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Review of the genus *Ipomoea*: traditional uses, chemistry and biological activities

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Review

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Abstract: Approximately 600-700 species of *Ipomoea*, Convolvulaceae, are found throughout tropical and subtropical regions of the world. Several of those species have been used as ornamental plants, food, medicines or in religious ritual. The present work reviews the traditional uses, chemistry and biological activities of *Ipomoea* species and illustrates the potential of the genus as a source of therapeutic agents. These species are used in different parts of the world for the treatment of several diseases, such as, diabetes, hypertension, dysentery, constipation, fatigue, arthritis, rheumatism, hydrocephaly, meningitis, kidney ailments and inflammations. Some of these species showed antimicrobial, analgesic, spasmolitic, spasmogenic, hypoglycemic, hypotensive, anticoagulant, anti-inflammatory, psychotomimetic and anticancer activities. Alkaloids, phenolics compounds and glycolipids are the most common biologically active constituents from these plant extracts.

Introduction

The Convolvulaceae comprise nearly 1650 predominantly tropical species. The genus *Ipomoea*, with approximately 500-600 species, comprises the largest number of species within the Convolvulaceae (Austin & Huáman, 1996). This family is dominated by twining or climbing woody or herbaceous plants that often have heart-shaped leaves and funnel-shaped flowers (Austin, 1997). The genus *Ipomoea* occurs in the tropics of the world although some species also reach temperate zones (Cao et al., 2005). The species of this genus are mainly distributed throughout the South and Central America countries, and Tropical Africa territories (Austin & Huáman, 1996). One of the most noticeable anatomical characteristics of the Convolvulaceae is the existence of cells, which secrete resin glycosides in the foliar tissues and in the roots of the plants. These glycoresins constitute one important chemotaxonomic marker of this family (Wagner, 1973) and are responsible for the purgative properties of some species of the Convolvulaceae (Pereda-Miranda & Bah, 2003). The focus of this review is to provide information on the structures and pharmacological activities of compounds isolated and identified from *ipomoea*.

Material and Methods

The pharmacological activities of compounds isolated and identified from *Ipomoea* were searched through SciFinder that is is one search tools. SciFinder retrieves information in databases produced by Chemical Abstracts Service (CAS) as well as the MEDLINE database of the National Library of Medicine. The CAS databases are: CAplusSM (reference database), REGISTRYSM (chemical structure database), CASREACT® (chemical reaction database), CHEMCATS® (commercial source database), and CHEMLIST® (regulatory database). The data were updated in January 2011, using biological activities or chemical constituents and *Ipomoea* as keywords.

Results and Discussion

Traditional uses

The genus *Ipomoea* since time immemorial have been in continuous use for different purposes, such as, nutritional, medicinal, ritual and agricultural. The knowledge constitutes a rich source of ethnomedical information for effective selection of plants to be evaluated by chemical studies (Pereda-Miranda & Bah, 2003). With regard to these nutritional purposes, it is necessary highlight the importance of the *I. batatas* (L.) Lam. This species originated from Central America, was widely cultivated and consumed almost throughout

the world (Zhao et al., 2005; Bovell-Benjamin, 2007). *I. aquática* Forsk is consumed as food in Sri Lanka, Hong Kong, Taiwan e China (Prasad et al., 2005a; Malalavidhane et al., 2000). *I aquatica* is one of the richest sources of carotenoids and chlorophylls (Wills & Azhari, 1996). The leaves of *I. aquatica* contain adequate quantities of most of the essential amino and are comparable to conventional foodstuffs such as soybean or whole egg, indicating the potential of *I. aquatica* for utilisation as a food supplement. Moreover, the leaves of *I. aquatica* are an excellent source of bioelements such as calcium, magnesium, iron, zinc, and copper (Rao et al., 1990). Other species consumed for purposes nutritional are *I. alba* L., *I. albivenia* (Lindl.) Sweet., *I. involucrata* P. Beauv. and *I. leptophylla* Torr.

Several species of the genus *Ipomoea*, as well as, of the Convolvulaceae family have the property of phytotoxicity, which mean suppressing the growth of other plants including invasive weeds. In Mexico, farmers make use of *I. tricolor* Cav. for this purposes (Bah & Pereda-Miranda, 1997).

Due to their content of ergot type alkaloids, several species of *Ipomoea* are used as hallucinogenics. Some of them were used in pre-Columbian times by ancient people to attain a state of mind sutable for divination during religious ceremonies and magical healing practices (Daló & Moussatché, 1978; Taber et al., 1963). Two species of *Ipomoea* are detached in the entheogen use. They are *I. corymbosa* (Rivea corymbosa) and *I. violaceae* L. The seeds these *Ipomoea* were known respectively as "ololiuhqui" and tlitliltzin in Aztecs lingua and they are still used even today by certain natives in Mexico (Halpern, 2004; Daló & Moussatché, 1978). Today, the ritual incorporates many elements from Catholic religion, including the names given to the plants, such as, "Seeds of the Virgin", Holy Mary Herb" and "Virgin's Cloak". Demontrating the syncretism with the Christian traditions and that for natives Ipomoea species are gift from the gods (Pereda-Miranda & Bah, 2003). To the resemblance of the natives in Mexico, still today, in the candomble, the "father of saint" also uses seeds and leaves of *Ipomoea* species, such as, *I. alba, I. pes-caprae* and *I. purpurea* in the preparations that are offered to the adept of the religion, to attain a state of mind sutable for divination in the ceremonial religious (Camargo, 1998).

Various species of *Ipomoea* have been used extensively, in many countries, in the traditional medicine for the treatment of several diseases (Chater 1). The most common use of the roots of *Ipomoea* species is to treat constipation (Pereda-Miranda & Bah, 2003).

Chemistry and biological activities

The phytochemistry of the *Ipomoea* genus has been studied since 1950. Some species of *Ipomoea* showed antimicrobial, analgesic, spasmolitic, spasmogenic, hypotensive, psychotomimetic and anticancer activities. The most common biologically active constituents from these plants (Chart 2) are ergoline alkaloids (**1-12**), indolizidine alkaloids (**13-15**), nortropane alkaloids (**16-19**), phenolics compounds (**20-32**), coumarins (**33-36**) norisoprenoids, diterpene, isocoumarin and benzenoids (**37-43**) flavonoids and antocianosides (**44-56**), glycolipids (**57-102**), lignan (**103**) and triterpenes (**104-110**).

Charter 1. Traditional uses of *Ipomoea* species.

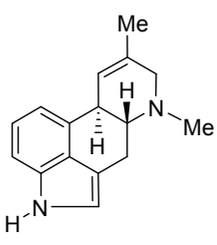
Species	Traditional uses
I. aquatica	Treatment of diabetes (indigenous medicine in Sri Lanka) (Jayaweera, 1982; Malalavidhane et al., 2001). Scorpion venom antidote (Uawonggul, et al., 2006), as emetic, diuretic, purgative, to treating debility, liver complaints, ringworm, leucoderma, leprosy, fever (Ghani, 1989; Mamun, et al., 2003), against nosebleed and high blood pressure (Prasad et al., 2005a).
I. asarifolia	Against itch (Silva, 2002).
I. batatas	Treatment of tumors of the mouth and throat. Leaves decoctions are used as alterative, aphrodisiac, astringent, bactericide, demulcent, fungicide, laxative and tonic. Sweetpotato is used to treating asthma, bugbites, burns, catarrh, ciguatera, convalescence, diarrhea, dyslactea, fever, nausea, renosis, splenosis, stomach distress, tumors, and whitlows (Duke & Wain, 1981). In region of Kagawa, Japan, a variety of white sweet potato has been eaten raw to treating anemia, hypertension and diabetes (Ludvik et al., 2004).
I. cairica	Treatment of rheumatism and inflammations (Ferreira et al., 2006).
I campanulata .	Antidote to snake poison (Singh et al., 2003).
I. carnea	Against Immunodeficiency Syndrome (AIDS) (Thailand) (Woradulayapinij et al., 2005) and to treat hypertension (Gabon) (Lamidi et al., 2000).
I. digitata	The powdered root is used in emaciation of children and also as tonic, alterative, aphrodisiac, demulcent, lactogogue, and cholagogue. Decoctions of root against constipation (Singh et al., 2004).

