THE CHEMISTRY OF THE GENUS *STEVIA* (ASTERACEAE)

by

Luis R. Hernández†, César A.N. Catalán* & Pedro Joseph-Nathan‡

Resumen

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Se describen brevemente las características morfológicas y los estudios citológicos realizados sobre el género *Stevia*. Teniendo en cuenta que la química del género podría ser útil para una más precisa delimitación de sus especies; para establecer relaciones entre química, morfología y números cromosómicos y para establecer relaciones con otros géneros de la tribu, se realiza una revisión de los compuestos aislados de 54 especies y 8 variedades estudiadas hasta 1997.

Palabras claves: *Stevia*, Asteraceae, Revisión química

Abstract

The morphological characteristic and the cytological studies made on the genus Stevia are described. Take into account that the chemistry of the genus might be useful for a more precise delimitation of their species; to establish relationships between chemistry, morphology and chromosomic number and to establish relationships with other genera of the tribe, the review of the isolated compounds from 54 species and 8 varieties already studied up 1997 is made.

Key Words: *Stevia*, Asteraceae, Chemical review

† Posdoctoral Fellow. Departamento de Química, Centro de Investigación y de Estudios Avanzados, Instituto Politécnico Nacional, Apartado 14-740, México, D.F. 07000, México, on leave Universidad Nacional de Tucumán, Argentina.

* Research Member of the National Research Council of Argentina (CONICET). Instituto de Química Orgánica, Facultad de Bioquímica, Química y Farmacia, Universidad Nacional de Tucumán, Ayacucho 491, S.M. de Tucumán 4000, Argentina

‡ Emeritus Professor. Departamento de Química, Centro de Investigación y de Estudios Avanzados, Instituto Politécnico Nacional, Apartado 14-740, México, D.F. 07000, México.

The genus *Stevia* belongs to the subtribe Ageratinae, tribe Eupatorieae, subfamily Asteroideae, family Asteraceae (**King & Robinson**, 1987; **Bremer**, 1994). It is an essentially Latin-American genus distributed from the southwestern part of the United States southward to central Argentina excepting the amazonian region. This genus is one of the most characteristic in the tribe Eupatorieae and has been delimited with a considerable precision in most of the classification systems since its original description.

Stevia has all its heads with five flowers, although there is no agreement if the monotypic genus *Metastevia* should be included in the genus *Stevia* (**Grashoff**, 1975; **King & Robinson**, 1987; **Bremer**, 1994).

Considering the large number of species (*ca.* 230) of the genus, there is a surprising uniformity of the basic floral structure, with similar characters repeated in different combinations, which difficult individual morphological characterizations. The hybridizations between several species are cited in the Grashoff thesis (**Grashoff,**, 1972) and apomixis in association with modified pollen forms was found in many of them. Four different pollen states have been reported by King and Robinson (**King & Robinson**, 1967) in two species, and different chromosome types seem to be present in these and other species. Some fertile populations appear in most, if not all, of the commonly apomictic species.

Although the variations in the pollen are still not taxonomically useful, it seems that the modified pollen forms are restricted to species from Mexico and Central America and to a few populations in South America. There is no report of modified pollen forms in typically Southamerican species of *Stevia*.

The variations of the pappus from awn-like to squamose segments has been considered taxonomically useful in this genus and it has been proven that these variations are stable in each head in each species.

The six sections: Podocephalae, Corymbosae, Fruticosae, Multiaristatae, Eustevia and Breviaristatae have been recognized in *Stevia*. The first three sections contain the Northamerican species and the remaining three contain the Southamerican ones. The species with laxly arranged and long-pedicellated heads belong to the Podocephalae section; the species with heads in dense corymbose clusters, according to the woodiness, are placed in Corymbosae or Fruticosae, and the herbaceous species are in the Corymbosae section (**Robinson**, 1930; **Grashoff**, 1972).

During the study of the Southamerican species it was first recognized by Baker (**Baker**, 1876) and later by Robinson (**Robinson**, 1932) that the Multiaristatae section groups all species with ten or more awns in the pappus. Furthermore, Robinson (**Robinson**, 1932) recognized the Eustevia section with short subequal squamellae or with some awns almost as long as the corolla length in the adelphocarps pappus, and the Breviaristatae section with an unequal pappus with the longest segments no longer than half the corolla length. The multiaristate condition is typical from South America, although erratically distributed between the species from this area. Multiaristate achenes are found in both species with lax inflorescens and with dense corymb head arrangements.

Stevia has been studied extensively from the cytological point of view and according to Grashoff (**Grashoff, Bierner & Northington**, 1972), the shrubby species have a gametic chromosome number n=12; herbaceous species, with laxly panicullated heads have n=11 without aneuploidy; most of the herbaceous species with heads in dense corymbs have 2n=34 univalents with notable aneuploidy. From some species as *S. plummerae* var. *durangensis*, up n=44 were found (**Keil & Stuessy**, 1975).

As indicated by King (**King, Kyhos, Powell, Raven & Robinson**, 1976), the great variations and extensive apomixis allow to interpret 2n=33 and 2n=34 as triploid derivatives of n=11. However, there is a tendency to interpret 2n=34, found in *Stevia*, as a possible n=17, in part due to the common existence of n=17 in other genera of the tribe. The lack of a close relationship between *Stevia* and any other genus with n=17, indicates that the chromosomic count should be interpreted on the basis of known counts n=11 and n=12. These numbers are common in the genus *Stevia* and related genera.

The chemisty of the genus *Stevia* is not uniform as can be see in the Tables. However, the main secondary metabolites are: sesquiterpene lactones, diterpenes and longipinanes.

According to the content of secondary metabolites, it is possible to establish subdivisions in the 60 taxa (54 species and 8 varieties) already studied. There are 17 taxa containing only sesquiterpene lactones; 6 taxa containing only longipinanes; 7 taxa containing only diterpenes; 7 taxa containing sesquiterpene lactones along with longipinanes; 6 taxa containing diterpenes along with longipinanes and only 4 taxa containing simultaneously sesquiterpene lactones, longipinenes and diterpenes. In the remaining 6 taxa: *S. cuzcoensis, S. galeopidifolia, S. microchaeta, S. nepetifolia, S. purpurea* and *S. soratensis*, non of these metabolites are reported, although further studies seem desirable for these species.

Most of the species, as can be see in Table 13, produce sesquiterpene lactones included in the first and second degree of biogenetic complexity given by Herz (**Herz**, 1977). However, the species *S. achalensis, S. isomeca, S. ovata (= S. rhombifolia), S. polyphylla* and *S. yaconensis* var. *aristifera* produce sesquiterpene lactones of the third degree of biosynthetic complexity. Table 1 shows that only *trans*-fused lactones toward C-6, which is the common lactonization in this genus, or only *cis*-fused lactones toward C-8 were isolated from *Stevia*, although, as an exception, *S. sarensis* shows both types of lactonization (**Zdero, Bohlmann, King & Robinson**, 1988). Germacranolides and guaianolides are the most common lactone skeletons in *Stevia*. The oxidation is frequently on C-3, C-8 and C-14; in guaianolides, although oxidation on C-2 was observed with certain frequency. The C-8 substituents are always b-orientated, a fact that is a characteristic in *Stevia*. A new sesquiterpene lactone skeleton, jujuyensolide was isolated from *S. jujuyensis* (**De Gutiérrez, Catalán, Díaz & Herz**, 1992; **Gil, Pacciaroni, Oberti, Díaz & Herz**, 1992).

Labdane, *ent*-labdane and *ent*-kaurane derivatives are the diterpene compounds commonly found in *Stevia*. Many glycosidic *ent*-kauranes have been isolated including the powerful sweteneer stevioside, which, from the commercial point of view is the most important compound of this genus (**Vis & Fletcher**, 1957; **Mazzei & Kuc**, 1968; **Pezzuto, Dhammika Nanayakkara & Kinghorn**, 1983). A new diterpene skeleton, stevisalicinone, was isolated from *S. salicifolia* (**Bohlmann & Zdero**, 1985).

Highly oxigenated longipinanes are the other frequently found secondary metabolites in *Stevia*. Positions C-7, C-8, C-9 and C-13 are the most commonly oxidized sites with hydroxy and/or acyloxy groups and C-1 generally is a keto function, which is a,b-unsaturated in many of the isolated compounds.

Longipinanes are generally found as a complex mixture of esters of difficult separation. This is the reason why during many years their structural elucidation remained elusive (**Román, del Río, Hernández, Joseph-Nathan, Zabel & Watson**, 1981; **Joseph-Nathan, Cerda-García-Rojas, Castrejón, Román & Hernández**, 1991) The stereochemistry of the acyloxy groups in the seven-membered ring was established by single crystal X-ray difraction studies of rastevione acetate and by chemical transformation of rastevione (**225**) (**Román, del Río, Hernández, Joseph-Nathan, Zabel & Watson**, 1981). The absolute configuration of these compounds is the same than (+)-longipinene, as was deduced from circular dichroism curves comparison of **288** and its diacetate, with vulgarone B (**Joseph-Nathan, Cerda, del Río, Román & Hernández**, 1986).

Preparation techniques and natural longipinene ester characterizations (**Joseph-Nathan, Cerda, Román & Hernández**, 1989; **Torres-Valencia, Cerda-García-Rojas & Joseph-Nathan**, 1995; 1998; **Torres-Valencia, J.M.; Cerda-García-Rojas, C.M.; Román, L.U.; Hernández, J.D. & Joseph-Nathan, P.** 1998) as well as many re-arrangements on the tricyclic skeleton of these compounds by acid (**Cerda-García-Rojas, del Río, Joseph-Nathan, Román & Hernández**, 1994; **Román, Hernández, del Río & Bucio**, 1991; **Román, Hernández, Cerda-García-Rojas, Domínguez-López & Joseph-Nathan**, 1992) or alkaline reactions (**Joseph-Nathan & Cerda-García-Rojas**, 1994; **Román, Zepeda, Morales, Hernández, Cerda-García-Rojas & Joseph-Nathan**, 1995; **Román, Zepeda, Morales, Flores, Hernández, Cerda-García-Rojas & Joseph-Nathan**, 1996) have been reported. A review of these reactions was recently published (**Joseph-Nathan**, 1997) and the longipinene photochemistry was recently reported (**Joseph-Nathan, Meléndez-Rodríguez, Cerda-García-Rojas & Catalán**, 1996).

The present review compiles, in fifteen tables, all chemical information available to date, of the 54 species and 8 varieties already studied, as follows: Table 1, sesquiterpene lactones; Table 2, non-lactonized sesquiterpenes; Table 3, longipinanes; Table 4, diterpenes and derivatives; Table 5, chromane derivatives; Table 6, benzofuran derivatives; Table 7, triterpenes and sterols; Table 8, flavonoids and Table 9, miscellaneous compounds.

Table 10 summarizes abbreviations of the substituents. Table 11 shows the chemically studied species and the secondary metabolites distribution. Table 12 shows the reported compounds for the most characteristic metabolites as sesquiterpene lactones, longipinanes and cyclic diterpenes, as well as the studied parts of the plant material and its geographic location. Table 13 shows the incidence of the different sesquiterpene lactone skeletons in *Stevia*. Table 14 shows the incidence of the different diterpene skeletons found in this genus, and finally, in Table 15 the distribution of the main secondary metabolites of the genus is compared.

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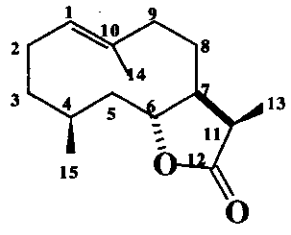
Table 1. Sesquiterpene Lactones isolated from *Stevia*

A - Germacrolides closed toward C-6



N°	Common name	Double bonds	Substituents	References
1		4,5	3β-OH 8β-OAc	Bohlmann & Zdero, 1985
2	Carmeline	4,5	3α-OAc 8β-OAc	Salmón et al., 1975
3	Costunolide	4,5; 11,13		Zdero et al., 1988; 1991
4	Grazielic acid	4,5; 11,13	8β-OTigl 10-CO2H	Schmeda-Hirschmann et al., 1986
5		4,5; 11,13	8β-OTigl-4'-OAc 10-CO2H	Schmeda-Hirschmann et al., 1986; Zdero et al., 1987
6		4,5; 11,13	8β-OTigl-4'-OH 10-CO2H	Zdero et al., 1987
7		4,5; 11,13	8β-OTigl-4'-OH 14-OH	Zdero et al., 1987
8	Hanphyllin	4,5; 11,13	3β-OH	Sigstad et al., 1991
9		4,5; 11,13	3β-OH 8β-OSarac	de Gutiérrez et al., 1992; Gil et al., 1992
10		4,5; 11,13	8β-OAc 10-CO2H	Gil et al., 1987
11		4,5; 11,13	3β-OH 8β-OTigl-4'-OAc-5'-OH	Bohlmann et al., 1986
12	Eupatoriopicrin	4,5; 11,13	8β-OTigl-4'-OH-5'-OH	Zdero et al., 1988; Sosa et al., 1985; Hernández et al., 1996b; de Hernández et al., 1998
13	Deoxyeupatorio-picrin	4,5; 11,13	8β-OTigl	Zdero et al., 1991
14		4,5; 11,13	3β-OH 8β-OAng	de Hernández et al., 1997

Table 1-A (cont.)

