[Revised structure of Pachanol C to 21β-acetyloxy-3β,14β,

30-trihydroxypachan-12-en-28-oic acid 14β,28-lactone]

by OKAZAKI *et al.* 2011.

***Trichocereus manguinii* BACKEBERG**

3-Methoxytyramine (1-10% of 10-50 mg of total alkaloids/ 100 grams fresh)

Hordenine (10-50% of the 10-50 mg of total alkaloids/ 100 grams fresh)

N-Methyltyramine (10-50% of 10-50 mg of total alkaloids/ 100 grams fresh)

Tyramine (10-50% of 10-50 mg of total alkaloids/ 100 grams fresh)

AGURELL *et al.* 1971b [Commercial source in the Netherlands]

***Trichocereus pachanoi* BRITTON & ROSE**

AKA “San Pedro”, “achuma”, “aguacolla”, “huachuma”, “giganton” & many other common names.

Albesiano & Kiesling renamed *T. pachanoi* as

***Trichocereus macrogonus* subsp. *pachanoi*.**

93.5% water by weight according to POISSON 1960.

Tyramine (trace) AGURELL 1969a and AGURELL 1969b

3-Methoxytyramine (0.01% by dry weight) CROSBY & McLAUGHLIN 1973 [Obtained via Californian commercial sources]; (1-10% of over 50 mg total alkaloid/ 100 gm fresh) AGURELL 1969b; (Less than 0.01% fresh) AGURELL 1969a. [Also reported in AGURELL & LUNDSTRÖM 1968]

Hordenine (trace) AGURELL 1969b

3,4-Dimethoxyphenethylamine (1-10% of over 50 mg total alkaloids/ 100 gm fresh) AGURELL 1969b [Obtained via European commercial sources]

3-Hydroxy-4,5-dimethoxyphenethylamine (trace) AGURELL 1969b

4-Hydroxy-3,5-dimethoxyphenethylamine (trace) AGURELL 1969a and 1969b. Also reported in AGURELL & LUNDSTRÖM 1968

Mescaline (Highly variable) 0.025%+ (over 25 mg per 100 gm) [AGURELL 1969b] to 0.12% [POISSON 1960 (Collected in Peru)] reported by fresh weight. [Also 0.04% fresh/ ~ 0.67% dry: AGURELL 1969a & 0.067-0.079% fresh: BRUHN & LUNDSTRÖM 1976a];

Recoveries from 0.331% [CROSBY & McLAUGHLIN 1973] up to 2.0 % [POISSON 1960] have been reported from dry plants. [See also TURNER & HEYMAN 1960 (Collected in Peru) who reported 0.9% by dry weight in misidentified plants] From 0.109%-2.375% dry wt. (6 specimens) was estimated photometrically in Swiss cultivated plants by HELMLIN & BRENNISEN 1992 [See Note below];

0.310% mescaline by fresh weight (3.10 mg/gm fresh as the average of three specimens; estimated using HPLC) They also reported an average of 2.06% by dry weight. (Ed.: Notice the obvious discrepancy.) Grown in Italy.

GENNARO *et al.* 1996;

GONZALES HUERTA 1960 recovered 4.5% mescaline from the outer tissues of correctly identified Peruvian plants.

She reported being able to obtain this yield only when using the approach of Folkers & Koniuszy 1939 rather than that described in Cruz Sanchez 1948.

CRUZ SANCHEZ 1948 reported recovering 5% dry wt; using only the outer layer of flesh (misidentified as *Opuntia cylindrica*).

[Alkaloid values are often very low in many cultivated plants but the controlling factors are not clear. Species appears highly variable in potency & palatability.]

See comments in **Activity Notes**.

[A gc estimate of 0.155% mescaline free base by dry wt. was made on a nongrafted control vs. 0.15% ten months after being used for grafting (with the mescaline-free *T. spachianus*). (Initially 2” by 12” plants) PUMMANGURA *et al.* 1982a];

[Alkaloid values are commonly low in many cultivated plants.]

Anhalonidine (0.01% of total alkaloid) AGURELL 1969a; (trace) AGURELL 1969b

Alkaloids were detected in BROWN *et al.* 1968 but none were identified.

[Anhalinine has been listed **in error**. The reference cited, AGURELL 1969b did not report this alkaloid.]

[Pellotine has been listed **in error**. The reference cited, LUNDSTROM 1970 did not report this alkaloid.]

Unidentified lactone-forming acid (tlc by KRINGSTAD & NORDAL 1975)

Aglycones isolated after acid or enzymatic hydrolysis of the isolated corresponding sapogenins:

Pachanols A & B

Bridgesigenins A, B & C

KINOSHITA *et al.* 1995

Some modern analytical reports for Peruvian *pachanoi*

Specimens not obviously being cultivated:

0.00% Cataratas, Otuzco, La Libertad

0.00% El Alisal, San Marcos, Cajamarca

0.45% KunturWasi, San Pablo, Cajamarca

1.14% Laquipampa, Ferreñafe, Lambayeque

0.23% Moyán, San Vicente, Lambayeque

0.28% Puykate, Ferreñafe, Lambayeque

0.94% Tocmoche, Chota, Cajamarca

0.38% Yanasara, Sánchez Carrión, La Libertad

Specimens obviously maintained as cultivated plants

0.55% Arequipa, Arequipa

0.80% Arequipa, Arequipa

0.86% Quequeña, Arequipa

1.13% Pueblo Libre, Lima

All of the above were reported in CJUNO *et al.* 2009 (Using dried outer green tissue)

No note included as to whether under cultivation

1.4% Barranca

0.78% Chiclayo

Both reported by REYNA PINEDO & FLORES GAÉRCES 2001

4.7% Matucana (harvested in Peru; analyzed in USA)

OGUNBEDEDE 2010 (Using dried outer green tissue)

BRUHN *et al.* 2008 reported lophophine,

3,4-methylenedioxyphenethylamine (homopiperonylamine),

and N,N-dimethyl-3,4-methylenedioxyphenethylamine (lobivine) to be new minor alkaloids in this species and in peyote. This paper needs to be viewed with reservations.

See comments in **Activity Notes**.

***T. pachanoi* notes:**

Note that this is nearly 23X from max to min (i.e A San Pedro specimen was observed that was almost 23 times stronger than another San Pedro that was simultaneously being evaluated) Notice also that Gennaro’s estimation was even higher.

A far more detailed look at this species (and many more images) can be found in **Part B San Pedro**

Cactus Chemistry: By Species

Trichocereus pachanoi

Cultivated under the mistaken name ***Trichocereus peruvianus*** Huancabamba.

0.54% mescaline by dry wt.

Grown by Oasis from seeds collected at Huancabamba.

(Image on next page)

OGUNBEDEDE 2010 (Using dried outer green tissue)

1.2% mescaline by dry wt.

Grown by SS from the same seed lot.

(Images on this page)

OGUNBEDEDE 2010 (Using outer green tissue)

Trichocereus pachanot?

This is by far the most commonly represented horticultural form of *pachanoi* in commerce in the USA and possibly also Australia (far more abundance of genetic diversity exists in Oz than in the USA)

My present suspicion is that this may be a hybrid that has displaced bona fide *pachanoi* as the predominate cultivar in the US. I do not suspect malice or deliberate deception just simple displacement over time due to the vast numbers generated by both individual growers and by commercial propagation operations due to its far greater growth rate & overall vigor, cold/heat tolerances and rot resistance when compared to a bona fide *Trichocereus pachanoi*.

My present GUESS based on its flowers, habit and intense vigor is that this may be a *bridgesii* crossed with a *pachanoi* or something similar but whether work is ever done that is capable of establishing this one way or another remains to be seen. It might be a product of horticulture but there is some, presently anecdotal, evidence to suggest it *might* have entered cultivation as a Bolivian collection during Harry Blossfeld's Andean expedition.

An error that I (Trout) have helped to widely propagate is referring to this cultivar as **Backeberg's clone**. Whether there really is such a thing as a clone line from Backeberg's hands that can be identified in horticulture **cannot presently be established despite the best efforts of friends in Germany**. IF Backeberg did bring a clone line into horticulture it would be a bona fide *pachanoi* and not the cultivar I have so often in past years mistakenly called Backeberg's clone.

See the growing summary of thoughts and photos at: "*pachanoi* or *pachanot*?"

http://troutnotes.com/pdf/Pachanoi_Pachanot.pdf

The main body of this thought is also now attached to the *San Pedro* PDF also located at the same website.

Presence of mescaline is established through innumerable human bioassays despite it not being clear if it has ever seen formal published analysis.

Pummangura's 0.155% material may also have been this plant but I cannot determine this one way or the other. It is tempting to think of other low values in the literature as being from the same source but it is clear that at least some came as seedlings which were produced by one or more of the many Western greenhouses supplied from known commercial collectors of wild seeds such as Karel Knize or Friedrich

Ritter or Harry Johnson and others AND there are two Peruvian samples that produced 0.00% mescaline for Cjuno so only more questions arise if looking closely at what little is known.

It IS clear that its mescaline content is generally low: typically it is less than 0.2% by dry weight. In the otherwise unpublished isolations appearing online values for mescaline concentrations falling in the range of 0.1% to less than 0.05% are the most common.

Based on their bioassay results it is believed by several anonymous correspondents that other alkaloids such as 3-Methoxytyramine and DMPEA may also be present.

***Trichocereus aff. pachanoi* (Peru 64.0762)**

(Clone wild collected by Paul C. Hutchison, Jerry K. Wright & R.M. Straw on August 8, 1964 as **PCH *et al.* 6212**)

0.82% mescaline by dry weight. (HPLC)

OGUNBEDEDE 2010 (using green outer tissue)

Originally collected from shaded canyon of Rio Marañon, Chagual, Huamachuco, La Libertad, above Chagual, 5 km below Aricapampa. Elev. 2740 m.

***Trichocereus pachanoi* cv. 'Tom Juul's Giant'**

[Note 6]

Unclear in origin prior to Tom Juul. Peru seems probable. 1.4% OGUNBEDEDE 2010 (using dried green outer layer)

Presence of Mescaline was both demonstrated by human bioassay and confirmed previously by gc-ms. but it should be emphasized that there are conflicting reports ranging from full activity at 4-6 inches to powerful trips with 1 foot to complete inactivity with 2 feet.) See the 1998 *Entheogen Review* [7 (3): 70] and [7 (4): 99-100] Bioassay information came from various friends.

See more details and lots of images in **Part B San Pedro**

Juul's Giant appears to be highly variable in potency with some apparently being completely inactive.

It is purported by some users to contain additional alkaloids and this has been supported in some but not all gc-ms.

At least 2 forms are in cultivation.

GC-MS by Shulgin showed them to be distinct from each other chemically even though the original source was believed to be identical (Jim Daniel)

Juul's Giant (A):

Unknown Isoquinoline was 90%

Mescaline less than 10%

minor Isoquinoline (not identified)

3 trace Isoquinolines (not identified)

[In a second sampling mescaline was the major alkaloid]

Juul's Giant (JM):

Major alkaloid was an Unknown compound

Second largest peak in the graphs appears to be a lab artifact.

Also observed some sort of phenylethanol

See more details in **Part B San Pedro**.

It actually gets more complicated as Sasha commented he had thusfar run gc-ms on 5 samples, several of which were from the same form, and came up with 5 different results.

***Trichocereus pallarensis* RITTER**

0.47% (dry outer green tissues) OGUNBEDEDE 2010 (From F. Ritter seed obtained from Winter in 1960; also depicted on entire page.)

Presence of Mescaline previously established through human bioassays. See 1998 *Entheogen Review* 7 (3): 70-71.

***Trichocereus pasacana* (WEBER) BRITTON & ROSE**

Candicine (0.08% dry wt.) MEYER & McLAUGHLIN 1980; (0.075% dry wt.) DAVIS *et al.* 1983

Holdenine (no quantification) MEYER & McLAUGHLIN 1980; (over 50% of 1-10 mg total alkaloids/ 100 gm fresh) AGURELL 1969b

N-Methyltyramine (no quantification) MEYER & McLAUGHLIN 1980

Tyramine (no quantification) MEYER & McLAUGHLIN 1980
Has been reported to have stimulant activity in human bioassays.
ANONYMOUS source (via Voogelbreinder)

***Trichocereus pasacana inermis* FRIČ 1928** was said to be a synonym for *Echinopsis valida* MONVILLE in KREUZINGER 1935.

Trichocereus peruvianoids see in **Part B San Pedro**

***Trichocereus peruvianus* BRITTON & ROSE**

AKA “*San Pedro*”, “*San Pedro Macho*”, “*cuchuma*”, “*Peruvian Torch*” and a number of other common names.

Appears to be 90% water by weight (See **Note A**).

Tyramine (over 50% of 1-10 mg total alkaloids/ 100 gm fresh - mescaline was not reported but two minor unknowns were present.) AGURELL 1969b [Obtained via European commercial sources]; (0.0085% dry wt.) PARDANANI *et al.* 1977 [Grown from seed in California]

3-Methoxytyramine (trace) AGURELL 1969b; (0.01% dry wt.) PARDANANI *et al.* 1977.

3,4-Dimethoxyphenethylamine (trace) PARDANANI *et al.* 1977.

4-Hydroxy-3,5-dimethoxyphenethylamine (0.0035% dry wt.) PARDANANI *et al.* 1977.

Mescaline (0.817% dry wt.) PARDANANI *et al.* 1977 (See **Note B**) [Underground mythology claiming that 1) this species has 10X the concentration of *T. pachanoi* & 2) that it is comparable to peyote in potency, appears to have **no basis in fact** (See **Note C**). I have been *told* that a half inch slice of a large fresh stem would yield 500 milligrams of mescaline but this lacks any sort of confirmation. [TURNER 1998 (*Entheogen Review* 7 (1): 18.) recommended 4 inches of a 4-1/2 inch diameter plant for the same amount. The amount used in TURNER's dose would indicate no more than 0.8% dry or 0.08% fresh wt. (See **Note D**) Other

human bioassays (ANONYMOUS) indicated that twice this much was required for the same dosage] Many appear to be weaker than this. 0.05% fresh weight may be a better estimate of an average value for good peruvian strains Mescaline was not detected by all investigators including **BOTH** AGURELL 1969b and DJERASSI *et al.* 1955 (**Note E**) 2-Chloro-mescaline (0.016% dry wt.) Thought to be an extraction artifact. PARDANANI *et al.* 1977

Traces of an unidentified triterpene lactone

DJERASSI *et al.* 1955b [Wild collected: Peru]

Unidentified waxy solid (0.22% by dry wt)

DJERASSI *et al.* 1955b

***T. peruvianus* notes:**

A: Based on one evaluation of a basal slice taken from *T. peruvianus* ‘Blue Form’.

B: PARDANANI *et al.* 1977 reported the material they analysed as being KK242 grown in California by Abbey Garden (from Knize seed) What they specifically analyzed is therefor really anyone's guess at this point but an educated guess would be that it was one of the spiny forms of KK242 as these are what **predominately** has been produced from Knize's KK242 seeds. See the assorted KK242 images included in **San Pedro** for an illuminating look.

C: This only *approaches* being a true statement if selectively comparing the only published isolation of mescaline from *T. peruvianus* with the lowest testing *T. pachanoi* reported to date.

The highest *T. pachanoi* with a mescaline isolation reported is well over twice Pardanani's value and an additional estimate exists that is nearly 3 times higher (Please remember that *T. pachanoi* exists which is many times stronger than other *T. pachanoi*.)

Similarly, the lowest published value for *T. pachanoi* [0.109%] is greater than the lowest published value for *L. williamsii* [0.1%]

D: Approximation based on a fresh weight determination of 128.5 grams per inch for a 3.75 inch in diameter *Trichocereus* specimen.

E: The material did give a positive Mayer test, but the ether soluble fraction tested neutral and they were unable to isolate any crystalline material so Djerassi concluded it contained no alkaloid. Agurell on the other hand WOULD have observed even traces of mescaline had they been present.

Important comment:

Every horticultural form and variety of *T. peruvianus* lacks a published analysis; except for two versions of “KK242”, one from Knize seed and one from a Knize cutting, the undefined commercial European material was examined by AGURELL and the Peruvian material that was screened by Djerassi.

A negative alkaloid analysis was also reported by a friend working with 1.5 year old material grown from seed in New Zealand but this however turned out to be material misnomered *Trichocereus peruvianus trujilloensis*. This was a Dick Van Geest collection that is not a *Trichocereus*. See more comments in *San Pedro*.

Species appears to be highly variable in potency & palatability.

To complicate matters further; even material from the same origin appears highly variable in alkaloid content. Whether this is the result of differences in season, environment, water or time of day of harvest has not been established.

To complicate matters even further still; material from a single clone has been reported to be highly variable in alkaloid content when bioassayed repeatedly.

More study is clearly needed.

Many more images of can be viewed in **Part B San Pedro** at <http://troutsnote.com/pdf/SP.pdf>

***Trichocereus peruvianus* KK242**

0.817% Mescaline. Seed grown by Abbey Garden using KK242 seeds from Karel Knize.

PARDANANI *et al.* 1977 (Using intact plant)

0.24% K242 propagated from a live cutting sent by Karel Knize.

OGUNBEDEDE 2010 (Using dried outer green tissue)

Widely asserted to be nearly useless or totally inactive according to anecdotal bioassay accounts.

Some of this is believed to be the result of some confusion between *peruvianus* and *cuzcoensis* in some commercial seeds originating from Karel Knize in Peru. See MS SMITH online for comments and the photograph at the bottom of this page. While it is certainly true that there are abundant occurrences of *cuzcoensis* produced from Knize seeds that were mislabelled KK242 this does not include a huge number of KK242 specimens worldwide which are *peruvianus* or *pachanoid*. There are also unmistakable *Trichocereus bridgesii* specimens which have been grown from Knize's KK242 seeds.

A plant obtained as a live cutting from Karel Knize in Peru as *Trichocereus peruvianus* **KK242 Matucana** has been shown to be as active as many *pachanoi* plants according to its grower.

***Trichocereus peruvianus* [or aff. *pachanoi*?]**

0.25% Mescaline. Chavin de Huantar, Huari, Ancash
CJUNO *et al.* 2009 (Using dried outer green tissue)

Images can be found online of the cacti growing at Chavin de Huantar.

***Trichocereus poco* BACKEBERG**

Hordenine (over 50% of 1-10 mg total alkaloids/ 100 gm of fresh plant) AGURELL 1969b [European commercial sources]

***Trichocereus puquiensis* RAUH & BACKEBERG**

Determined to contain Mescaline.

0.28% Chaviña, Lucanas, Ayacucho

0.13% Chumpi, Parincochas, Ayacucho

0.11% Incuyo, Parincochas, Ayacucho

0.50% Vado, Lucanas, Ayacucho

SERRANO 2008 & CJUNO *et al.* 2009 (Wild Peruvian collections)

0.13% mescaline (From a clone collected by Paul Hutchison)
OGUNBEDEDE 2010

[Both accounts above analyzed dried outer green tissues.]

The monstrose form has been reported to be mescaline containing in human bioassay.

20 inches was described as being of “medium strength”
(Correspondent requesting anonymity)

***Trichocereus purpureopilosus* WEINGART**

Tyramine (10-50% of 10-50 mg of total alkaloids/ 100 grams fresh) AGURELL *et al.* 1971b

N-Methyltyramine (10-50% of 10-50 mg of total alkaloids/ 100 grams fresh) AGURELL *et al.* 1971b [Obtained via commercial source in the Netherlands]

***Trichocereus riomizquiensis* Ritter**

0.40% grown from Ritter's seed (FR 856)

OGUNBEDEDE 2010 (dried outer green tissue)

***Trichocereus santaensis* RAUH & BACKEBERG**

Successful bioassay reported by source requesting anonymity.

0.31% Mescaline. Mancos, Yungay, Ancash

CJUNO *et al.* 2009 (Wild Peruvian collection.)

0.32% (using **OST 92701** seed-grown in cultivation.)

OGUNBEDEDE 2010

(Everything above using dried outer green tissue.)

PALOMINO's 1972 dissertation details the process he used for isolating alkaloids and describes their physiological effects on mice (with results that were strongly reminiscent of the comments in CRUZ SANCHEZ 1948)

He described *Trichocereus santaensis* as being of “low toxicity.” (Meaning low alkaloid?) Oddly, it never mentioned how he identified the plant or what the alkaloids were.

Our thanks to Dr. Carlos Ostolaza for completing the details concerning this obscure paper.

***Trichocereus santiaguensis* (SPEGAZZINI) BACKEBERG**

Hordenine (10-50% of the 1-10 mg of total alkaloids/ 100 grams fresh) AGURELL *et al.* 1971b [commercial sources in Germany & the Netherlands]

Tyramine (10-50% of 1-10 mg of total alkaloids/ 100 grams fresh) AGURELL *et al.* 1971b

Trichocereus santiaguensis is considered to be conspecific with *T. spachianus*. HUNT 2006

***Trichocereus schickendantzii* (WEBER) BRITTON & ROSE**

N-Methyltyramine (trace) AGURELL 1969b

Hordenine (over 50% of 1-10 mg total alkaloids/ 100 gm fresh) AGURELL 1969b [Obtained via European commercial sources]

***Trichocereus schoenii* RAUH & BACKEBERG**

Mescaline was isolated from three wild Peruvian collections:

0.22% Cotahuasi, La Unión, Arequipa (June)

0.20% Pampacola, Castilla, Arequipa (July)

0.14% Huambo, Arequipa (April)

All of above from SERRANO 2008 & CJUNO *et al.* 2009 (dried outer green tissue; all percentages by dry weight)

See also the work of CHOQUENAIRA *et al.* 2007

Trichocereus schoenii is now merged with *T. cuzcoensis*.

***Trichocereus scopulicola* RITTER**

0.85% Grown from **FR 991** seed by NMCR

OGUNBEDEDE 2010 (dried outer green tissue)

Despite some earlier attempts to reject this as an invalid species, Hunt recognizes it as a valid *Echinopsis* species: *Echinopsis scopulicola* (RITTER) MOTTRAM - presenting as the describer someone who has neither written nor published a taxonomic description! [Personal communication with Roy Mottram]

First demonstrated to contain mescaline based on human bioassays.

See **Activity Notes**.

T. scopulicola is presently suspected of being extinct in the wild.

Trichocereus scopulicolus RITTER See as *Trichocereus scopulicola* RITTER.

This descriptionless name appeared in Backeberg's *Cactus Lexicon*, seemingly to bring the spelling into line with the other *Trichocereus* species. Backeberg commented that no description was available. Evidently his dislike/hatred of Ritter caused him to not be able to obtain any of Ritter's three published descriptions.

***Trichocereus skottsbergii* BACKEBERG**

N-Methyltyramine (1-10% of 10-50 mg of total alkaloids/ 100 grams fresh) AGURELL *et al.* 1971b

Hordenine (Over 50% of the 10-50 mg of total alkaloids/ 100 grams fresh) AGURELL *et al.* 1971b [Obtained via commercial source in Germany]

Trichocereus smrsonianus Reported to be "psychoactive" but "different than *San Pedro*" ANONYMOUS in correspondence 1998. Needs an analysis.

***Trichocereus spachianus* (LEMAIRE) RICCOBONO**

AKA "White torch"

Tyramine (trace) MATA *et al.* 1972, also reported in MATA & McLAUGHLIN 1976. Not observed by AGURELL 1969b.

N-Methyltyramine (0.007% dry wt.) MATA *et al.* 1972, also reported in MATA & McLAUGHLIN 1976; Not observed by AGURELL 1969b

Hordenine (over 50% of 1-10 mg total alkaloids/ 100 gm fresh) AGURELL 1969b [Obtained via European commercial sources]. Also reported in MATA & McLAUGHLIN 1976 [The cited reference MATA *et al.* 1980 (which appears listed for this compound) actually intended to indicate MATA & McLAUGHLIN 1980 but it does not include this species]

Candicine (??) RETI 1950, RETI 1954 & RETI & CASTRILLON: all citing private communication from HAAGEN-SMIT & OLIVIER. [AGURELL 1969b & MATA & McLAUGHLIN 1976 have been listed with regards to this compound but neither detected it. AGURELL specifically did not look for quaternary compounds; both simply mentioned a prior report.]; 0.093% by dry weight: DAVIS *et al.* 1983

[Mescaline has been **erroneously** listed for this species; the reference cited, PUMMANGURA & McLAUGHLIN 1982, [i.e. PUMMANGURA *et al.* 1982a] specifically stated that they DID NOT detect the presence of mescaline.]

Reported to contain Kaempferol & Quercetin (Flavonols) RICHARDSON 1978 (based on acid hydrolysis).

See comments in **Activity Notes**.

***Trichocereus* sp. N.Chile (TORRES & TORRES)**

Presence of Mescaline has been proven by human bioassay

TORRES & TORRES 1995

Lacking published analysis.

***Trichocereus* sp. SS02** (a *T. bridgesii* form) Reported to be a reliably effective form in multiple human bioassays; presence of mescaline demonstrated in GC-MS (seemingly as sole alkaloid?) Needs taxonomic study and an analysis.

ANONYMOUS 1999 & 2000.

There are many named and unnamed *Trichocereus* cultivars, forms or maybe even some species that are in need of analysis and/or have been determined to be active in human bioassays.