I. indica	As purgative and healing broken bones (Hawaii) (Abbott & Shimazu, 1985).
I. leptophylla	The smoke of burneed the roots in treatment of nervousness (Native Americans Pawnee) (Gilmore, 1977). The root for stomach distress (Lakota people) and tonic (early European settlers) (Barnes et al., 2003).
I. muricata	To treating several types of skin ailments such as chronic and gangrenous wounds, cuts and blisters due to burns (Philippines). Glycerol preparations of the crude drug of *I. muricata* are used for the treatment of pharyngitis and an otic preparation for the treatment of otitis externa (Ysrael, 2003).
I. murucoides	The smoke from the burned tree is used against mosquitoes (Mexico). Infusions of the leaves, bark and flowers to treat inflamations and against scorpion bites (León et al., 2005).
I. nil	Treatments against cancer (East Asia) (Ko et al., 2004).
I. orizabensis	As purgative (American and European pharmacopeas) (Pereda-Miranda, 1995), anthelmintic and to treat abdominal fever, dysentery, epilepsy, hydrocephaly, meningitis and tumors (Martinez, 1990).
I. pes-caprae	Treatment of inflammatory and algesic processes (Souza et al., 2000). Heated leaves are used to treating wound, skin infections, inflamed sores and stings from poisonous fish, manta-ray and insects (Australian) (Infusions have been recommended for treating hypertension, kidney ailments and decoctions to treat digestive disorders, colic, internal and external pain, dysentery, inflammations, fatigue, strain, arthritis and rheumatism. The roots are used in diuretic disorders and in constipation (Pereda-Miranda et al., 2005; Lorenzi & Abreu Matos, 2002; Diaz, 1976; Martinez, 1989).
I. purga	As purgative (Pereda-Miranda & Bah, 2003).
I. purpurea	Infusions are used as diuretic, to stop hemorrhage (Bolivia), as purgative and to treat syphilis (Africa) (Camargo, 1998).
I. stans	Infusions of the roots have been used for treating epileptic seizures (Mexico), nephrits, ophthalmic diseases and paralysis, as antiespasmodic and sedative agent (Diaz, 1976). As purgative (Pereda-Miranda & Bah, 2003).
I. stolonifera	As diuretic and to treat pain after childbirth, stomach problems, inflamations, furunculosis, swelling and wound (Paula et al., 2003).

Chart 2. Bioactive compounds from the genus *Ipomoea.*

Substances	Species	Activities
Ergoline alkaloids		
Agroclavine (**1**)	*I. fistulosa* *I. mueller* *I. tricolor*	Antimicrobial Cytostatic
hanoclavine I (**2**)	*I. asarifolia* *I. hederacea* *I. muelleri* *I. corymbosa* *I. tricolor* *I. violacea*	Psychotropic Psychotomimetic
elymoclavine (**3**)	*I. hederacea* *I. muelleri* *I. corymbosa* *I. parasitica* *I. violacea*	Psychotropic Psychotomimetic
ergine (LSA) (**4**)	*I. asarifolia* *I. muelleri* *I. corymbosa* *I. tricolor* *I. violacea*	Psychotropic Psychotomimetic
erginine (**5**)	*I. muelleri* *I. corymbosa* *I. tricolor* *I. violacea*	Psychotropic Psychotomimetic
ergocristine (**6**) ergotamine (**7**)	*I. tricolor*	Psychotropic Psychotomimetic

ergometrine or ergonovine (**8**)	*I. muelleri* *I. corymbosa* *I. tricolor* *I. violacea*	Psychotropic Psychotomimetic Vasoconstrictor Hemostatic Uterotonic
ergosinine (**9**)	*I. palmata*	Uterotonic
festuclavine (**10**)	*I. muelleri*	Antimicrobial
lysergol (**11**)	*I. hederacea* *I. muelleri* *I. parasitica* *I. petaloidea* *I. corymbosa* *I. violacea*	Psychotropic Psychotomimetic
penniclavine (**12**)	*I. hederacea* *I. muelleri* *I. corymbosa* *I. violacea*	Psychotropic



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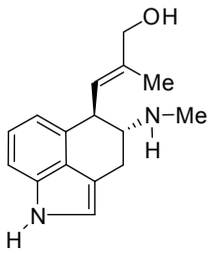

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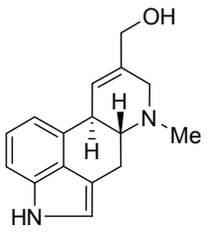

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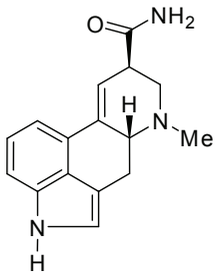

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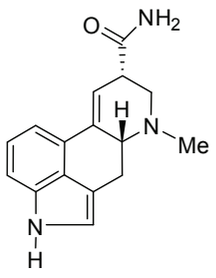

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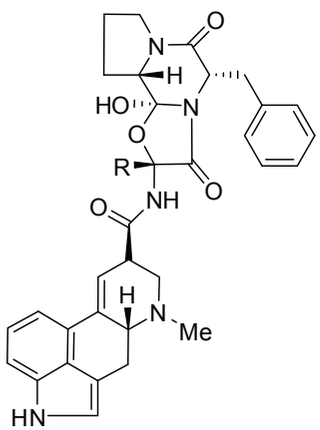
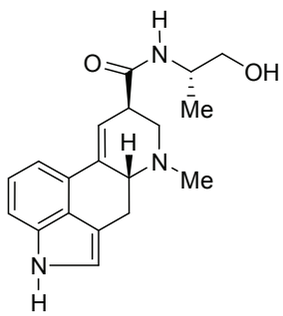


6 R=$CH(Me)_2$
7 R=Me



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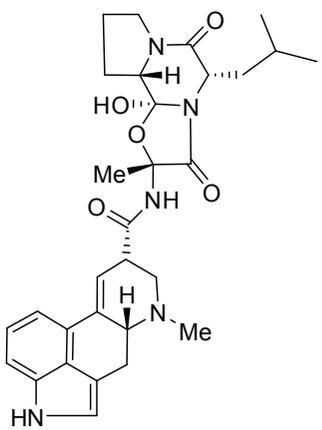

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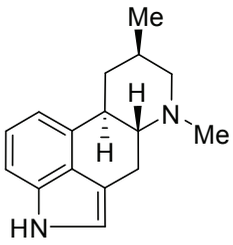

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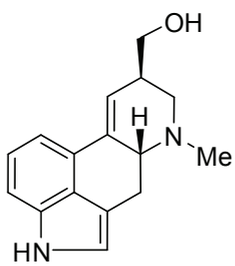

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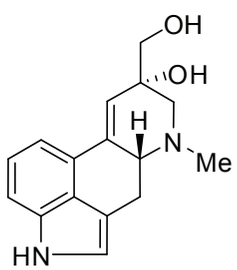