N°	Common name	Double bonds	Substituents	References
15		4,5; 11,13	8β-OTigl-4'-OH	**de Hernández et al., 1998; Zdero et al., 1988**
16		4,5; 11,13	8β-OTigl-4'-OH-5'-OTigl	**de Hernández et al., 1998; Zdero et al., 1988**
17 or **18**		4,5; 11,13	3β-OH 8β-OSarac 14-OH	**de Gutiérrez et al., 1992**
		4,5; 11,13	3β-OH 8β-OSarac 15-OH	
19		4,5; 11,13	3β-OAc 8β-OTigl-4'-OH 14-OH	**Hernández et al.; 1994**
20		4,5; 11,13	3β-OAc 8β-OTigl-4'-OAc 14-OH	**Hernández et al.; 1994**
21		4,5; 11,13	8β-OH 14-OH	**Hernández et al.; 1996b**
22		4,5; 11,13	8β-OTigl 14-OH	**Hernández et al.; 1996b**
23		4,5; 11,13	3β-OH 8β-OTigl 14-OH	**Hernández et al.; 1996b**
24		4,5; 11,13	3β-OH 8β-OTigl-4'-OH 14-OH	**Hernández et al.; 1996b**
25		4,5; 11,13	3β-OAc 8β-OTigl 14-OH	**Hernández et al.; 1996b**
26		4,5; 11,13	3β-OH 8β-OH 14-OTigl	**Hernández et al.; 1996b**
27		4,5; 11,13	3α-OH 8β-OTigl 14-OH	**Hernández et al.; 1996b**
28		4,5; 11,13	3β-OAc 8β-OSar 14-OH	**Hernández et al.; 1996a**

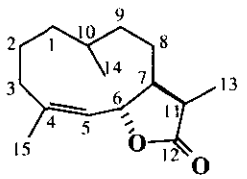
Table 1-A (cont.)

N°	Common name	Double bonds	Substituents	References
29		4,5; 11,13	3β-OAc 8β-OTigl 14-OH	**Hernández et al.; 1996a**
30		4,5; 11,13	8β-OSar 14-OH	**Hernández et al., 1996**
31		4,5; 11,13	8β-OSarac 14-OH	**Hernández et al., 1996**
32		4,5; 11,13	3β-OH 8β-OAng 9β-OH	**de Hernández et al., 1997**
33	eupatolide	4,5; 11,13	8β-OH	**de Hernández et al., 1998**
34		4,5; 11,13	8β-OTigl-4'-OH-5'-OAc	**de Hernández et al., 1998**
35		4,5; 11,13	8β-OTigl-4'-OAc-5'-OH	**de Hernández et al., 1998**
36	4-*epi*-tansanin	11,13	3-oxo	**Sigstad et al., 1991**
37		11,13	3-oxo 8β-OSar	**de Gutiérrez et al., 1992;** **Gil et al., 1992**
38		11,13	3-oxo 8β-OSarac	**de Gutiérrez et al., 1992;**

B - Germacrolides closed toward C-8

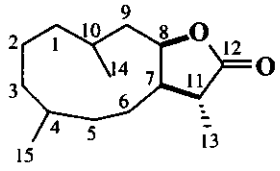
N°	Common name	References
39	4a,5b-epoxy-8-epi-inuninolide	**Calderón** et al., 1987b
40	----------	**Zdero** et al., 1988

C - Heliangolides closed toward C-6



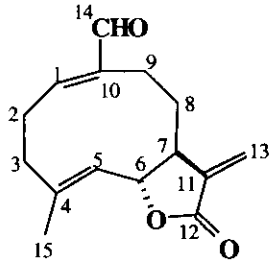
Nº	Common name	Double bonds	Substituents	References
41	11,13-Dihydroeucannabinolide	1,10	3β-OAc 8β-OTigl-4'-OH-5'-OH	**Gómez et al., 1983**
42	Eucannabinolide	1,10; 11,13	3β-OAc 8β-OTigl-4'-OH-5'-OH	**Zdero et al., 1988;** **Calderón et al., 1987a**
43		1,10; 11,13	3β-OAc 8β-OTigl-4'-OAc-5'-OH	**Calderón et al., 1987a**
44	Hiyodorilactone F	1,10; 11,13	3β-OAc 8β-OTigl-4'-OH-5'-OAc	**Calderón et al., 1987a**
45		1,10; 11,13	3β-OAc	**de Heluani et al., 1989**
46		1,10; 11,13	3α-OH 8β-OSar	**de Gutiérrez et al., 1992;** **Gil et al., 1992**
47		1,10; 11,13	3α-OAc 8β-OSar	**de Gutiérrez et al., 1992;** **Gil et al., 1992**
48		1,10; 11,13	3α-OAc 8β-OAng	**de Hernández et al., 1997**
49		1,10; 11,13	3-oxo 8β-OSar	**de Gutiérrez et al., 1992;**
50		1,10; 11,13	3-oxo 8β-OSarac	**de Gutiérrez et al., 1992;**
51		1,10; 11,13	3β-OH 8β-OTigl 14-OH	**Hernández et al., 1996a**
52		1,10; 11,13	3β-OH 8β-OSarac 14-OH	**Hernández et al., 1996a**
53		1,10; 11,13	3α-OH 8β-OSarac 14-OH	**Hernández et al., 1996a**
54	3-Acetylpulverolide	10,14; 11,13	1β-OH 3β-OAc	**de Heluani et al., 1989**
55		11,13	1β,10α-epoxy 3β-OAc	**de Heluani et al., 1989**

D - Heliangolides closed toward C-8



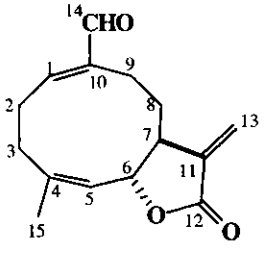
Nº	Double bonds	Substituents	References
56	1,10	3-oxo Me-15α	**Gil et al., 1990**
57	1,10, 4,5	3β-OAc	**Gil et al., 1990**
58	4,5	1α,10β-epoxy 3β-OAc	**Gil et al., 1990**

E - Melampolides



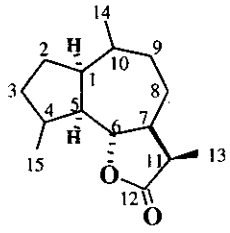
Nº	Substituents	References
59	8b-OTigl-4'-OAc	**Hernández** et al., 1994; **Schmeda-Hirschmann** et al., 1986; **Zdero** et al., 1987
60	8b-OTigl-4'-OH	**Zdero** et al., 1987
61	8b-OSarac	**Hernández** et al., 1996a

F - cis, cis-germacranolides



Nº	Substituents	References
62	8b-OTigl-4'OAc	**Schmeda-Hirschmann et al., 1986**
63	8b-OTigl-4'OH	**Zdero et al., 1987**

G - Guaianolides closed toward C-6



N°	Common name	Double bonds	Substituents	References
64	Christinine I	1,10	2β-OAc 3α,4α-epoxy 8β-OAc	**Calderón et al., 1989;** **Salmón et al., 1973**
65	Christinine II	1,10	2β-OMebu 3α,4α-epoxy 8β-OTigl	**Salmón et al., 1977**
66	Christinine III	1,10	2β-OMebu 3α,4α-epoxy 8β-OAc	**Calderón et al., 1989;** **Salmón et al., 1977**
67		1,10	3α,4α-epoxy 8β-OAc	**Bohlmann & Zdero 1985**
68	Steviserrolide A	1,10; 2,3	4β-OH 8β-OAc	**Calderón et al., 1989**
69	Steviserrolide B	1,10; 2,3	4α-OH 8β-OAc	**Calderón et al., 1989**
70		1,10; 2,3; 7,11; 8.9	2-OH 3-OEpang 4α-OH	**de Hernández et al., 1997**
71	Achillin	1,10; 3,4	2-oxo	**de Heluani et al., 1989**
72		1,10; 3,4	8β-OAc	**Bohlmann & Zdero 1985**
73	Leukodin	1,10; 3,4	2-oxo Me-13 α	**Martínez et al., 1988**
74		1,10; 3,4; 7,11; 8.9	2-oxo	**de Hernández et al., 1997**
75		1,10; 3,4; 7,11; 8.9	2-oxo 3-OEpang	**de Hernández et al., 1997**
76		1,10; 3,4; 7,11; 8,9	2-oxo 3- Cl	**de Hernández et al., 1997;** **Gil et al., 1989**
77	Dehydroleukodin	1,10; 3,4; 11,13	2-oxo	**de Heluani et al., 1989;** **Sigstad et al., 1991;** **Sosa et al., 1989**

Table 1-G (cont.)

Nº	Common name	Double bonds	Substituents	References
78		1,10; 3,4; 11,13	8β-OTigl-4'-OH-5'-OB	**Zdero et al., 1991**
79		1,10; 3,4; 11,13	2-oxo	**Sigstad et al., 1991**
			9α-OH	
80		1,10; 3,4; 11,13	8β-OH	**Bohlmann et al., 1982**
81		1,10; 3,4; 11,13	2-oxo	**de Hernández et al., 1997;**
			8β-OAng	**Gil et al., 1989**
82		1,10; 3,4; 11,13	8β-OB	**Bohlmann et al., 1982;**
				Zdero et al., 1988
83		1,10; 3,4; 11,13	8β-C-4'α-OH	**Bohlmann et al., 1986**
84		1,10; 3,4; 11,13	8β-C-4'β-OH	**Bohlmann et al., 1986**
85		1,10; 3,4; 11,13	2-oxo	**de Hernández et al., 1997**
			3-OH	
			8β-OAng	
86		1,10; 3,4; 11,13	2-oxo	**de Hernández et al., 1997**
			3-Cl	
			8β-OAng	
87		1,10; 3,4; 11,13	2-oxo	**de Hernández et al., 1997**
			8β-OEpang	
88		1,10; 3,4; 11,13	2-oxo	**de Hernández et al., 1997**
			3-Cl	
			8β-OEpang	
89*		1,10; 11,13	2α-OH	**de Hernández et al., 1997;**
			3α,4α-epoxy	**Gil et al., 1989**
			8β-OAng	
90#		1,10; 11,13	2β-OH	**Gil et al., 1989**
			3α,4α-epoxy	
			8β-OAng	
91		1,10; 11,13	2α-OAng	**de Hernández et al., 1997**
			3α,4α-epoxy	
			8β-OAng	
92		1,10; 11,13	2α-OAng	**de Hernández et al., 1997**
			3α,4α-epoxy	
			8β-OEpang	
93		1,10; 11,13	2α-OMebu	**de Hernández et al., 1997**
			3α,4α-epoxy	
			8β-OEpang	
94		1,10; 11,13	3α,4α-epoxy	**de Hernández et al., 1997**
			8β-OAng	
95		1,10; 11,13	2α-OH	**de Hernández et al., 1997**
			3β-OH	
			4α-OH	
			8β-OAng	

Table 1-G (cont.)