See **Part B San Pedro** for details and many images.

The book is available and there is a pdf download at <http://troutnotes.com/pdf/SP.pdf>

***Trichocereus strigosus* (SALM-DYCK) BR. & R.**

Tyramine (trace) NIETO *et al.* 1982

Hordenine (Sole alkaloid present. 10-50 mg/ 100 grams fresh: AGURELL *et al.* 1971b [Commercially obtained greenhouse material grown in Germany]. (0.139% dry wt.: NIETO *et al.* 1982)

Mescaline (trace) NIETO *et al.* 1982

Candicine (0.11% dry wt.) NIETO *et al.* 1982 [Material from Argentina; Medoza and San Juan provinces]

[One unidentified base also reported. NIETO *et al.* 1982]

***Trichocereus tacnaensis* RITTER** Needs an analysis Considered a synonym of *T. peruvianus* by Hunt

***Trichocereus tacaquirensis* (VAUPEL) CARDENAS ex BACKEBERG** Needs an analysis. *Trichocereus taquimbalensis* CARDENAS is now considered a subspecies of *E. tacaquirensis* by Hunt.

***Trichocereus taquimbalensis* CARDENAS**

3-Methoxytyramine. (trace)

Hordenine (1-10% of 10-20 mg total alkaloid/ 100 gm)

3,4-Dimethoxyphenethylamine (trace)

Mescaline (5-25+ mg. per 100 grams)

AGURELL *et al.* 1971b [Obtained via commercial source in the Netherlands] (all % are as **fresh weight**)

See comments in **Activity Notes**.

***Trichocereus terscheckii* (PARMENTIER) BRITTON & ROSE**

92-95% water by weight RETI & CASTRILLÓN 1951
Total alkaloid content varied between 0.25-1.2% dry wt.
RETI & CASTRILLÓN 1951 [Collected from the wild in Argentina]
3,4-Dimethoxyphenethylamine Observed as minor alkaloid by Shulgin in GC-MS
N-Methyl- 3,4-dimethoxyphenethylamine Observed as minor alkaloid by Shulgin in GC-MS
N,N-Dimethyl-3,4-dimethoxyphenethylamine Observed as minor alkaloid by Shulgin in GC-MS
Mescaline (5-25+ mg. per 100 grams fresh.) (Major alkaloid) AGURELL 1969b [Obtained via European commercial sources]; [Also noted in AGURELL 1969a: "contains rather exclusively mescaline"] (Minor alkaloid [Reported a yield of 4 gm. from 10 kg. dry: 0.04% dry wt]; sometimes entirely absent in higher alkaloid material) RETI & CASTRILLÓN 1951. Found to be the major alkaloid by Shulgin in GC-MS (material from NW Argentina)
N-Methylmescaline Observed by Shulgin in GC-MS
N,N-Dimethylmescaline (Trichocereine) Major alkaloid (5:1 ratio with mescaline). RETI & CASTRILLÓN 1951. [Not observed by AGURELL 1969b. Observed by Shulgin in GC-MS.]
Anhalonine (trace detected) RETI & CASTRILLÓN 1951. Shulgin unable to detect in GC-MS
Needs further analysis. Unpublished GC-MS has variously shown mescaline as the only alkaloid, the major of multiple alkaloids or only a minor alkaloid.
(Conflicting analysis seems to be the norm. An hplc example taken from the Internet: 0.061% [sic] mescaline content by dry wt. Of 0.72% total alkaloid: 16% was mescaline [0.11%], 44% was Anhalonine or some PEA 0.32[%], 30% was either methyl or dimethyl mescaline [0.22%] and 10% was an unidentified PEA [0.07%]. There appears to be mathematical errors in this account so it should all be viewed with caution. For instance 16% of 0.72 is 0.11 not 0.061)
The claim of DMT being in this cactus resulted from an unfortunate **typo** by Schultes & Hofmann; intending N,N-Dimethylmescaline **not** N,N,-Dimethyltryptamine. This **error** has sadly taken on a life of its own via the counterculture rumor mills.

See comments in **Activity Notes**.

***Trichocereus thelegonoides* (SPEGAZZINI) BRITTON & ROSE**

Hordenine (Sole alkaloid; 10-50 mg/ 100 grams fresh)
AGURELL *et al.* 1971b [Obtained via commercial source in Germany]
Mescaline (traces) SINISCALCO 1983. **Not** detected by AGURELL *et al.* 1971b.

***Trichocereus thelegonus* (WEBER) BRITTON & ROSE**

N-Methyltyramine (trace) AGURELL *et al.* 1971b
Hordenine (Over 50% of the 10-50 mg of total alkaloids/ 100 grams fresh) AGURELL *et al.* 1971b [Obtained via the Kew Royal Botanical Gardens & a commercial source in Germany]

Trichocereus torataensis RITTER Needs an analysis Considered a synonym of *T. peruvianus* by Hunt

***Trichocereus tulhuayacensis* OCHOA**

Claim for the presence of mescaline is made by CAYCHO JIMENEZ 1977 (page 91) but he cites no reference to support his assertion.

See comments in **Activity Notes**.

***Trichocereus tunariensis* CARDENAS**

Tyramine (10-50% of 10-50 mg of total alkaloids/ 100 grams fresh) AGURELL *et al.* 1971b
Hordenine (10-50% of the 10-50 mg of total alkaloids/ 100 grams fresh) AGURELL *et al.* 1971b [Obtained via commercial source in the Netherlands]

***Trichocereus uyupampensis* BACKEBERG**

0.053% OGUNBEDEDE 2010

UC records indicated this was grown from a clone deposited at Monaco by Backeberg. (Analysis using dried outer green tissue)

I presently (2012) believe this plant to be misidentified. The results of the analysis performed by Ogunbodede were accurate but the identification of this species by Monaco was not.

***Trichocereus validus* (MONVILLE) BACKEBERG**

Mescaline (Over 25 mg. per 100 grams fresh.) AGURELL *et al.* 1971b [Obtained via the Kew Royal Botanical Gardens]
Note that there are SEVERAL unrelated plants stuffed into this name as represented in horticulture. NOT synonymous with *Echinopsis valida* which is short and clumping. It has been uselessly redesignated as *Echinopsis* sp. by Hunt. The stout, taller columnar form apparently rarely offsets, and is MOST LIKELY what was analyzed by Agurell. Its not possible to know with any certainty.

Seemingly without further comment or a reference, HUNT inexplicably refers to this as = *?T. uyupampensis*.

Echinopsis forbesii was said to be synonymous with *Echinopsis valida* MONVILLE by BRITTON & ROSE

Trichocereus terscheckii was said to be synonymous with *Echinopsis valida* MONVILLE in KREUZINGER 1935

***Trichocereus vollianus* BACKEBERG**

Mescaline (traces by dry weight)
SINISCALCO 1983

Trichocereus volcanensis Lack an analysis

***Trichocereus werdermannianus* BACKEBERG**

Tyramine (trace) AGURELL 1969a and 1969b
3-Methoxytyramine (trace) AGURELL 1969b
3,4-Dimethoxyphenethylamine (1-10% of 10-50 mg total alkaloids/ 100 gm fresh) AGURELL 1969b [Obtained via European commercial sources]
4-Hydroxy-3,5-dimethoxyphenethylamine (trace)
AGURELL 1969b; (0.1% of total alkaloid) AGURELL 1969a

Mescaline (5 to 25+ mg. per 100 grams fresh.) AGURELL 1969a and 1969b

[3,4-diMeO-5-OH-PEA is also listed, **in error**, for this species. Neither AGURELL 1969 nor T.A. SMITH 1977, the references cited, reported this compound.]

Human bioassays have found this species to be highly variable; it is claimed that some are active and others are not. ANONYMOUS source relayed via MS SMITH 1998

Reported in some human bioassays to be 2-3X as strong as *T. pachanoi*. 1998 *Entheogen Review* 7 (3): 70-71.

According to David Hunt's CITES Cactaceae Checklist *werdermannianus* no longer existed and was absorbed into *terscheckii*. This was done apparently without further comment and with no reference to any source that did not keep them separated.

In Hunt's Cactus Lexicon they reappeared as separate species. Patching the hole in the Rules of Nomenclature which permits this type of casual publication of taxonomic nomenclatural decision making will be required if cactus taxonomy is ever to become a branch of science. It is often regarded as science but the reality is that taxonomy needs to require the same proofs or reference to published reasoning that is demanded by good science.

In this case we can only scratch our head and wonder.

Amusingly, almost as fast as ANDERSON published the merger in *The Cactus Family*, some botanical gardens such as UC changed the name tags on their *werdermannianus* specimens.

Tunilla soehrensii (BRITTON & ROSE) D.R.HUNT & ILIFF See as *Tephrocactus soehrensii*

A comment on the state of the genus Turbinicarpus.

Many members of this genus has been repeatedly shuffled and recombined as various varieties, subspecies and forms of each other with seemingly little to no agreement with earlier workers.

This seemingly constant revision with its novel recombinations of former species within one species or another (and the repetition of the same but with totally different subspecific assignments) is a major source of the confusion in horticulture; (especially among those growers who disdain the use of trinomials).

It is also a major source of the assorted labeling inconsistencies that the careful reader will notice below. We have left all *Turbinicarpus* depicted AS they were labeled (altering only their subspecific placements for the sake of uniformity) since all are either in the collections of serious *Turbinicarpus* collectors/growers or botanical gardens. We are certainly not qualified to sort out the taxonomic mess known as the genus *Turbinicarpus* but look forward to the day that DNA work begins to help set it on a more sound basis.

Our choices of synonyms used do not indicate our agreement with them, we have simply attempted to present this in a manner enabling the reader to see what analytical work has been done. We suggest that any taxonomic treatments of the genus or relationships within it be viewed with a healthy dose of caution pending DNA work.

Another problematic issue regards the fact that most of the Turbos are highly variable based on conditions of growth and that European labelings frequently conflict with the presented identifications of North American horticultural material.

We therefore present the following, largely, as they were labeled. *Caveat lector!*

***Turbinicarpus alonsoi* Glass & Arias**

(% dry weight)

N-Methyltyramine (0.0052 ± 0.0008%)

Hordenine (0.0048 ± 0.0008%)

N-Methyl-3,4-dimethoxyphenethylamine (0.0020 ± 0.0005%)

Pellotine (0.0075 ± 0.0009%)

ŠTARHA *et al.* 1999b

[All *Turbinicarpus* species analyzed by Dr. Štarha were seed grown in Czechoslovakian greenhouses.]

Turbinicarpus bonatzii G.Frank Needs an analysis.

Turbinicarpus dicksoniae (Glass & Foster) Glass & Hofer See as

Turbinicarpus schmiedickeanus ssp. dicksoniae

Turbinicarpus flaviflorus G.Frank & Lau See as ***Turbinicarpus***

schmiedickeanus ssp. flaviflorus

Turbinicarpus gracilis Glass & Foster See as ***Turbinicarpus***

schmiedickeanus ssp. gracilis

Turbinicarpus hoferi Luethy & Lau Needs an analysis.

Turbinicarpus laui Glass & Foster Needs an analysis.

Turbinicarpus jauernigii G.FRANK Needs an analysis.

Turbinicarpus klinkerianus BACKEBERG & H.J.JACOBSEN See as

Turbinicarpus schmiedickeanus ssp. klinkerianus

Turbinicarpus krainzianus (G.FRANK) BACKEBERG See as ***Turbinicarpus***

pseudomacrochele ssp. krainzianus

Turbinicarpus krainzianus VAR. *MINIMUS* See as ***Turbinicarpus***

pseudomacrochele ssp. krainzianus f. minima

Turbinicarpus lausseri Needs an analysis.

Turbinicarpus lilinkeudus Needs an analysis.

***Turbinicarpus lophophoroides* (WERDERMANN) BUXBAUM & BACKEBERG**

Phenethylamine (1.04% [± 0.27] of total alkaloid fraction of Over 500 mg total alkaloids per 100 gm of fresh plant)

Tyramine (1.82% [± 0.17] of total alkaloid fraction of Over 500 mg total alkaloids per 100 gm of fresh plant)

N-Methyltyramine (0.13% [± 0.11] of total alkaloid fraction of Over 500 mg total alk./ 100 gm of fresh)

Hordenine (91.69% [± 0.54] of total alkaloid fraction of Over 500 mg total alkaloids per 100 gm of fresh plant)

Mescaline (Trace detected)

N-Methylmescaline (0.51% [± 0.11] of total alkaloid fraction of Over 500 mg total alk./ 100 gm of fresh)

N,N-Dimethylmescaline (Trace detected)

O-Methylanhalidine (0.55% [± 0.02] of total alkaloid fraction of over 500 mg total alk./ 100 gm of fresh)

Cactus Chemistry: By Species

Anhalinine (0.15% [\pm 0.08] of total alkaloid fraction of Over 500 mg total alkaloids per 100 gm of fresh plant)
Anhalonidine (2.37% [\pm 0.12] of total alkaloid fraction of Over 500 mg total alkaloids per 100 gm of fresh plant)
Pellotine (0.46% [\pm 0.08] of total alkaloid fraction of Over 500 mg total alkaloids per 100 gm of fresh plant)

ŠTARHA *et al.* 1999c

Turbinicarpus lophophoroides ssp. *jauernigii* (FRANK) BATTALIA &

ZANOVELLO See as *Turbinicarpus jauernigii*

Turbinicarpus macrochele (WERDERMANN) BUXBAUM & BACKEBERG

See as *Turbinicarpus schmiedickeanus* ssp. *macrochele*

Turbinicarpus macrochele ssp. *macrochele* var. *polaskii* P. LECHNER

& JANTSCHGI See as *Turbinicarpus schmiedickeanus* f. *polaskii*

Turbinicarpus macrochele var. *schwarzii* f. *polaskii* KLADIWA See

as *Turbinicarpus schmiedickeanus* f. *polaskii*

Turbinicarpus polaskii BACKEBERG See as *Turbinicarpus*

schmiedickeanus f. *polaskii*

Turbinicarpus panarito Needs an analysis.

***Turbinicarpus pseudomacrochele* (BACKEBERG)**

F. BUXBAUM & BACKEBERG

Hordenine (Sole alkaloid. 1-10 mg of total alkaloids/ 100 gm. fresh.) BRUHN & BRUHN 1973

***Turbinicarpus pseudomacrochele* ssp. *krainzianus* (G. FRANK) GLASS & FOSTER**

Phenethylamine (1.12% [\pm 0.13] of total alkaloid fraction of 250-500 mg total alkaloids per 100 gm of fresh plant)

Tyramine (0.98% [\pm 0.18] of total alkaloid fraction of 250-500 mg total alkaloids per 100 gm of fresh plant)

N-Methyltyramine (Trace detected) [Not listed in Štarha 2001c]

Hordenine (49.60% [\pm 0.55] of total alkaloid fraction of 250-500 mg total alkaloids per 100 gm of fresh plant)

Mescaline (2.48% [\pm 0.19] of total alkaloid fraction of 250-500 mg total alkaloids per 100 gm of fresh plant)

N-Methylmescaline (3.27% [\pm 0.09] of total alkaloid fraction of 250-500 mg total alk./ 100 gm of fresh)

N,N-Dimethylmescaline (2.89% [\pm 0.15] of total alkaloid fraction of 250-500 mg total alk./ 100 gm of fresh)

[Candicine is also listed in Štarha 2001c but the only citation given is Štarha *et al.* 1999c which does not support it.]

O-Methylanhalidine (0.77% [\pm 0.04] of total alkaloid fraction of 250-500 mg total alk./ 100 gm of fresh)

Anhalinine (29.24% [\pm 0.04] of total alkaloid fraction of 250-500 mg total alkaloids per 100 gm of fresh plant)

Anhalonidine (2.44% [\pm 0.13] of total alkaloid fraction of 250-500 mg total alkaloids per 100 gm of fresh plant)

Pellotine (0.36% [\pm 0.08] of total alkaloid fraction of 250-500 mg total alkaloids per 100 gm of fresh plant)

ŠTARHA *et al.* 1999c

Dehydrogeosmin - Minor volatile in floral scent.

Sesquiterpene alcohol 1 - Trace volatile in floral scent.

Sesquiterpene alcohol 2 - Minor volatile in floral scent.

SCHLUMBERGER *et al.* 2004 (in tepals; gc-ms)

***Turbinicarpus pseudopectinatus* (BACKEBERG) GLASS & FOSTER**

Hordenine (Over 50% of over 50 mg of total alkaloids/ 100 gm. fresh.) BRUHN & BRUHN 1973

Phenethylamine (0.98% [\pm 0.12] of total alkaloid fraction of over 500 mg total alkaloids per 100 gm of fresh plant)

Tyramine (3.18% [\pm 0.19] of total alkaloid fraction of over 500 mg total alkaloids per 100 gm of fresh plant)

N-Methyltyramine (25.15% [\pm 1.21] of total alkaloid fraction of over 500 mg total alkaloids per 100 gm of fresh plant)

Hordenine (62.11% [\pm 2.42] of total alkaloid fraction of over 500 mg total alkaloids per 100 gm of fresh plant)

N-Methylmescaline (1.11% [\pm 0.13] of total alkaloid fraction of over 500 mg total alkaloids per 100 gm of fresh plant)

N,N-Dimethylmescaline (Trace detected)

O-Methylanhalidine (1.92% [\pm 0.15] of total alkaloid fraction of over 500 mg total alkaloids per 100 gm of fresh plant)

Anhalinine (2.88% [\pm 0.15] of total alkaloid fraction of over 500 mg total alkaloids per 100 gm of fresh plant)

ŠTARHA *et al.* 1999 (*P. pseudopectinata* was analyzed as *Turbinicarpus* synonym. Seed grown in Czechoslovakia)

Turbinicarpus roseiflorus (BACKEBERG) G. FRANK Needs an analysis.

***Turbinicarpus schmiedickeanus* (BÖDEKER) BUXBAUM & BACKEBERG**

Also encountered *schmiedeckianus*; we used the spelling of GLASS & FOSTER 1977

Phenethylamine (1.1% [\pm 0.12] of total alkaloid fraction of 100-250 mg total alkaloids per 100 gm of fresh plant)

Tyramine (5.46% [\pm 0.14] of total alkaloid fraction of 100-250 mg total alkaloids per 100 gm of fresh plant)

N-Methyltyramine (Trace detected) [Not listed in Štarha 2001c]

Hordenine (43.02% [\pm 1.86] of total alkaloid fraction of 100-250 mg total alkaloids per 100 gm of fresh plant)

N-Methylmescaline (1.02% [\pm 0.21] of total alkaloid fraction of 100-250 mg total alkaloids per 100 gm of fresh plant)

N,N-Dimethylmescaline (Trace detected)

O-Methylanhalidine (2.76% [\pm 0.42] of total alkaloid fraction of 100-250 mg total alkaloids per 100 gm of fresh plant)

Anhalinine (17.19% [\pm 1.00] of total alkaloid fraction of 100-250 mg total alkaloids per 100 gm of fresh plant)

Anhalonidine (19.86% [\pm 1.41] of total alkaloid fraction of 100-250 mg total alkaloids per 100 gm of fresh plant)

Pellotine (9.02% [\pm 0.06] of total alkaloid fraction of 100-250 mg total alkaloids per 100 gm of fresh plant)

ŠTARHA *et al.* 1999c

Turbinicarpus schmiedickeanus* ssp. *dickisoniae
(GLASS & FOSTER) N.P.TAYLOR

Phenethylamine (1.70% \pm 0.15) of total alkaloid fraction of 250-500 mg total alkaloids per 100 gm of fresh plant)
Tyramine (2.59% \pm 0.13) of total alkaloid fraction of 250-500 mg total alkaloids per 100 gm of fresh plant)
N-Methyltyramine (0.51% \pm 0.02) of total alkaloid fraction of 250-500 mg total alkaloids per 100 gm of fresh plant)
[Not listed in Štarha 2001c]
Hordenine (42.45% \pm 0.45) of total alkaloid fraction of 250-500 mg total alkaloids per 100 gm of fresh plant)
[Mescaline is also listed in Štarha 2001c but the only citation given is ŠTARHA *et al.* 1999c]
[N-Methylmescaline is also listed in Štarha 2001c but the only citation given is ŠTARHA *et al.* 1999c]
O-Methylanhalidine (1.42% \pm 0.30) of total alkaloid fraction of 250-500 mg total alkaloids per 100 gm of fresh plant)
Anhalinine (2.78% \pm 0.31) of total alkaloid fraction of 250-500 mg total alkaloids per 100 gm of fresh plant)
Anhalonidine (22.70% \pm 1.14) of total alkaloid fraction of 250-500 mg total alkaloids per 100 gm of fresh plant)
Pellotine (19.33% \pm 0.28) of total alkaloid fraction of 250-500 mg total alkaloids per 100 gm of fresh plant)
ŠTARHA *et al.* 1999c

Turbinicarpus schmiedickeanus* ssp. *flaviflorus
(FRANK & LAU) GLASS & FOSTER

Phenethylamine (1.01% \pm 0.21) of total alkaloid fraction of 100-250 mg total alkaloids per 100 gm of fresh plant)
Tyramine (3.08% \pm 0.08) of total alkaloid fraction of 100-250 mg total alkaloids per 100 gm of fresh plant)
N-Methyltyramine (Trace detected) [Not listed in Štarha 2001c]
Hordenine (92.05% \pm 0.71) of total alkaloid fraction of 100-250 mg total alkaloids per 100 gm of fresh plant)
Mescaline (Trace detected)
N-Methylmescaline (Trace detected)
O-Methylanhalidine (2.89% \pm 0.46) of total alkaloid fraction of 100-250 mg total alkaloids per 100 gm fresh)
Anhalinine (Trace detected)
Anhalonidine (0.88% \pm 0.12) of total alkaloid fraction of 100-250 mg total alkaloids per 100 gm of fresh plant)
Pellotine (0.15% \pm 0.07) of total alkaloid fraction of 100-250 mg total alkaloids per 100 gm of fresh plant)
ŠTARHA *et al.* 1999c

Turbinicarpus schmiedickeanus* ssp. *gracilis
(GLASS & FOSTER) GLASS

Tyramine (4.98 \pm 0.28% of total alkaloid content)
N-Methyltyramine (trace)
Hordenine (48.15 \pm 0.97% of total alkaloid content)
O-Methylanhalidine (2.48 \pm 0.42% of total alkaloid content)
Anhalinine (20.69 \pm 1.12% of total alkaloid content)
Pellotine (7.92 \pm 0.56% of total alkaloid content)
Anhalonidine (trace)
Štarha 2001c cited Štarha 2001b

Turbinicarpus schmiedickeanus* ssp. *klinkerianus
(BACKEBERG & JACOBSON) N.P.TAYLOR

Tyramine (2.95 \pm 0.15% of total alkaloid content)
N-Methyltyramine (trace)
Hordenine (52.15 \pm 0.40% of total alkaloid content)
N-Methylmescaline (trace)
O-Methylanhalidine (2.78 \pm 0.40% of total alkaloid content)
Anhalinine (37.15 \pm 0.90% of total alkaloid content)
Pellotine (0.43 \pm 0.15% of total alkaloid content)
Anhalonidine (trace)
Štarha 2001c cited Štarha *et al.* 2000

Turbinicarpus schmiedickeanus ssp. *klinkerianus* f. *schwarzii* (Shurly) Panarotto *See as* *Turbinicarpus schmiedickeanus* ssp. *schwarzii*

Turbinicarpus schmiedickeanus* ssp. *macrochele
(WERDERMANN) GLASS & FOSTER

Tyramine (2.90 \pm 0.15% of total alkaloid content)
N-Methyltyramine (trace)
Hordenine (49.01 \pm 1.38% of total alkaloid content)
O-Methylanhalidine (2.50 \pm 0.30% of total alkaloid content)
Anhalinine (35.42 \pm 0.85% of total alkaloid content)
Pellotine (0.03 \pm 0.10% of total alkaloid content) [Given on p. 89 but not included in its by-species listing on p. 52)
Anhalonidine (trace)
Štarha 2001c cited Štarha 2001b

Turbinicarpus schmiedickeanus* f. *polaskii

Tyramine (2.93 \pm 0.20% of total alkaloid content)
N-Methyltyramine (trace)
Hordenine (49.11 \pm 1.18% of total alkaloid content)
O-Methylanhalidine (2.58 \pm 0.25% of total alkaloid content)
Anhalinine (36.88 \pm 0.92% of total alkaloid content)
Pellotine (0.38 \pm 0.10% of total alkaloid content) [Given on p. 89 but not included in its by-species listing on pp. 51-52)
Anhalonidine (trace)
Štarha 2001c cited Štarha 2001b

Turbinicarpus schmiedickeanus ssp. *rubriflorus* (SHURLY) PANAROTTO *See as* *Turbinicarpus schmiedickeanus* ssp. *schwarzii* f. *rubriflorus*

Turbinicarpus schmiedickeanus* ssp. *schwarzii
(SHURLY) N.P.TAYLOR

Phenethylamine (1.07% \pm 0.42) of total alkaloid fraction of 250-500 mg total alkaloids per 100 gm of fresh plant)
Tyramine (2.92% \pm 0.25) of total alkaloid fraction of 250-500 mg total alkaloids per 100 gm of fresh plant)
N-Methyltyramine (Trace detected) [Not listed in Štarha 2001c]
Hordenine (48.81% \pm 2.72) of total alkaloid fraction of 250-500 mg total alkaloids per 100 gm of fresh plant)
Mescaline (1.26% \pm 0.21) of total alkaloid fraction of 250-500 mg total alkaloids per 100 gm of fresh plant)
N-Methylmescaline (0.98% \pm 0.24) of total alkaloid fraction of 250-500 mg total alkaloids per 100 gm fresh)

N,N-Dimethylmescaline (Trace detected) [Not listed in Štarha 2001c]

O-Methylanhalidine (2.82% [\pm 0.41] of total alkaloid fraction of 250-500 mg total alkaloids per 100 gm fresh)

Anhalinine (39.57% [\pm 1.14] of total alkaloid fraction of 250-500 mg total alkaloids per 100 gm of fresh plant)

Anhalonidine (0.52% [\pm 0.11] of total alkaloid fraction of 250-500 mg total alkaloids per 100 gm of fresh plant)

Pellotine (0.41% [\pm 0.11] of total alkaloid fraction of 250-500 mg total alkaloids per 100 gm of fresh plant)

ŠTARHA *et al.* 1999c

The former members of *Wigginsia* have been placed in *Parodia*.