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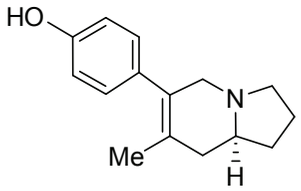
Indolizidine alkaloids		
ipalbidine (**13**)	*I. alba* *I. muricata* *I. hardwickki*	Analgesic Antioxidant
2-*epi*-lentiginosine (**14**)	*I. carnea*	Potent inhibitory activitytoward rat α-mannosidase
swainsonine (**15**)	*I. carnea*	Immunomodulatory Antimetastatic Potent inhibitory activity toward rat α-mannosidase



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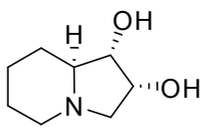

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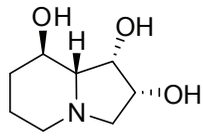

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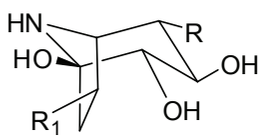
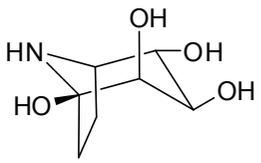
Nortropane alkaloids		
calystegine B1 (**16**) calystegine B2 (**17**) calystegine C1 (**18**)	*I. alba* *I. aquatica* *I. batatas* *I. carnea* *I. hederifolia* *I. eremnobrocha* *I. obscura* *I. pes-caprae* *I. setifera* *I. violacea*	Potent inhibitory activity toward rat lysosomal β-glucosidase.
calystegine B3 (**19**)	*I. alba* *I. aquatica* *I. batatas* *I. carnea* *I. hederifolia* *I. eremnobrocha* *I. obscura* *I. pes-caprae* *I. setifera* *I. violacea*	Moderate inhibitory activity toward rat α- and β-mannosidases
Phenolics compounds		
N-cis-feruloyl tyramine (**20**) 21: *N-trans*-feruloyl tyramine (**21**)	*I. aquatica*	Inhibition of prostaglandin synthesis
cafeic acid (**22**)	*I. batatas* *I. muricata*	Antioxidant Antimutagenic
3-*O*-caffeoyl-quinic acid (clorogenic acid) (**23**)	*I. batatas* *I. fistulosa*	Hypoglycemic, antimutagenic antioxidant and inhibition of HIV replication
3,5-di-*O*-caffeoyl-quinic acid (**24**) (isoclorogenic acid a)	*I. aquatica* *I. batatas* *I. pes-caprae* *I. fistulosa*	Hypoglycemic, antimutagenic antioxidant and inhibition of HIV replication. Antifungal, antispasmodic Collagenase inhibitory

3,4-di-*O*-caffeoyl-quinic acid (**25**) (isoclorogenic acid b)	*I. aquatica* *I. batatas* *I. pes-caprae*	Hypoglycemic, antimutagenic antioxidant and inhibition of HIV replication. Collagenase inhibitory
4,5-di-*O*-caffeoyl-quinic acid (**26**) (isoclorogenic acid c)	*I. aquatica* *I. batatas* *I. pes-caprae* *I. fistulosa*	Hypoglycemic, antimutagenic antioxidant and inhibition of HIV replication. Collagenase inhibitory
3,4,5-tri-*O*-caffeoyl-quinic acid (**27**)	*I. batatas*	Hypoglycemic, antimutagenic Antioxidant and inhibition of HIV replication
3,5-di-*O*-caffeoyl-4-*O*-coumaroyl-quinic acid (**28**) 4,5-di-*O*-caffeoyl-1,3-di-*O*-coumaroyl-quinic acid (**29**) 4,5-di-*O*-caffeoyl-quinic acid methyl ester (**30**) 3,4-di-*O*-caffeoyl-quinic acid methyl ester (**31**) 3,5-di-*O*-caffeoyl-quinic acid methyl ester (**32**)	*I. pes-caprae*	Collagenase inhibitory



16 R=H; R_1=OH
17 R=OH; R_1=H
18 R=R_1=OH



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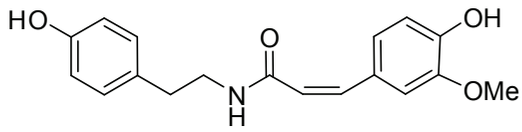

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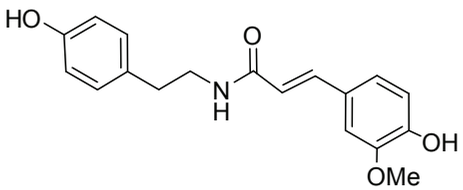

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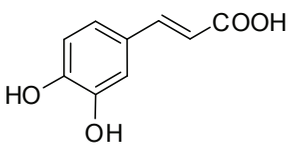

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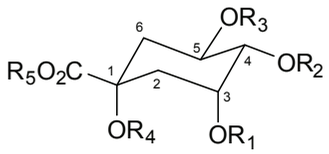
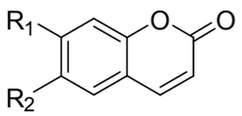


23 R_1=caffeoyl; R_2=R_3=R_4=R_5=H
24 R_1=R_3=caffeoyl; R_2=R_4=R_5=H
25 R_1=R_2=caffeoyl; R_3=R_4=R_5=H
26 R_2=R_3=caffeoyl, R_1=R_4=R_5=H
27 R_1=R_2=R_3=caffeoyl; R_4=R_5=H
28 R_1=R_3=caffeoyl; R_2=coumaroyl; R_4=R_5=H
29 R_1=R_4=coumaroyl; R_2=R_3=caffeoyl; R_5=H
30 R_1=R_4=H; R_2=R_3=caffeoyl; R_5=Me
31 R_1=R_2=caffeoyl; R_3=R_4=H; R_5=Me
32 R_1=R_3=caffeoyl; R_2=R_4=H; R_5=Me

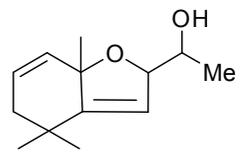
Coumarins		
coumarin (**33**)	*I. turpethum*	Cytotoxic, immunostimulant and antiedema
scopoletin (**34**)	*I. batatas* *I. cairica* *I. digitata* *I stans* *I. turpethum*	Hepatoprotective Spasmolytic Inhibition of prostate cancer proliferation Acetylcholinesterase inhibitory Antioxidant Anticoagulant Anti-HIV
esculetin (**35**)	*I. batatas*	Antioxidant Anticoagulant Anti-HIV
umbelliferon (**36**)	*I. batatas* *I. cairica* *I. digitata*	Anticoagulant Anti-HIV