N°	Common name	Double bonds	Substituents	References
96	Ludartin	1,10; 11,13	3α,4α-epoxy	**Sosa et al., 1989**
97†		3,4; 10,14	8β-OH Me-13α	**Bohlmann et al., 1979; 1986**
98		3,4; 10,14; 11,13	2-oxo	**de Heluani et al., 1989**
99		3,4; 10,14; 11,13	8β-OTigl-4'-OH-5'-OA	**Zdero et al., 1991**
100		3,4; 10,14; 11,13	8β-OTigl-4'-OH-5'-OB	**Zdero et al., 1991**
101		3,4; 10,14; 11,13	8β-OTigl-4'-OAc-5'-OH	**Zdero et al., 1991**
102		3,4; 10,14; 11,13	8β-OTigl-4'-OH-5'-OAc	**Zdero et al., 1991**
103		3,4; 10,14; 11,13	2-oxo 8β-OH	**Zdero et al., 1988**
104		3,4; 10,14; 11,13	8β-OTigl-4'-OH	**Bohlmann et al., 1986** **Hernández et al., 1995;** **Zdero et al., 1991**
105	Eupahakonenin B	3,4; 10,14; 11,13	8β-OB	**Bohlmann et al., 1979; 1986;**[r] **de Hernández et al., 1998;** **Hernández et al., 1995;** **Sosa et al., 1984; 1985;** **Zdero et al., 1988; 1991**
106		3,4; 10,14; 11,13	8β-C-4'α-OH	**Bohlmann et al., 1986;** **Zdero et al., 1991**
107		3,4; 10,14; 11,13	8β-C-4'β-OH	**Bohlmann et al., 1986;** **Zdero et al., 1991**
108	Ligustrin	3,4; 10,14; 11,13	8β-OH	**Bohlmann et al., 1979;** **Hernández et al., 1995**
109		3,4; 10,14; 11,13	8β-O-C-4'-oxo	**Hernández et al., 1995**
110		3,4; 10,14; 11,13	8β-O-D	**Hernández et al., 1995**
111		3,4; 10,14; 11,13	2α-OH 8β-OAng	**de Hernández et al., 1997**
112		3,4; 10,14; 11,13	8β-OTigl-4'-OH-5'-OTigl	**de Hernández et al., 1998**
113	Breviarolide	3,4; 11,13	8β-OTigl-4'-OH 10β-CH2OH	**Hernández et al., 1994;** **Oberti et al., 1986**
114		3,4; 11,13	8β-OTigl-4'-OH 10β-CH2OAc	**Hernández et al., 1994**
115		3,4; 11,13	8β-OTigl-4'-OAc 10β-CH2OH	**Hernández et al., 1994**
116		3,4; 11,13	8β-OTigl 10β-CH2OH	**Hernández et al., 1994**
117	10-*epi* -breviarolide	3,4; 11,13	8β-OTigl-4'-OH 10α-CH2OH	**Hernández et al., 1994**

Table 1-G (cont.)

N°	Common name	Double bonds	Substituents	References
118		3,4; 11,13	8β-OSarac 10β-CH_2OH	**Hernández et al., 1996a**
119		3,4; 11,13	8β-OSar 10β-CH_2OH	**Hernández et al., 1996a**
120		3,4; 11,13	8β-OSarac 10α-CH_2OH	**Hernández et al., 1996a**
121		3,4; 11,13	8β-OSar 10α-CH_2OH	**Hernández et al., 1996a**
122		3,4; 11,13	2-oxo 10β-OH	**Sigstad et al., 1991**
123		3,4; 11,13	2-oxo 8β-OEpang 10β-OH	**de Hernández et al., 1997**
124	10-*epi*-8-deoxi-cumambrin B	3,4; 11,13	10β-OH	**Sigstad et al., 1991;** **Salmón et al., 1977**
125		10.14	3α,4α-epoxy	**Sigstad et al., 1991**
126		10.14	3β-OH 4α-OH	**Sigstad et al., 1991**
127		10.14	3α-OH 4β-OH	**Sigstad et al., 1991**
128		10,14; 11,13	3β-OH 4α-OH	**Sigstad et al., 1991**
129		10,14; 11,13	3α-OH 4β-OH	**Sigstad et al., 1991**
130	Estafiatin	10,14; 11,13	3α,4α-epoxy	**Bohlmann et al., 1979;** **de Heluani et al., 1989;** **Sigstad et al., 1991;** **Zdero et al., 1988**
131		11,13	3α,4α-epoxy 10α,14-epoxy	**de Heluani et al., 1989**
132		11,13	3α,4α-epoxy 10β,14-epoxy	**de Heluani et al., 1989**

Table 1-G (cont.)

N° Common name	Double bonds	Substituents	References
133	11,13	3β,4β-epoxy 10β-OH	**Sigstad et al., 1991**
134	11,13	1-OH 2-oxo 3α,4α-epoxy 8β-OEpang 10-OH	**de Hernández et al., 1997**

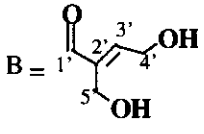
r: Isolated also from roots.

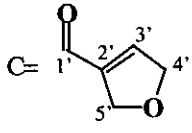
* Structure revised according to de **Hernández, Hernández, Catalán, Gedris, & Herz,** 1997.

Tentative structure according to de **Hernández, Hernández, Catalán, Gedris, & Herz,** 1997..

† Structure revised according to **Bohlmann, Zdero, King, & Robinson,** 1986.

A = Sar





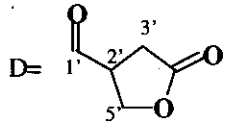
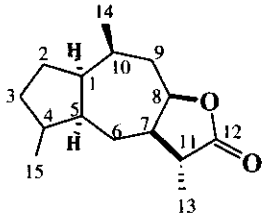


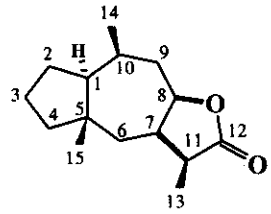
Table 1-H - Guaianolides closed toward C-8



Nº	Common name	Double bonds	Substituents	References
135		1,10; 2,3; 4,5		**Zdero et al., 1988**
136		1,10; 3,4		**Zdero et al., 1988**
137		3,4; 10,14	15- OAc	**Gil et al., 1990; Zdero et al., 1988**
138		3,4; 10,14	15- OH	**Zdero et al., 1988**
139		3,4; 11,13	5α-OH	**Zdero et al., 1988**
140		4,5		**Zdero et al., 1988**
141		4,5	3-oxo	**Bohlmann et al., 1986; Oberti et al., 1983; Zdero et al., 1988**
142		4,5	3β-OH	**Zdero et al., 1988**
143		4,5	1α-OH 3-oxo	**Bohlmann et al., 1986**
144		4,5	3-oxo 7α-OH	**Bohlmann et al., 1986**
145		4,5; 11,13		**Zdero et al., 1988**
146		4,5; 11,13	3α-OH	**Zdero et al., 1988**
147		4,5; 11,13	3α-OMe	**Zdero et al., 1988**
148		4,5; 11,13	3β-OH	**Zdero et al., 1988**
149		4,5; 11,13	3β-OMe	**Zdero et al., 1988**
150		4,5; 11,13	3β-OAc	**Zdero et al., 1988**
151	Achalensolide	4,5; 11,13	3-oxo	**Bohlmann et al., 1986; Oberti et al., 1983; Zdero et al., 1988**
152		4,15; 11,13; 10,14		**Bohlmann et al., 1986**
153*	Inuviscolide	11,13; 10,14	4α-OH 8α-12-ólido	**Calderón et al., 1987b**
154	4-Acetyl-8-*epi*-inuviscolide	11,13; 10.14	4α-OAc	**Calderón et al., 1987b**

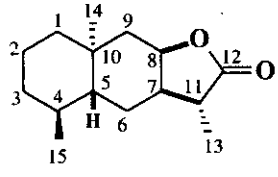
* Probably an artifact produced by Silica gel catalyzed cyclization of 39 (**Calderón, Quijano, Gómez-Garibay, Sánchez, Ríos, & Fronczek**, 1987b).

Table 1-I - Pseudoguaianolides



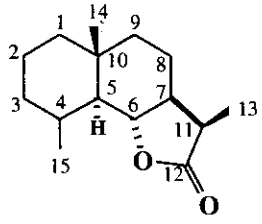
N°	Common name	Double bonds	Substituents	References
155			2α-OH 4-oxo	**Bohlmann et al., 1985**
156			2α-OAc 4-oxo	**Bohlmann et al., 1985**
157		2,3	4-oxo	**Bohlmann et al., 1985**
158	Stevin	11,13	2β-OAc 4β-OH	**Ríos et al., 1967**

Table 1-J - Eudesmanolides closed toward C-8



N°	Common name	Double bonds	Substituents	References
159			3α-OH Me-14β H-5α	**Bohlmann et al., 1986**
160		1,2; 4,15; 11,13		**Bohlmann et al., 1986**
161		1,2; 4,15; 11,13	3-oxo	**Bohlmann et al., 1986**
162		4,5	Me-14β H-5α	**Zdero et al., 1988**
163		4,5; 11,13	3-oxo Me-14β	**Bohlmann et al., 1986**
164	Isoalantolactone	4,15	Me-14β H-5α	**Zdero et al., 1988**
165		4,15; 11,13		**Zdero et al., 1988**
166		4,15; 11,13	1α-OH	**Bohlmann et al., 1986**
167	Isotelekin	4,15; 11,13	3α-OH Me-14β H-5α	**Bohlmann et al., 1986**

Table 1-K - Eudesmanolides closed toward C-6



N°	Common name	Double bonds	Substituents	References
168		3,4	1β-OH 8β-OAc	**Martínez-Vazquez et al., 1990**
169	Santamarin	3,4; 11,13	1β-OH	**Zdero et al., 1991**
170		3,4; 11,13	1β-OH 8β-OTigl-4'-OH	**Hernández et al., 1994;** **Hernández et al., 1996b**
171		3,4; 11,13	1β-OH 8β-OTigl-4'-OH-5'-OH	**de Hernández et al., 1998**
172		4,5	1β-OH 8β-OAc	**Martínez-Vazquez et al., 1990**
173		4,5; 11,13	1β-OH 8β-OTigl-4'-OH-5'-OH	**de Hernández et al., 1998**
174		4,15	1β-OH 8β-OAc	**Martínez-Vazquez et al., 1990**
175	Reynosin	4,15; 11,13	1β-OH	**Zdero et al., 1991**
176		4,15; 11,13	1β-OH 8β-OTigl-4'-OH	**Hernández et al., 1996b**
177		4,15; 11,13	1β-OH 8β-OA	**Hernández et al., 1996b**

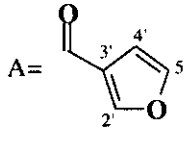
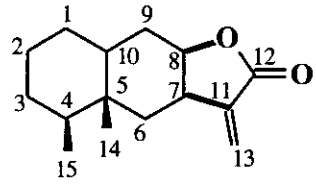
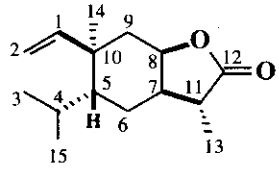


Table 1-L - Eremophilanolides



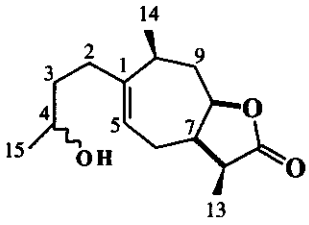
N°	Common name	Double bonds	Substituents	References
178		1,10		**Bohlmann et al., 1986; Zdero et al., 1988**
179		1,10	2α-OH	**Bohlmann et al., 1986**
180		1,10	3β-OH	**Bohlmann et al., 1986**
181		1,10	3-oxo	**Bohlmann et al., 1986**
182		9,10		**Bohlmann et al., 1986; Zdero et al., 1988**
183		9,10	3β-OH	**Bohlmann et al., 1986**
184		9,10	3-oxo	**Bohlmann et al., 1986**

Table 1-M - Elemanolides



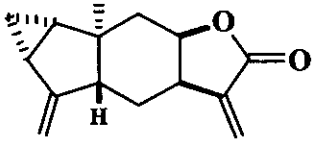
N°	Common name	Double bonds	Substituents	References
185	Callitrin	3,4		**Gil et al., 1990**
186		3,4	15-OH	**Bohlmann et al., 1986**
187		3,4; 11,13		**Bohlmann et al., 1986**
188		3,4; 11,13	15-OH	**Bohlmann et al., 1986**
189		4,15; 11,13		**Zdero et al., 1988**
190		4,15; 11,13	(5,10-*epi*)	**Zdero et al., 1988**

Table 1-N - Xanthanolides



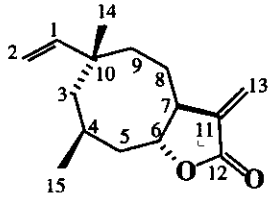
N°	References
191	**Bohlmann** et al., 1985

Table 1-O - Onoseriolides



N°	References
192	**Bohlmann** et al., 1986

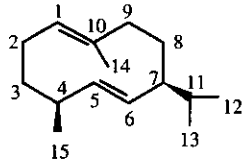
Table 1-P - Jujuyensolides



N°	Substituents	Reference
193	3-oxo 8b-OSar	**de Gutiérrez** et al., 1992; **Gil** et al., 1992
194	3-oxo 8b-OSarac	**de Gutiérrez** et al., 1992

Table 2 - Non-lactonized sesquiterpenes

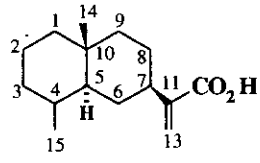
A- Germacranes



N°	Common name	Double bonds	Substituents	References
195			4a-OH	**Bohlmann et al., 1977[a]**
196			4a-OH 15-OAc	**Bohlmann et al., 1982[r]**
197	Germacrene D	4,15		**Bohlmann & Zdero, 1985;[a]** **Bohlmann et al., 1976;[a] 1977;[a,r] 1979;[a] 1982;[a,r] 1986;[a,r]** **Schmeda-Hirschmann et al., 1986;[a]** **Zdero et al., 1987;[a,r] 1988;[a,r] 1991[a]**

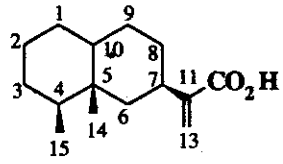
a: Isolated from aerial parts; r: Isolated from roots.