Turbinicarpus schmidickeanus* ssp. *schwarzii* f. *rubriflorus

Tyramine (2.90 \pm 0.12% of total alkaloid content)

Hordenine (48.99 \pm 0.40% of total alkaloid content)

O-Methylanhalidine (2.51 \pm 0.25% of total alkaloid content)

Anhalinine (37.58 \pm 1.83% of total alkaloid content)

Pellotine (0.33 \pm 0.10% of total alkaloid content)

Štarha 2001c: the actual primary source citation is unclear to me. (It was not given separately in the by-species listing.

The data above appears on page 89. The by-species listing for *schwarzii* appears to imply that Štarha 1999 and/or Štarha *et al.* 1999c was the reference(s) BUT neither one is listed for O-Methylanhalidine or for Pellotine in the by-species entry on page 52.)

Turbinicarpus schwarzii (SHURLY) BACKEBERG

See as *Turbinicarpus schmidickeanus* var. *schwarzii*

Turbinicarpus swoboda Diers & Esteves Pereira

Needs an analysis.

Turbinicarpus valdezianus (MOELLER) GLASS & FOSTER

Needs an analysis.

Wigginsia arechavaletai

Mucilage determined to be comprised of Arabinose (2.1%), Galactose (18.3%), Galacturonic acid (20.8%), Rhamnose (51.6%) & Xylose (2.7%).

MOYNA & DiFABIO 1978 (Analyzed MAM 1694)

***Wigginsia erinacea* (HAWORTH) D.M.PORTER**

Hordenine (%) DEVRIES *et al.* 1971

Mucilage polysaccharide was found to be 0.31% percentage of total weight of fresh plant.

Uronic acid content of polysaccharide: 51%

Rhamnose: arabinose, galactose (3.7:1:2.7)

MINDT *et al.* 1975

***Wigginsia macrocantha* (ARECHAULETA) D.M.PORTER**

Hordenine (%) DEVRIES *et al.* 1971

***Wigginsia tephrocantha* (LINK & OTTO) D.M.PORTER**

Hordenine (%) DEVRIES *et al.* 1971

Weddellite & α -quartz were identified as druses, bipyramids (few) & crystal sand (abundant).

MONJE & BARAN 2002

Activity (& Mythology) Notes

The word 'mythology' appears in the title for an important reason. In the section that follows many medical and ethnomedicinal applications are mentioned. This is historical information that has been collected from the literature and the inclusions should not be regarded or assumed to mean that they are accurate or appropriate or effective in their recorded applications. None of this should this be regarded as a recommendation to employ any of these for any application or to suggest how to treat any medical conditions. Or for that matter, for any reason. I believe that the error-to-fact ratio in this area of the published literature is disturbingly high. Ethnographic and anthropological accounts in particular may actually be mistakenly overlaying linear Western concepts onto comments made by nonlinear thinkers; especially when they assert hallucinogenic activity. If a worker reporting a particular claim did not include confirmation in the form of a known human bioassay, ideally their own so a meaningful report can be made, it needs to be regarded as only anecdotal hearsay. Some applications are better evaluated, even if they are just as poorly understood, such as the topical employment of a number of cacti as analgesics.

5 San Pedros

The "5 San Pedros" purportedly recognized by some Peruvian shamans (Personal communication with a correspondent in South America requesting anonymity)

Photos to the immediate right & occurring later herein were used with permission.

These plants were said to have been collected in the vicinity of Matucana, Peru except for the one on the far right which was purported to be a *bridgesii* from Huanuco.

Attempts to obtain live cuttings including the dark *pachanoi* second from the right procured the specimen that was analyzed by Ogunbodede.

See comments and images for the one second from the far left under *Haageocereus acranthus*

See comments and images for the one on the far right under *Lemaireocereus laetus* and *Lemaireocereus matucanense*.

I know little about them beyond the unconfirmed claim that they are said to be used by shamans in Peru as San Pedro. Additional photographs of the plants that were shipped from Peru are on the previous page.

Acanthocereus pentagonus

(This is now *Acanthocereus tetragonus*)

Antihelminthic activity (no detail or reference). SOULAIRE 1947

Has an edible fruit. STANDLEY 1924: 906-907

Aporocactus flagelliformis

Dried flowers are used for "heart affections" in the form of an infusion.

The juice of the stems is caustic and used internally as a vermifuge. This application is claimed to be dangerous.

STANDLEY 1924: 917

Pronounced antihelminthic activity.

Flower infusion is used in Mexico against eclampsia.

Flowers are sold in markets under the name *flor de cuerno* (horn flower.) Comments lacked details or references.

SOULAIRE 1947

Ariocarpus bravoanus

Lacks any published analysis.

Used for medicinal purposes MILLER 2000

Ethanol extract is used externally as analgesic in Mexico.

ANONYMOUS 2000

Ariocarpus bravoanus ssp. hintonii

Lacks published analysis.

Used as an externally applied analgesic in Mexico.

ANONYMOUS 2000

Ariocarpus fissuratus

"peyote cimarrón" (see comments below)

"sunami" (Tarahumara),

LUMHOLTZ 1902 claimed that an intoxicating drink was prepared from this species by the Tarahumares. The plant was said to be "even more powerful than waname" and used similarly. In the region of the headwaters of the Río Concho, PENNINGTON 1963 (p. 159) includes it as a "narcotic" cacti and noted that the expressed juice from *Ariocarpus fissuratus* was sometimes added to *tesguino* by the Tarahumana to "make the corn beer more enjoyable."

Calling it "peyote" HAVARD 1896 made a similar comment that it was eaten raw or added to liquor to increase the effects. It is not adequately clear though that Havard was not confusing this plant with West Texas peyote. STANDLEY 1924 also refers to the use of this name but says it is incorrect.

Older tubercles are said to be smoked in Mexico for "mildly hallucinogenic effects" lasting several hours.

ANONYMOUS 2000.

"Consumed fresh or ground in water, it was taken in the same manner as *Lophophora*. This "hikuli" was also used as a stimulant by the runners." BYE 1979

While peyote cimarrón *sensu* Thord-Gray would appear to be a different plant, this has become its common name both in Mexico and among Western drug users. (STANDLEY 1924 also gave this name) As recently as the late 1970s a person could find this cacti being offered for sale under that name by street vendors in Austin, Texas. While the anecdotal accounts of friends said they were the wrong plants that did not produce the same effects as peyote, they were being sold specifically intended for drug use purposes.

LUMHOLTZ 1902 also made the comment "Robbers are powerless to steal anything where Sunami calls soldiers"

Chewed and placed upon bruises, bites and wounds.

PENNINGTON 1963:186

Ariocarpus kotschoubeyanus

Ethanol extract of whole plant used externally as analgesic

for blows & bruises. <http://www.ariocarpus.tsnet.co.net> & www.bruntdemon.co.uk/cactus/mexico/img2054-55.html

Said to show some type of activity in human bioassay but to be “*more mild*” than *A. fissuratus*. ER 1999

Ariocarpus retusus

Used for fever. JOHNSON 1999

Reported to be smoked as a recreational inebriant similarly to *Ariocarpus fissuratus*.

The rare Huichol shaman is said to use 2 tubercles as an oral dose after a 5 year apprenticeship. ANONYMOUS 2000

STANDLEY 1924 notes the use of the name “*peyote*” but says that it is incorrect.

SOULAIRE 1947 commented that this species enjoys the same reputation in Mexico as *peyotl* but did not include a reference.

Huichol: *tsuwiri*

Furst comments that a person with an impure heart, meaning a person who has not properly purified himself prior to their peyote journey may be tricked into thinking this plant was peyote “*because it is capable of sorcery and deception.*”

Furst was told by Huichols it was “*very dangerous*” to eat. Interestingly saying a person “*who had a “Huichol heart”* would not be fooled into doing so.”

Furst described the effects as being *Datura*-like and characterized by unpleasant delusions ranging from terrifying hallucinations to obsessions with sexual partners who had not been properly confessed prior to the pilgrimage.

“*Afterwards they become more afflicted and frightened. Because they begin to see many things. Terrible, crazy things. Animals they see, animals which are poisonous... There before them a deep pit, very large, very dark. They jump into this pit, escaping from those animals. It is as if one had thrown these animals at them, great heaps of those snakes, great heaps of those scorpions, as if from a basketful of those animals. But no, there are no animals. There are no snakes. There are no scorpions. There is no pit. There is where he jumped, where he fell in his terror; there is no pit. Only the ground, only the sand with the cactus thorns which pierce him.*”

FURST 1971

Astrophytum asterias

Called “*peyote*” according to STANDLEY 1924

Sometimes collected by South Texas peyote distributors and given as good luck fetish to NAC members. Occasionally reported to be eaten by NAC members. TERRY 2007. Anecdotal accounts from drug users report this species to be inactive. One of several cactus species sold by Austin, Texas street vendors in the 1970s as “*peyote cimarrón*.”

Astrophytum capricorne

Antimicrobial activities studied in GARZA PADRÓN 2010.

Astrophytum myriostigma

Called “*peyote cimarrón*” (in Durango) STANDLEY 1924

Antimicrobial activities studied in GARZA PADRÓN 2010.

Jackrabbits are said to become visibly intoxicated from eating this plant and to develop a taste for it. ENTHEOGEN REVIEW 1998.

Brasiliopuntia brasiliensis

Roots have antipyretic properties.

The fruit gives a refreshing drink that is effective against scurvy.

Branches are used as a calming poultice for sciatica

Sap has been used for swelling of eyelids.

SOULAIRE 1947

An unidentified *Opuntia* species was claimed by Rivier & Lindgren to be incorporated into ayahuasca as an admixture called *tchai*. More recently Antonio Bianchi & Giorgio Samorini presented it to only be used alone, as a hallucinogen, due to the mixture being “*too strong*”. BIANCHI & SAMORINI 1993 included an image of the leaves on page 38 that suggested to this author that it was possibly a *Brasiliopuntia*.

Field work by R. Stuart in 2001 proved that the identity was *Brasiliopuntia brasiliensis*. Bob Wallace funded the research.

Stuart had been provided with the source’s contact information by Antonio Bianchi. Stuart went to Peru and undertook a course of introduction to the plant that was guided by the shaman. Stuart collected live material for propagation, and prepared herbarium vouchers - positively establishing the identity of the plant.

While in Peru Stuart also bioassayed it multiple times; first under guidance of the shaman and later independently. After repeated failures while working directly with the shaman, Stuart concluded anything he was experiencing was entirely due to the green tobacco that was being added to the expressed juice of the *tchai* leaf. Stuart tested this by secretly ingesting a much larger amount of the plant without tobacco and in combination with an MAOI.

Stuart proposed that the story may have been created to satisfy the questions of ethnobotanists desiring to be told of even more ayahuasca admixtures. Perhaps bolstered by noticing the ethnobotanists were not checking the claims with bioassays.

The interesting and entertaining account of his adventure can be found in the 2002 *Enthogen Review*.

Carnegeia gigantea

The saguaro is one of three plants that the Seri people of northwestern Mexico believe used to be human (FELGER & MOSER 1991).

There are ethnological reports of the saguaro being fermented into an intoxicating brew but none that reported it as hallucinogenic.

BRUHN 1971b discussed this 5% *alcoholic* drink made by the Papagos. Earlier in this century, DENSMORE 1929 was told by one native informant that the drink enabled him to receive songs but his other informants denied this.

BRUHN 1973 made a comment that it contains a potentially active alkaloid but that any indication of or reference to its use as a drug was lacking. Despite that, *Carnegeia gigantea*

has been rumored for many years to be a psychedelic plant.

A typical example is LEMMO 1977 which is clearly asserting claims about something that author has never actually tried. Reckless and sometimes sensational rhetoric is common in what few accounts exist; for instance Lemmo's assertion that a single fallen limb could feed an army of trippers.

Apparently very few people have tried it or else almost no one is reporting on what it did.

The biggest exception I'm aware of is a youtube video asserting that a footlong section of a rib holds enough of a dose for "*myself and some friends to enjoy the magic*".

That quote was from among the comments made by a person who appears to have first hand experience. It was taken from a youtube video posting on the "sugaro" by Daniel Vitalis. http://www.youtube.com/watch?v=6_-kNjwVO2g.

Incredibly Vitalis urges viewers to preserve the secret:

"So the Arizona state tree is a psychoactive plant. Shhhh!"

"We want to keep this kinda private."

If wanting to keep something private, posting a youtube video for the masses would not seem like it would be among the most effective approaches?

There were two positive accounts posted in response to that video but only one included details of the dose ingested. 2.5 tablespoons of the outer green layer sounded like a strong dose for that person and the physical distress he reported was echoed by several people online. One person at an online drug forum related a second-hand referenceless comment that 1 tablespoon of the green outer layer was believed to be a dose but included no more details.

Many aspects are reminiscent of Earl's account of the cardon. In particular, the seeming fact that almost no one, in this case except Vitalis, sounded like they had more than one experience with it.

In an article entitled "*Ever Tried This PsychoActive Cactus?*" posted on his website Daniel Vitalis comments: "*So, I was hesitant to leak this news.... but I just couldn't hold it in any longer!*"

"Yes, its true... the Arizona State Flower grows atop a Psychedelic Cactus!"

"This is one of those interesting Herbal Secrets that has been, all along, hidden right under our noses! When I was first told about this I could hardly believe it. The very Symbol of the Desert is a Mind Altering Herb!"

The responses to his online video are maybe the most intriguing part of this story.

The most common are people who insist the saguaro is not active (apparently based on never having heard this before); some are so certain of this they are aggressive, rude and hostile.

The second most common response is outrage for his cutting on a cactus that people loved.

Among the replies to Vitale's youtube video are two bioassay comments:

(typos left intact)

"I'm going to let everyone know, I ate the green inner bark. I felt the effects about 45 minutes after. It came on all at one and was so powerful it knocked me off my feet. Patterns of color everywhere, I saw my soul from the future if you can

imagine. My spirit was young, playful, and charming to say the least. My spirit and I didn't communicate with words.... But we were communicating. And the information he gave me was that life after death is by far the grandest adventure that could ever be experienced. He came to me out of a yellow void. He could have been easy to miss amongst all the colors and swirling patterns he was jumping up and down waiving his arms so that I could notice him!!! I had this experience today in the desert. Ate about two and a half tablespoons, threw up an hour later, had an anxiety attack, tried to walk back to my truck that was 2 miles away, took five steps and collapsed on all fours. I crawled to the nearest palo verde tree for shade and laid down. The effects were so nauseating I didn't care if I laid on a rattlesnake, scorpion, or cholla. I will always remember this experience."

Itsjames1

"I tried eating a couple tablespoons of the dark inner bark a year ago after seeing this video and reading the page on your website. I definitely noticed strong effects within half an hour of consumption. The world became extremely dreamlike and I drifted in and out of consciousness into a lucid dream state. (my first experience with lucid dreaming). Overall it was like no other psychoactive I've ever experienced, but the taste is worse than anything I've ever eaten."

pigmie1

Posted on an online drug forum:

"tried it once never again. My eye was twitching and I could feel if wiggle in a bad way when I looked around. Coordination totally fucked up. Felt like if was toxic to the nerves. My body was tense and shaking. Felt like I was starving but couldn't eat. I was completely restless and couldn't find a comfortable position. Kept getting the hiccups and feeling the cactus coming up. Finally puked. It feels like you have Parkinson's or something. Mild visuals with some weird auditory hallucinations. Feels toxic overall it's not worth it. Just thinking of that taste turns my stomach, that sandy textured bitter flesh."

Eek

In Voogelebreinder a comment in Ratsch (1998, 155) is noted:

"The Seri refer to saguaro as a peyote substitute, suggesting a possible psychoactive use for the plant, although no specifics concerning such a use are available."

Unfortunately Ratsch employs this statement as a photo caption without any comment or a pertinent reference.

Psychotropia quoted "The sap, which flows from the cactus when it has been wounded, is very bitter. When ingested, it typically produces nausea and dizziness (Bruhn & Lundstrom 1976, 197)." but that paper does not say that.

Conflict seemingly exists surrounding analytical reports concerning the alkaloids that are present in Saguaro (Suggesting a high degree of variability based on presently undefined factors). It may just be a matter of age and part analyzed but the question is one for a future worker to resolve.

For a summarized overview:

Gigantine was only reported in substantial amounts during

analysis of wild collected adult cacti and was found to be higher in the growing tips. (see BROWN *et al.* 1972)

BRUHN & LUNDSTRÖM 1976b reported isolating 22 mg of gigantine from 15 kilos of fresh material. It was not reported in greenhouse grown plants, nor in young plants that were being grown outdoors in Arizona. (see BRUHN *et al.* 1970).

BRUHN *et al.* 1970 and BRUHN & LUNDSTRÖM 1976) found salsolidine to be the major alkaloid, whereas BROWN *et al.* 1972 did not observe salsolidine in any samples they tested. They did all agree that carnegine was present in decent amounts.

Cephalocereus leucocephalus

Fruit used for producing *tesguino*.

PENNINGTON 1963

Corynopuntia reflexispina

Used traditionally for treating diarrhea. JOHNSON 1999

Cereus hexagonus

DUKE cites PITTIER for its use as diuretic and for enterrhagia.

Cereus jamaracu

DAVET 2005 reported some antimicrobial and antifungal activity.

Cereus peruvianus

There are references to this plant as being hallucinogenic and as containing Mescaline.

Both of those assertions are clearly in error.

ROUHIER 1927 is thusfar the earliest instance of the mistaken claim that I can locate.

From page 73:

“ Le *Cereus peruvianus* est le seul représentant de la famille des Cactacées, à côté naturellement du Peyotl, qui ait été utilisé par les Indiens dans le sorcellerie.”

=

“*Cereus peruvianus* is the only representative of the family of the Cactaceae, next to of course peyote, which has been used by the Indians in witchcraft”

The reference to COBO 1653: 451 on page 90 in ROUHIER where he equates this species with “*la diabolique huachuma*” clearly indicates that this was based entirely on confusion with San Pedro (*T. pachanoi*).

Rouhier’s mistake was repeated in HOBSCLETTE 1929, JACQUET 1934 and also in SOULAIRE 1947. Hobschette and Soulaire both included Cobo’s description which leaves no doubt that Cobo was discussing San Pedro.

See more details (and Cobo’s comments) in ***Sacred Cacti Part B. San Pedro***

Cereus quadrangularis

DUKE cited HARTWELL for its use in cancers.

Cereus repandus

DUKE lists uses for diarrhea and as shampoo or soap.

Corynopuntia reflexispina (WIGGERS & ROLLINSON)

BACKEBERG

Diarrhea. DUKE

Coryphantha compacta

Tarahumara names:

“*bakana*”; “*bakánawa*”; “*wichuri*”; “*Santa Polí*” (BYE 1979)

Bye reported finding this to be a powerful medicinal plant employed by Tarahumara shamans and feared by some of the Tarahumara. It was regarded as a form of hikuri and Bye suspects it to be referable to *bakanawa* in Bennett and Zingg.

While an analysis of the Tarahumara “*bakana*” was said to be underway in BYE 1979, the results were either not published or the analysis was not performed.

THORD-GRAY 1955 described “*baka-nawa*” as the most feared plant next to *hi-kuri* (p. 573)

“*This is a quite a common small ball-cactus, apparently inoffensive but considered very “powerful medicine”.*”

“*In certain sections of Tarahumaraland this plant is used in place of peyote.*” (THORD-GRAY 1955: 84)

“*..baka-nori has a ball shaped root and is used the same way. It may be the same plant.*” (THORD-GRAY 1955: 84)

The roots of both of these cacti are said to be “*chewed and then rubbed on the legs of the runners to make them light of foot.*” (THORD-GRAY 1955: 345) Its application is often topical.

Bennett & Zingg commented that it was a common ball cactus they were cautioned not to touch. Their informant said it was second only to hikuli in power. Later in their account they say “*The users consider this root more powerful than peyote.*”

It was said to be used as a cure by shamans but that it could not be kept for more than three years by any one individual and needs to be sold or hidden after that point.

“*The whole root is stirred in boiling water and used as a drink or application for many diseases. It is applied to the back for sickness in the lungs.*”

“*The small ball is chewed by the shaman, and the patient anointed with it wherever he feels pain.*” “*During a race the shaman continually chews a bit to have it ready for the runners who tire.*”

“*The plant is so strong that runners anoint themselves with it three days before an important race.*”

The plant is said to be used by shamans, not peyoteros. The shamans make special trips to obtain it. Bennett & Zingg were told that the plant must be harvested on Friday and smoked with incense. Anyone is permitted to harvest or carry the cactus but it is mostly used by the shamans. The shamans carry small bits of the root in their bags. The root has many uses.

“*Losing or burning one of the plants makes it very angry, and the offender is apt to become sick, turn crazy, or die. When one sleeps near the roots, he may hear singing as it moves*

about. By chewing it a bit, the singing becomes clearer.”

Coryphantha elephantidens

MS SMITH 2002 related that “A personal correspondent had observed *C. elephantidens* sold under the title of peyote in a Mexico City market. With a note of caution, my acquaintance went on to mention the possibility that many cacti, medicinal or not, are considered peyote to indigenous groups.”

From <http://www.cactus-mall.com/mss/old.html>

Coryphantha macromeris

RE:

Coryphantha macromeris (ENGELMANN) LEMAIRE
&

Coryphantha runyonii BRITTON & ROSE

Claims for mescaline’s presence in these two species appear in the literature **erroneously**.

BARCELEUX presents *C. macromeris* as a mescaline containing cacti for no clear reason other than perhaps thinking rumors of use indicate that mescaline is present.

This species is purported to be a mild hallucinogen in its own right for reasons other than mescaline.

The claim purporting hallucinogenic activity first appeared in OTT 1976 who cited his own unpublished lab notes and Jerry McLaughlin, unpublished data, as his references. Schultes & Hofmann included Ott’s observation in *Botany & Chemistry...* and in *Plants of the Gods*. However, in his later works Ott began citing Schultes & Hofmann’s secondary reference (to him!) and ceased to cite either himself or Dr. McLaughlin.

Coryphantha runyonii appears to be listed seemingly for nothing more than being considered to be a varietal form of *Coryphantha macromeris*. Its reported analysis is commonly merged with that of *C. macromeris* in phytochemical databases.

Neither species has ever been found to contain mescaline.

Some counterculture ‘new age’ churches (such as “Crystal”) have been established declaring *Coryphantha macromeris* as their sacrament. The literature we have seen suggests that they might be less than informed. We have been unable to locate even a single person who has actually tried it.

The plant is also rumored to be one fifth as strong as the peyote cactus. Which I suspect is due to a comparison of the mg/kg figures in the literature. This would place an effective dose in excess of two pounds of plant material; **if** thought of in terms of weight for weight equivalencies of cacti.

However, this is likely to be **in error** as it must be remembered that, while macromerine has been reported to be one-fifth the potency of mescaline, the reported percentage of occurrence is around one tenth that normally encountered in peyote for mescaline.

This implies that, IF it were active as a hallucinogen, **50 times** more plant material would be required, not 5. There is also the reality that this plant lacks a thorough analysis and one of the alkaloids noted as present but unidentified possesses MAOI capabilities. Shulgin proposed a “*cactihuasca*” potential for *Coryphantha* species based on reported MAOI properties of some of the *Coryphantha* alkaloids. (SHULGIN in a personal conversation during 2005)

We have, so far, been unable to find any other person who

has sampled this plant. Surely there must be someone which implies that either every single person who tried it found that it was so incredibly good they didn’t want to share it and independently suppressed the knowledge or else it was not worth bothering to recount. I’d lean towards the latter notion myself.

Mescaline would seem obvious as a preferable alternative, especially as current law potentially considers macromerine to be a controlled substance thanks to the modern blanket of illegality.

My only bioassay involved around half a pound (nearly half of one large and very old plant) harvested while frozen in mid-winter.

Nausea was pronounced and lengthy (far worse on both counts than with peyote), there was a distinct pharmacological action but it was an insufficient dose to enable a hallucinogenic experience.