33 $R_1=R_2=H$
34 $R_1=OH$; $R_2=OMe$
35 $R_1=R_2=OH$
36 $R_1=OH$; $R_2=H$

Norisoprenoids, diterpene, isocoumarin and benzenoids		
actinidol (**37**)	*I. pes-caprae*	Inhibition of ethyl phenylpropiolate-induced rat ear oedema
trans-β-damascenone (**38**) E-phytol (**39**)	*I. pes-caprae*	Antispasmodic activity
3,4-dihydro-8-hydroxi-3-methylisocoumarin (**40**) eugenol (**41**) 4,4,7-trimethyl-1,4-dihydro-2-hydroxy-1-naftalenone (**42**) 4-vinyl-guaiacol (**43**)	*I. pes-caprae*	Inhibition of prostaglandin synthesis
Flavonoids and antocianosides		
3α,7β-*O*-D-diglycopyranosyl-dihydroquercetin (**44**)	*I. aquatica*	Antioxidant; cytotoxic, *in vitro.*
peonidin (**45**)	*I. batatas*	Antioxidant
3-*O*-(2-*O*-(6-*O*-*E*-caffeoyl-β-D-glycopyranosyl))-(6-*O*-*E*-caffeoyl)-β-D-glycopyranosyl)-5-*O*-β-D-glycopyranoside-cianidin (**46**)	*I. asarifolia* *I. batatas* *I. purpurea*	Antioxidant
3-*O*-Sophoroside-5-*O*-glycosil-cianidin (**47**)	*I. batatas*	Antimutagenic
3-*O*-(6-*O*-*trans*-caffeoyl-2-*O*-β-glycopyranosyl-β-glycopyranoside)-5-*O*-β-glycoside-cianidin (**48**) 3-*O*-(6-*O*-*trans*-caffeoyl-2-*O* -β -glycopyranosyl-β-glycopyranoside)-5-*O*-β-glucoside-peonidin (**49**)	*I. batatas*	Antioxidant

3-*O*-(2-*O*-(6-*O*-*p*-hydroxybenzoil-β-D-glucopyranosyl))-(6-*O*-*E*-caffeoyl)-β-D-glucopyranosyl)-5-*O*-β-D-glycopyranoside-cianidin (**50**)	*I. batatas*	Antioxidant
3-*O*-(2-*O*-(6-*O*-*E*-feruloyl-β-D-glycopyranosyl))-(6-*O*-*E*-caffeoyl)-β-*D*-glycopyranosyl)-5-*O*-β-D-glycopyranoside-cianidin (**51**)	*I. batatas*	Antioxidant Antimutagenic
3-*O*-(2-*O*-(6-*O*-*E*-caffeoyl-β-D-glycopyranosyl))-(6-*O*-*E*-caffeoyl)-β-D-glycopyranosyl)-5-*O*-β-D-glycopyranoside-peonidin (**52**) 3-*O*-(2-*O*-(6-*O*-p-hydroxybenzoil-β-D-glycopyranosyl))-(6-*O*-*E*-caffeoyl)-β-D-glycopyranosyl)-5-*O*-β-D-glycopyranoside-peonidin (**53**)	*I. batatas*	Antioxidant
3-*O*-(2-*O*-(6-*O*-*E*-feruloyl-β-D-glycopyranosyl))-(6-*O*-*E*-caffeoyl)-β-D-glycopyranosyl)-5-*O*-β-D-glycopyranoside-peonidin (**54**)	*I. batatas*	Antioxidant Antimutagenic Anti- hyperglycemic
3-*O*-β-D-glycofuranosyl quercetin (**55**)	*I. pes-caprae*	Antinociceptive
heavenly blue anthocyanin (**56**)	*I. tricolor* *I. nil*	Protection against UV-B radiation



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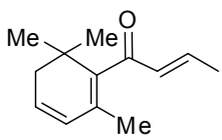

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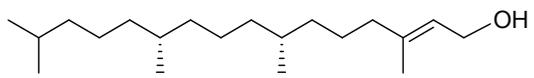

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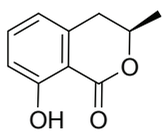

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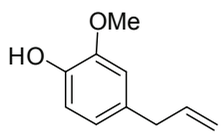

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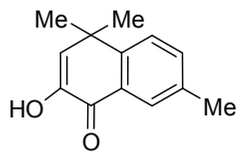

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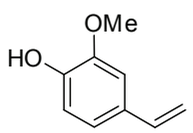

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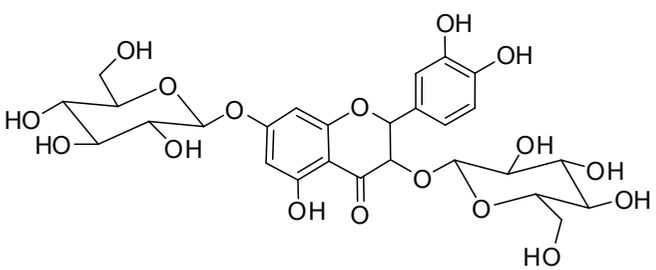

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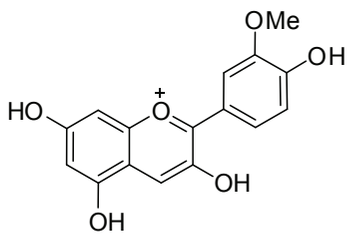

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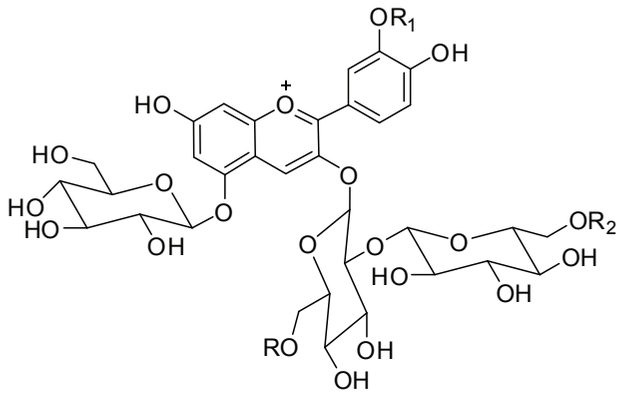
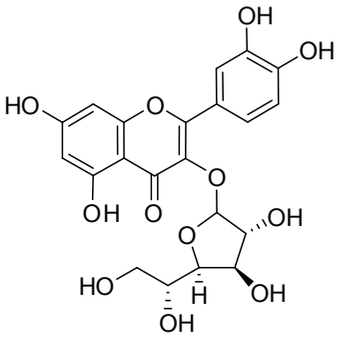
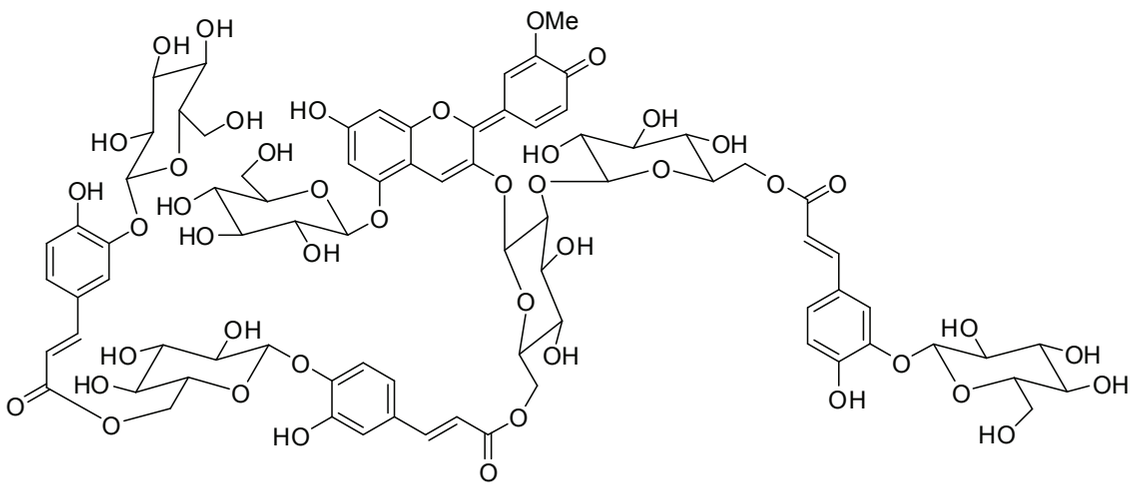