B- Eudesmanes



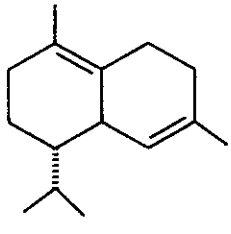
N°	Double bonds	Substituents	References
198	3,4		**Bohlmann et al., 1986; Zdero et al., 1991**
199	3,4	2α-OH	**Bohlmann et al., 1986**
200	3,4	2-oxo	**Bohlmann et al., 1986**
201	4,5		**Bohlmann et al., 1986; Zdero et al., 1991**
202	4,5	3β-OH	**Bohlmann et al., 1986**
203	4,5	3-oxo	**Bohlmann et al., 1986**
204	4,15		**Zdero et al., 1988; 1991**

C- Eremophilanes



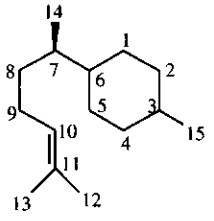
N°	Double bonds	Substituents	References
205	1,10		**Zdero et al., 1988**
206	1,10	2-oxo	**Bohlmann et al., 1986**
207	9,10		**Bohlmann et al., 1986; Zdero et al., 1988**
208	9,10	2β-OH	**Bohlmann et al., 1986**
209	9,10	3β-OH	**Bohlmann et al., 1986**
210	9.10	3-oxo	**Bohlmann et al.. 1986**

D- Cadinanes



N°.	Common name	References
211	d-cadinene	**Fujita** et al., 1977

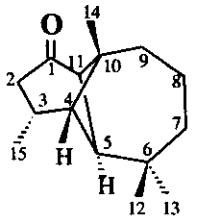
E- Bisabolene derivatives



N°	Common name	Double bonds	Substituents	References
212			1-oxo 2β,3β-epoxy 15-OAng	**Schmeda-Hirschmann et al., 1986[r]**
213			1-oxo 2β,3β-epoxy	**Bohlmann et al., 1976;[a,r]** **Bohlmann & Zdero 1985[a]**
214		2,3	1-oxo 15-OAc	**Bohlmann et al., 1977[r]**
215		2,3	1-oxo 15-OH	**Bohlmann et al., 1977[r]**
216		2,3	1-oxo 15-OAng	**Schmeda-Hirschmann et al., 1986[r]** **Bohlmann et al., 1982;[r]**
217		2,3	1α-OH 15-OAng	**Schmeda-Hirschmann et al., 1986[r]**
218		2,3	1α-OAc 3-CO2H	**Calderón et al., 1984[a]**
219		2,3	1α-OH 3-CO2H	**Calderón et al., 1984[a]**
220	1-bisabolone	2,3	1-oxo	**Bohlmann et al., 1976;[a,r] 1977;[a,r]** **Zdero et al., 1988[a]**
221	bisabolene	2,3		**Zdero et al., 1991[a]**
222	bisabolol	3,4	7α-OH	**Bohlmann et al., 1986[r]**

a: Isolated from aerial parts; r: Isolated from roots.

Table 3 - Longipinanes



N°	Double bonds	Substituents	References
223		7β-OAng 9α-OAng	Gil et al., 1987;[a] Zdero et al., 1987[r]
224		7β-OAng 9α-OAc	Zdero et al., 1987[r]
225		7β-OAng 8α-OAng 9α-OH	Amaro et al., 1988;[a] Bohlmann & Zdero 1985;[a] Román et al., 1981;[r] 1993;[r] Sánchez-Arreola et al., 1995[r]
226		7β-OTigl 8α-OTigl 9α-OH	Amaro et al., 1988[a]
227		7β-OAng 9α-OAng 13-OAng	Gil et al., 1987;[a] Zdero et al., 1988[a,r]
228		7β-OAng 9α-OAng 13-OAc	Zdero et al., 1988[a,r]
229		7β-OAng 9α-OAc 13-OAng	Zdero et al., 1988[a]
230		7β-OAng 13-OAc	Zdero et al., 1988[a]
231		7β-OAng 9α-OAng 13-OH	Zdero et al., 1988[a,r]
232#		7β-OAc 9α-OAng	Bohlmann et al., 1979[a,r]
233#		7β-OAng 9α-OEpang	Bohlmann et al., 1979[a,r]
234		7β-OAng 8α-OAng 9α-OAng	Bohlmann & Zdero, 1985[r]
235		7β-OAng 8α-OAng	Sánchez-Arreola et al., 1995[r]

Table 3 (cont.)

Nº	Double bonds	Substituents	References
236		7β-OAng 8α-OAng 13-OAng	**Bohlmann & Zdero, 1985[r]**
237		9α-OAng 13-OAng	**Román et al., 1995[r]**
238		9α-OAng 13-OTigl	**Román et al., 1995[r]**
239		7β-OAng 8α-OH 9α-OAng	**Sánchez-Arreola et al., 1995[r]**
240		7β-OH 8α-OAng 9α-OAng	**Sánchez-Arreola et al., 1995[r]**
241		7β-OAng 8α-OAc 9α-OAng	**Sánchez-Arreola et al., 1995[r]**
242	2,3		**Bohlmann & Zdero, 1985[a]**
243#	2,3	7β-OAng 9α-OAng	**Bohlmann & Zdero, 1985;[a,r] Bohlmann et al., 1977;[r] 1979;[r] 1986;[r] Gil et al., 1987;[a] Guerra-Ramírez et al., 1998;[r] Joseph-Nathan et al., 1991;[r] Román et al., 1995;[r] Zdero et al., 1987[r]**
244	2,3	7β-OAng 13-OAng	**Bohlmann & Zdero, 1985;[r] Bohlmann et al., 1986;[a,r] Gil et al., 1987;[r] Zdero et al., 1991[a]**
245	2,3	7β-OAng 9α-OAng 13-OAng	**Gil et al., 1987;[r] Zdero et al., 1991[a]**
246	2,3	7β-OAng 9α-OAc	**Amaro et al., 1988;[a] Bohlamnn & Zdero, 1985;[a] Guerra-Ramírez et al., 1998[r]**
247#	2,3	7β-OAng 8α-OAng 9α-OH	**Bohlmann et al., 1977;[r] Amaro et al., 1988;[a] Sánchez-Arreola et al., 1995[r]**
248	2,3	7β-OAc 9α-OAng 13-OAng	**Cerda-García-Rojas et al., 1993[r]**
249	2,3	7β-OAc 9α-OSen 13-OAng	**Cerda-García-Rojas et al., 1993[r]**
250	2,3	7β-OAc 13-OAng	**Cerda-García-Rojas et al., 1993[r]**
251†	2,3	7β-OAng 9α-OSen	**Bohlmann & Zdero, 1985;[a] Bohlmann et al., 1977;[r] Guerra-Ramírez et al., 1998;[r] Joseph-Nathan et al., 1991;[r] Román et al., 1989[r]**

Table 3 (cont.)

N°	Double bonds	Substituents	References
252	2,3	7β-OTigl 9α-OSen	**Guerra-Ramírez et al., 1998;[r] Joseph-Nathan et al., 1991[r]**
253#	2,3	7β-OTigl 9α-OAng	**Bohlmann et al., 1976;[r] 1977;[r] Guerra-Ramírez et al., 1998;[r] Joseph-Nathan et al., 1991[r]**
254	2,3	7β-OTigl 9α-OIsoval	**Guerra-Ramírez et al., 1998[r]**
255#	2,3	7β-OSen 9α-OSen	**Bohlmann et al., 1977;[r] Guerra-Ramírez et al., 1998;[r] Joseph-Nathan et al., 1991[r]**
256	2,3	7β-OSen 9α-OAng	**Guerra-Ramírez et al., 1998;[r] Joseph-Nathan et al., 1991[r]**
257	2,3	7β-OH 13-OH	**Bohlmann et al., 1986[r]**
258	2,3	1-H2	**Bohlmann et al., 1979[a,r]**
259#	2,3	7β-OAng 9α-OH	**Bohlmann et al., 1977;[r] 1979[r]**
260	2,3	7β-OMeacr	**Bohlmann & Zdero, 1985[a]**
261	2,3	7β-OAng 9α-OIsoval	**Bohlmann & Zdero, 1985;[a,r] Guerra-Ramírez et al., 1998[r]**
262	2,3	7β-OIsobu	**Bohlmann & Zdero, 1985[a]**
263	2,3	7β-OAng	**Bohlmann & Zdero, 1985;[a,r] Bohlmann et al., 1986;[r] Sánchez-Arreola et al., 1995[r]**
264	2,3	7β-OMeacr 9α-OIsobu	**Bohlmann & Zdero, 1985[a]**
265§#	2,3	7β-OEpang 9α-OAng	**Bohlmann & Zdero, 1985;[a,r] Bohlmann et al., 1979[r]**
266§	2,3	7β-OEpang* 9α-OAng	**Bohlmann & Zdero, 1985[a,r]**
267#	2,3	7β-OAng 8α-OAng	**Bohlmann & Zdero, 1985;[r] Bohlmann et al., 1977;[r] Sánchez-Arreola et al., 1995;[r] Román et al., 1993[r]**
268	2,3	7β-OAng 8α-OAng 9α-OAng	**Bohlmann & Zdero, 1985[r]**
269	2,3	7β-OAng 8α-OAng 13-OAng	**Bohlmann & Zdero, 1985[r]**
270#	2,3	7β-OSen 9α-OH	**Bohlmann et al., 1977[r]**
271#	2,3	7β-OAng 9α-OTigl	**Bohlmann et al., 1976[r]; 1977[r]; Guerra-Ramírez et al., 1998[r]**

Table 3 (cont.)

N°	Double bonds	Substituents	References
272#	2,3	7β-OSen 9α-OTigl	**Bohlmann et al., 1977;[r] Guerra-Ramírez et al., 1998[r]**
273	2,3	7β-OSen 9α-OIsoval	**Guerra-Ramírez et al., 1998[r]**
274#	2,3	7β-OSen 9α-OMeacr	**Bohlmann et al., 1977[r]**
275#	2,3	7β-OTigl 9α-OMeacr	**Bohlmann et al., 1977[r]**
276#	2,3	7β-OH	**Bohlmann et al., 1977[r]**
277#	2,3	7β-OAng 8α-OMebu	**Bohlmann et al., 1977[r]**
278#	2,3	7β-OAng 8α-OMebu 9α-OH	**Bohlmann et al., 1977[r]**
279†	2,3	9α-OAng 13-OAng	**Bohlmann et al., 1977[r]**
280#	2,3	7β-OMeacr 9α-OMeacr	**Bohlmann & Zdero, 1985;[a] Bohlmann et al., 1977;[r] Joseph-Nathan et al., 1991[r]**
281#	2,3	7β-OMeacr 9α-OTigl	**Bohlmann et al., 1977;[r] Joseph-Nathan et al., 1991[r]**
282	2,3	7β-OMeacr 9α-OSen	**Guerra-Ramírez et al., 1998;[r] Joseph-Nathan et al., 1991[r]**
283#	2,3	7β-OMeacr 9α-OAng	**Bohlmann & Zdero 1985;[a] Bohlmann et al., 1977;[r] 1979;[r] Guerra-Ramírez et al., 1998;[r] Joseph-Nathan et al., 1991[r]**
284#	2,3	7β-OAng 9α-OMeacr	**Bohlmann & Zdero 1985;[a] Bohlmann et al., 1977;[r] 1979;[r] Joseph-Nathan et al., 1991[r]**
285#	2,3	7β-OTigl 9α-OTigl	**Bohlmann et al., 1977;[r] Guerra-Ramírez et al., 1998;[r] Joseph-Nathan et al., 1991[r]**
286	2,3	7β-OAng 8α-OAc 9α-OAng	**Sánchez-Arreola et al., 1995[r]**
287	2,3	7β-OAng 8α-OIsobu	**Sánchez-Arreola et al., 1995[r]**
288‡	2,3	7β-OH 9α-OH	**Román et al., 1985[r]**
289	3,15	1- H2 2-oxo	**Bohlmann & Zdero, 1985[a]**

a: Isolated from aerial parts; r: Isolated from roots.