There were persistent side effects such as a weird feeling of unreality and a strange shiny plastic appearance to objects which lasted for several weeks after ingestion.

I found it more weird than anything else with an underlying sense of borderline irritability that reminded me more of ephedrine or *Catha edulis* leaf.

While it is clearly in need of further evaluation, there are no plans or desire to evaluate it at a higher level. [Its worth recalling that J.R. Briggs felt similarly after sampling a partial peyote button.]

The lengthy after effects causes some empathy for the assertion that permanent insanity could result from the use of *Coryphantha* species by people who weren’t prepared. While thinking it unlikely, the possibility of prolonged effects or after effects had been considered before hand, due to the warnings, and so, while concerned and in some spots challenged, I was not overly worried. If a person experienced this and was not prepared, or was unstable to begin with, the duration and weirdness of the side-effects might potentially cause them some problems.

Its important to mention that if either macromerine or normacromerine is indeed a hallucinogenic alkaloid, or if normacromerine is, they would be the **ONLY** N-methylated phenethylamines that are known to be hallucinogenic.

N-methylation normally ameliorates hallucinogenic activity, doing so **even on DOM** (STP). If *any* activity remains on an N-methylated phenethylamine it is generally that of an amphetamine type stimulant.

As is noted under normacromerine in *The Cactus Alkaloids*, the conjecture by SHULGIN (personal communication) concerning potential interactions of this alkaloid with known MAOI *Coryphantha* alkaloids needs some study.

Coryphantha palmeri

There is an odd report by DOMÍNGUEZ *et al.* 1970 that seems to have been left uninvestigated by later workers.

In this paper they mention that *Coryphantha palmeri* was employed as a “*narcotic*”. They observed 4 spots during tlc but were unable to get the alkaloid they isolated to crystallize and never identified it. (They did identify other nonalkaloidal components by mp, tlc, IR, UV, MS and NMR.) This is often cited as a report finding no alkaloid in this species. We do not

think the issue is settled yet. More work is needed.

Cylindropuntia acanthocarpa

Ingested for gastrointestinal disturbances. JOHNSON 1999

***Cylindropuntia bigelovii* (ENGELMANN) KNUTH**

Used as a diuretic. JOHNSON 1999

Cylindropuntia leptocaulis

Mexico: “*tasajillo*”, “*tasajulla*”, “*garumbulo*”

CASTETTER & OPLER 1936 reported a claim purporting psychoactivity from fruit consumption but I am unable to find anyone who can reproduce these results in their bioassays.

They were said to have such “*pronounced narcotic effects that the Indians will not walk close to plants which bear them, and they claim that eating a single fruit will make one “drunk and dizzy.”*” [Never mind that the fruit have tiny glochids.]

I would suspect that this might have arisen out of a Mescalero’s sense of humor. I can almost hear the words “*Hey cowboy, ...*”

They are commonly included on the lists of the cactus species fruit eaten as food by the indigenous southwestern peoples.

Cylindropuntia versicolor

Chemical studies performed on *Aspergillus terreus* yielded interesting products. (It was inhabiting the rhizosphere of *Opuntia versicolor*.)

Among them was (+)-Terrecyclic acid A which was found to be “*capable of disrupting the cell cycle through an apparent arrest to progression at the G(1) and G(2)/M phases in this p53 competent cell line.*”

WIJERATNE *et al.* 2003

Terrecyclic acid A (TCA) isolated from this fungus was also determined to be active as a small-molecule inducer of the heat shock response and showed anticancer activity. It was suggested that it affects pathways involved with oxidative and inflammatory cellular stress responses.

TURBYVILLE *et al.* 2005

Cylindropuntia whipplei

Used to treat diarrhea. JOHNSON 1999

Dolichothele uberiformis

The juice from this cactus injected into a frog rapidly caused its death. (from SOULAIRE 1947) This refers to a brief comment made in LEWIN 1894.

Echinocereus enneacanthus

Employed in Dropsy; Used as Piscicide & Vermifuge.

DUKE cited KROCHMAL & KROCHMAL 1973

Called the “*strawberry cactus*” due to its fruit. STANDLEY 1924

Echinocereus stramineus

“*pitahaya*”

Prized for its edible fruit, STANDLEY 1924

Echinocereus coccineus

Echinocereus salm-dyckianus

Echinocereus triglochidiatus

BENNETT & ZINGG 1935 do not mention any drug use of any *Echinocereus* despite making comment on their commonness.

Tarahumara name: “*hikuri*”; “*wichuri*”

Mexican name: “*pitallita*”

Bye reported that *Echinocereus triglochidiatus* ENGELM. and *E. salm-dyckianus* SCHEER “are “*hikuri*” of the sierras and can be used in the same manner as the preceding types although they are not as powerful.”

BYE 1979

“*High mental qualities are ascribed especially to all species of Mammillaria and Echinocactus, small cacti, for which a regular cult is instituted. The Tarahumares designate several varieties as hikuli, though the name belongs properly only to the kind most commonly used by them. These plants live for months after they have been rooted up, and the eating of them causes a state of ecstasy. They are therefore considered demi-gods, who have to be treated with great reverence, and to whom sacrifices have to be offered.*”

LUMHOLTZ (1902: 303) uses the name *Echinocactus* but his accompanying illustration is very clearly that of an *Echinocereus*.

It seems certain that what Bye referred to as *Echinocereus triglochidiatus* was *Echinocereus coccineus*. Confusion between the two species is quite common but *Echinocereus triglochidiatus* has a more northerly distribution.

I am only aware of one person bioassaying this plant. He told me he experienced something vague and weird but was unable to obtain any interesting results despite subsequently isolating pure alkaloids and ingesting them alone and combined with an MAOI.

Arizona hedgehog cactus (*Echinocereus triglochidiatus* var. *arizonicus*) was purported by CROSSWHITE 1992 as being under threat of illegal poaching for its purported DMT content. One has to wonder how much incidence of this actually existed before this report and how much, if any, has occurred after it.

Speculations by Crosswhite that its “[...] evolutionary history may be linked to trading by the prehistoric Salado culture, implying that the species may actually be an early cultivar” does not seem to be based on anything that is real.

See USFWS 2001.

The Isleta in New Mexico ate the pulp of *Echinocereus triglochidiatus* after baking it or making it into a candy with sugar. *Echinocereus fendleri* and *Echinocereus gonacanthus* were roasted and used as food by the Cochiti.

Several species are valued as food but more are highly regarded for their fruit.

CASTETTER 1935: 26

Echinocereus chrysocentrus (golden spined strawberry)

Echinocereus coccineus (hedgehog cactus)

Echinocereus fendleri (desert strawberry)

Echinocereus leeanus (salmon-flowered hedgehog)

Echinocereus rigidissimus (rainbow cactus)

were all valued for their fruit by the Mescalero.

CASTETTER & OPLER 1936: 41

Echinopsis multiplex

An aqueous decoction of *Echinopsis multiplex* showed *in vivo* tumor growth inhibition activity and increased the survival time of rats with solid tumour S180 and Lewis pulmonary carcinoma. (p.o. 30 g/kg and 60 g/kg).

In vitro study of their plasma showed that it inhibited DNA synthesis in YAC-1 tumour cells and significantly suppressed the proliferation of EAC tumour cells (anti-neoplastic effect). CHEN *et al.* 1999

Echinocereus mamillosus RÜMLER

SOULAIRE 1947 says it has a “narcotic” action and, in animals, a lethal dose causes death by respiratory depression.

Echinocereus reichenbachii

REMINGTON *et al.* 1918 appears to have *somehow* confused this with *Pachycereus pecten-aboriginum* when saying:

“From *Cereus Caespitosus* Engl. and A. Gray, Heyl separated an alkaloid, pectenine, which, according to Heffter (*A. Pharm.*, 1901, ccxxxix, s. 462), produced both in cold and warm blooded animals tetanic convulsions with heightened reflexes. According to the experiments of Mogilewa, the alkaloid acts upon the isolated frog’s heart as a depressant.”

GRIEVE 1931 appears to draw from this source when writing: “*Cereus caespitosus*. An alkaloid separated from this variety, called Pectenine, produces tetanus convulsions in animals.”

Cereus caespitosus became *Echinocereus reichenbachii*. The comments by Heffter appear within the pages of HEYL 1901 but this paper does not discuss *Cereus caespitosus*.

All of the varieties of bona fide *Echinocereus reichenbachii* appear to lack any analysis?

Epiphyllum oxypetalum

A comment appeared in the *Enthogen Review* that a large dose of a water extract cause “hallucinations” (DEKORNE 1997).

In checking the purported reference (HUSON 2001) AARDVARK 2006 discovered not only was the claim taken from GRIEVE 1931 but it actually referred to *Selenicereus grandiflorus* rather than to *Epiphyllum oxypetalum*!

Epiphyllum oxypetalum apparently has some type of pharmacological/physiological actions.

All in isolated tissue preparations:

“decreased the flow rate of perfusion fluid in isolated guinea-pig lungs.”

“shortened the guinea-pig tracheal chain.”

“increased the spontaneous activity of the rat and mouse jejunum and elicited contraction of the guinea-pig ileum”

The responses of the tracheal chain and the ileum were similar to the responses produced by acetylcholine or by histamine. Chow found this could be blocked or reversed by atropine and by chlortrimeton.

“caused a shortening of the rat aortic strip which was antagonized by phentolamine.”

“exhibited both inotropic and chronotropic effects on isolated rat auricles and hearts, which could be blocked by propranolol.”

“produced slow contraction of the nictating membrane in anesthetized cats. This response was readily abolished by phentolamine.”

CHOW *et al.* 1977 (Above was from the English abstract.)

Duke’s database lists *Epiphyllum oxypetalum* being used for “Longevity” citing BURKILL 1966.

I have not yet obtained that paper.

Epiphyllum phyllanthus

Duke’s database lists this species being used as “cardiac” & “tonic” citing DUKE 1972

Serves as a bandage for burns & wounds. SOULAIRE 1947

Tested in animals for possible antidepressant effects. Choice based on “being traditionally used for the treatment of bad dreams, witchcraft, or madness”, according to a Guaymí Indian informant. AARDVARK 2006 cited ANDERSON 2004a

Epiphyllum spp.

Culina: “Wamapanako” (RIVIER & LINDGREN 1977)

Sharanahua: “Pukara” (PINKLEY 1969)

“Pokere” (RIVIER & LINDGREN 1977)

An unspecified *Epiphyllum* species is said to be used by the Peruvian Sharanahua as an ayahuasca admixture. (appearing in RIVIER & LINDGREN’s 1972 listing)

Only one leaf of the *Epiphyllum* species is added to ayahuasca or else its unboiled juice is consumed along with the prepared hoasca.

Homer PINKLEY 1969 commented that there is an herbarium voucher of the *Epiphyllum* (made by L. Rivier & I. Rüff) present in the Economic Herbarium of Oakes Ames at Harvard.

Duke's database lists an unspecified *Epiphyllum* species being used for "intestine"; citing ALTSCHUL 1973.

An unspecified *Epiphyllum* species is said to be used as an appetite stimulant in Costa Rica.

AARDVARK 2006 cited ANDERSON 2004b.

WORLDS WONDER REMEDY

Report of the Council on Pharmacy and Chemistry

Worlds Wonder Remedy is said to be prepared by macerating "the leaves of certain cactus plants, among them being the 'Alligator Tail cactus,' the 'Philo' cactus and several other species of cactus in brandy. No evidence is submitted in regard to the possible properties of the 'Alligator Tail,' the 'Philo' cactus or the identities and properties of the 'other species.' Neither are the quantities of the leaves in a given amount of the wonder remedy declared. It is claimed "We have also found this medicine to be a very good cure for nervousness, headache and all pains of the body, especially stomach trouble, indigestion, cancer of the stomach and we have also given it to people sick at this time of the year and they did not know what ailed them but it made them feel fine."

The Council has no evidence that this preparation has therapeutic virtues, and in the absence of such proof declared the claims unwarranted and preposterous.

AMERICAN MEDICAL Association 1918

Maybe "Philo cactus" intended *Phyllocactus* but I do not have a guess for "Alligator tail cactus". *Aloe vera*, several other *Aloe* species, and a rampant *Kalanchoe* amazingly all are known by the common name 'Alligator cactus'.

Epithelantha micromeris

Asserted hallucinogenic based on some intriguing statements but this may be a cross-cultural conceptual force-fitting?

"Mulato" (Tarahumara)

"This is believed to make the eyes large and clear to see sorcerers, to prolong life and to give speed to the runners."

LUMHOLTZ 1902

THORD-GRAY 1955 purported this to be the Tarahumara's "peyote mulato": "...credited with great intellectual and moral qualities. A small dose of this plant will open the busi-ra (eyes). One can then clearly see the evil wizards and witches. It will prolong life and increase the speed of a runner in a race."

Mentioned by PENNINGTON 1963: 166 as a "narcotic" cactus with use similar to *Lophophora*. Said to not be available at that time in Tarahumara country. "Specimens of *Epithelantha micromeris* in possession of Indians near Guaguachic and Nararachic are claimed to have been brought from slopes of ranges northeast of Valle de Allende, beyond the Rio Florido."

"The whole plant, as well as the fruit (although it is considered less effective), is used to stimulate and protect runners (Lumholtz 1902- Pennington, 1963). "... use appears to be restricted to the upper regions of the Rio Conchos."

BYE 1979

The phrase "much less effective" is interesting. This author has eaten the fruit of this cactus many times and never experienced stimulation, or any other effect, even faintly. They taste mildly sweet and similar to *Opuntia* flower petals

Standley noted that they are considered edible in México and called *chilotes*. STANDLEY 1924: 933

WEST & McLAUGHLIN 1977 demonstrated the (rather consistent) toxicity of the saponin extract when injected into mice. Toxicity ranged from death within 24 hours at 100 mg/kg to death within 1 hour at 1 gram per kg.]

"Rosapara"

Described as a "more advanced vegetative stage of the preceding species—though it looks quite different, being white and spiny. This, too, must only be touched with very clean hands, in the moral sense."

Lumholtz comments that the only people who are allowed to handle it are those "well baptised" and that "It is a good Christian and keeps a sharp eye on the people around it; and when it sees anyone doing some wrong, it gets very angry, and either drives the offender mad or throws him down precipices. It is therefore very effective in frightening off bad people, especially robbers and Apaches."

LUMHOLTZ 1902

Ferocactus covillei

= *Ferocactus emoryi*

Used for treating sores. DUKE.

Ferocactus sp

Used for headaches, chest and women's complaints. DUKE

Haageocereus (Weberbauerocereus) acranthus

This species appears to lack published analysis.

It was asserted to contain mescaline in CAYCHO JIMENEZ who made this claim without including a reference.

This first image was sent to me to illustrate material that was purportedly being used by shamans in Peru.

[See illustrated PDF for images]

Haageocereus (Weberbauerocereus) cephalomacrostibas

AKA *Trichocereus cephalomacrostibas*

This species also lacks any published analysis.

Asserted to contain mescaline in CAYCHO JIMENEZ who made this claim without including a reference.

Harrisia divaricata (LAMARK) LOURTEIG

Antihelmintic (no reference included)

REMINGTON *et al.* 1918

Harrisia nashii BRITTON (now *H. gracilis*)

Vermifuge (Haiti) - ŠTARHA 2001

Hylocereus undatus

Caustic stem juice employed internally and externally for a vermicide. The internal use is said to be dangerous.

Widely cultivated for its fruit.

STANDLEY 1924: 913

Lemaireocereus hystrix

[Name accepted as *Stenocereus fimbriatus* -- commonly encountered as synonym *Stenocereus hystrix*]

DUKE cites HARTWELL for "*Cereus fimbriatus*" being used for warts.

This species appears in the analytical literature only under the more commonly encountered *Stenocereus* synonym.

Lemaireocereus hystrix from Jamaica was analyzed by Carl Djerassi in the 1950s and was reported to be devoid of alkaloid. It was found to contain an uncharacterized triterpene lactone that he termed the hystrix lactone. This lactone also showed up in several other species of *Lemaireocereus*.

More recently one ethnobotanical supplier has been claiming this plant to at least sometimes be potent with mescaline.

The material being sold under this name as live cuttings and dried outer flesh first appeared labeled *Trichocereus cuzcoensis*. It then was renamed as a *peruvianus* variety and then a *peruvianus* hybrid before settling on *Stenocereus hystrix*.

When I asked the owner about the name and identification he said the name was assigned by a botanist who examined the vegetative material.

The first cutting I obtained did resemble the material growing in the greenhouse at the Huntington. (The Huntington material was collected from Puerto Rico).

He also commented that only material growing in one stand on the Dominican Republic was active and not the others growing elsewhere on the island. How this was determined, how it was first determined to be active and why it was suspected of being a hybrid (and with what), were not known to him.

The claim is that this material is mescaline containing and found to be active in human bioassay at 20 grams of dried material but it was commented on by the vendor that too much rain had reduced the potency in at least one harvest so he changed the estimated dosage range to 20-40 grams.

I have been unable to locate anyone bioassaying anything except for pre-prepared dried commercial flesh.

It needs an analysis starting with a living cactus. My two attempts to obtain live material proved problematic.

Lemaireocereus laetus

[Name accepted as *Armatocereus laetus*]

Over 20 years ago, Wade Davis purported that cactus was used as a San Pedro substitute by a shaman near Huancabamba. It was purportedly called pishicol by Davis' informant although our contact said it was locally called San Pedro.

Human bioassays of cultivated material have thus far been without results although I am only aware of two attempts neither of which included the amount used or the form of preparation.

In his 1983 paper on "Plants of the San Pedro Cult" Davis

claimed that herbarium vouchers had been prepared and that an analysis was ongoing but did not mention the results in either DAVIS 1997 or 1999. Correspondence with Davis & D.M. McKenna established that an analysis was never performed.

Lemaireocereus matucanense

[Name accepted as *Armatocereus matucanense*]

This is listed as a good species in HUNT 2006, yet Hunt also comments: "*doubtfully distinct from Armatocereus laetus*"

This cactus is purported to be employed as a type of San Pedro in parts of Peru. (Information from Grizzly; personal communication) It is claimed to be "strong".

Independent confirmation of that activity has not been performed. As was also the case with Davis, Grizzly and friends did not bioassay the plant so the claim remains anecdotal.

That particular population needs analysis.

Leuchtenbergia principis

Purported to be used for treating wounds in "*beasts of burden*". STANDLEY 1924: 934

It may be unrelated but in a massive rat invasion of my cactus nursery many years ago this was one of a very few species left completely untouched even as seedlings.

Lemaireocereus thurberii

Fruit used by the Tarahumara for producing *tesgüino*.

PENNINGTON 1963

Fruit colors the urine like blood. STANDLEY 1924: 901

Lemaireocereus queretaroensis

Called "*pitahaya*" due to edible fruit. STANDLEY 1924

Used in Mexico as a purgative. SOULAIRE 1947

Lophocereus schottii

FELGER & MOSER 1991 mention that the *senita* is one of the three plants that the Seri believe was once a human.

Traditionally used for cancer. DUKE (HARTWELL)

Antimicrobial & other biological activities studied in:

FIMBRES & GARCÍA 1998

MORALES 2006

RICO-BOBADILLA *et al.* 2001

Lack of the appropriate enzyme for converting cholesterol into 7-dehydrocholesterol (termed the "Neverland" gene) makes this plant an obligate food source for *Drosophila pachea*. Without consumption of Lathosterol it would be unable to successfully mature. LANG *et al.* 2012

Lophophora fricii

Cultivated *Lophophora fricii* were reported nonhallucinogenic at 3 gm/kg in HABERMANN 1978a.

Lophophora jourdaniana

Cultivated *Lophophora jourdaniana* were bioassayed successfully (for mescaline) at 3gm/kg in HABERMANN 1978a.

LEWIN 1894 commented that "Hildman" isolated an alkaloid in 1889 and showed that it caused convulsions in frogs. This was apparently personal communication with Lewin rather than published work.

Lophophora williamsii

"The dried plants have been in use among the native people [in Mexico] since precolumbian times, and are still employed, although their use is forbidden by law."

"[...] the general effects are somewhat like those resulting from the use of hashish."

STANDLEY 1924

"...used by Rio Grande Indians to produce intoxication -- similar to cannabis, during religious ceremonies;"

"Heart and respiratory stimulant, tonic, adjuvant to digitalis, narcotic, slightly slows pulse, produced mental and physical weariness, sleep without untoward symptoms; excessive quantities produce spasms resembling strychnine poisoning; pneumothorax, tuberculosis, angina pectoris, asthmatic dyspnea, hysteria."

CULBRETH 1927

The equating of peyote's activity with that of either opium or hashish is common in the early literature.

Green plants are "chewed and placed upon bruises, bites and wounds." (Pennington 1963)

"anodyne, antirheumatic, bitter, cardiac, cardiotonic, emetic, entheogen, febrifuge, intoxicant, lactagogue, narcotic, panacea"

JOHNSON 1999 ref#6

"arthritis, backache, common cold, corns, diabetes, fever, gastrointestinal disturbances, headache, infection, influenza, orthopedic ailments, sunstroke, tuberculosis, venereal ailments, wounds"

JOHNSON 1999 ref#7

"...many uses in folkloric medicine including the treatment of arthritic, consumption, influenza, intestinal disorders, diabetes, snake and scorpion bites and datura poisoning."

"The Huichol rub the juices of fresh peyote into wounds to prevent infection and to promote healing."

"It is used to gain knowledge, prophesize the future, and for almost every type of illness. It is also applied externally to painful joints."

JOHNSON 1999

Extract is used externally for bruises, fractures, rheumatism, swellings and joint pain in the form of linament, ointments and cremes. Used orally or topically as an analgesic.

Commercially produced and marketed online there is also a cottage industry that exists producing *pomada de peyote*.

In the region of the headwaters of the Río Concho, PENNINGTON 1963:159 noted that the expressed juice from *Lophophora williamsii* was sometimes added to *tesgüino* to "make the corn beer more enjoyable."

HAVARD had made a very similar claim.

The plant has many folk medicinal applications. See **Sacred**

Cacti or ANDERSON or McLAUGHLIN for a listing of additional uses.

Machaerocereus gummosus

"pitaya agria", "pitahaya agria", "pitahaya", "agria"

Crushed stems sometimes thrown into water to stupefy fish.

Bears a popular fruit called *tajuá* (Cochimi).

STANDLEY 1924

Antimicrobial & antineoplastic activities studied in MORALES 2006.

General phytochemical screening in GARZA PADRÓN 2005.

Mamilloopsis senilis

BRUHN 1973a noted that Dr. J.N. Rose mentioned *Mamilloopsis senilis* as a "sacred cactus" of the Tarahumara in his article entitled "Notes on useful plants of Mexico" [ROSE 1899]

BYE 1979 refers to the plant as "*Mamillaria senilis*" and mentions that that ROSE "related an incident of Nelson who, while collecting in southern Chihuahua, reported encountering a Tarahumara who was fearfully reluctant to assist in collecting a similar cactus"

Rose had given the name as "*Mamillaria senilis*" stating the potential of deferring to Weber's new *Mamilloopsis* once he had seen it flower.

Rose speculated that this could be the "*hikora rosapara*" mentioned by Lumholtz.

He related an account of E.W. Nelson in 1898:

"This is one of the sacred plants of the Tarahumari Indians and I was informed that the Indians who have had little intercourse with the Mexicans can not be induced to touch one of them. The specimens I secured were gathered by a Tarahumari man living on the ranch where I stopped. When I told the Indian to gather the plants from the top of a great rock he hesitated and only did it when I insisted upon his compliance. In pulling the specimen loose he tore on another plant and before descending he raised the fallen plant and replacing its root in position he packed the soil very carefully about it. This little incident illustrates the respect in which these people hold this plant." (ROSE 1899: 258)

With the three notable exceptions of the analysis of *Mamillaria microcarpa* (considered either synonymous with or varietal of *Mamillaria grahamii*), and of *M. heyderi* (which was determined to contain no hallucinogenic alkaloids), and of the related *M. meiacantha*, which was reported to contain one unidentified alkaloid, there has been no chemical work performed for *Mamilloopsis senilis* or any the species of *Mamillaria* claimed to be held in high respect by the Tarahumara (such as *Mamillaria grahamii* var. *olivae*). Unless one wants to also count LEWIN 1894b reporting several *Mamillaria* species to be nontoxic,

Amusingly, entirely based on Bruhn's comments that *Mamillaria heyderi* had been reported to have been used ethnobotanically and that he had found that it contained N-methyl-DMPEA, this alkaloid found itself mistakenly listed in Usdin & Efron (and beyond) as a known hallucinogenic compound.

The Genus *Mammillaria*

The milky sap of some species were used to remove warts.
STANDLEY 1924: 975

DUKE/ MARTÍNEZ mentions use for earaches, dysentery, insecticidal, poison (not indicated whether as poison or for treating poisoning), pulicide, purgative, snake repellent.

Mammillaria grahamii (sunset cactus)

Mammillaria grahamii var. *olivae* (snowball pincushion)

Mammillaria mainae (horned toad cactus)

all have fruit that were valued by the Mescalero.