55

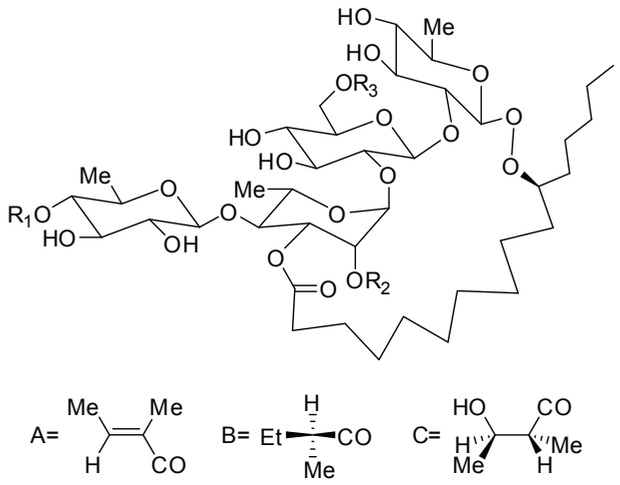
46 R=R_2=caffeoyl; R_1=H
47 R=R_1=R_2=H
48 R=caffeoyl; R_1=R_2=H
49 R=caffeoyl; R_1=Me; R_2=H
50 R=caffeoyl; R_1=H; R_2=*p*-hydroxy-benzoyl
51 R=R_2=caffeoyl; R_1=Me
52 R=caffeoyl; R_1=H; R_2=*p*-hydroxy-benzoyl
53 R=caffeoyl; R_1=Me; R_2=*p*-hydroxy-benzoyl
54 R=caffeoyl; R_1=Me; R_2=feruloyl



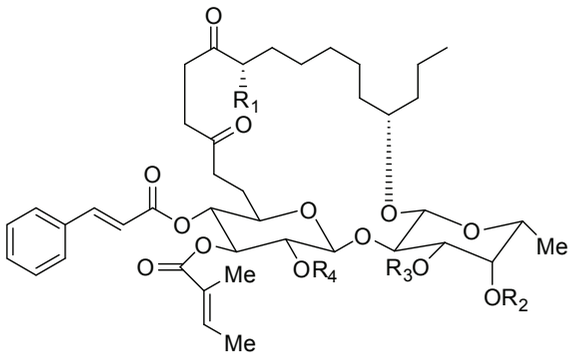
56

Glycolipids		
scammonine I (**57**)	*I. orizabensis*	Weak cytotoxicity against oral human epidermal carcinoma. Against methicillin-resistant staphylococcal
scammonine II (**58**)	*I. orizabensis*	Weak cytotoxicity against oral human epidermal carcinoma,
ipomoeassins A-E (**59-63**)	*I. squamosa*	Cytotoxic against ovarian carcinoma
murucin 1 (**64**)	*I. murucoides*	Cytotoxic against ovarian carcinoma
orizabins I-IV (**65-68**)	*I. orizabensis*	Laxative
orizabins V-VII (**69-7**1)	*I. orizabensis*	Weak cytotoxicity against oral human epidermal carcinoma

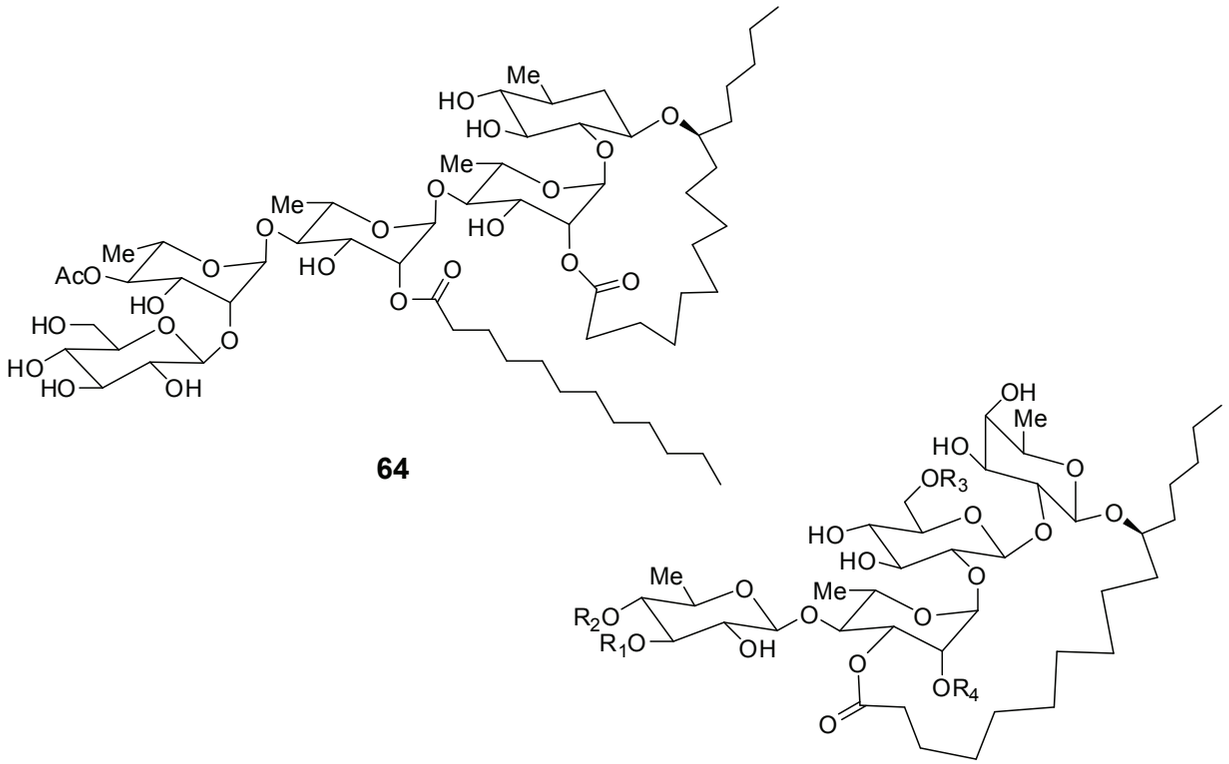
orizabins IX-XXI (**72-84**)	*I. orizabensis*	Cytotoxicity against oral epidermoid carcinoma but weak cytotoxicity against colon carcinoma, squamoux cell cervix carcinoma and ovarium cancer
orizabin VIII (**85**)	*I. orizabensis*	Weak cytotoxicity against colon carcinoma.
pescaproside A (**86**) pescapreins I-IV (**87-90**)	*I. pes-caprae*	Weak cytotoxicity against nasopharyngeal, colon, squamous cell cervical and ovarian carcinomas
simonin IV (**91**)	*I. batatas*	Fitotoxicity
stansin 5 (**92**)	*I. stans*	Cytotoxicity against cervical and ovarian carcinomas
tricolorin A (**93**)	*I. tricolor*	Fitotoxicity; Cytotoxic against breast carcinoma; Cytotoxicity against oral epidermoid carcinoma and weak cytotoxicity against colon, cervical and ovarian carcinomas Antibacteriana against *Staphylococcus aureus*
tricolorin B (**94**)	*I. tricolor*	Cytotoxicity against oral epidermoid carcinoma and weak cytotoxicity against colon, cervical and ovarian carcinomas. Antibacteriana against *Staphylococcus aureus*.
tricolorins C e E (**95, 96**) tricolorins D, F-J (**97-102**)	*I. tricolor*	Cytotoxicity against oral epidermoid carcinoma and weak cytotoxicity against colon, cervical and ovarian carcinomas.