§ The absolute configuration of the epoxyangelates side chain was determined by Torres-Valencia, Cerda-García-Rojas, Román, Hernández, & Joseph-Nathan, 1998

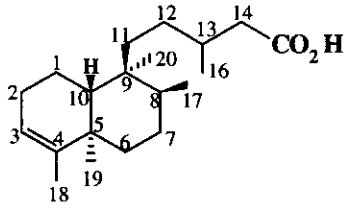
Structure revised (Bohlmann & Zdero, 1985; Román, del Río, Hernández, Joseph-Nathan, Zabel, & Watson, 1981; Bohlmann, Ates, Jakupovic, King, & Robinson, 1982).

† Structure revised according to Bohlmann & Zdero, 1985.

‡ Obtained by saponification of a mixture of esters.

Table 4 - Diterpenes and derivatives

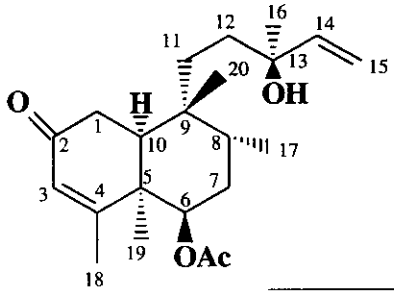
A- *trans*-clerodanes



N°	Common name	Double bonds	Substituents	References
290	Stephalic acid	13,14(Z)	20-OH	**Angeles et al., 1982**
291*		13,14 (Z)	2β-OAc Me-17α	**Bohlmann et al., 1982**
292*		13,14 (Z)	Me-17α	**Bohlmann et al., 1982**

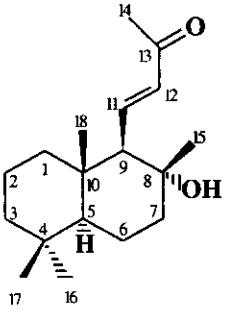
* Me-17 stereochemistry should be revised based on **290** which was determined by X-ray analysis (**Angeles, Folting, Grieco, Huffman, Miranda & Salmón,** 1982).

B- *cis*-clerodanes



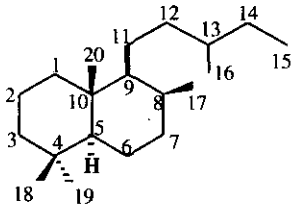
N°	Reference
293	**Bohlmann & Zdero 1985**

C- Bisnorditerpenes



N°	Common name	Substituents	References
294	Sterebin A	6α-OH 7β-OH	**Oshima et al., 1986**
295	Sterebin B	6α-OAc 7β-OH	**Oshima et al., 1986**
296	Sterebin C	6α-OH 7β-OAc	**Oshima et al., 1986**
297	Sterebin D	7β-OH	**Oshima et al., 1986**

D- Labdanes

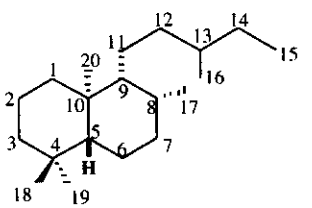


N°	Common name	Double bonds	Substituents	References
298	Labdanolic acid		8α-OH 14-CO2H	**Bohlmann & Zdero 1985**
299		7,8	2β-OH 15-OH	**Zdero et al., 1988**
300		7,8	3-oxo 15-OH	**Zdero et al., 1988**
301	Catavinic acid	7,8	14-CO2H	**Bohlmann et al., 1976**
302		8,17; 13,14(Z)	2α-OH 7α-OH 14-CO2H	**de Gutiérrez et al., 1992**
303	Sterebin E	11,12(E); 13,14(E)	6α-OH 7β-OH 8α-OH 15-OH	**Oshima et al., 1988**
304	Sterebin F	11,12(E); 13,14(Z)	6α-OH 7β-OH 8α-OH 15-OH	**Oshima et al., 1988**
305	Sterebin G	11,12(E); 13,16	6α-OH 7β-OH 8α-OH 14-OH 15-OH	**Oshima et al., 1988**
306	Sterebin H	C-14 epimer of Sterebin G		**Oshima et al., 1988**
307		12,13; 14,15	7β-OAc 8α-OH	**Bohlmann & Zdero 1985**
308		12,13; 14,15	6α-OH 7β-OAc 8α-OH	**Bohlmann & Zdero 1985**
309		12,13 (Z); 14,15	7β-OAc 8α-OH	**Bohlmann & Zdero 1985**
310		12,13 (Z); 14,15	6α-OH 7β-OAc 8α-OH	**Bohlmann & Zdero 1985**

Table 4-D (cont.)

N°	Common name	Double bonds	Substituents	References
309		12,13 (Z); 14,15	7β-OAc 8α-OH	**Bohlmann & Zdero 1985**
310		12,13 (Z); 14,15	6α-OH 7β-OAc 8α-OH	**Bohlmann & Zdero 1985**
311	6α-Angeloyloxy-nidorellol	12,13; 14,15	6α-OAng 7β-OH 8α-OH	**Quijano et al., 1982; Zdero et al., 1988**
312	Abienol	12,13; 14,15	8α-OH	**Zdero et al., 1988**
313		12,13; 14,15	7β-OH 8α-OH	**Zdero et al., 1988**
314		12,13; 14,15	6α-OH 7β-OH 8α-OH	**Zdero et al., 1988**
315	Labdenolic acid	13,14(Z)	8α-OH 14-CO2H	**Amaro-Luis & Hung 1988; Bohlmann & Zdero 1985; Zdero et al., 1988**
316	6a-Angeloyloxy-sclareol	14,15	6α-OAng 8α-OH 13β-OH	**Quijano et al., 1982**
317	Jhanol	14,15	8,13β-oxide 19-OH	**Sholichin et al., 1980**
318	Manoyl oxide	14,15	8α,13α-oxide	**Bohlmann & Zdero 1985**
319	*epi*-Manoyl oxide	14,15	8α,13β-oxide	**Bohlmann & Zdero 1985**

E- *ent*-Labdanes

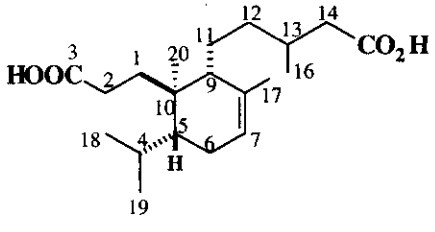


N°	Common name	Double bonds	Substituents	References
320		7,8	3-oxo 14- CO_2H	**Escamilla & Ortega 1991**
321		7,8; 13,14	2β-OH 15-OH	**Zdero et al., 1991**
322		7,8; 13,14	2β-OH 15-OAc	**Zdero et al., 1991**
323		7,8; 13,16; 14,15	4β-CO_2H 15,16-oxide	**Salmón et al., 1983**
324	Salicifoliol	7,8; 14,15	2-OH 13-OH	**Ortega et al., 1980**

Table 4-D (cont.)

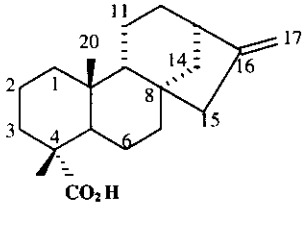
N°	Common name	Double bonds	Substituents	References
325		8,17; 12,13; 14,15	7β-OH 12,15-oxide	**Bohlmann et al., 1982**
326		12,13(Z); 14,15	6β-OH 7α-OAc	**Zdero et al., 1987**
327		12,13(Z); 14,15	6β-OAc 7α-OH	**Zdero et al., 1987**
328		12,13(Z); 14,15	6β-OH 7α-OH	**Zdero et al., 1987**
329		12,13(Z); 14,15	7α-OH	**Zdero et al., 1987**
330	Austroinulin	12,13(Z); 14,15	6β-OH 7α-OH 8-OH	**Sholichin et al., 1980**
331	Stevinsol (6-O-Acetylaustroinulin)	12,13(Z); 14,15	6β-OAc 7α-OH 8-OH	**Calderón et al., 1984** **Ortega et al., 1980** **Sholichin et al., 1980**
332		12,13; 14,15	6β-OH 7α-OH	**Zdero et al., 1987**
333		12,13; 14,15	7α-OH	**Zdero et al., 1987**

F- Seco *ent*-labdanes



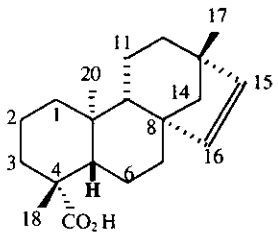
N°	Double bonds	References
334		**Escamilla & Ortega,** 1991
335	13,14(Z)	**Escamilla & Ortega, 1991**

G- Kauranes



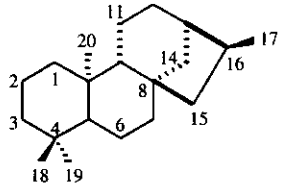
N°	Common name	Substituents	References
336	Kaurenic acid		**Bohlmann et al., 1979; Quijano et al., 1982**
337	Angeloylgrandifloric acid	15a-OAng	**Quijano et al., 1982**

H- Beyerene derivatives



Nº	Common name	Substituents	References
338	Beyerenic acid		**Bohlmann et al., 1982; Schmeda-Hirschmann et al., 1986; Zdero et al., 1987**
339		7b-OH	**Zdero et al., 1987**
340		12a-OH	**Zdero et al., 1987**

I- *ent*-Kauraness



Nº	Common name	Double bonds	Substituents	References
341			4α-CO_2H 16β-OH 17-OH	**Amaro-Luis, 1993**
342	Paniculoside IV		4α-COO-Glc 16α-OH 17-OH	**Kaneda et al., 1978; Yamasaki et al., 1977**
343	Subpubescensoside		4α − COO−Glc(2→1)Glc, (3→1)Glc 11β,16α-oxide	**Román et al., 1995**
344*			4α-CO_2H 16α-OH 17-OH	**Kohda et al., 1976b**
345	Stevionolide	5,6	6,19-6lido 7-oxo 16α-OAc	**Amaro-Luis, 1993**
346		9,11; 16,17	4α-CO_2H	**Amaro-Luis, 1993; Zdero et al., 1988**
347		9,11; 16,17	4α-CO_2H 12β-OEt	**Ortega et al., 1985[a]**
348		16,17	19-OH	**Amaro-Luis, 1993**
349		16,17	4α-CO_2H 15α-OSen	**Amaro-Luis, 1993; Bohlmann et al., 1982**
350	*ent*-Kaurenic acid	16,17	4α-CO_2H	**Amaro-Luis, 1993; Amaro-Luis, & Adrian, 1988; Bohlmann et al., 1979; 1982; Schmeda-Hirschmann et al., 1986; Zdero et al., 1987; 1988**

Table 4-I (cont.)