CASTETTER & OPLER 1936: 41

Mammillaria arietina LEMAIRE

LEWIN 1894 commented that this species was found to be nontoxic. [Now considered a synonym of *Mammillaria magnimamma* var. *arietina* (LEM.) SALM-DYCK]

Mammillaria centricirrha var. *pachythele*

LEWIN 1894 commented that this species was found to be nontoxic. [*Mammillaria centricirrha* LEMAIRE is now considered a form of *Mammillaria magnimamma*]

Mammillaria craigii

"Tarahumara names: "wichuri"; "witculiki" (BENNETT & ZINGG 1935), "wichuriki" (THORD-GRAY 1955)

Mexican names: "peyote de San Pedro"; "biznaga" (BENNETT & ZINGG 1935; THORD-GRAY 1955)

" In the Barranca de Batopilas, *M. craigii* is respected by all Tarahumara.

Mistreating it, such as making botanical specimens of it, is considered very ' dangerous and terrifies many natives who may see it being collected by a botanist."

BYE 1979

Field work by Bye established that *M. craigii* LINDSAY and not *M. heyderii* was the cactus discussed by BENNETT & ZINGG 1935 & THORD-GRAY 1955 under the name "wichu-ri-ki".

This is commonly implied to have hallucinogenic activity or even to have fruit which is hallucinogenic but careful reading is suggested as the comments from Bennett & Zingg clearly said "The small, red fruit is sweet and casually eaten." And what was said by THORD-GRAY 1955: "It has a small red fruit which is eaten. This plant is greatly feared, as it is supposed to have magical powers. [...] The shaman also uses this plant as a very important medicine to clear his vision so that he can see sorcerors and prolong life. The medicine will also make the foot light and increase the speed of a runner in a race."

THORD-GRAY also commented "...It matters not how well the suku-ru-ame [witch] is hidden, the shaman can see him clearly."

"The heart of the cactus is used to cure or relieve headaches. After the spines are removed, the plant is cut up into two or more pieces, roasted for a few minutes and then part of the stuff is pushed into the ear."

THORD-GRAY 1955: 483

After similarly discussing its application for a headache remedy Bye goes on to comment "The upper portion of the plant is said to be the most effective. The top, with the spines removed, is ingested and is said to put one to sleep soon. During this sleep, the person "travels" to distant places and sees brilliant colors. If the person is not prepared, it will drive him crazy. Its effects are said to be similar to "hikuli"."

It is unclear where this comment came from. I'm assuming from Bye's informants rather than a confusion with his account for *M. grahamii* v. *olivae*.

Mammillaria craigii currently lacks any published analysis.

It has however been reported to be used in Oz as recreational drug. The dose is said to be a single specimen 4 inches or so in diameter. The spines are first removed and the entire body of the plant eaten. Fortunately there are a large number of large seed grown specimens available.

Friends with first-hand experience describe it as being MD-MA-like. Whether this is realistic or if it just an expression of the "tastes-like-chicken" phenomenon, where people describe something new by comparison to the closest thing in their experience, I do not know.

It is said by different bioassayists to be only mildly or not particularly hallucinogenic but with a euphoric component and pleasant stimulation causing it to become popular in at least some small subsets of the many Australian dance circles.

Clearly more work is needed.

Mammillaria geminispina

Employed for excrescence. DUKE (HARTWELL)

Mammillaria grahamii var. *olivae*

"Tarahumara name: "hikuri"

Mexican name: "peyote"

" Small clusters of this cactus (Fig. 3) are found on the slopes of Barranca de Batopilas and are reported to be the actual "hikuri" of this region. It is said to be distinguished from similar species of *Mammillaria* by the reddish central spines and the reddish vascular tissue in the plant stem. The fruit and top of the plant with the spines removed are eaten and are said to cause drowsiness followed by "travel" with brilliant colors. It is taken by the shaman and participants during special ceremonies. If improperly used, the plant can cause a person to go crazy. Specimens of this Tarahumara "peyote" are awaiting analysis."

BYE 1979

I have been unable to locate the results of that analysis or determine if it occurred.

Somehow *M. grahamii* found itself added to the list.

CASTETTER & OPLER 1936 mention *Mammillaria grahamii* and var. *olivae* as having fruit which are eaten as food.

Mammillaria heyderii

In 1935 Bennett & Zingg reported on the use of *Mammillaria heyderii* by the Tarahumara.

Thord-Gray & Robert A. Bye Jr. later published comments that among its many magical powers the plant was used for locating wizard and increasing speed in runners. It was also said to be used for inducing sleep during which time shamans would travel to distant places and see brightly colored things. "...greatly feared for its magical powers. This medicine will clear his vision. It matters not how well the suku-ru-ame [witch] is hidden, the shaman can see him clearly."

THORD-GRAY 1955

These assertions were apparently considered by later workers to be conclusive proof of hallucinogenic use. Perhaps noteworthy is the fact that no Western workers ever bioassayed the plant.

In 1973 Jan Bruhn commented on the results of an analysis reporting the presence of N-Methyl-DMPEA while repeating the claim of those earlier workers.

Interestingly, as a result of that paper (BRUHN & BRUHN 1973) a person can find this substance listed as a hallucinogen in a number of academic and online resources based entirely on that single report of its occurrence in this species. It is even common to find this plant discussed as a hallucinogen and that activity attributed to this alkaloid despite there being no report of a bioassay and the pure compound apparently never having seen any pharmacological evaluation.

Most pertinently, but incredibly having no impact on the persistence of the above accounts, in Bye's 1979 report on the hallucinogenic plants used by the Tarahumara it was determined that the species employed by the Tarahumara was not *Mammillaria heyderii* but *Mammillaria craigii*.

PENNINGTON 1963:118 mentions *Mammillaria heyderii* only in regards to its fruit being used as food.

DUKE lists uses for earache, headache, deafness and longevity. He also reiterates the erroneous claim it is used as a hallucinogen.

Mammillaria magnimamma

Lactagogue. DUKE

Mammillaria microcarpa

Earache. DUKE (Unclear if this is in reference to its synonymity with *Mammillaria grahamii* or if this was as independent claim.)

Mammillaria polythele MARTIUS

LEWIN 1894 commented that this species had been found to be nontoxic.

Mammillaria pulchra HAWORTH

LEWIN 1894 commented that this species was found to be nontoxic. *M. pulchra* is not currently recognized.

Matucana madisoniorum (HUTCHISON) ROWLEY

Matucana madisoniorum is rumored variously to be used in Peruvian native medicine and to contain mescaline.

It presently appears that rumors of this species as either 1) a hallucinogen or 2) a mescaline container are erroneous.

Until fairly recently this species was rare in cultivation. When it was discovered it was a rare cacti in the wild suggesting that any medicinal usage would have to be very localized. Furthermore when Hutchison returned to the original type locality he was unable to locate any plants remaining. Their absence was suspected to be the result of an abundance of local goats. Other occurrences have been found.

It is unclear why Paul Hutchison thought it contained mescaline or why he believed it to have ethnomedical applications or if these are mistaken conclusions reached by others.

It would also be valuable to track down any actual field reports of use and determine what application they actually had. Cacti are used for MANY purposes by native cultures; hallucinogenesis is only one. An anti-infective topical agent seems every bit as likely.

Additionally analysis of it has produced no evidence of evidence of mescaline or of any other alkaloid (unpublished GC-MS by Shulgin; personal communication) Shulgin's analysis was performed on a specimen provided to him by one of Hutchison's former students and was a clone from a plant from the original type collection. I saw the specimens that were extracted (and helped him mince the fresh plants with heavy scissors) so can say with certainty that they were very typical looking, nearly bald with a few weak spines. Sasha kept live plants for voucher material.

Rumors of that particular material being a mescaline container are clearly erroneous.

Regardless, this entire genus deserves a detailed analysis.

Melocactus bellavistensis

Melocactus bellavistensis has been purported to have hallucinogenic use in Catamayo Valley in Ecuador. KVIST & MORAES R. 2006.

There are many problems with the claims around this plant. Most notably the apparent unavailability of its primary reference: VIVANCO 2000. It probably merits an analysis but needs some published primary work that is not made of unobtainium.

Claims about this plant presently should be regarded with some reservation. There were some additional comments on it made by Peter Gorman (who refers to it as the "moon cactus") that really do not deserve even this much of a mention. (In *High Times* and on his webpage.)

Melocactus depressus HOOKER

An arabinogalactan from this species was reported to show activity at stimulating phagocytosis.

DA SILVA & PARENTE 2002

Myrtillocactus geometrizans

“*garambullo*”

Pulp is used in Mexico as a diuretic & antipyretic.
SOULAIRE 1947.

Peniocerol, Macdougallin and Chichipecogenin from an extract of plant and roots were all reported to have insecticidal and insect growth regulation activity.

CÉSPEDES *et al.* 2005

Sometimes called the *berry cactus* or the *billberry cactus*.

Fruit is popular and sold fresh or dried in local Mexican markets.

Fruit are referred to as *garambullos* or *billberries*.

***Melocactus peruvianus* VAUPEL**

CAYCHO JIMENEZ 1977 (page 91) asserted that it contains mescaline but did not offer any supportive reference.

An analysis may be indicated but the origin for the claim seems questionable.

Neoraimondia macrostibas

Said to be incorporated into the drink known as *cimora*.

CRUZ SANCHEZ 1948 (as *Cereus macrostibas*)

This is presented as being in combination with other cacti and plants.

See a more detailed discussion in OTT 1993 & in ***Sacred Cacti Part B. San Pedro*** pages 110-112;.

To locate a pdf of the San Pedro book:

<http://troutsnote.com/pdf/SP.pdf>

***Nopalea cochenillifera* (L.) SALM-DYCK**

“*nocheznopalli*” (Nahuatl), “*nopal de San Gabriel*” (Oaxaca), “*tuna mansa*” (Puerto Rico), “*tuna*”, “*nopal*” (El Salvador)

Joints used as poultice for articular rheumatism, erysipelas, ophthalmia, earache and toothache. STANDLEY 1924

Pink or red floral tissues used as refreshing tea. SOULAIRE 1947

An important host plant for cochineal insects (hence its name).

[The cochineal insect was also commercially cultivated on *Opuntia elatior* MILL., *Opuntia horrida* SD, *Opuntia nopalilla* KARW., *Opuntia Hernandezii* DC, *Opuntia tuna* MILL., & *Pereskia bleo* DC. SOULAIRE 1947]

***Nopalea karwinskiana* (SALM-DYCK) SCHUMANN**

“*nopalillo de flor*” (Jalisco), “*nopalillo*”

Root said to be used as remedy for dysentery.

STANDLEY 1924

Obregonia denegrii

DUKE lists as used for Antibiotic, Poison (unclear if used as a poison or as a remedy for poisoning), Sympathomimetic.

Opuntia basilaris

Used as an analgesic.

Employed to treat skin ailments and warts.

JOHNSON 1999

Warts - HARTWELL

Opuntia bigelovii

Diuretic - DUKE

Opuntia dillenii see as *Opuntia stricta* var. *dillenii*

Opuntia echinocarpa

An ethyl acetate extract derived from a strain of *Fusarium oxysporum* (mitosporic Hypocreales; an endophytic fungi inhabiting the stem tissue of *Opuntia echinocarpa* AKA “silver cholla”) were reported, using bioassays, to possess activity for the inhibition of metastasis [Using the wound-healing assay (WHA)] and proliferation/survival [MTT assay].

BASHYAL *et al.* 2007

Opuntia elatior

Antiseptic, Biliousness, Boils, Coughs, Expectorant, Guinea worms, Inflammation, Ophthalmia, Pertussis, Sores & Spasms.

DUKE

Opuntia engelmannii

“*Cactus apple*”

“*Arizona cactus pear extracts effectively inhibited cell growth in several different immortalized and cancer cell cultures, suppressed tumor growth in nude mice, and modulated expression of tumor-related genes. These effects were comparable with those caused by a synthetic retinoid currently used in chemoprevention trials.*” ZOU *et al.* 2005

The owner of the company making this product told me that it is obtained from *Opuntia engelmannii*.

Used to treat “women’s ailments”. JOHNSON 1999

Opuntia ficus-indica

Used as a diuretic and for treating diarrhea.

Flowers employed for dysentery.

SOULAIRE 1947

Poultice used for “*various painful conditions*”, ulcers, sores & boils. EL-MOGHAZY *et al.* 1982

Used as an emollient.

Used to treat calluses, corns, leprosy, measles, tumors.

Also for kidneys.

JOHNSON 1999

DUKE lists uses as: Burn (Radiation), Callus, Corns, Decongestant, Diabetes, Diarrhea, Diuretic, Emollient, Internulcer, Kidney, Leprosy, Measles, Piles, Scald, Sore, Sunburn, Tumor & Wounds.

Anti-hyperglycemic effects were only evident in temporarily hyperglycemic mice.

ALARCON-AGUILAR *et al.* 2003

The betalain distribution and antioxidant activity for three Sicilian cultivars of *Opuntia ficus-indica* was studied by Butera.

The antioxidant activities of methanolic extracts from the edible pulp of the three cultivars were investigated as was the amount of reducing capacity for purified betanin and indicaxanthin.

The yellow cultivar exhibited the highest amount of betalains, followed by the red and white ones.

The methanolic fruit extracts showed a marked antioxidant activity (measured as 6-hydroxy-2,5,7,8-tetramethylchroman-2-carboxylic acid (Trolox) equivalents per gram of pulp), dose-dependently inhibited the organic hydroperoxide-stimulated red cell membrane lipid oxidation, and inhibited metal-dependent and metal-independent low-density lipoprotein oxidation.

The extract from the white fruit showed the highest protection in all models of lipid oxidation.

Purified betanin and indicaxanthin were both reported to be more effective at scavenging the [2,2'-azinobis(3-ethylbenzothiazoline-6-sulfonic acid)] diammonium salt cation radical than Trolox.

BUTERA *et al.* 2002

The 8 flavonoids isolated from the ethyl acetate fractions of an extract of the fruits and stems of *Opuntia ficus-indica* var. *saboten* had antioxidant activity and neuroprotective effects studied. All found to be active at inhibiting lipid peroxidation and free radical scavenging. Quercetin and its 3-methyl ether were found to inhibit XO activity (in vitro).

Quercetin was more active than (+)-dihydroquercetin. (Quercetin 3-methyl ether = most active.)

LEE *et al.* 2003

Opuntia fragilis

Used for skin ailments & throat ailments. JOHNSON 1999

Opuntia fulgida

DUKE lists for: Toothache, Diarrhea & Short-windedness.

Opuntia humifusa (= *Opuntia compressa*)

Used to treat skin ailments. JOHNSON 1999

Extract of the pads was shown to possess potent antioxidant, radical scavenging and antiinflammatory activity.

One of the active radical scavengers was determined to be quercetin. CHO *et al.* 2006

LLOYD BROTHERS (1903, 1908) says *Opuntia rafinesquei* (now *Opuntia humifusa*) has been "inexcusably substituted" for *Selenicereus grandiflorus*.

Opuntia imbricata

Decoction of fruit used to set cochineal dye. STANDLEY 1924

Opuntia lindheimeri

Used for bruises (veterinary), dyspepsia, mumps, swelling.

JOHNSON 1999, DUKE

Opuntia megacanthus

Showed activity at reducing plasma glucose but was suggested to demonstrate possible kidney toxicity (in rodents).

BWITI *et al.* 2000

Employed as a laxative. JOHNSON 1999

Used for inflammation, pregnancy. JOHNSON 1999

Pads used as a poultice. DUKE

STANDLEY 1924: the "best edible tunas" come from this species.

Opuntia megarhiza

Employed for treating fractures & inflammation. JOHNSON 1999

Palmer reported the fleshy roots to be used as poultices for fractures and inflammation. STANDLEY 1924

Opuntia moniliformis (L.) STEUDEL

Used to treat tumors. JOHNSON 1999 (from HARTWELL)

Opuntia phaeacantha ENGELMANN

"Tulip prickly pear"

Use in "women's ailments". JOHNSON 1999

Opuntia plumbea ROSE

Used for skin ailments & "women's ailments". JOHNSON 1999

Opuntia polyacantha HAWORTH

Used in folk medicine for backache, diarrhea, moles, warts, & wounds JOHNSON 1999 (HART was source for the first two.)

The word "poison" is listed in JOHNSON 1999 but it is not clear if that means being used *as* a poison or *for* treating poisoning.

Opuntia pseudo-tuna SALM-DYCK

Used for treating tumors. JOHNSON 1999 (from HARTWELL)

Opuntia rafinesquei ENGELMANN

See under *Opuntia humifusa*.

Opuntia reflexispina WIGGERS & ROLLINSON

See as *Corynopuntia reflexispina*

Opuntia reticulata

A semimonstrose plant known as *Opuntia zebrina*, *Opuntia zebrina* forma *reticulata* and *Opuntia dillenii* forma *reticulata* Purgative & antihelminthic.

Root has dental application.

SOULAIRE 1947

Opuntia spp.

Young joints are applied as poultices to reduce inflammation. STANDLEY 1924

DUKE lists as being used for:

Astringent, Boils, Diarrhea, Diuretic, Dysentery, Dysuria, Expectorant, Eye, Hair-Tonic, Hallucinogen (erroneous), Headache, Inflammation, Insomnia, Lactagogue, Poultice, Snakebite, Swelling, Thirst, Tuberculosis, Tumors & Wounds.

Opuntia streptacantha

An extracted fraction believed to be proteinaceous in nature was found to inhibit replication of a number of DNA and RNA viruses in vitro and in vivo.

AHMAD *et al.* 1996

Administration of a stem extract to mice, horses, and humans was reported to inhibit replication of a number of RNA- and DNA-viruses including Equine herpes virus, Herpes simplex virus Type 2, HIV-1, influenza virus, pseudorabies virus, and respiratory syncytial disease virus. The active component was not identified but was suspected to be proteinaceous.

AHMAD *et al.* 1996

A “highly stable trypsin-like proteinase inhibitor” was isolated from seeds and characterized. TORRES-CASTILLO *et al.* 2009

No anti-hyperglycemic effects observed, except in alloxan-diabetic mice. ALARCON-AGUILAR *et al.* 2003

Opuntia stricta var. *dillenii*

most often analyzed as *Opuntia dillenii*

Used to treat pimples. JOHNSON 1999

Guineaworms, Ophthalmia, Pimples, Sores, Syphilis. DUKE “Actions: Promotes the flow of *ch ‘i*, invigorates blood circulation, clears up heat, removes toxin.”

Chest & abdominal pain due to nervousness, dysentery, hemorrhoids, cough, sore throat, lung abscess, mastitis, snakebite. 30-60 grams fresh stem is given as a dose HSU *et al.* 1986

Employed in Chinese folk medicine for diabetes, gastric ulcer & inflammatory conditions.

An aqueous ethanolic extract of stems showed significant radical scavenging activity.

QIU *et al.* 2002

LORO *et al.* 1999 reported that the aqueous extract of *Opuntia dillenii* fruit exhibited central analgesic properties associated with an antiinflammatory action.

Analgesic & antiinflammatory effects were found to be present in the fruit, flowers & stem but were the most pronounced in the alcohol extract of the fresh flowers.

AHMED *et al.* 2005

Methanolic extract of cladodes and also purified Opuntioside-I, an α -pyrone glycoside that had been isolated from the cladodes, showed potent hypotensive activity *in vivo*.

SALEEM *et al.* 2005

Opuntia tuna (L.) MILL.

Used to treat asthma, diarrhea, gonorrhea, rheumatism. JOHNSON 1999 (from KROCHMAL & KROCHMAL 1973)

Stems are boiled and used as poultice for rheumatism. JOHNSON 1999

Fruit for asthma, diarrhea, gonorrhea. JOHNSON 1999

Pachycereus marginatus

“hair black”, “inflammation” MARTINEZ 1969

Pachycereus pecten-aboriginum

Tarahumara: “cawe”, “cawé”, “chawe”, “wichowaka”, “wichowáka”, “bitaya mawali”

Mexican: “cardon”, “hecho”

One Tarahumara name, *wichowaka*, appears to be derived from *wichuwa-ka*; a term meaning “crazy” or “demented”.

The plant is said to be used by crushing young branches to yield a juice which is added to 3 times as much water and then consumed. A fermented version is said to be purgative.

BYE described the juice expressed from its stems as being “occasionally used by the Tarahumara of the western barrancas to induce visions, along with quick intoxication during “tesguinadas”.”

BYE 1979

PENNINGTON 1963:166-167 mentions this as being one of the “narcotic” cacti used similarly to *Lophophora*.

“There is some minor utilization of juice from young branches of *cawe* (*Pachycereus pecten-aboriginum*) in ceremonies held in western canyons. A piece of the branch is crushed in a hollow rock and the expressed juice is added to water; about one part of juice to three parts of water. This mixture is claimed to produce the same effect as drinking a “mixture of jikuri and water; and results in dizziness and visions.” PENNINGTON 1963

In spite of long reported accounts of *Pachycereus pecten-aboriginum* (and others) being used ritually, and chemical evaluations being done, there has apparently been no published pharmacological assessment concerning which, if any, of its contained alkaloids are entheogenically active.

BRUHN & LINDGREN 1976 found the main alkaloid to be salsolidine in the wild plants they tested. This physiologically active alkaloid is not a hallucinogenic compound although it is thought to play a role in perceptual disturbances experienced by alcoholics.

This certainly is an area both ripe and long overdue for an evaluation. [RETI 1950 notes that both Carnegine and Pilocereine are known to be fairly toxic in mammals.]

Pennington’s ethnological account mentioned that young branches are used, as opposed to young plants or older branches. Gigantine was found to be most prevalent in the growing tips of saguaro branches and was not observed in younger cultivated plants, so perhaps may be some rationale to the selection of this part of adult plants of *P. pecten-aboriginum*. Alkaloids often vary in levels and actual composition between plant parts and it is not uncommon for active growth to have an entirely different composition in some plants.

The chemical evaluations concerning this particular plant (at least those we have seen) have not taken this into account. Native people who have an intimate familiarity with plants rarely do anything without purpose. Such things are often overlooked or dismissed as trivial or unimportant. They may be, and sometimes are, but one cannot automatically assume they can be disregarded.

Used in Mexican folk medicine:
Gastric ulcers (Citing BRAVO 1964)
Cancer remedy (Citing HARTWELL 1968)
(Both of which mention rather than being a primary account.)
Heliamine was reported to inhibit the growth of sarcoma 45 in rats by 60-79%, in CHACHOYAN et al. 1973.
STROMBOM & BRUHN 1978

Pachycereus pringlei

One of the three cactus that the Seri believe used to be human.
Felger & Moser 1985

Earl Campbell concluded elements in Baja cave art represented the cardon in a supernatural context.
Using a unique combination of Baja cave art, literature searches, intuitive guidance and personal courage Earl eventually harvested a section of cactus, cooked it into a tea in his hotel room, returned to the rock shelter that had been his inspiration, and ingested it. In doing so, Earl uncovered the activity of the cardon. He presented a story of his experience that he believed put him in contact with both the plant and the people who once used it. He described hearing their language, seeing their dress, manners & customs, and watching their lives.

Following his adventure Earl sought out Sasha Shulgin in an attempt to stimulate more research into the plant's bioactivity.

A nice account of the next part of the story appears at:
mdma.net/alexander-shulgin/alexander-shulgin-x.html

"So Shulgin dissolved the extract of the cactus into fruit juice, then poured a 4-ounce cup for each person. But his experiment went awry. "At about the two-hour point, my visual experiences became totally swamped by an overwhelming fear of moving," recalls Shulgin, the 77-year-old chemist who introduced ecstasy to the world. His wife, Ann, had an even more severe reaction. Out on the deck, she remembers, "I could see the full moon shining down on me with what felt like chilling contempt, and I thought, What an awful, stupid way to die." With her pulse racing, she went inside to check on her husband, who was upstairs in one of the bedrooms, lying still in the dark. "He said he was OK as long as he didn't move." Early the next morning, Shulgin assembled his test group, still in pajamas, to assess the effects of the cactus extract. All 12 of them had taken the same compound, but half had become violently ill, while the other six had the kind of pleasant but unremarkable experience Shulgin expected. The results, he decided, were inconclusive."

In a series of personal conversation between 2001-2005 Shulgin commented on his observation of N-Methylmescaline in the plant and its possible significance. He mentioned that, despite its established lack of interesting properties, he then suspected that was probably the active compound, enabled to be active orally by due to the presence of one or more

MAOIs. Sasha referred to the combination as cactihuasca. He also lamented about the difficulty of finding bioassayists for completing this research. Apparently this was due to a heavy body load for both the plant and pure compound combinations. This is essentially where the matter still stands today, a decade later.

Pachycereus pringlei has been reported to be used for:

Aches	Earache	Rabies
Blood clotting	Evil eye	Sores
Bruises (JOHNSON 1999)	Fever	Tumors
Burns	Hemorrhoids	Ulcer
Digestive problems	Headache	Vaginal bleeding
Cancer: stomach	Kidney problems	Varicose veins
Cancer: uterus (JOHNSON 1999)	Pimples	Venereal disease
Cough	Poor circulation	Wound healing
Cramps	Poisonous snake bites	
Diabetes	Rheumatism (also in JOHNSON 1999)	DIMAYUGA 1996 (except where noted)

Suspected of being the plant that CLAVIGERO 1789 described being used by missionaries for creating a balsam for wounds and bruises by boiling down the juice of its branches.
STANDLEY 1924: 895

Pelecyphora aselliformis

"peyote", "peyotillo"

Used to treat fevers in San Luis Potosí. STANDLEY 1924: 973
DUKE lists also used for anodyne, antibiotic, rheumatism.