57 R_1= A; R_2=B; R_3=H
58 R_1=H; R_2=B; R_3=H

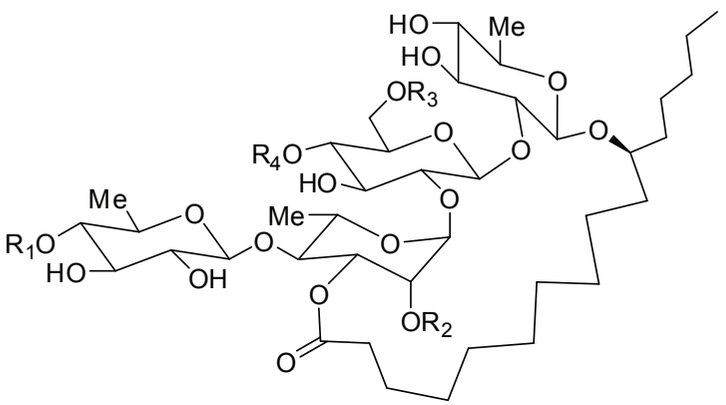


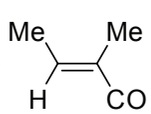
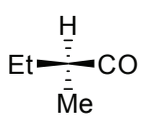
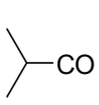
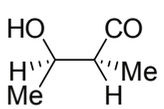
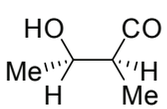
59 R_1=R_3=R_4=H; R_2=Ac
60 R_1=R_2=R_3=R_4=H
61 R_1=OH; R_2=Ac; R_3=R_4=H
62 R_1=OAc; R_2=Ac; R_3=R_4=H
63 R_1=OAc; R_2=R_3=R_4=H



64

65 R_1=H; R_2=α-methyl-butanoyl; R_3=2-methyl-3-hydroxy-butanoyl; R_4=tigloyl
66 R_1=H; R_2=isobutanoyl; R_3=2-methyl-3-hydroxy-butanoyl; R_4=tigloyl
67 R_1=H; R_2=R_3=2-methyl-3-hydroxy-butanoyl; R_4=tigloyl
68 R_1=isobutanoyl; R_2=H; R_3=2-methyl-3-hydroxy-butanoyl; R_4=tigloyl



A = 
B = 
C = 
D = 
E = 

69 R_1=D; R_2=B; R_3=R_4=H
70 R_1=R_4=H; R_2=D; R_3=B
71 R_1=R_4=H; R_2=B; R_3=D
72 R_1=A; R_2=B; R_3=H; R_4=D
73 R_1=A; R_2=D; R_3=C; R_4=H
74 R_1=A; R_2=E; R_3=C; R_4=H
75 R_1=A; R_2=C; R_3=D; R_4=H
76 R_1=A; R_2=C; R3=E; R4=H
77 R1=A; R2=D; R_3=B; R_4=H
78 R_1=A; R_2=E; R_3=B; R_4=H
79 R_1=A; R_2=B; R_3=D; R_4=H
80 R_1=A; R_2=B; R_3=E; R_4=H
81 R_1=B; R_2=D; R_3=B; R_4=H
82 R_1=B; R_2=E; R_3=B; R_4=H
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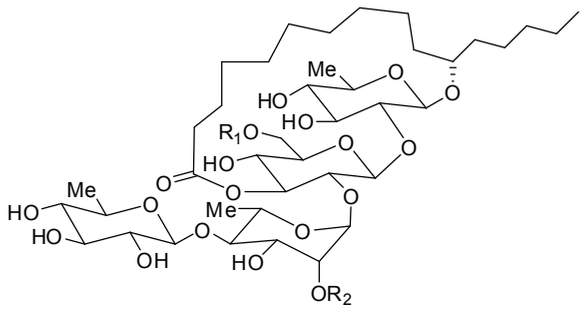
84 R_1=B; R_2=B; R_3=E; R_4=H



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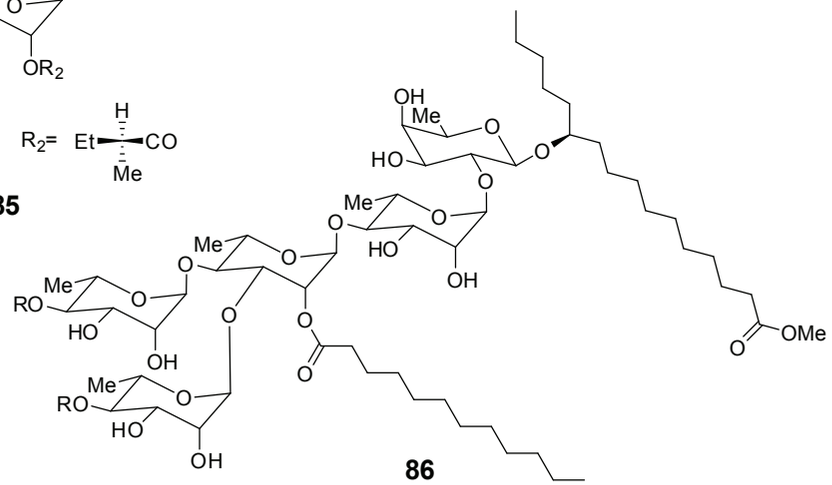

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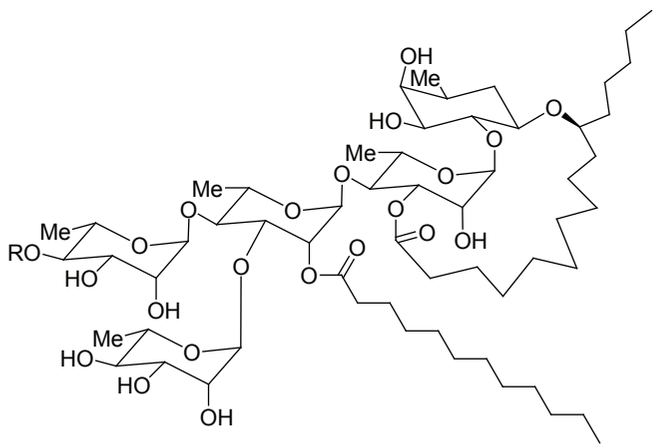
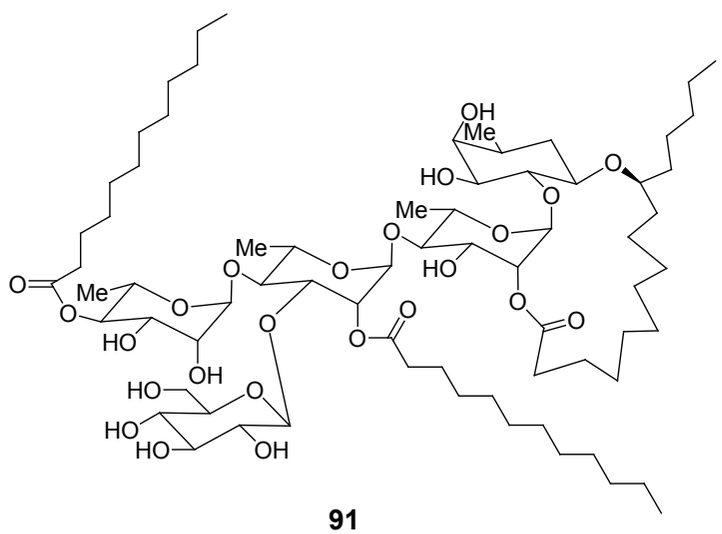