Nº	Common name	Double bonds	Substituents	References
351		16,17	4α-CO_2H 15β-OAc	**Amaro-Luis, & Adrian, 1988**
352		16,17	4α-CO_2H 15α-OTigl	**Bohlmann et al., 1982**
353	Rebaudioside A	16,17	4α-COO-Glc 13 – O –Glc(2→1 Glc, 3→1 Glc)	**Kobayashi et al., 1977; Kohda et al., 1976a; Sakamoto et al., 1977**
354	Rebaudioside B	16,17	4α-CO_2H 13 – O –Glc(2→1 Glc, 3→1 Glc)	**Kohda et al., 1976a; Sakamoto et al., 1977**
355	Rebaudioside C (Dulcoside B)	16,17	4α-COO-Glc 13 – O –Glc(2→1 Rh, 3→1 Glc)	**Kobayashi et al., 1977; Sakamoto et al., 1977a**
356	Rebaudioside D	16,17	4α – COO-Glc(2→1 Glc) 13 – O –Glc(2→1 Glc, 3→1 Glc)	**Sakamoto et al., 1977a; Sakamoto et al., 1977b**
357	Rebaudioside E	16,17	4α – COO-Glc(2→1 Glc)	**Sakamoto et al., 1977a; 1977b**
358	Dulcoside A	16,17	4α-COO-Glc 13 – O –Glc(2→1 Glc)	**Kobayashi et al., 1977**
359	Stevioside	16,17	4α-COO-Glc 13 – O –Glc(2→1 Rh)	**Kinghorn et al., 1984; Kobayashi et al., 1977; Kohda et al., 1976a; Sakamoto et al., 1977a**
360	Steviolbioside	16,17	4α-CO_2H 13 – O –Glc(2→1 Glc)	**Kohda et al., 1976a; Sakamoto et al., 1977a**
361	Paniculoside I	16,17	4α-COO-Glc 15β-OH	**Yamasaki et al., 1976; 1977; Kaneda et al., 1978**
362	Paniculoside II	16,17	4α-COO-Glc 11β-OH 15β-OH	**Yamasaki et al., 1976; 1977; Kaneda et al., 1978**
363	Paniculoside III	16,17	4α-COO-Glc 11β-OH 15-oxo	**Yamasaki et al., 1976; 1977; Kaneda et al., 1978**
364	Paniculoside V	16,17	4α-COO-Glc 15β-OGlc	**Yamasaki et al., 1977; Kaneda et al., 1978**
365		16,17	4α-CO_2H 12α-OH	**Ortega et al., 1985**[a]

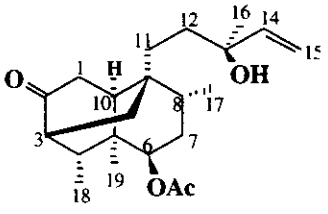
Table 4-I (cont.)

N°	Common name	Double bonds	Substituents	References
366*		16,17	4α-CO_2H 15β-OH	**Kohda et al., 1976b**
367*		16,17	4α-CO_2H 11β-OH 15β-OH	**Kohda et al., 1976b**
368*		16,17	4α-CO_2H 11β-OH 15-oxo	**Kohda et al., 1976b**

r: Isolated from roots

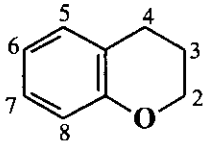
* Aglicone from enzimatic hydrolysis.

J- Stevisalicinone



N°	References
369	**Bohlmann & Zdero, 1985**

Table 5 - Chromane derivatives



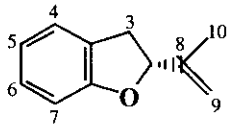
N°	Common name	Double bonds	Substituents	References
370		2,3	2-methyl 4-oxo 5,7- dihydroxy	**Bohlmann et al., 1976[a]**
371	Methylripariochromene A	3,4	2,2- dimethyl 6- Ac 7,8- dimethoxy	**Kohda et al., 1976c[a]**
372		3,4	2,2- dimethyl 5- $CH(OH)CH_3$ 6- methoxy	**Bohlmann et al., 1986[r]**
373		3,4	2,2- dimethyl 6,7- dimethoxy	**Zdero et al., 1991[a]**

Table 5 - (cont.)

N°	Common name	Double bonds	Substituents	References
374		3,4	2,2- dimethyl 7- methoxy	**Quijano et al., 1982**[a]
375		3,4	2,2- dimethyl 7,8- dimethoxy	**Quijano et al., 1982**[a]
376		3,4	2,2- dimethyl 6- Ac	**Bohlmann & Zdero, 1985**[a,r]

[a]: Isolated from aerial parts; [r]: Isolated from roots.

Table 6 - Benzofurane derivatives

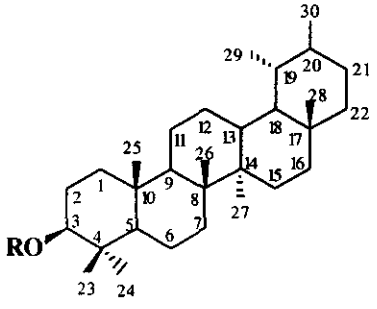


N°	Common name	Double bonds	Substituents	References
377			4- Ac 5- OCH3	**Bohlmann & Zdero, 1985**
378			3b-OAng 5- OH 6- Ac	**Bohlmann & Zdero, 1985**
379*			4- CH(OH)CH3 5- OCH3	**Bohlmann & Zdero, 1985;** **Bohlmann et al., 1986;** **Hernández et al., 1994**
380			4- OCH3 5- CH(OH)CH3	**Bohlmann & Zdero, 1985**
381	Hydroxyeuparin	2,3	5- Ac 6- OH 10- OH	**Bohlmann et al., 1979**
382		2,3; 8,9-dihydro	5- Ac 8- OH	**Bohlmann & Zdero, 1985**

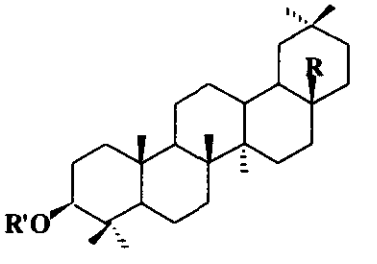
[r]: Isolated from roots.

*In **Bohlmann, Zdero, King & Robinson, 1986** the C-2 stereochemistry was incorrectly drawn as b.

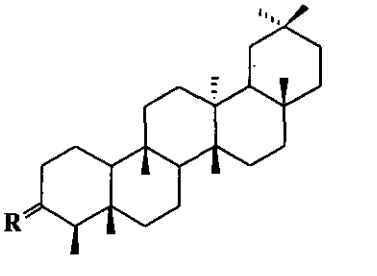
Table 7 - Triterpenes and Sterols



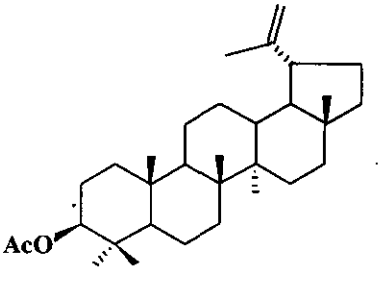
N°	Common name	R	R'	References
383	Taraxasterol	$\Delta^{20,30}$ H		**de Gutiérrez et al., 1992; Domínguez et al., 1974; Kohda et al., 1976b**
384	Taraxasteryl acetate	$\Delta^{20,30}$ Ac		**Bohlmann et al., 1986; Kohda et al., 1976b; Zdero et al., 1987**
385	Pseudotaraxasterol	$\Delta^{20,21}$ H		**de Heluani et al., 1989**



386	β-Amyrin	$\Delta^{12,13}$ CH_3	H	**de Gutiérrez et al., 1992; de Heluani et al., 1989; Escamilla & Ortega, 1991**
387	β-Amyrin Acetate	$\Delta^{12,13}$ CH_3	Ac	**Bohlmann et al., 1979; Sholichin et al., 1980**
388	Oleanolic acid	$\Delta^{12,13}$ CO_2H	H	**de Gutiérrez et al.,1992**
389	Germanicol	$\Delta^{18,19}$ CH_3	H	**de Heluani et al., 1989**



390	Friedelin	O		**Amaro-Luis &Adrian, 1988; Cerda-García-Rojas et al., 1993;[r] Joseph-Nathan et al., 1991[r]**
391	Friedelan-3β-ol	β-OH		**Joseph-Nathan et al., 1991[r]**



392	*D:C*-Friedours-7-en-3β-ol acetate			**Cerda-García-Rojas et al., 1996;[r] Joseph-Nathan et al., 1991[r]**

Table 7 (cont.)

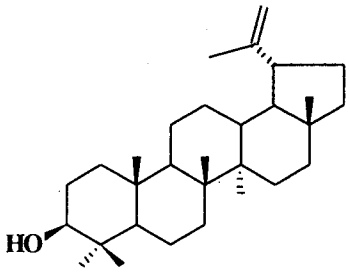
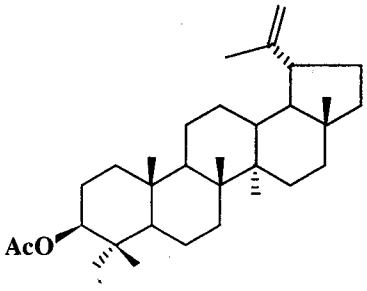
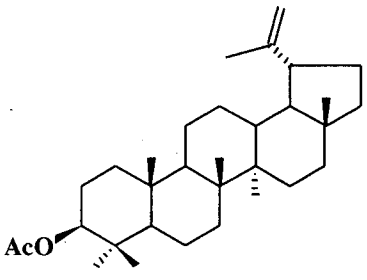
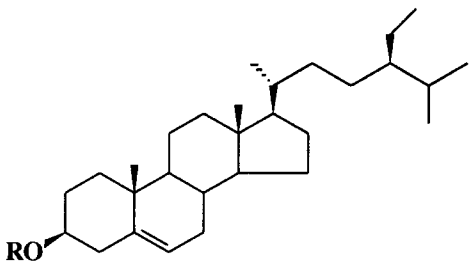
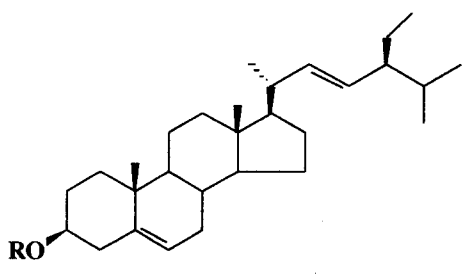
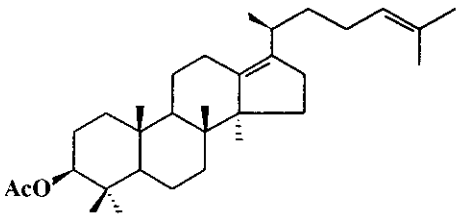
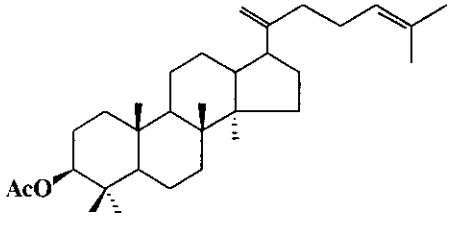
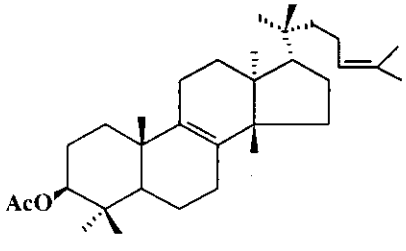
	N°	R	Common name	References
	**393**		Lupeol*	**Bohlmann et al., 1979; de Gutiérrez et al., 1992; de Heluani et al., 1989; Escamilla & Ortega, 1991**
	**394**		Lupeyl acetate	**Bohlmann et al., 1982; Schmeda-Hirschmann et al., 1986; Zdero et al., 1987**
	**395**		Lupeyl acetate Δ^{12}	**Bohlmann et al., 1979; 1982**
	**396**	**H**	β-Sitosterol	**Amaro-Luis & Adrian, 1988; Amaro & Hung, 1985; de Gutiérrez et al., 1992; Domínguez et al., 1974; Quijano et al., 1982 Sholichin et al., 1980**
	397	**Glc**	β-Sitosterolglucoside	**Hernández et al., 1996a**
	**398**		Stigmasterol	**Amaro-Luis & Adrian, 1988; Cerda-García-Rojas et al., 1993;[r] de Gutiérrez et al., 1992 Quijano et al., 1982; Sánchez-Arreola et al., 1995;[r] Sholichin et al., 1980**
	399	**Glc**	Daucosterine or Daucosterol	**Amaro-Luis & Adrian, 1988; Amaro & Hung, 1985**

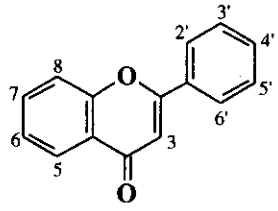
Table 7 **(cont.)**

	N°	R	Common name	References
	**400**			**Mata et al., 1991**
	**401**			**Bohlmann et al., 1979**
	**402**	Eupha-8,24-dien-3β-yl acetate		**Sánchez-Arreola et al., 1995**

r: Isolated from roots.

* From *Stevia rebaudiana* three unidentified esters of lupeol were isolated (**Sholichin, Yamasaki, Miyama, Yahara, & Tanaka**, 1980) and from *S. triflora*, lupenyl esters and *epi*-friedelinol were isolated (**Amaro-Luis, & Adrian**, 1988).