Peniocereus greggii (ENGELMANN) BRITTON & ROSE

"night-blooming cereus", "reina de noche", "ho' o' k iwa", "huevo de venado"

Fruit mixed with deer grease is used as a salve for sores.

CASTETTER & UNDERHILL 1935: 65

Used as a plaster for lung inflammation, similarly to *P. striata* below. CASTETTER & BELL 1937: 42

Peniocereus striatus (BRANDEGEE) BUXBAUM

as *Wilcoxia striata* (T. S. BRANDEGEE) BRITTON & ROSE

"cardoncillo", "dahlia-rooted cereus", "pitahayita", "jarramatraca", "racamatraca", "sacamatraca"

Valued medicinally in Baja California.

"The tubers are sometimes crushed and a cloth saturated with the juice applied to the chest for lung troubles"

GOLDMAN 1916: 356

"A cloth saturated with the juice of the crushed roots is sometimes applied to the chest to relieve inflammation of the lungs."

STANDLEY 1924: 903

“A cloth saturated with juice of the crushed roots was applied to the chest to relieve inflammation of the lungs.”

CASTETTER & BELL 1937: 42

Pereskia aculeata

Fruits expectorant and antisyphilitic. SOULAIRE 1947

Pereskia bleo

Known as expectorant and antisyphilitic. Used in the treatment of yellow fever. Its sap is used to clarify water. SOULAIRE 1947

Used in local Malasian folk medicine for the treatment of cancer & tumors, atopic dermatitis, diabetes, gastric pain, headache, inflammation, rheumatism and ulcers. The fresh leaves are usually consumed raw or as a decoction. SIM *et al.* 2010a cited GOH 2002, RAHMET 2004 & TAN *et al.* 2005.

Whole plant is used to treat gastrointestinal problems (Panama) SIM *et al.* 2010a cited GUPTA *et al.* 1996.

Cytotoxic effects (apoptosis) on various cancer cell lines. SIM *et al.* 2010a cited ER *et al.* 2007, SRI NURESTRI *et al.* 2008 & TAN *et al.* 2005. TAN *et al.* 2005 had demonstrated a cytotoxic activity against the human breast carcinoma T47-D cell line. ER *et al.* 2007 reported some degree of antiproliferative activity against some cell lines under some conditions but also noted a mutagenic potential in the presence of liver enzymes.

Acute toxicity studies for this & *P. grandifolia* produced no deaths so the LD₅₀ of the methanolic extract was estimated to be in excess of 2.5 grams/kg of body weight. SIM *et al.* 2010a

Pereskia grandifolia

“*Jarum Tujuh Bilah*” (Malaysia)

Used in local Malasian folk medicine for the treatment of cancer & tumors, atopic dermatitis, diabetes, gastric pain, headache, high blood pressure, inflammation, rheumatism, ulcers and “for revitalizing the body”.

The fresh leaves are usually consumed raw or as a decoction. SIM *et al.* 2010 cited GOH 2002 & RAHMET 2004.

Cytotoxic effects on various cancer cell lines. SIM *et al.* 2010 cited SRI NURESTRI *et al.* 2009 & TAN *et al.* 2005

Fruit reportedly used to reduce swellings.

SAHU *et al.* 1974 (citing ANONYMOUS 1969: 309)

Pereskia guamacho

Gum used in lung disorders and catarrh.

Leaves used in enemas or as flavoring in herbal teas.

Fruit are refreshing, diuretic and produce a pleasant drink.

SOULAIRE 1947

Used as cicatrizant, refrigerant, suppurative. Used for inflammation, sores, syphilis. JOHNSON 1999

Rhipsalis cassytha

Antihelminthic activity. SOULAIRE 1947

Rhipsalis conferta

The juice from this cactus caused death by cardiac arrest when injected. (from SOULAIRE 1947)

This refers to comments in LEWIN 1894 concerning experiments on cold blooded animals. (I am unaware of any *good* outcomes ever being reported after injecting cactus juice.)

***Rhipsalis pachyptera* PFEIFFER**

Fruit is used for fevers in Brazil. SOULAIRE 1947

***Cereus Bonplandii* J.PARMENTIER ex PFEIFFER**

This is an old name that is usually considered to be a synonym or a variety of *Selenicereus grandiflorus*.

It is claimed to possess the same properties as *S. grandiflorus* but the Lloyd Brothers' *Drug Treatise* dismisses this.

“FITCH” was mentioned as regarding this to be an “*antipsoric of remarkable power*” and purported curing eczema, deposits in urine, dropsy of cardiac and renal origin, neuralgia & insanity. CLARKE also indicates the stem tincture for emaciation, affections of the heart and of the kidneys.

CLARKE 2002 (1900)

Selenicereus coniflorus

“...gathered in large quantities in Veracruz and shipped to the United States for use in preparation of medicine.”

STANDLEY 1924: 914

The intended application was not mentioned.

Selenicereus grandiflorus

Drug extracted from plant used to treat rheumatism.

STANDLEY 1924: 914

Used for dropsy according to JOHNSON 1999.

“Cardiac stimulant (tonic), diuretic, similar to digitalis, but non-cumulative, counter-irritant; cardiac palpitation and weakness, heart failure from valvular disease, angina pectoris, aortic regurgitation, dropsies, low fevers, Grave's disease, tobacco toxemia, sexual exhaustion.”

CULBRETH 1927

From the LLOYD BROTHERS 1903/1908 “*Drug treatise*” :

Used in Jamaica & in Mexico for fevers, breathing difficulties, In excess amounts acts as an irritant producing diarrhoea, increases size of pulse, calming to stomach, raises blood pressure and body temperature, useful for cases of impotency in young men, as a sexual tonic for women, dyspepsia, Grave's disease, angina, anti-tobacco smoking aid, aortic hypertrophy, nerve sedative, relieves symptoms of menopause, emmenagogue, neuritis, nerve tonic & restorative

More widely reknown as a cardiotonic. More words on that follow.

A thoughtfully concerned comment cautioning that *Selenicereus grandiflorus* contained cardiac glycosides appeared at the Cactus_etc chat group.

An online search reveals no shortage of claims asserting the presence as well as claims of the absence of cardioactive glyco-

sides in *Selenicereus grandiflorus* but none find it necessary to include a reference to an actual evaluation.

VOGEL *et al.* 2005 asserts it to be “*Digitalis-like*” in either its effects or application (said table did not differentiate them) and warned: “*Increases effects of hypoglycemics; may enhance effects of cardiac glycosides, angiotensin-converting enzyme inhibitors, antiarrhythmics, beta-blockers, and calcium channel blockers.*”

ERNST 2003 and “Data extracted from” FUGH-BERMAN 2000 were given as the references. The 2003 article cited ERNST 2000 as his source. When contacted, Dr. Ernst very graciously provided me with a copy of that elusive paper. This proved to contain a previous presentation of the aforementioned information.

The 2000 article cited FETROW & AVILA 1999.

Fetrow & Avila were pharmacists who assembled what they intended to serve as a medical & health professional's reference work on this subject.

Fetrow & Avila flatly stated: “*The plant contains a digitalis-like glycoside, either cactine or hordenine (N,N-dimethyl-4-hydroxy-beta-phenethylamine).*”

Fetrow & Avila might have gleaned their assertion from elsewhere or it might reflect merely a bad verbal assemblage or translation of what they encountered elsewhere.

However, let's consider that rather densely inaccurate line that states *Selenicereus grandiflorus* to contain a cardioactive glycoside, either cactine or hordenine.

Cactine is generally believed to be synonymous with at least one of the known phenethylamines, usually it is said to be a synonym of hordenine. One must, however, ask the question of whether it was this or tyramine, or if it was one or more alkaloids. So far as I can tell, new plant material or medicinal preparations were what was always extracted for analysis and no actual samples of Sultan's 'cactine' were ever analyzed by later workers.

While hordenine, tyramine and N-methyltyramine are thought to be mild stimulants with an indirect action on the heart, they are all simple phenethylamine alkaloids and they are not glycosides. And none of them possess any digitalis-like activity.

Hordenine and tyramine have been reported to be present in at least potentially pharmacologically significant amounts for someone brewing a tea from dried stems (See respectively PETERSHOFFER-HALBMEYER *et al.* 1982 and WAGNER & GREVEL 1982a) but, as mentioned in an earlier post, the reports of these two alkaloids in this species have always been at odds with each other rather than their being reported as co-occurring.

I can also locate a referenceless claim online for the occurrence of N-methyltyramine in this species but not an analytical account that reported its presence. This claim was encountered within a summary report on the veterinary use of a homeopathic solution of *Selenicereus grandiflorus* that was posted in 1999 by “*The European Agency for the Evaluation of Medicinal Products. Veterinary Medicines Evaluation Unit.*” My request for clarification, emailed to their posted contact address, was returned as undeliverable.

These alkaloids are also not thought to be particularly active as cardiotonics. In a referenceless claim in Fetrow & Avila it was asserted that the believed mechanism of action of

Selenicereus grandiflorus had not been supported in humans and that earlier work had found its preparations inert. While one can find at least assertions to the contrary in medical literature stretching back into the 1800s, it is just as easy to locate agreements with their conclusions.

Even if however the contained alkaloids turn out to be effective cardiotonics (which most workers consider doubtful), the most commonly used - and studied - form appears to be a 1:100 homeopathic dilution; which should not be expected to contain pharmacologically meaningful amounts of alkaloid. Many workers have used dried and prepared stems for making a tincture.

The LLOYD BROTHERS 1903/1908 “*drug treatise*” insisted that in addition to high quality and an adequate dosage (not homeopathic), the use of fresh plant juice for preparing the tincture was crucial for it retaining good activity. Finley Ellingwood, writing in that treatise (p.6), claims that the accounts of ineffectuality revolve around heated, poorly prepared or otherwise inactive versions.

Their account of its actions bear reading as they do not suggest it to be particularly toxic or *Digitalis-like* although they do include descriptions of many actions on cardiac function. (That work is available online in PDF format.)

FETROW & AVILA continued and pointed to a more recent study in rats and dogs reporting “*a positive inotropic effect on the heart with increased systolic and diastolic pressures and peripheral blood flow volume.*” (This was in reference to HAPKE 1995 who evaluated pure hordenine using very high dosages.)

They ended their entry with an ‘analysis’ beginning with the peculiar statement “*Although night-blooming cereus contains a digitalis-like glycoside, its use as a substitute for digitalis preparations (digoxin or digitoxin) or treatment of heart-related disorders has not been evaluated in humans.*”

Fetrow & Avila's only references were HAPKE 1995 and WADSWORTH & FAULDS 1992.

The first paper discusses a pharmacological evaluation of hordenine and makes no mention of cardioactive glycosides, digitalis-like alkaloids or *Selenicereus grandiflorus*. The second paper appears to have only marginal connectiveness, at best, to the pharmacology of *Selenicereus grandiflorus* and none to the subject of digitalislike cardioactive glycosides. As was true for HAPKE 1995, it does not even mention these compounds or *Selenicereus grandiflorus*.

While the glycosides cactin, narcissin and flavonol-3-glycoside were reported as being isolated from its flowers by HORHAMMER *et al.* 1966, I cannot determine that any of the three other than narcissin has ever seen pharmacological evaluation. Whatever evaluation narcissin has seen is apparently limited to a Chinese language article so I am presently unable to glean more. As its concentration in *Selenicereus grandiflorus* is believed to be 0.05% by dry weight and its activity appears to revolve around decreased capillary permeability, it seems unlikely to make a significant contribution toward a purported digitalis-like action.

My present GUESS is that someone somewhere saw that “*glycosides*” were reported from the flowers of the plant, noticed that the species was considered to be cardioactive in application and assumed there was a connection between the two that is, so far as I can determine, unwarranted. It could simply be that casual reading caused someone to mistakenly

link the words “cardioactive” and “glycoside” together into the familiar phrase “cardioactive glycosides”. Whatever the case this appears to have occurred fairly early in its clinical history.

MELERO 2000 includes a very nice discussion of cardioactive steroids and glycosides that clearly shows that these particular compounds are quite different from any of the steroids or glycosides reported as occurring within any member of the Cactaceae, including *Selenicereus*.

Most glycosides have little or no discernable pharmacological activity of any type.

Several other earlier claims asserting that cardioactive glycosides occur in this species have been encountered but I have not yet obtained their purported references, when references are included. (For instance PETERSHOFFER-HALBMEYER *et al.* 1982 made a unclearly referenced statement purporting a digitalislike substance -- “[...] digitalisähnliche Stoffe zurückgeführt werden.” In their listed references we did find another source that similarly made the claim “[...] “digitalisähnliche” Stoffe enthalten soll.” Interestingly, that paper by FROHNE 1977 enclosed digitalislike in quotation marks. Frohne did not include any references but did comment that any newer work on the pharmacology or establishing the structures of what is responsible was not known to him.)

STANDLEY 1924 also makes the unreferenced statement “Action similar to digitalis” which no doubt lodged in some people’s mind.

Part of this topic achieving life that it was not warranted was probably due to the fact that medical professionals helped propagate the line both online and in prestigious peer reviewed journals. Peer review only works when said peers take the time to review the details of published data.

If it concerns something deemed trivial, such as in this case a plant species that was not in use by modern medicine, it is easy for no one to care enough to look deeper, especially if the mistake appears in a commentary supporting the lack of use.

My thanks go to Dr. Edzard Ernst for graciously providing a copy of his paper from *Perfusion*, also to Leo Martin for providing several very pertinent references and to Dr. Martin Terry for his help in obtaining some obscure papers.

One other odd note concerning *Selenicereus grandiflorus*. Some years ago I received a cutting from a San Pedro consumer in Austin who combines the juice of this plant with that brew. He claimed this was traditional practice but I have never been able to find any support for that claim.

Stenocereus alamosensis

Anti-type I allergy activity of the saponins with RBL-2H3 (Rat basophilic leukemia) cells was studied by measuring the β -hexosaminidase release inhibitory activity.

Gummoside A methyl ester was found to show activity ($IC_{50} = 99.5$ IM)

KAKUTA *et al.* 2012

Stenocereus eruca

Anti-type I allergy activity of the saponins with RBL-2H3 (Rat basophilic leukemia) cells was studied by measuring the β -hexosaminidase release inhibitory activity.

Thurberoside A exhibited mild activity ($IC_{50} = 166.9$ IM).

KAKUTA *et al.* 2012

Machaerogenic acid was reported to be an antagonist of the CCR6 receptor in a biological screening by ROTH 2011.

Trichocereus atacamensis

Trichocereus atacamensis (San Pedro de Atacama, Chile) has been reported to have mild stimulant activity in human bioassays. [Dosage was 6-8” of a single rib. ANONYMOUS]. Analysis is lacking.

Trichocereus bridgesii

Mescaline estimates based on isolations that have been posted online by anonymous sources in Oz have largely been between 0.12% to 0.23% with the occasional strain giving 1-2%

The common reports of potency greater than seems to be able to be accounted for by the reported mescaline content (based on human bioassays) has lead a number of people to speculate that an MAOI or some other interactive alkaloid may also be present. More research seems warranted.

Bridgesii is not just potent but apparently used at the folk level

For example, one correspondent requesting anonymity has reported that *bridgesii* was used commonly, but privately, in Bolivia and was abundant both in the wild and cultivation. He found numerous examples of intensive propagation as well as heavily harvested plants, The reported potency was described as “phenomenal”.

While Miguel Kavlin has claimed he could not find it in use by anyone other than himself in Bolivia, Darylene Dickson reported it being used there and sold in La Paz. However she misidentified it as *T. pachanoi* due to its name San Pedro.

Part of this may stem from an eradication campaign aimed at *bridgesii* stands around major urban areas, conducted by the Bolivian military around the end of the 1970s. This was apparently in response to an influx of “hippies”. One individual recalled seeing soldiers shaving the head of a long haired man in public by during that time period. (Personal communication with Bolivian correspondent requesting anonymity)

Murple also made an interesting comment that he was unable to locate any stands of *bridgesii* in the La Paz area that did not show signs of heavy harvesting. He claimed to have encountered a quarter mile hedge of *bridgesii* in which he was unable to find a single stem that had not seen a harvest.

Trichocereus chiloensis

Used to treat tumors. JOHNSON 1999 (i.e. HARTWELL)

Trichocereus cuzcoensis

Sold in Cuzco as a hair rinse. KAMM personal communication.

Used for treating cancer. JOHNSON 1999 (i.e. HARTWELL)

Plant shown on lower right (in pdf) was sold as *Trichocereus cuzcoensis* but obviously misidentified. The dried commercial material purported to be from this plant is proven to contain mescaline in human bioassays. Said to have been field collected at Huamanga near Cuzco in Peru. Doses of 20 grams are reported by bioassayists.

It may not be a *Trichocereus*. An identification and an analysis is needed.

Trichocereus huallanca or huayanca.

This name is not published. Nor is its variant *T. huayanca*.

This is not simply not a good *Trichocereus* species name, this plant is not a *Trichocereus*.

In fact it is unmistakably an *Opuntia* of some sort, most likely in what is now termed the *Austrocylindropuntia*. It does not appear to be *Opuntia cylindrica* despite the general resemblance.

A number of similar appearing species are known, for instance *Opuntia kuehrichiana*, but I have no clue about the actual identity of this *Opuntia* species.

More information and an analysis would be nice but perhaps a waste of time? My present suspicion is this claim is a scam as the dried material sold by the same vendor represented as being as flesh from this plant clearly did not come from the plant pictured. Despite a cutting being organized, no live material was included in the shipment.

See images in illustrated PDF: Notice that those dried pieces came from a columnar cactus with straight ribs and not from this plant which is imbricate? There seems to be too much wrong with this picture to encourage me to waste much more time on it.

Trichocereus pachanoi

Widely employed as a sacramental brew for treating and diagnosing illnesses.

Used for spiritual, shamanic & religious purposes; credited with enhancing precognition & health. HEAVEN 2013

Employed as emetic, entheogen & hypnotic JOHNSON 1999

Used for enteritis, evil-eye, gastritis, pneumonia, sterility. JOHNSON 1999

Monstrose forms are rumored to be especially active in human bioassays. (Anecdotal claim made by vendors in the Lima plant drug market)

OSTOLAZA 1996 illustrated the cristate form being depicted in a supernatural context by the Paracas culture in Peru. See more in *Sacred Cacti Part B San Pedro*.

Trichocereus schoenii

GRIZZLY encountered specimens in Colca Canyon, Peru showing evidence of intensive repeated harvesting suggesting its use for brew preparation. (Personal communication 2005)

Trichocereus scopulicola

First proven to contain Mescaline based on human bioassays.

In the US this was using NMCR grown material but no actual details were included beyond an opinion of substantially greater potency than *Trichocereus pachanoi*. (Personal communication from MARGADARSI.)

In Oz this was using material that was seed grown from Ritter seeds initially but by the late 1960s Australian commercial cactus producers in Victoria began successfully producing their own seeds.

Personal communication from Snu Voogelbreinder reported good results using 800-1000 gm fresh wt. of Australian material.

Voogelbreinder also determined that modern human sacramental usage was wider and older than suspected; by people mistakingly thinking it was *T. pachanoi*!

It might be suspected that this may eventually prove to be true for any indigenous users as well since *bridgesii* and *pachanoi* are apparently used interchangeably in Bolivia by people who would not consider this to be substantially different.

As the species is believed to be extinct in the wild this is rather a moot point.

Trichocereus spachianus

Reported to be “psychoactive” but “different than San Pedro”

ANONYMOUS in correspondence 1998.

Another correspondent claims to have determined it to be utterly inactive based on their bioassays.

Another reported becoming “deathly” ill for a few hours.

Needs further analysis.

Trichocereus taquimbaleensis

D.M. TURNER asserted successful bioassays but included no details.

GRIZZLY reported encountering specimens in Bolivia showing evidence of harvesting on a scale suggestive of brew preparation. (Personal communication 2005)

Trichocereus terscheckii

Reported fully active in human bioassays conducted in California. Some were stronger than others while others had simple stimulant effects. ANONYMOUS; in correspondence 1998.

Forms with simple stimulant action were described by one user as feeling like “‘dirty’ speed”. ANONYMOUS; in correspondence 2006.

Trichocereus tulhuayacensis

A claim for the presence of mescaline is made by CAYCHO JIMENEZ 1977 (page 91) but he cites no reference to support his assertion.

The presence of mescaline would not be surprising in this species.

In considering these cacti, it is important to keep in mind that cacti have many folk uses -- not just use as hallucinogens.

They are common and popularly used as hair rinses, in healing baths, for washing clothing, for treating fevers, stomach or intestinal complaints, as poultices and for "purifying water". The latter I am assuming is in reference to removing heavy metal contamination as is now being done industrially using *Opuntia* cuticle? See BARRERA-DÍAZ *et al.* 2005 & 2006. [A future entry on this subject is coming to this book.]

Drinking water polluted by toxic metal run-off from mining activities and/or volcanic soils is common in the Andes.

Traditional Ethanol-sources

Cephalocereus leucocephalus

See comments within *Lemaireocereus thurberi* below.

Carnegiea gigantea

Fruit syrup is used to prepare an intoxicating beverage.

STANDLEY 1924: 909

The only important intoxicating beverage used by the Papago is said to be a cider made from the fruit of the saguaro.

In its habitat, the brew making process is a matter of elaborate ceremony for every village with the brewing, the drinking and the intoxication itself being vital parts of the annual ritual for bringing rain.

While individual families brew their own at home, there is a communal co-creation of the ceremonial brew and the council house is kept warm by a small fire to aid the fermentation process. Each family contributes a jar of boiled juice.

As soon as the juice is decanted from its air-tight container into a large jar, it is mixed with four times as much water. Sometimes a starter from a previous batch may be added if the fermentation is too slow.

Fermentation is allowed to proceed for seventy-two hours.

"The resulting drink, called *navai't*, is a crimson-colored sort of cider with a slightly nauseating taste, which, when drunk in the ritual quantity induces vomiting. This beverage is almost impossible to keep, therefore the tradition is that the whole supply must be consumed within twenty-four hours."

CASTETTER & UNDERHILL 1935: 26

Lemaireocereus thurberi

In the southern part of their territory, the Papago made a drink similar to *navai't* using the fruit of *Lemaireocereus thurberi*. It was the ceremonial drink for that region.

CASTETTER & UNDERHILL 1935: 26

"Fruits of *cawe* (*Lemaireocereus Thurberi*) and *naplsora* (*Cephalocereus leucocephalus*), are used in preparing a fruit *tesgiino* in western canyons. Pulp from ripe fruit is mashed upon a *mataka* or upon any convenient rock. The juice is collected and mixed with water which is boiled for several hours and set aside to ferment. The common catalyst is *batari*, bark of *kakwari* (*Randia echinocarpa*, *R. Watsoni* and *R. laevigata*) and *kaya* (*Coutarea pterosperma*), which is readily available in the canyons."

PENNINGTON 1963: 155.

STANDLEY suggested the early accounts of a *cardon* that created a brew which turned the urine red-like-blood referred to *Lemaireocereus Thurberi*.

Pachycereus pecten-aboriginum

Bye described the fresh juice expressed from young branch tips of the stems of this plant as finding occasional use "[...] by the Tarahumara of the western barrancas to induce visions, along with quick intoxication during 'tesguinadas'. The sap may be added to corn 'tesguino' or cooked and fermented alone, although this last preparation is said to act as a strong purgative."

BYE 1979

Other cactus fruit

Ferocactus and *Opuntia* species provide fruit to the Tarahumara that, when they are available in sufficient quantities, are mashed and strained free from seeds. This juice is then diluted with water and boiled in the same manner as the other *tesgiinos*.

Pennington comments that in the Urique Canyon strained but undiluted and unboiled juice obtained from fruits of any of the local cactus species is put in the sun to ferment for several hours. "It is said to turn to 'wine' very quickly and when drunk produces a heady sensation that does not last as long as that caused from drinking boiled *tesgiino*. There is a tradition in the canyons that the setting aside of fruit juice for quick fermentation was formerly a widespread practice."

PENNINGTON 1963: 155.

The Papago once made a fermented drink from *Opuntia engelmannii* fruit but this was never extensively used and lacked any ceremonial significance.

CASTETTER & UNDERHILL 1935: 26

Colonche is boiled and fermented *Opuntia* fruit juice. *Nochote* or *nochocle* is a fermented brew made from *Opuntia* fruit juice, pulque and water.