87 R=H
88 R=2-methyl-propanoyl
89 R=(2*S*)-methyl-butanoyl
90 R=*n*-hexanoyl



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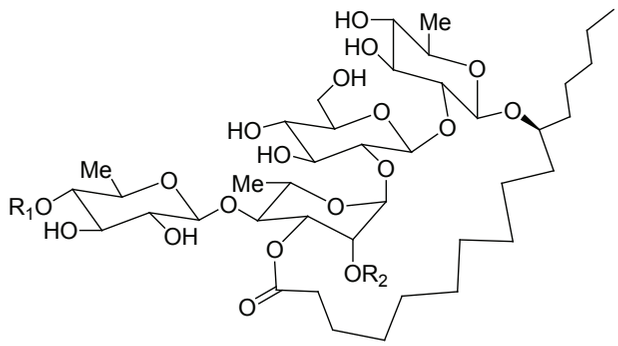
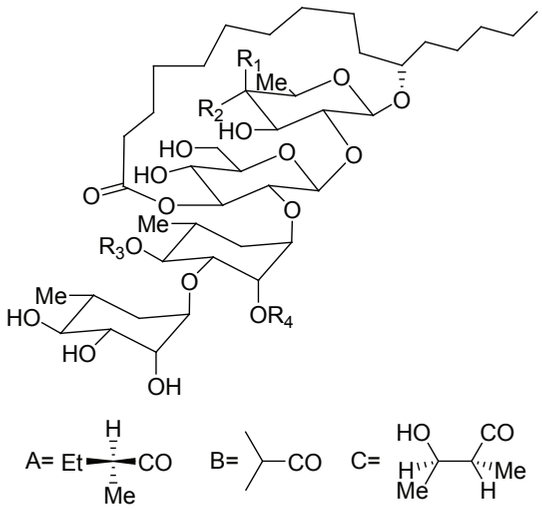
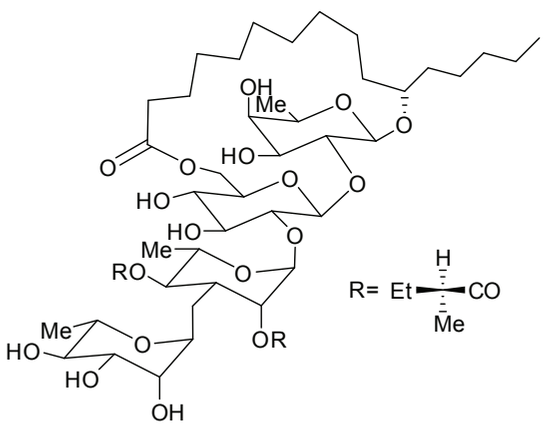


92 R_1=R_2=2-methyl-butanoyl



93 R_1=OH; R_2=H; R_3=R_4=A
94 R_1=OH; R_2=H; R_3=B; R_4=A
95 R_1=OH; R_2=H; R_3=C; R_4=A
96 R_1=H; R_2=OH; R_3=R_4=A



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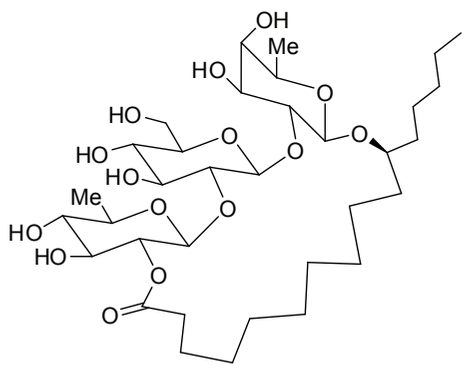

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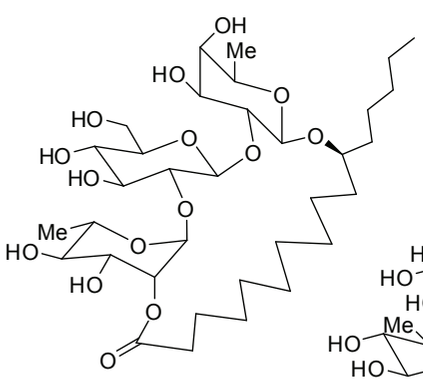

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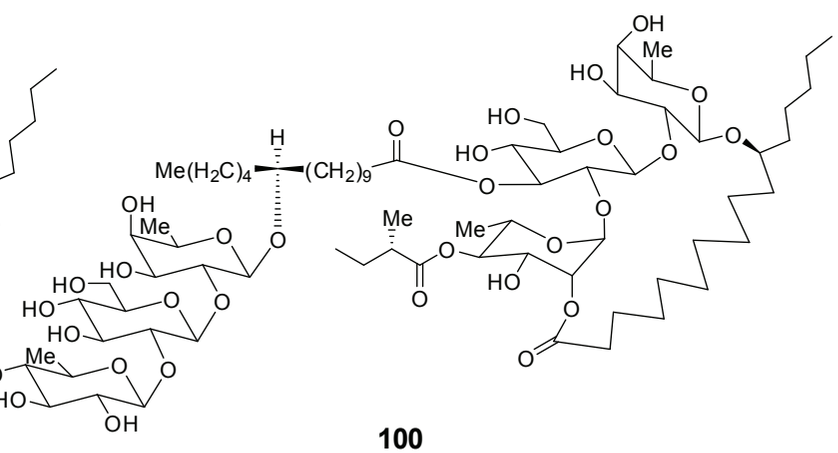

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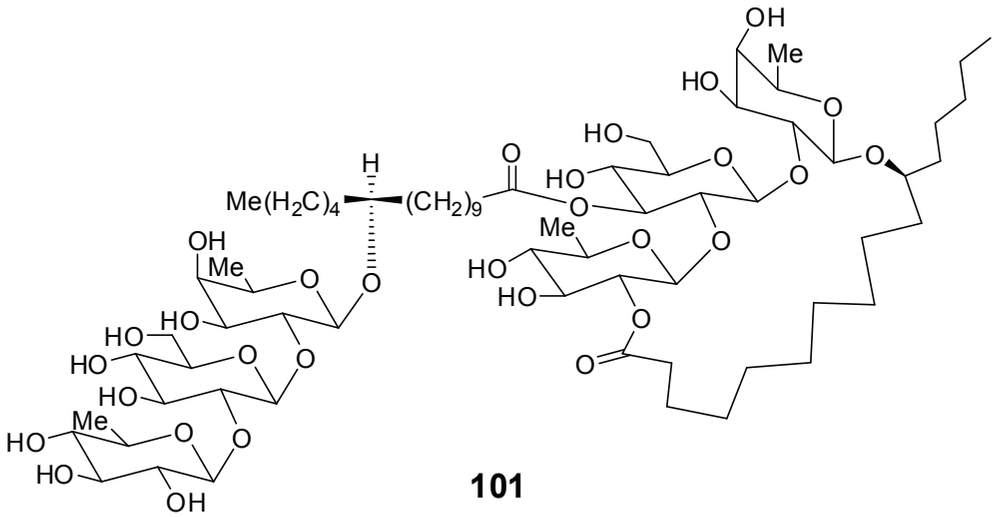