Table 8 - Flavonoids[§]



N°	Common name	Substituents	References
403	7,4'-dimetoxy naringenin	2,3-dihydro 5-hydroxy 7,4'-dimethoxy	**Ortega et al.,, 1980**
404		2,3-dihydro 5,3'-dihydroxy 7,4'-dimethoxy	**Ortega et al.,, 1980**
405		2,3-dihydro 5,3',4'-trihydroxy 7-methoxy	**Ortega et al.,, 1980**
406	Artemetin	5-hydroxy 3,6,7,3',4'-pentamethoxy	**de Gutiérrez et al., 1992;** **Sosa et al., 1985**
407		5-hydroxy 3,6,7, 4'-tetramethoxy	**de Gutiérrez et al., 1992**
408	Cirsimaritin-4'-O-β-D-Glc	5-hydroxy 6,7-dimethoxy 4'-O-β-D-glc	**Rajbhandari & Roberts, 1985a**
409		5-hydroxy 6,7,4'-trimethoxy	**Hernández et al., 1996b**
410		6-hydroxy 5,7,4'-trimethoxy	**Hernández et al., 1996b**
411		5,6-dihydroxy 7,8,4'-trimethoxy	**Domínguez et al.,, 1974;** **Mendiondo & Seeligman, 1985**
412	Apigenin-4'-O-Glc	5,7-dihydroxy 4'-O-glc	**Rajbhandari & Roberts, 1983**
413	Apigenin-7-O-Glc	5,4'-dihydroxy 7-O-glc	**Rajbhandari & Roberts, 1985b**
414	Eupatorin	5,3'-dihydroxy 6,7,4'-trimethoxy	**Hernández et al., 1994;** **Rajbhandari & Roberts, 1985a** **Sosa et al., 1984; 1985**
415	Casticin	5,3'-dihydroxy 3,6,7,4'-tetramethoxy	**Hernández et al., 1994; 1996a**
416	Eupatilin	5,7-dihydroxy 6,3',4'-trimethoxy	**Hernández et al., 1995;* 1996b;** **Amaro & Hung, 1985**
417	Santin	5,7-dihydroxy 3,6,4'-trimethoxy	**Rajbhandari & Roberts, 1985a**

Table 8 (cont.)

Nº	Common name	Substituents	References
418	Sakuranetin	5,4'-dihydroxy 7-methoxy	**Bohlmann et al., 1976**
419	Pectolinaringenin	5,7-dihydroxy 6,4'-dimethoxy	**Amaro, & Hung, 1985**
420		5,7-dihydroxy 3,6,3',4'-tetramethoxy	**Rajbhandari & Roberts, 1985b**
421	Cirsimaritin	5,4'-dihydroxy 6,7-dimethoxy	**Hernández et al., 1996b; Sosa et al., 1984**
422	Policladin (= Crisosplenetin)	5,4'-dihydroxy 3,6,7,3'-tetramethoxy	**de Gutiérrez et al., 1992**
423	Centaureidin	5,7,3'-trihydroxy 3,6,4'-trimethoxy	**Rajbhandari & Roberts, 1983; 1984; 1985a; 1985b**
424	Kaempherol-3-O-Rh	5,7,4'-trihydroxy 3-O-rh	**Rajbhandari & Roberts, 1983**
425	Luteolin-7-O-β-D-Glc	5,3',4'-trihydroxy 7-O-β-D-glc	**Rajbhandari & Roberts, 1983; 1984; 1985a**
426	Luteolin-4'-O-β-D-Glc	5,7,3'-trihydroxy 4'-O-β-D-glc	**Rajbhandari & Roberts, 1985a**
427	Hispidulin	5,7,4'-trihydroxy 6-methoxy	**Gil et al., 1989; Rajbhandari & Roberts, 1985a**
428		5,7,4'-trihydroxy 3,6-dimethoxy	**Rajbhandari & Roberts, 1985a**
429	Jaceosidin	5,7,4'-trihydroxy 6,3'-dimethoxy	**Gil et al., 1992**
430†		5,3',4'-trihydroxy 3,6,7-trimethoxy	**Rajbhandari & Roberts, 1985b**
431	Jaceidin	5,7,3'-trihydroxy 3,6,4'-trimethoxy	**Rajbhandari & Roberts, 1985b**
432	Quercitrin	5,7,3',4'-tetrahydroxy 3-O-rh	**Rajbhandari & Roberts, 1983**
433	Quercetin-3-O-L-Rh	5,7,3',4'-tetrahydroxy 3-O-L-rh	**Rajbhandari & Roberts, 1985b**
434	Quercetin-3-O-β-D-Glc	5,7,3',4'-tetrahydroxy 3-O-β-D-glc	**Rajbhandari & Roberts, 1983; 1984; 1985a**
435	Quercetin-3-O-β-D-Gal	5,7,3',4'-tetrahydroxy 3-O-β-D-gal	**Rajbhandari & Roberts, 1984; 1985a; 1985b**
436	Quercetin-3-O-α-L-Arab	5,7,3',4'-tetrahydroxy 3-O-α-L-arab	**Rajbhandari & Roberts, 1983; 1984; 1985a**
437	Quercetin-3-O-α-L-Rh-D-Gal	5,7,3',4'-tetrahydroxy 3-O-α-L-rh-D-gal	**Rajbhandari & Roberts, 1985a**
438	Quercetin-3-O-Digal	5,7,3',4'-tetrahydroxy 3-O-Digal	**Rajbhandari & Roberts, 1984; 1985b**

Table 8 (cont.)

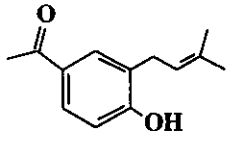
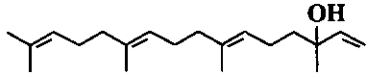
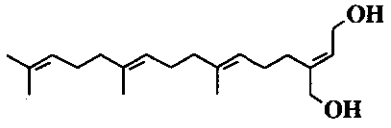
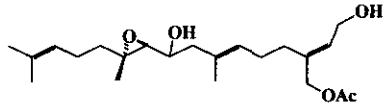
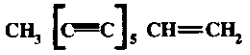
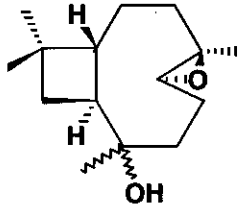
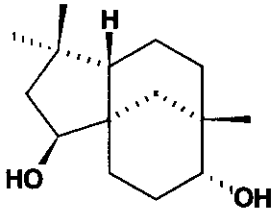
N°	Common name	Substituents	References
439	Quercetin-3-O-Gal-Rh	5,7,3',4'-tetrahydroxy 3-O-gal-rh	**Rajbhandari & Roberts, 1984**
440	Quercetin-3-O-D-Gal-D-Glc	5,7,3',4'-tetrahydroxy 3-O-D-gal-D-glc	**Rajbhandari & Roberts, 1985b**
441	Quercetagetin-4'-metoxi-3-O-Arab	5,6,7,3'-tetrahydroxy 3-O-arab 4'-methoxy	**Rajbhandari & Roberts, 1984**

§From *S. mercedensis* a sulfated flavonoid was isolated (**Mendiondo & Seeligman**, 1985).
*In **Hernández, Catalán, Cerda-García-Rojas, & Joseph-Nathan**, 1995 the flavonoid isolated was eupatlilin and not eupatorin as reported.
†Structure revised according to **Wollenweber & Dietz**, 1981.
glc: glucoside; rh: rhamnoside; gal: galactoside; Digal: digalactoside; arab: arabinoside.

Table 9 - Miscellaneous

N°	Common name or structure	References
442	Biciclogermacrene	**Bohlmann et al., 1982;[a,r] 1986;[a] Schmeda-Hirschmann et al., 1986;[a] Zdero et al., 1988[a]**
443	1β,10α-epoxycaryophyllene	**Bohlmann & Zdero, 1985;[a] Schmeda-Hirschmann et al., 1986 [a]**
444	*p*-hydroxyacetophenone	**Bohlmann et al., 1979[a]**
445	Linoleic acid	**Schmeda-Hirschmann et al., 1986[a]**
446	Linolenic acid	**Schmeda-Hirschmann et al., 1986[a]**
447	α-Humulene or α-Caryophyllene	**Bohlmann et al., 1986;[a] Fujita et al., 1977;[a] Zdero et al., 1988[a]**
448	γ-Humulene or Isohumulene	**Zdero et al., 1987;[r] Bohlmann & Zdero, 1985;[a,r] Bohlmann et al., 1977;[r] 1979 [a,r]**
449	Triacontane	**Domínguez et al., 1974[a]**
450	Caryophyllene or β-Cariophyllene	**Bohlmann et al., 1982;[r] Fujita et al., 1977[a]**
451	Caryophyllene oxide	**Amaro-Luis & Adrián, 1997;[a] Fujita et al., 1977;[a] Martelli et al., 1985[a]***
452	Loliolide	**Sigstad et al., 1991[a]**
453	Chamazulene	**Calderón et al., 1989[a]**
454	Longicyclene	**Román et al., 1989[r]**
455	Nerolidol	**Bohlmann & Zdero, 1985;[a] Bohlmann et al., 1977;[a] Fujita et al., 1977[a]**
456	α-Terpineol	**Fujita et al., 1977[a]**
457	Terpinen-4-ol	**Fujita et al., 1977[a]**
458	α-Pinene	**Bohlmann & Zdero, 1985[a,r]**
459	Myrthenyl cinnamate	**Bohlmann & Zdero, 1985[a]**
460	Himachalol	**Bohlmann & Zdero, 1985[a]**

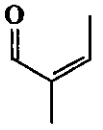
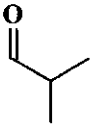
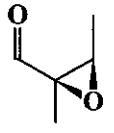
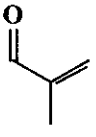
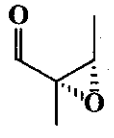
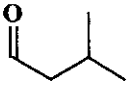
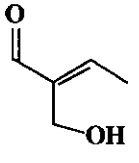
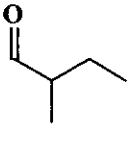
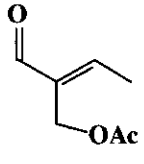
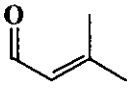
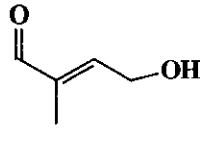
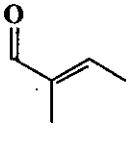
Table 9 - Miscellaneous (cont.)

N°	Common name or structure	References
461	β-Farnesene	**Bohlmann et al., 1977;[a] Fujita et al., 1977[a]**
462	Linalool	**Fujita et al., 1977[a]**
463	8-E-hydroxylinalool	**Hernández et al., 1994[a]**
464	β-Bergamotene	**Schmeda-Hirschmann et al., 1986[r]**
465	Spathulenol	**Martelli et al., 1985[a]***
466		**Zdero et al., 1991[a]**
467		**Bohlmann et al., 1982[a]**
468		**Bohlmann et al., 1982[a]**
469		**Bohlmann & Zdero, 1985[a]**
470		**Bohlmann et al.,1977[r]**
471		**Amaro-Luis & Adrián, 1997[a]**
472		**Amaro-Luis & Adrián, 1997[a]**

[a]: Isolated from aerial parts; [r]: Isolated from roots.