STANDLEY 1924: 865

References

- [Brackets around a title indicates it is likely an English translation of the actual title.]
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Major= Greater than 10% of total volatiles
Minor= Greater than 1% but less than 10% of total volatiles
Trace = Less than 1% of total volatiles
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Cactus Phenethylamines: A Tabular Key to their Structural Formulas

Position:	2	3	Phenyl 4	5	6	Ethyl β	α	Amine N1	N2	N3+
Compound										
Phenethylamine	H	H	H	H	H	na	na	H	H	na
Amphetamine*	H	H	H	H	H	na	Me	H	H	na
N-Methylphenethylamine	H	H	H	H	H	na	na	Me	H	na
Methamphetamine*	H	H	H	H	H	na	Me	Me	H	na
N,N-Dimethylphenethylamine	H	H	H	H	H	na	na	Me	Me	na
Ubine	H	H	H	H	H	HO	na	Me	Me	na
Coryphanthine	H	H	H	H	H	MeO	na	Me	Me	Me+
Tyramine	H	H	HO	H	H	na	na	H	H	na
Octopamine	H	H	HO	H	H	HO	na	H	H	na
N-Methyltyramine	H	H	HO	H	H	na	na	Me	H	na
Synephrine	H	H	HO	H	H	HO	na	Me	H	na
β -O-Methylsynephrine	H	H	HO	H	H	MeO	na	Me	H	na
β -O-Ethylsynephrine	H	H	HO	H	H	EtO	na	Me	H	na
Hordenine	H	H	HO	H	H	na	na	Me	Me	na
Candicine	H	H	HO	H	H	na	na	Me	Me	Me+
4-Methoxyphenethylamine	H	H	MeO	H	H	na	na	H	H	na
4-Methoxy- β -hydroxyphenethylamine	H	H	MeO	H	H	HO	na	H	H	na
N-Methyl-4-methoxyphenethylamine	H	H	MeO	H	H	na	na	Me	H	na
Longimammine	H	H	MeO	H	H	HO	na	Me	H	na
N,N-Dimethyl-4-methoxyphenethylamine	H	H	MeO	H	H	na	na	Me	Me	na
N,N-Dimethyl-4-methoxy- β -hydroxyphenethylamine	H	H	MeO	H	H	HO	na	Me	Me	na
O-Methyl-candicine	H	H	MeO	H	H	na	na	Me	Me	Me+

* Not reported as a cactus alkaloid; included for structural comparison

Trouts Notes on Cactus Chemistry

PEA cont.	Position:	2	3	Phenyl 4	5	6	Ethyl β	α	Amine N1	N2	N3+
Compound											
Dopamine		H	HO	HO	H	H	na	na	H	H	na
Norepinephrine		H	HO	HO	H	H	HO	na	H	H	na
Epinephrine		H	HO	HO	H	H	na	na	Me	H	na
Epinephrine		H	HO	HO	H	H	HO	na	Me	H	na
N-Methyladrenaline		H	HO	HO	H	H	HO	na	Me	Me	na
Coryneine		H	HO	HO	H	H	na	na	Me	Me	Me+
3-Hydroxy-4-methoxyphenethylamine		H	HO	MeO	H	H	na	na	H	H	na
3-Methoxytyramine		H	MeO	HO	H	H	na	na	H	H	na
Normetanephine		H	MeO	HO	H	H	HO	na	H	H	na
N-Methyl-3-methoxytyramine		H	MeO	HO	H	H	na	na	Me	H	na
Metanephine		H	MeO	HO	H	H	HO	na	Me	H	na
NAMT		H	MeO	HO	H	H	na	na	C(O)Me	H	na
N,N-Dimethyl-3-methoxytyramine		H	MeO	HO	H	H	na	na	Me	Me	na
Salicifoline*		H	MeO	HO	H	H	na	na	Me	Me	Me+
N-Methylmetanephine		H	MeO	HO	H	H	HO	na	Me	Me	na
3,4-Dimethoxyphenethylamine		H	MeO	MeO	H	H	na	na	H	H	na
3,4-Dimethoxy- β -hydroxyphenethylamine		H	MeO	MeO	H	H	HO	na	H	H	na
3,4-Dimethoxy-N-methylphenethylamine		H	MeO	MeO	H	H	na	na	Me	H	na
Normacromerine		H	MeO	MeO	H	H	HO	na	Me	H	na
Calipamine		H	MeO	MeO	H	H	MeO	na	Me	H	na
N-Acetyl DMPEA		H	MeO	MeO	H	H	na	na	C(O)Me	H	na

* Not reported as a cactus alkaloid; included for structural comparison

Structural tables: Phenethylamines

PEA cont.	Position:	2	3	Phenyl 4	5	6	Ethyl β	α	Amine N1	N2	N3+
Compound											
3,4-Dimethoxy-N,N-dimethylphenethylamine		H	MeO	MeO	H	H	na	na	Me	Me	na
Macromerine		H	MeO	MeO	H	H	HO	na	Me	Me	na
β -Methoxy-3,4-dimethoxy-N,N-dimethylphenethylamine		H	MeO	MeO	H	H	MeO	na	Me	Me	na
3-Nitrotyramine		H	NO ₂	HO	H	H	na	na	H	H	na
3,4,5-Trihydroxyphenethylamine*		H	OH	OH	OH	H	na	na	H	H	na
3,4-Dihydroxy-5-methoxyphenethylamine		H	HO	HO	MeO	H	na	na	H	H	na
3-Hydroxy-4,5-dimethoxyphenethylamine		H	HO	MeO	MeO	H	na	na	H	H	na
N-Methyl-3-hydroxy-4,5-dimethoxyphenethylamine		H	HO	MeO	MeO	H	na	na	Me	H	na
N-Formyl-3-hydroxy-4,5-dimethoxyphenethylamine		H	HO	MeO	MeO	H	na	na	C(O)H	H	na
N-Acetyl-3-hydroxy-4,5-dimethoxyphenethylamine		H	HO	MeO	MeO	H	na	na	C(O)Me	H	na
N,N-Dimethyl-3-hydroxy-4,5-dimethoxyphenethylamine		H	HO	MeO	MeO	H	na	na	Me	Me	na
4-Hydroxy-3,5-dimethoxyphenethylamine		H	MeO	HO	MeO	H	na	na	H	H	na
Mescaline		H	MeO	MeO	MeO	H	na	na	H	H	na
N-Methylmescaline		H	MeO	MeO	MeO	H	na	na	Me	H	na
N-Formylmescaline		H	MeO	MeO	MeO	H	na	na	C(O)H	H	na

* Not reported as a cactus alkaloid; included for structural comparison

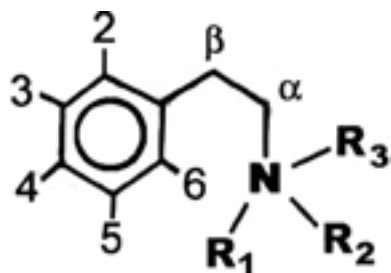
Trouts Notes on Cactus Chemistry

PEA cont. Compound	Position:	2	3	Phenyl 4	5	6	Ethyl β	α	Amine N1	N2	N3+
N-Acetylmescaline		H	MeO	MeO	MeO	H	na	na	C(O)Me	H	na
β -Hydroxy-mescaline		H	MeO	MeO	MeO	H	HO	na	H	H	na
Trichocereine		H	MeO	MeO	MeO	H	na	na	Me	Me	na
3,4,5-Trimethoxyphenylalanine*		H	MeO	MeO	MeO	H	na	-CO ₂ H	H	H	na
2-Chloro-mescaline**		Cl	MeO	MeO	MeO	H	na	na	H	H	na
2,6-Dichloro-mescaline*		Cl	MeO	MeO	MeO	Cl	na	na	H	H	na

* Not reported as a cactus alkaloid; included for structural comparison

** Believed to be extraction artifact

Generic structural diagram for phenethylamine table



Phenethylamine Key:

Abbreviations

α : Carbon adjacent to the nitrogen.

β : Carbon adjacent to the phenyl ring.

Cl: Chlorine

C(O)H: Formyl

C(O)Me: Acetyl

CO₂H: COOH: Carbonyl

EtO: Ethoxy

H: Hydrogen

HO: Hydroxy

Me: Methyl

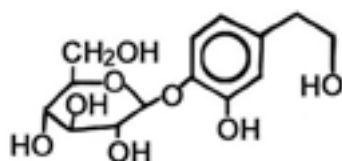
Me⁺: Methyl cation

MeO: Methoxy

na: Not applicable.

NO₂: Nitrate

PEA: Phenethylamine



Structure of Lemairin

Cactus Isoquinolines: A Tabular Key to their Structural Formulas

(The following includes related isoquinolines that do not occur in cacti; these are included for comparative purposes)

Compound	R5	R6	R7	R8	R1	R2a	R2b	R4	unsat
mono-ring-sub									
1. Longimammatine	H	MeO	H	H	H H	H	na	H	na
2. Weberidine	H	H	MeO	H	H H	H	na	H	na
3. Longimammosine	H	OH	H	H	H H	Me	na	H	na
4. Longimammidine	H	H	H	OH	H H	Me	na	H	na
5. ?-Mono-MeO-1-Me-THIQ (MIKES)	MeO (position?)				Me	H	na	H	na
6. Longimammamine	H	H	H	OH	H H	Me	na	OH	na
7. Arizonine	H	H	H	MeO	OH H	Me	na	H	na
di-ring-sub									
8. Heliamine	H	MeO	MeO	H	H H	H	na	H	na
9. Dehydroheliamine	H	MeO	MeO	H	H	H	na	H	1,2
10. Backebergine	H	MeO	MeO	H	H	H	na	H	1,2 3,4
11. Lemaireocereine	H	H	MeO	MeO	H H	H	na	H	na
12. Dehydrolemaireocereine	H	H	MeO	MeO	H	H	na	H	1,2
13. Isobackebergine	H	H	MeO	MeO	H	H	na	H	1,2 3,4
14. Uberine	MeO	H	OH	H	H H	Me	na	H	na
15. Corypalline	H	MeO	OH	H	H H	Me	na	H	na
16. Salsolinol*	H	OH	OH	H	Me	H	na	H	na
17. Salsoline	H	OH	MeO	H	Me	H	na	H	na
18. Isosalsoline	H	MeO	OH	H	Me	H	na	H	na
19. Salsolidine	H	MeO	MeO	H	Me	H	na	H	na
20. Dehydrosalsolidine	H	MeO	MeO	H	Me	H	na	H	1,2

* Not reported as a cactus alkaloid; included for structural comparison

Trouts Notes on Cactus Chemistry

Isoquinoline cont.	R5	R6	R7	R8	R1	R2a	R2b	R4	unsat
21. N-Methylheliamine (O-Methyl-corypalline)	H	MeO	MeO	H	H	Me	na	H	na
22. Hydrohydrastinine*	H	-O-CH-O-H		H	H H	Me	na	H	na
23. N-Methylisosalsoline	H	MeO	OH	H	Me	Me	na	H	na
24. Lophocereine	H	MeO	OH	H	<i>i</i> -butyl	Me	na	H	na
25. Carnegine	H	MeO	MeO	H	Me	Me	na	H	na
26. Tepenine	H	H	MeO	MeO	Me	Me	na	H	na
27. Calycotomine*	H	MeO	MeO	H	-MeOH	H	na	H	na
28. Isosalsolidine	H	MeO	MeO	H	Me	H	na	H	1,2 3,4
29. Dehydrosalsolidine	H	MeO	MeO	H	Me	H	na	H	1,2
tri-ring-sub 30. HydrocotarnineH	-O-Me-O-		MeO	Me	Me	na	H	na	
31. Anhalamine	H	MeO	MeO	OH	H	H	na	H	na
32. Isoanhalamine	H	OH	MeO	MeO	H	H	na	H	na
33. Anhalinine	H	MeO	MeO	MeO	H	H	na	H	na
34. Nortehuanine	MeO	MeO	MeO	H	H	H	na	H	na
35. Anhalidine	H	MeO	MeO	OH	H	Me	na	H	na
36. Isoanhalidine	H	OH	MeO	MeO	H	Me	na	H	na
37. Anhalonine	H	MeO	-O-Me-O-		Me	H	na	H	na
38. Anhalonidine	H	MeO	MeO	OH	Me	H	na	H	na
39. Iso-anhalonidine	H	OH	MeO	MeO	Me	H	na	H	na
40. Lophophorine	H	MeO	-O-Me-O-		Me	Me	na	H	na
41. O-Methyl-anhalonidine	H	MeO	MeO	MeO	Me	H	na	H	na
42. Tehuanine	MeO	MeO	MeO	H	H	Me	na	H	na
43. Tehuanine-N-oxide	MeO	MeO	MeO	H	H	Me	®O	H	na
44. Gigantine	Me	Me	Me	na	na	H	OH	na	na
Incorrect proposal	OH	H	MeO	MeO	MeO	MeO	H	H	Me
45. Pellotine	H	MeO	MeO	OH	Me	Me	na	H	na
46. Isopellotine	H	OH	MeO	MeO	Me	Me	na	H	na 3,4

* Not reported as a cactus alkaloid; included for structural comparison

Structural tables: Isoquinolines

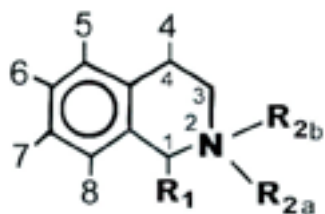
Isoquinoline cont. tri-ring-sub cont.	R5	R6	R7	R8	R1	R2a	R2b	R4	unsat
47. O-Methylpellotine	H	MeO	MeO	MeO	Me	Me	na	H	na
48. Pterocereine	glucose-O-	MeO	MeO	H	-MeOH	Me	na	H	na
49. Deglucoptercereine	OH	MeO	MeO	H	-MeOH	Me	na	H	na
50. Deglucoptercereine-N-oxide	OH	MeO	MeO	H	-MeOH	Me	®O	H	na
51. Anhalotine (Iodide)	H	MeO	MeO	OH	H	Me	I	H	na
52. Lophotine (Iodide)	H	MeO	-O-Me-O-		Me	Me	I	H	na
53. Peyotine (Iodide)	H	MeO	MeO	MeO	Me	Me	I	H	na
54. 3,4-Dihydro-6,7-diMeO-8-OH-IQ	H	MeO	MeO	OH	H	H	na	H	1,2
55. 3,4-Dihydro-6,7-diMeO-8-OH-2-Me-isoquinolinium inner salt	H	MeO	MeO	O ⁻	H	Me ⁺	na	H	1,2
56. 3,4-Dihydro-6,7-diMeO-8-OH-1-Me-isoquinoline	H	MeO	MeO	OH	Me	H	na	H	1,2
57. 3,4-Dihydro-6,7-diMeO-8-OH-1,2-diMe-isoquinolinium inner salt	H	MeO	MeO	O ⁻	Me	Me ⁺	na	H	1,2
58. Pycnarrhine* 1,2	H	MeO	OH	H	H	Me ⁺ OH ⁻		na	H
59. N-Methyl-6,7-dimethoxy-isoquinolinium chloride*	H	MeO	MeO	H	H	Me ⁺ Cl ⁻	na	H	1,2
60. Peyoglutam	H	MeO	MeO	OH	-CH ₂ -CH ₂ -C(O)-		na	H	na
61. Mescalotam	H	MeO	MeO	MeO	-CH ₂ -CH ₂ -C(O)-		na	H	na
62. Peyoxylic acid	H	MeO	MeO	OH	-CO ₂ H	H	na	H	na
63. O-Methyl-peyoxalic acid	H	MeO	MeO	MeO	-CO ₂ H	H	na	H	na
64. Peyoruvic acid	H	MeO	MeO	OH	-Me -CO ₂ H	H	na	H	na
65. O-Methylpeyoruvic acid	H	MeO	MeO	MeO	-Me -CO ₂ H	H	na	H	na
66. Isonortehuanine	MeO	MeO	MeO	H	H	H	na	H	1,2 3,4
67. Dehydronortehuanine	MeO	MeO	MeO	H	H	H	na	H	1,2
68. Peyophorine	H	MeO	-O-Me-O-		Me	Et	na	H	na

* Not reported as a cactus alkaloid; included for structural comparison

Trouts Notes on Cactus Chemistry

Isoquinoline cont. tetra-ring-sub	R5	R6	R7	R8	R1	R2a	R2b	R4	unsat
69. ?-Mono-OH-tri-MeO-2-Me-THIQ (MIKES)	(MeO) ₃ & OH (positions?)				H	Me	na	H	1,2 3,4
70. ?-Tri-MeO-1-Me-1,2,3,4-dehydro-IQ (MIKES)	(MeO) ₃ (positions?)				Me	H	na	H	1,2 3,4
71. ?-Tri-MeO-1-Me-1,2-dehydro-IQ (MIKES)	(MeO) ₃ (positions?)				Me	H	na	H	1,2
72. Norweberine	MeO	MeO	MeO	MeO	H	H	na	H	na
73. Dehydronorweberine	MeO	MeO	MeO	MeO	H	H	na	H	1,2
74. Isonorweberine	MeO	MeO	MeO	MeO	H	H	na	H	1,2 3,4
75. Pachycereine	MeO	MeO	MeO	MeO	Me	H	na	H	na
76. Dehydropachycereine	MeO	MeO	MeO	MeO	Me	H	na	H	1,2
77. Isopachycereine MeO	MeO	MeO	MeO	Me	H	na	H	1,2	3,4
78. Weberine	MeO	MeO	MeO	MeO	H	Me	na	H	na
79. N-Methylpachycereine trimeric	MeO	MeO	MeO	MeO	Me	Me	na	H	na
80. Pilocereine	H H H	MeO MeO MeO	OH XO YO	X Y H	i-butyl i-butyl i-butyl	Me Me Me	na na na	H H H	na na na

Generic structural diagram for isoquinoline table



Isoquinoline key:

Abbreviations

1,2: 1,2-Dehydro

3,4: 3,4-Dehydro

CO₂H: COOH: Carbonyl

H: Hydrogen

Me: Methyl

MeO: Methoxy

na: Not applicable

OH: Hydroxy

-O-Me-O-: Methylenedioxy

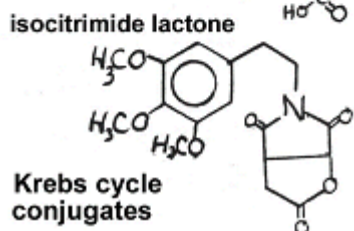
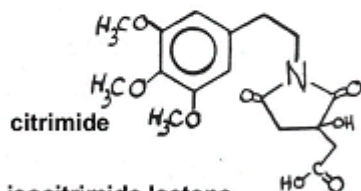
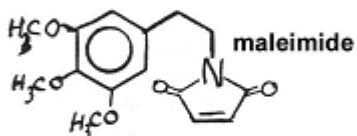
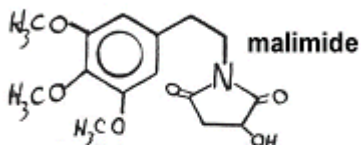
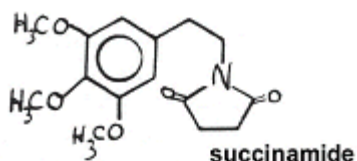
X: Point of attachment (X-X)

Y: Point of attachment (Y-Y)

Structural table Isoquinolines in alphabetical order

Name	List #	Name (cont.)	List #	Name (cont.)	List #
?-Mono-MeO-1-Methyl-THIQ		Heliamine	8	Peyoglutam	60
5		Heliamine, Dehydro-	9	Peyophorine	68
?-Mono-OH-tri-MeO-2-Methyl-THIQ		Heliamine, N-Methyl-	21	Peyoruvic acid	64
69		Hydrocotarnine	30	Peyoruvic acid, O-Methyl-	65
?-Tri-MeO-1-Methyl-1,2,3,4-dehydro-isoquinoline	70	Hydrohydrastinine	22	Peyotine (Iodide)	53
?-Tri-MeO-1-Methyl-1,2-dehydro-isoquinoline	71	Isoanhalamine	32	Peyoxylic acid	62
3,4-Dihydro-6,7-dimethoxy-8-hydroxy-1,2-dimethyl-isoquinolinium inner salt	57	Isoanhalidine	36	Peyoxylic acid, O-Methyl-	63
3,4-Dihydro-6,7-dimethoxy-8-hydroxy-1-methyl-isoquinoline	56	Isoanhalonidine	39	Pilocereine	80
3,4-Dihydro-6,7-dimethoxy-8-hydroxy-2-methyl-isoquinolinium inner salt	55	Isobackebergine	13	Pterocereine	48
3,4-Dihydro-6,7-dimethoxy-8-hydroxy-isoquinoline	54	Isonortehuanine	66	Pterocereine, Degluco-	49
Anhalamine	31	Isonorweberine	74	Pycnarrhine	58
Anhalamine, Iso-	32	Isopachycereine	77	Salsolidine	19
Anhalidine	35	Isopellotine	46	Salsolidine, Dehydro-	20
Anhalidine, Iso-	36	Isosalsolidine	28	Salsolidine, Dehydro-	29
Anhalinine	33	Isosalsoline	18	Salsolidine, Iso-	28
Anhalonidine	38	Isosalsoline, N-Methyl-	23	Salsoline	17
Anhalonidine, Iso-	39	Lemaireocereine	11	Salsoline, Iso-	18
Anhalonidine, O-Methyl-	41	Lemaireocereine, Dehydro-	12	Salsoline, N-Methyl-iso-	23
Anhalonine	37	Longimammamine	6	Salsolinol	16
Anhalotine (Iodide)	51	Longimammatine	1	Tehuanine	42
Arizonine	7	Longimammidine	4	Tehuanine, Dehydronor	67
Backebergine	10	Longimammosine	3	Tehuanine, Isonor-	66
Backebergine, Iso-	13	Lophocereine	24	Tehuanine, Nor-	34
Calycotomine	27	Lophophorine	40	Tehuanine-N-oxide	43
Carnegine	25	Lophotine (Iodide)	52	Tepenine	26
Corypalline	15	Mescalotam	61	Uberine	14
Corypalline, O-Methyl-	21	N-Methyl-6,7-dimethoxy-isoquinolinium chloride	59	Weberidine	2
Deglucopterocereine	49	N-Methylheliamine	21	Weberine	78
Deglucopterocereine-N-oxide	50	N-Methylisosalsoline	23	Weberine, Dehydro-nor-	73
Dehydroheliamine	9	N-Methylpachycereine	79	Weberine, Isonor-	74
Dehydro-lemaireocereine	12	Nortehuanine	34	Weberine, Nor-	72
Dehydronortehuanine	67	Nortehuanine, Dehydro-	67		
Dehydronorweberine	73	Nortehuanine, Iso-	66		
Dehydropachycereine	76	Norweberine	72		
Dehydrosalsolidine	20	Norweberine, Dehydro-	73		
Dehydrosalsolidine	29	Norweberine, Iso-	74		
Gigantine	44	O-Methyl-anhalonidine	41		
		O-Methylcorypalline	21		
		O-Methylpellotine	47		
		O-Methylpeyoruvic acid	65		
		O-Methylpeyoxylic acid	63		
		Pachycereine	75		
		Pachycereine, Dehydro-	76		
		Pachycereine, Iso-	77		
		Pachycereine, N-Methyl-	79		
		Pellotine	45		
		Pellotine, Iso-	46		
		Pellotine, O-Methyl-	47		

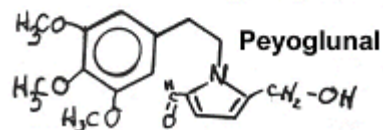
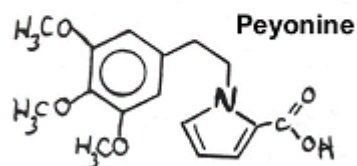
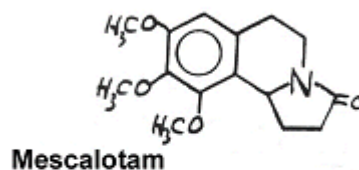
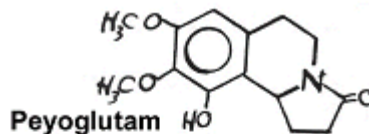
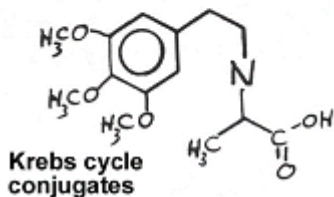
Mescaline Krebs acid conjugates & other compounds:



Krebs cycle
conjugates



mescaloruvic acid



Peyonine and Peyoglunal are pyrrole derivatives rather than Krebs cycle conjugates; they are included on this page only for convenience.

The remaining Krebs acid conjugates include Peyoxylic acid, O-Methylpeyoxalic acid, Peyoruvic acid & O-Methylpeyoruvic acid. These are included in the tables above.

Some Cactus Triterpenoids, Sterols & Similar Molecules

A Tabular Key to their Structural Formulas

(The following includes several related compounds that do not occur in cacti; these are included for comparative purposes)

Compound	Ring	R1	R2	R3	R4	R5	R6	R7	R8	R9
β -Amyrin	C	OH	Me	H H	H H	H	Me H	H H	Me	Me
α -Sitosterol C8=C9	B	OH	Me	H	H	Et	Me	na	na	na
β -Sitosterol C5=C6	B	OH	H	H	H	Et	Me	na	na	na
α -Spinasterol C7=C8 C22=C23	B	OH	H	H	H	Et	Me	na	na	na
3- β -Hydroxy-11 α ,12 α -epoxyoleanan-28,13B-olide C11-O-C12	C	OH	Me	H H	H H	-O-C(O)- (to C13)	H H	H H	Me	Me
Alamosenogenin	C	OH	Me	H H	OH H	CHO	H H	H H	CH ₂ OH	Me
Betulin	A	OH	Me	Me	H	CH ₂ OH	H H	H	=CH ₂	H
Betulinic acid	A	OH	Me	Me	H	CO ₂ H	H H	H	=CH ₂	H
Bridgesigenin A	C	OH	Me	-O-C(O)- (to R5)	H H	(from R3)	H H	H H	CH ₂ OH	Me
Bridgesigenin B	C	OH	Me	-O-C(O)- (to R5)	H H	(from R3)	H OH	OH H	CH ₂ OH	Me
Bridgesigenin C	C	OH	Me	-O-C(O)- (to R5)	H H	(from R3)	H OH	AcO H	CH ₂ OH	Me
Calenduladiol acc. to KIRCHER 1980	A	OH	Me	Me	OH	Me	H	H H	=CH ₂	H
Calenduladiol acc. to KASPRZYK et al 1970	A	OH	Me	Me	OH	Me	H	H H	=CH ₂	OH
Campesterol C5=C6	B	OH	Me	H	H	Me	Me	na	na	na
Chichipegenin	C	OH	Me	H H	OH H	CH ₂ OH	OH H	H H	Me	Me
Cholestane (all saturated)	B	H	H	H	H	H	Me	na	na	na
Cholesterol (all saturated)	B	OH	H	H	H	H	Me	na	na	na
Cholesterol C5=C6	B	OH	H	H	H	H	Me	na	na	na
Cochalic acid	C	OH	Me	H H	OH H	CO ₂ H	H H	H H	Me	Me

Trouts Notes on Cactus Chemistry

Compound	Ring	R1	R2	R3	R4	R5	R6	R7	R8	R9
Cyclostenol (all saturated)	B	OH	H	OH	Me	H	-C(H ₂) - (to C9)	na	na	na
Dumortierigenin	C	OH	Me	-O-C(O)- (to R5)	H H	(from R3)	OH H	H H	Me	Me
Epithelanthate	D	OH	Me	na	na	na	na	na	na	na
Erynginol A	C	OH	Me	H H	OH H	CH ₂ OH	OH H	OH H	CH ₂ OH	Me
Erythrodiol	C	OH	Me	H H	H H	CH ₂ OH	H H	H H	Me	Me
Friedelan-3 α -ol No Me at C1 Me at C4, C13 & C18	C	OH	Me	H H	H H	Me	H H	H H	Me	Me
Friedelin No Me at C1 Me at C4, C13 & C18	C	=O	Me	H H	H H	Me	H H	H H	Me	Me
Gummosogenin	C	OH	Me	H H	OH H	CHO	H H	H H	Me	Me
Longispinogenin	C	OH	Me	H H	OH H	CH ₂ OH	H H	H H	Me	Me
Lophenol 7=8	B	OH	H	H	H	H	Me	na	na	na
Lupenetriol	A	OH	Me	Me	OH	CH ₂ OH	H	H	=CH ₂	H
Lupeol	A	OH	Me	Me	H	Me	H H	H	=CH ₂	H
Macdougallin 8=9	B	OH	Me	OH	Me	H	Me	na	na	na
Machaeric acid	C	OH	Me	H H	H H	CO ₂ H	H H	=O	Me	Me
Machaerinic acid	C	OH	Me	H H	H H	CO ₂ H	H H	OH	Me	Me
Machaerogenin 12=13	C	OH	Me	H H	H H	-C(O)-O- (to R7)	H H	(from R5) H	CH ₂ OH	Me
Maniladiol	C	OH	Me	H H	OH H	Me	H H	H H	Me	Me
Methyl betulinate	A	OH	Me	Me	H	COOMe	H H	H	=CH ₂	H
Methyl epithelanthate	D	OH	Me	na	na	na	na	na	na	na
Methyl machaerinate	C	OH	Me	H H	H H	COOMe	H H	=O	Me	Me

Structural tables: Triterpenes & sterols

Compound	Ring	R1	R2	R3	R4	R5	R6	R7	R8	R9
Methyl oleanolate	C	OH	Me	H H	H H	COOMe	H H	H H	Me	Me
Methyl queretaroate	C	OH	Me	H H	H H	COOMe	H H	H H	CH ₂ OH	Me
Myrtillogenic acid	C	OH	Me	H H	OH H	CH ₂ OH	H H	H H	CH ₂ OH	Me
Oleanolic acid	C	OH	Me	H H	H H	CH ₂ OH	H H	H H	Me	Me
Oleanolic aldehyde	C	OH	Me	H H	H H	CHO	H H	H H	Me	Me
Pachanol A C12=C13 C14=C15	E	OH	Me	Me	H H	-C(O)-O- (to R7)	H H	(from R5) H	CH ₂ OH	Me
Pachanol B C11=C12 C13=C18	E	OH	Me	Me	H H	-C(O)-O- (to R7)	OH H	(from R5) H	CH ₂ OH	Me
Pachanol C C12=C13 OH at 14	E	OH	Me	Me	H H	-C(O)OH	H H	OAc H	CH ₂ OH	Me
Pachanol D C12=C13	E	OH	Me	Me	H H	-C(O)-O- (to C14)	OH H	H H	CH ₂ OH	Me
Peniocerol C8=C9	B	OH	H	OH	H	H	Me	na	na	na
Queretaroic acid	C	OH	H	H H	H H	CO ₂ H	H H	H H	CH ₂ OH	Me
Queretarol	C	OH	H	H H	H H	CH ₂ OH	H H	H H	CH ₂ OH	Me
Stellatogenin	A	OH	Me	Me	H	-C(O)-O- (to R7)	H H	(from R5) H	Me OH	H
Stenocereol C8=C9 C22=C23	B	OH	H	OH	Me	H	Me	na	na	na
Stenocereol C8=C9 C22=C2	B	OH	H	OH	Me	H	Me	na	na	na
Stigmasterol C5=C6 C22=C23	B	OH	H	H	H	H	Me	na	na	na
Taraxerol C14=C15 No Me at C14 Me at C13 & C18	C	OH	Me	H H	H H	Me	H H	H H	Me	Me

Compound	Ring	R1	R2	R3	R4	R5	R6	R7	R8	R9
Thurberin	A	OH	Me	Me	H	Me	H H	H	=CH ₂	H
Thurberogenin acc to HEGNAUER	A	OH	Me	Me	H	-C(O)-O- (to R7)	H H	(from R5)	=CH ₂	H
Thurberogenin acc to KIRCHER	A	OH	Me	Me	H	-C(O)-O- (to R6)	(from R5) H H		=CH ₂	H
Thurberol C8=C9 C14=C15	B	OH	H	OH	H	H	Me			
Treasegenic acid	C	OH	Me	H H	H H	CO ₂ H	H H	OH H	CH ₂ OH	Me

Triterpenoids Key:

Abbreviations:

Stereochemistry is not reflected in table unless indicated in structural diagram

=: Indicates position of a double bond

COOMe: Methyl ester

-O-: Epoxy

A, B, C, or D: Ring structure (see diagrams)

Et: Ethyl: C₂H₅

OH: Hydroxy

C#: Indicates specific carbon atom
to

H: Hydrogen

“to R#”: Indicates the place it is bonded

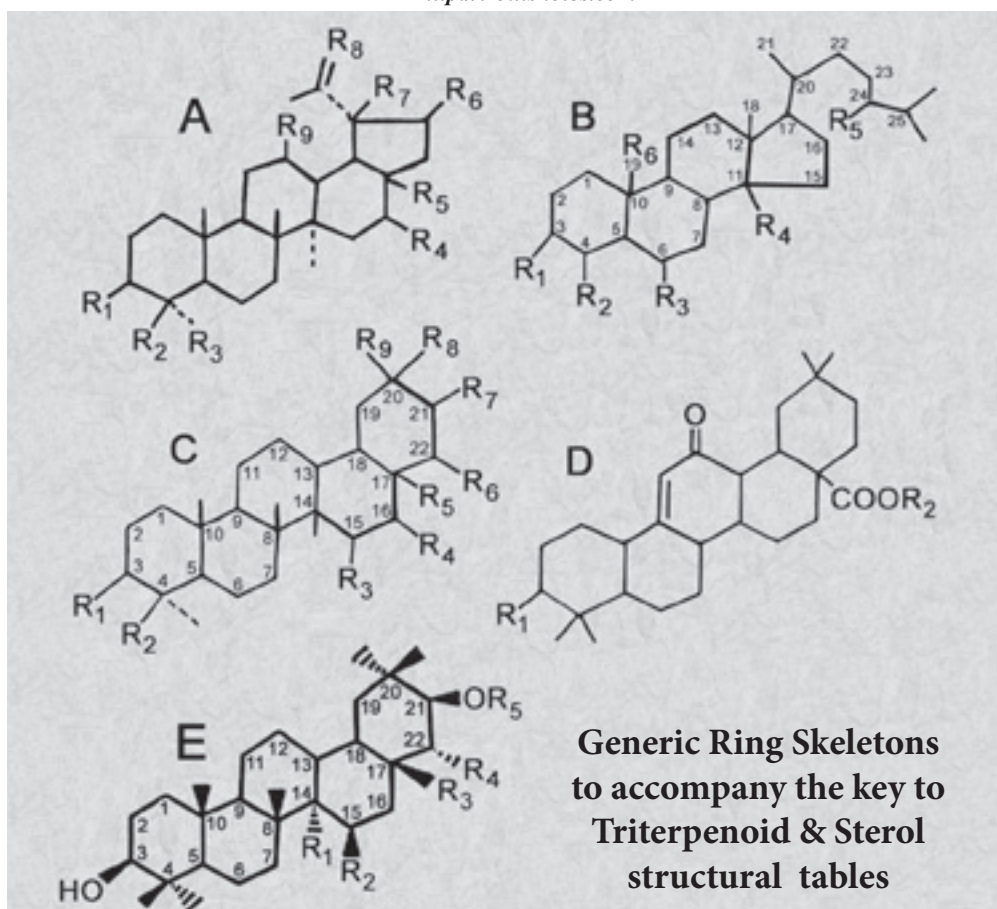
CHO: formyl

Me: Methyl

“from R#”: Indicates where it is linked

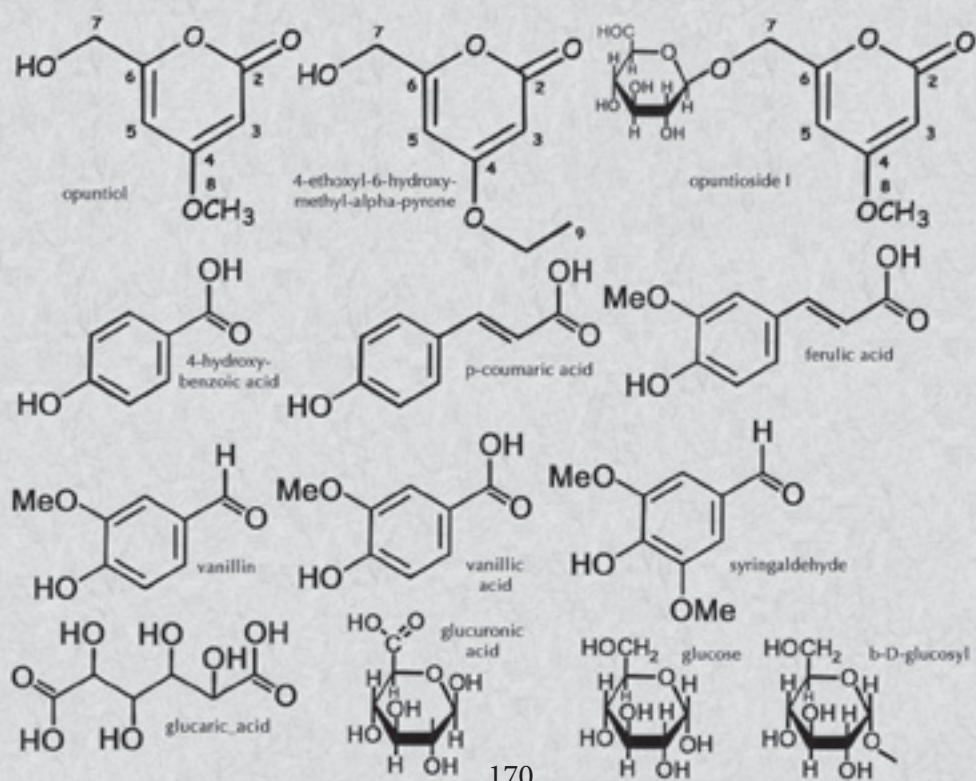
CO₂H: COOH: Carbonyl

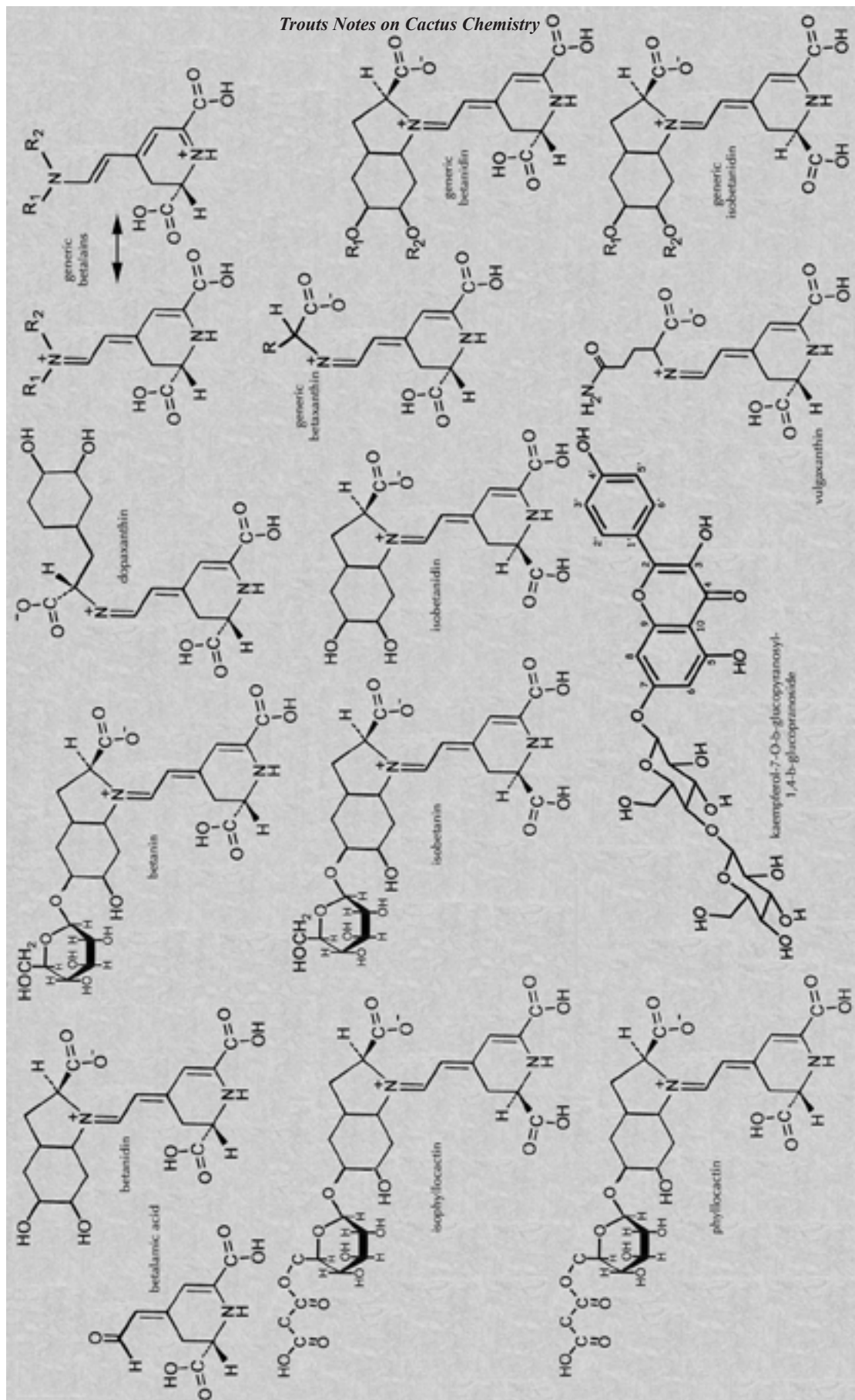
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Generic Ring Skeletons
to accompany the key to
Triterpenoid & Sterol
structural tables

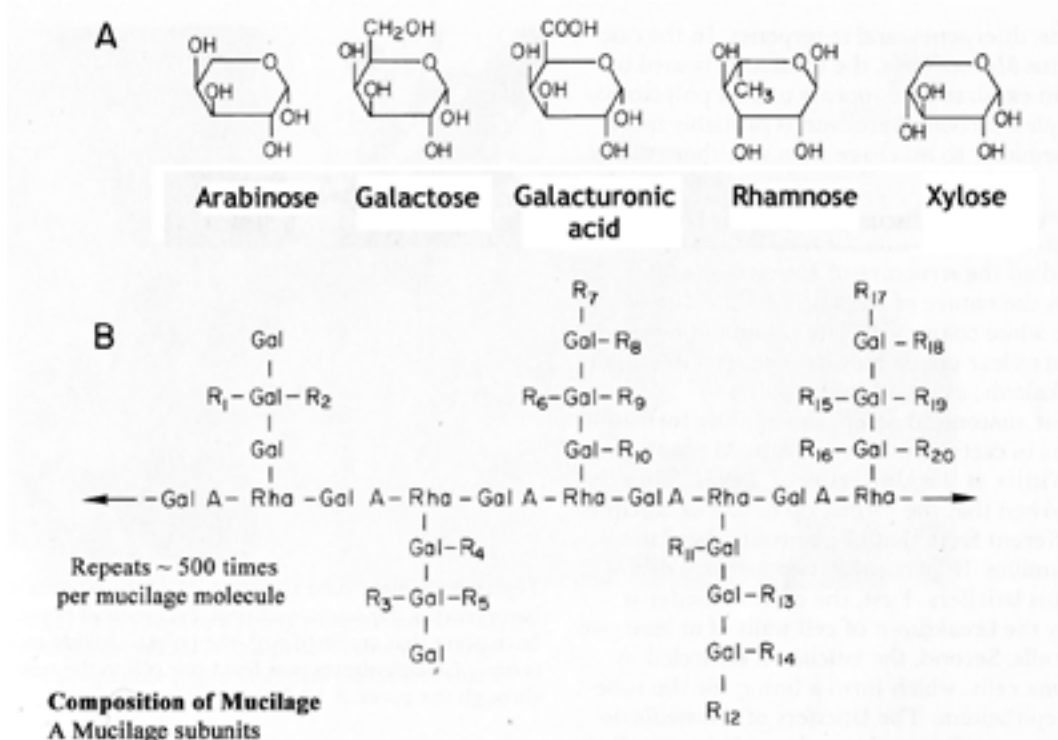
Some other nonalkaloidal molecules





What is Cactus Slime?

Mucilage



Composition of Mucilage

A Mucilage subunits

B Tentative proposal for repeating units in *Opuntia ficus-indica* mucilage.

The 20 side chains (R) contain around 15 xylose and 25 arabinose residues in total.

Adapted from McGarvie & Parolis 1981a-c

Mucilage is often used to describe an aqueous solution of gums.

Mucilages are different from gums however in that gums are usually produced in response to injury and are secreted into cavities whereas mucilage is produced inside of highly specialized cells that accumulate it between the cell wall and the cell membrane.

Mucilages are water soluble complex acidic or neutral polysaccharides of high molecular weight. Some components are related to cell wall components such as galactose, arabinose, xylose, rhamnose and galacturonic acid.

Mucilages are highly branched and fibrous. This makes them not just large but very sticky and troublesome to handle.

Most cactus mucilages have not been studied except for some of the *Opuntias*

In *Opuntia ficus-indica* the mucilage consists of alternating rhamnose and galacturonic acid residues to which are attached side chains composed of three galactose residues.

Arabinose and xylose residues branch from the galactose. It is believed that arabinose is attached to the galactose and xylose is attached to the arabinose.

Some galactose side chains have only arabinose and some others have two arabinose residues and one xylose.

Other *Opuntia* species were found to have different ratios of these sugar residues.

In *Opuntia* they were found to act as a calcium storage reservoir. As much as 20% of the plant's calcium may be associated with its mucilage.

This is due to the carboxylic acid moiety of galacturonic acid creating a strongly negative charge (causing the whole molecule to have a net negative charge)

See:

AMIN *et al.* 1970

MCGARVIE & PAROLIS 1979

MEDINA-TORRES 2000

MINDT *et al.* 1975

TECHTENBERG & MAYER 1981

Betalains

Betalains are water soluble pigments that are typically associated with cacti and other members of the Caryophyllae.

Betacyanins are red-violet and are the immonium conjugates of betalamic acid with cyclodopa. They are often glycosides.

Betaxanthins are yellow and are the **nonglycosidic** immonium conjugates of betalamic acid with any of the various known amino acids or other amines.

These are the pigments in cactus fruit & flowers rather than anthocyanins.

Biominerals

Remnants of a couple of dead eagle's claw cactus (see illustrated version for image), AKA *Echinocactus horizontalis*, in Hudspeth County, Texas visibly show abundant biominerals deposited in the form of hydrated calcium oxalate. This material is the most important way that cacti sequester atmospheric carbon dioxide. Stored in the form of the oxalate they slowly decompose into calcium carbonate.

The cortex of older regions within the stem was found to contain up to 50% of its dry weight as the oxalate (in the form of druses of Weddellite) RIVERA & SMITH 1979

A similar picture is true for *Echinocereus stramineus* (see the carcass below, also in Hudspeth County.)

There are many species of minerals which can form and some of them have taxonomic value. There also can be dynamic biotransformations during both the life and decay of the plant.

Two trends may interest readers:

Trichocereus species produce druses of Weddellite (Calcium oxalate dihydrate $\text{CaC}_2\text{O}_4 \cdot (2+x) \text{H}_2\text{O}$ [with $x \leq 0.5$]). These look like small white drusy crystalline spheroids (this is the white 'sand' in the bottom of San Pedro tea). It can be 'readily' biotransformed into Whewellite.

Opuntia species mainly produce Whewellite (Calcium oxalate monohydrate $\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$) Commonly forms acutely pointed radiating druses. These look like jagged 3-D stars.

The reported occurrences of biominerals are scattered through the text. The references cited will take interested readers into this fascinating world.

Spines

The glochids of at least two species were said to be composed of pure crystalline cellulose.

MEYER & McLAUGHLIN 1982 cited PRITCHARD & HALL 1976.

Spines consist of an "intimate composite " of a compact arrangement of slender cellulosic microfibrils (0.4mm x 6–10µm) embedded in a matrix of arabinan.

VIGNON *et al.* 2004

Spines were described as a nanofiber composite that consists of roughly 50% cellulose and 50% arabinan.

The strength values of *Opuntia ficus-indica* under three point bending stress was greater than several composite materials (more than double carbon fiber reinforced polycarbonate (13 GPa)³ but less than half an individual E-glass fiber (72 GPa)³.

Also measured % of crystallinity and found there was no correlation between percent crystallinity of the spines and flexural stress.

Pilosocereus pachycladus had the strongest spines of the species they examined.

COOPER *et al* 2013

Species	% Crystallinity
<i>Echinocactus platyacanthus</i>	53.4
<i>Echinocactus grusonii</i>	54.7
<i>Echinopsis terscheckii</i>	75.9
<i>Myrtillocactus geometrizans</i>	48.0
<i>Pilosocereus languinosus</i>	72.9
<i>Pachycereus pringlei</i>	65.6
<i>Pilosocereus ulei</i>	75.8
<i>Pilosocereus pachycladus</i>	75.9
<i>Stenocactus crispatus</i>	64.7
<i>Stenocactus multicostatus</i>	51.4
<i>Stenocactus vaupelianus</i>	57.6
<i>Stenocereus thurberi</i>	76.3
COOPER <i>et al</i> 2013	

DJERASSI *et al.*, [1954 *JACS* 76: 4089-4091], reported the successful use of a blow torch to deal with spines that caused handling difficulties even with heavy gloves. The qualitative and quantitative analytical results from cacti they despined this way showed no difference from controls. Obviously some care is needed to avoid cooking the flesh.

Wire clippers, needlenose pliers & safety glasses also work.

TROUT'S NOTES

PDFs & books:

The return of *Sacred Cacti* -- in its 4th edition!
<http://sacredcacti.com>

San Pedro
<http://www.troutsnotes.com/SP.html>

Opening comments from *Sacred Cacti*
http://www.troutsnotes/pdf/SC3_A.pdf

Some Other Succulents
http://www.troutsnotes/pdf/SoS_2004_Trout.pdf

Cactus Chemistry By Species
<http://www.troutsnotes/pdf/C10.html>

The Cactus Alkaloids
<http://www.troutsnotes/pdfC13.html>
formerly known as
Appendix A

Thanks to EROWID

The ayahuasca book is online with copyright free text
http://erowid.org/library/books_online/ayahuasca_apa/

Some Simple Tryptamines
<http://www.troutsnotes.com/pdf/SP.html>

The Genus *Desmodium*

http://www.troutsnotes.com/pdf/D2_2004_Trout.pdf

More information:

TROUT'S NOTES
<http://troutsnotes.com>

Highly recommended website:

CACTUS CONSERVATION INSTITUTE
<http://www.cactusconservation.org/>