*: Caryophyllene oxide and spathulenol, along with other 52 components were identified from the essential oil of *Stevia rebaudiana* (**Martelli et al.**, 1985)

Table 10 - Abbreviations

Ac		Ang	
Isobu		Epang	
Meacr		Epang*	
Isoval		Sar	
Mebu		Sarac	
Sen		Tigl-4'-OH	
Tigl			

glc	Glucoside	rh	Rhamnoside
gal	Galactoside	arab	Arabinoside

Table 11 - Distribution of secondary metabolites in *Stevia*

Species	Sesquiterpene Lactones				Lg	Sq	DT	TT & St	Fl	Oth	References
	Ge	Gu	Eu	Oth							
S. achalensis		+	+	+	+	+				+	Bohlmann et al., 1986; Oberti et al., 1983
S. aff. tomentosum			+								Martínez-Vazquez et al., 1990
S. alpina var. *alpina*		+		+							de Heluani et al., 1989
S. alpina var. *glutinosa*											de Hernández et al., 1998
S. amambayensis	+			+		+	+	+		+	Schmeda-Hirshmann et al., 1986
S. andina						+	+	+			Zdero et al., 1987
S. aristata	+			+	+	+	+	+		+	Zdero et al., 1987
S. berlandieri					+	+	+	+	+	+	Bohlmann & Zdero, 1985; Domínguez et al., 1974
S. boliviensis		+			+	+		+		+	Bohlmann et al., 1979
S. breviaristata	+	+	+	+					+		Hernández et al., 1994; Oberti et al., 1986
S. chamaedrys	+	+	+			+					Zdero et al., 1991
S. cuzcoensis									+		Rajbhandari & Roberts, 1985b
S. eliator					+						Bohlmann et al., 1977
S. eupatoria		+			+	+	+				Ortega et al., 1985; Zdero et al., 1991
S. galeopsidifolia									+		Rajbhandari & Roberts, 1985b
S. gilliesii		+									Hernández et al., 1995
S. grisebachiana	+	+								+	Sigstad et al., 1991
S. hyssopifolia var. *hyssopifolia*						+	+			+	Zdero et al., 1991
S. isomeca				+							Bohlmann et al., 1985
S. jaliscensis					+		+				Bohlmann et al., 1976
S. jujuyensis	+			+			+	+	+		de Gutiérrez et al., 1992; Gil et al., 1992
S. lemmonia	+	+			+	+	+			+	Bohlmann & Zdero, 1985
S. lucida					+		+	+	+		Amaro & Hung, 1985; Amaro-Luis, 1993; Amaro-Luis & Hung, 1988; Amaro et al., 1988; Guerra-Ramírez et al., 1997; Salmón et al., 1983
S. maimarensis	+		+						+		Hernández et al., 1996a
S. mandonii					+	+		+			Bohlmann et al., 1979
S. mercedensis	+	+			+	+		+	+	+	Bohlmann et al., 1986; Mendiondo & Seeligman, 1985
S. microchaeta									+		Rajbhandari & Roberts, 1985a
S. monardaefolia				+			+	+	+	+	Gómez et al., 1983; Quijano et al., 1982; Rajbhandari & Roberts, 1985a
S. myriadenia		+				+	+	+		+	Bohlmann et al., 1982
S. nepetifolia									+		Rajbhandari & Roberts, 1984
S. origanoides				+	+			+	+		Calderón et al., 1987; Cerda-García-Rojas et al., 1993; Rajbhandari & Roberts, 1985a
S. ovata (=*S. rhombifolia*)	+	+		+	+	+	+			+	Bohlmann et al., 1977; Calderón et al., 1987a; Kaneda et al., 1978; Ríos et al., 1967; Román et al., 1981

Table 11 (cont.)

Species	Sesquiterpene Lactones				Lg	Sq	DT	TT & St	Fl	Oth	References
	Ge	Gu	Eu	Oth							
S. paniculata							+	+			Yamasaki et al., 1976; 1977; Kohda et al., 1976
S. phlebophylla							+				Kinghorn et al., 1984
S. pilosa		+									Martínez et al., 1988
S. polycephala					+	+	+				Bohlmann et al., 1977; Angeles et al., 1982
S. polyphylla	+	+	+	+		+					Zdero et al., 1988
S. potrerensis	+				+						Gil et al., 1987
S. procumbens	+	+							+		Sosa et al., 1985
S. purpurea						+			+	+	Bohlmann et al., 1976
S. rebaudiana						+	+	+	+	+	Fujita et al., 1977; Kohda et al., 1976; Kobayashi et al., 1977; Oshima et al., 1986; 1988; Rajbhandari & Roberts, 1983; Sakamoto et al., 1977a; 1977b; Sholichin et al., 1980
S. salicifolia					+	+	+	+		+	Bohlmann & Zdero, 1985; Calderón et al., 1984; Cerda-García-Rojas et al., 1996; Mata et al., 1991; Román et al., 1985
S. salicifolia var. *salicifolia*							+				Ortega et al., 1980
S. salicifolia var. *typica*							+				Ortega et al., 1980
S. samaipatensis		+				+	+				Zdero et al., 1988
S. sanguinea	+	+							+		de Hernández et al., 1997; Gil et al., 1989
S. sarensis	+	+		+		+	+			+	Zdero et al., 1988
S. satureifolia		+							+		Sosa et al., 1984
S. seleriana							+	+			Escamilla & Ortega, 1991
S. serrata	+	+			+				+	+	Bohlmann et al., 1977; Calderón et al., 1989; Kohda et al., 1976; Rajbhandari & Roberts, 1985b; Román et al., 1981; 1993; Salmón et al., 1973; 1975; 1977; Sánchez-Arreola et al., 1995
S. setifera		+				+	+	+		+	Bohlmann et al., 1979
S. soratensis									+		Rajbhandari & Roberts, 1985b;
S. subpubescens					+		+			+	Román et al., 1989; 1995
S. subpubescens var. intermedia					+			+			Joseph-Nathan et al., 1991
S. triflora					+						Amaro et al., 1988
S. vaga	+	+		+					+		Hernández et al., 1996b
S. viscida					+						Román et al., 1995
S. yaconensis	+	+			+	+	+			+	Zdero et al., 1988
S. yaconensis var. *aristifera*		+		+							Gil et al., 1990
S. yaconensis var. *subeglandulosa*		+									Sosa et al., 1989

Ge: germacrolides; Gu: guaianolides; Eu: Eudesmanolides; Lg: longipinenes; Sq: Sesquiterpenes; DT: diterpenes; TT: triterpenes; ST: sterols; Fl: flavonoids; Oth: Others

Table 12. Sesquiterpene Lactones (SL), Longipinenes (Lon) and Diterpenes (DT) isolated from *Stevia

Species	Collection from	Part studied	Compounds reported		
			SL	Lg	DT
S. achalensis	Argentina	Aerial	**141; 143-144; 151-152; 159-161; 163; 166-167; 178-184; 186-188; 192**	**244; 257**	
S. aff. tomentosum	Mexico	Aerial	**168; 172; 174**		
S. alpina var. alpina	Argentina	Aerial	**45; 54-55; 71; 77; 98; 130-132**		
S. alpina var. glutinosa			**12; 15-16; 33-35; 105; 112; 171; 173**		
S. amambayensis		Aerial; Roots	**3-4; 59; 62**		**338; 350**
S. andina	Peru	Aerial			**328-329; 332-333 350**
S. aristata	Paraguay	Aerial; Roots	**4-6; 59-60; 63**	**223-224; 243**	**326-328; 338-340**
S. berlandieri	Mexico	Aerial		**243**	**307-310; 318**
S. boliviensis	Bolivia	Aerial; Roots	**130**	**232-233; 243; 258-259; 265; 283-284**	
S. breviaristata	Argentina	Aerial; Roots	**19-20; 57; 113-117; 170**		
S. chamaedrys	Mexico	Aerial	**11; 13; 101-102; 104-107; 169; 175**		
S. cuzcoensis	Peru	Aerial			
S. eliator	Guatemala	Roots		**279**	
S. eupatoria	Mexico	Aerial	**78; 99-100**	**244-245**	**347; 365**
S. galeopsidifolia	Peru	Aerial			
S. gilliesii	Argentina	Aerial	**104-105; 108-110**		
S. grisebachiana	Argentina	Aerial	**8; 36; 77; 79; 122; 124-130; 133**		
S. hyssopifolia var. hyssopifolia	Mexico	Aerial			**321-322**
S. isomeca	Mexico	Aerial	**155-157; 191**		
S. jaliscensis		Aerial; Roots		**253; 271**	**301**
S. jujuyensis	Argentina	Aerial	**9; 17 or 18; 37-38; 46-47; 49-50; 193-194**		**302**
S. lemmonia	Mexico	Aerial; Roots	**1; 67; 72**	**225; 234; 236; 243-244; 263; 267-269**	**469**
S. lucida	Venezuela; Mexico	Aerial, Roots		**243; 246; 251-256; 261; 271-273; 282-283; 285**	**315; 323; 341; 345-346; 348-350**
S. maimarensis	Argentina	Aerial	**12; 21-27; 170; 176-177**		

Table 12 (cont.)

Species	Collection from	Part studied	Compounds reported		
			SL	Lg	DT
S. mandonii	Bolivia	Aerial; Roots		**243; 258-259; 265**	
S. mercedensis	Argentina	Aerial; Roots	**10; 83-84, 97; 104-107**	**243-244, 263**	
S. microchaeta	Mexico	Aerial			
S. monardaefolia	Mexico	Aerial	**41**		**311, 316; 336-337**
S. myriadenia	Brazil	Aerial; Roots	**80; 82**		**291-292; 325; 338; 349-351; 467-468**
S. nepetifolia	Mexico	Aerial			
S. origanoides	Mexico	Aerial; Roots	**42-44**	**248-250**	
S. ovata (=*S. rhombifolia*)	Mexico; Jap. (cul.); Guatemala	Aerial; Roots	**39; 153-154; 157**	**225**	**342; 360-363**
S. paniculata	Jap. (cul.)	Aerial			**342; 344; 360-363; 366-368**
S. phlebophylla	Mexico	Aerial			**358**
S. pilosa	Mexico	Aerial	**73**		
S. polycephala	Mexico; Guatemala	Aerial; Roots		**243; 251; 253; 255; 259; 270-272; 274-276; 280-281; 283; 285**	**290**
S. polyphylla	Bolivia	Aerial	**40; 139-142, 145-151; 162; 164-165; 178; 182; 189-190**		
S. potrerensis	Argentina	Aerial	**9**	**223; 227; 243-245**	
S. procumbens	Argentina	Aerial	**12; 105**		
S. purpurea		Aerial; Roots			
S. rebaudiana	Paraguay; Jap. (cul.); Filip. (cul.)	Aerial			**294-297; 303-306; 317; 330-331; 352-359**
S. salicifolia	Mexico	Aerial; Roots		**242-243; 246; 251, 260-266; 280, 283-284; 288-289**	**293; 298; 319; 331; 369**
S. salicifolia var. *salicifolia*	Mexico	Aerial			**324**
S. salicifolia var. *typica*	Mexico				**331**
S. samaipatensis	Bolivia	Aerial	**135-138**		**299-300**
S. sanguinea	Argentina	Aerial	**14; 32; 48; 70, 74-76; 81; 85-90; 91-95; 111; 123, 134**		
S. sarensis	Bolivia	Aerial	**12; 15-16; 42, 82, 105, 141; 151**		**311-315**
S. satureifolia	Argentina	Aerial	**105**		
S. seleriana	Mexico	Aerial			**320; 334-335**

Table 12 (cont.)

Species	Collection from	Part studied	Compounds reported		
			SL	Lg	DT
S. serrata	Mexico; Jap. (cul.); Guatemala	Aerial; Roots	**2; 64-66; 68-69**	**225; 235; 239-241; 247; 263; 267; 277-278; 281; 286-287**	
S. setifera	Bolivia	Aerial	**97; 105; 108**		**336; 350**
S. soratensis	Peru	Aerial			
S. subpubescens	Mexico	Aerial; Roots		**243; 251;**	**343**
S. subpubescens var. *intermedia*	Mexico	Roots		**243; 251-253; 255-256; 280-285**	
S. triflora	Venezuela	Aerial		**225-226; 247**	
S. vaga	Argentina	Aerial	**28-31; 51-53; 61; 118-121**		
S. viscida	Mexico	Roots		**237-238**	
S. yaconensis	Bolivia	Aerial; Roots	**11; 103; 130**	**227-231**	**346; 350**
S. yaconensis var. *aristifera*	Argentina	Aerial	**56-58; 137; 185**		
S. yaconensis var. *subeglandulosa*	Argentina	Aerial	**77; 96; 124**		

*For references see Table 11

Table 13 - Incidence of the skeletons of sesquiterpene lactones in *Stevia* (Taxones studied: 60)

Structure	Closed toward	N° of species	N° of compounds
Germacrolides	C-6	16	35
	C-8	2	2
Heliangolides	C-6	7	15
	C-8	1	3
Melampolides	C-6	4	3
cis,cis-germacranolides	C-6	2	2
Guaianolides	C-6	20	70
	C-8	6	20
Pseudoguaianolides	C-8	2	4
Eudesmanolides	C-6	4	8
	C-8	2	9
Eremophilanolides	C-8	2	7
Elemanolides	C-8	3	6
Xanthanolides	C-8	1	1
Onoseriolides	C-8	1	1
Jujuyensolides	C-6	1	2

Table 14 - Incidence of the skeletons of cyclic diterpenes in *Stevia* (Taxones studied: 60)

Structure	N° of species	N° of compounds
trans- Clerodanes	2	3
cis- Clerodanes	1	1
Bisnorditerpenes	1	4
Labdanes	9	22
ent- Labdanes	9	14
Seco *ent*- labdanes	1	2
Kauranes	2	2
ent- Kauranes	12	27
Beyerene derivatives	3	3
Stevisalicinone	1	1

Table 15 - Distribution of the principals secondary metabolites in *Stevia* (Taxones studied: 60)

Compound	N° of species	%
Sesquiterpene Lactones (SL)	34	58
Diterpenes (DT)	26	44
Longipinenes (Long)	22	37
DT + SL	12	20
SL + Long	11	19
DT + Long	11	19
DT + SL + Long	5	8

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