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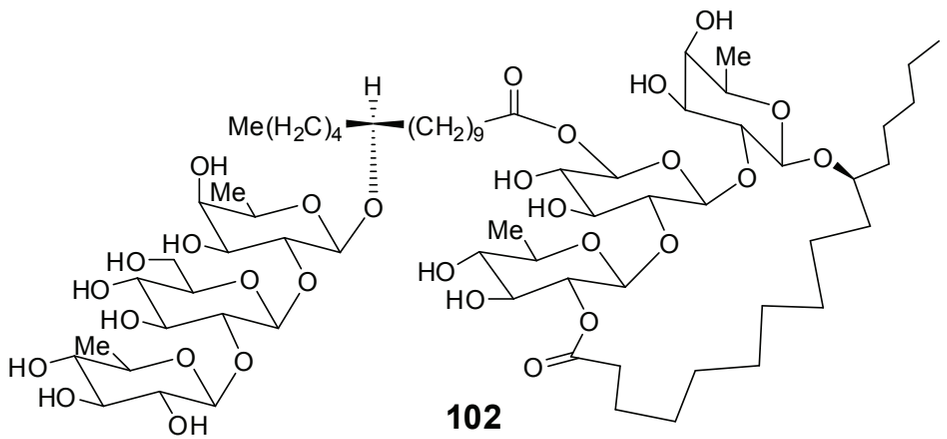
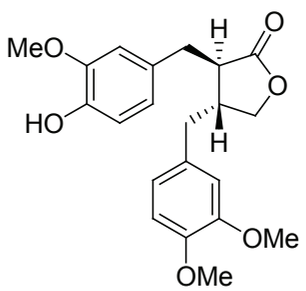


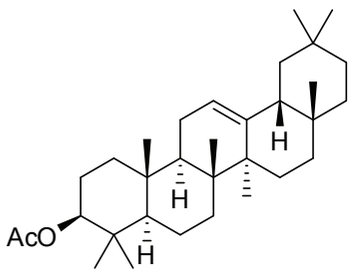
102

Lignan		
arctigenin (**103**)	*I. cairica*	Antioxidant, anti-inflammatory and inhibition of HIV replication



103

Triterpene		
β-amirin acetate (**104**)	*I. batatas* *I. pes-caprae*	Antinociceptive
α-amirin acetate (**105**)	*I. pes-caprae*	Antinociceptive
boehmeryl acetate (**106**)	*I. batatas*	Ovopositional stimulant for *Cylas formicarius elegantulus*
betulinic acid (**107**) glochidone (**108**)	*I. pes-caprae*	Antinociceptive
friedelin (**109**)	*I. batatas*	Antibacteriana against *Staphylococcus aureus* and antifungal against *Pseudallescheria boydii*
taraxerol (**110**)	*I. digitata*	Acetylcholinesterase inhibitory



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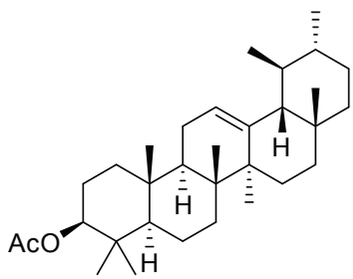

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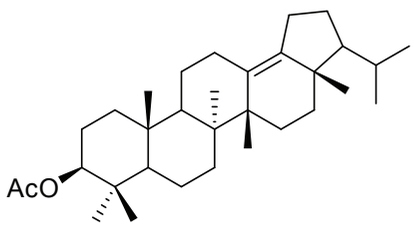

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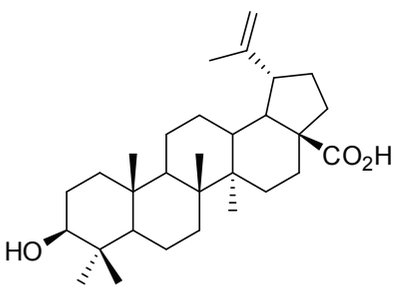

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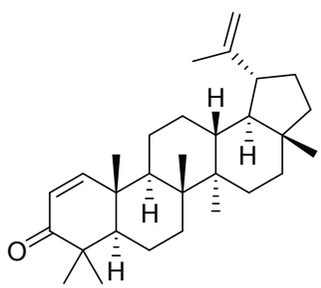

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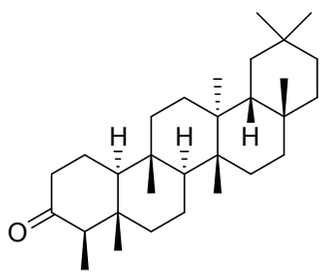

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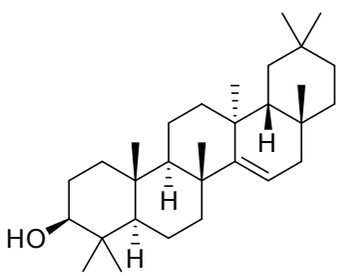

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I. alba L.

Indolizidine alkaloids were isolated from the seeds of *I. alba*: ipalbine ipalbidine, isoipomine, ipalbidinium, *E*-ipomine, *Z*-ipomine, methoxyipomine, dimethoxyipomine and ipohardine (Ikhiri et al., 1987; Gourley et al., 1969). Ipalbidine (**13**) demonstrated non-addictive analgesic properties (Honda et al., 2003; Wang & Chu, 1996). Moreover it showed inhibitory effects on respiratory burst of leukocytes and scavenged oxygen-free radicals (Chen & Chu, 1998). Calystegines A5, B1 and B2 were isolated from the herbal material and roots of this plant (Schimming et al., 1998; 2005a). Calystegines B1 and B2 (**16** and **17**) are known to be potent inhibitors of rat lysosomal β-glucosidase (Haraguchi et al., 2003).

I. aquatica Forssk.

Calystegines B1 e B2 (**16** and **17**) beyond B4 were also found in *I. aquatica* (Schimming et al., 1998; 2005a). *N-cis*-Feruloyltyramine and *N-trans*-feruloyltyramine (20 and 21) isolated from roots of *I. aquatica* are inhibitors of prostaglandin synthesis (Tseng et al., 1986; 1992). An aqueous extract of *I. aquatica* showed as effective as the oral hypoglycaemic drug tolbutamide in reducing the blood sugar levels in rats (Malalavidhane et al., 2000; 2001). Isochlorogenic acids a, b and c (**24-26**) isolated of this species showed inhibitory activity of disaccharide-degrading enzyme. This research opens the possibility for the use of these substances as a food additive and a remedy for the prevention and treatment of diabetes and obesity (Okudaira et al., 2005). Isochlorogenic acids *a, b* and *c* (**24-26**) are also found in other species of *Ipomoea*, such as *I. batatas* and *I. pes-caprae* and exhibited colagenase inhibitory and were almost nocytotoxic (Teramachi et al., 2005), beyond to showed radical scavenging activities (Islam et al., 2003) and inhibition of HIV infection (Mahmood et al., 1993; Islam et al., 2002a). Isochlorogenic acids a (**24**) presents still antifungal activity (Stange et al., 2001) and significant anti-spasmodic activity (Trute et al., 1997).

Some studies showed the medicinal effects of this plant on liver diseases, eye diseases, and constipation (Malalavidhane et al., 2000). *I. aquatica* was screened for its activity against fibroblast cell lysis after *Heterometrus laoticus* scorpion venom treatment. However, the result was clearly negative (Uawonggul et al., 2006). Diuretic activity has been observed in extract of *I. aquatica* when investigated in the Swiss albino mice. This study supports the popular use of this plant as diuretic (Mamun et al., 2003).

The crude methanolic extract of *I. aquatica*, as well as, its column fraction and the purified compound 7-*O*-β-D-glucopiranosil-dihidroquercetina-3-*O*-β-D-glucopiranosideo (**44**) isolated from it, were investigated for cytotoxic properties against normal and cancer cell lines, Vero (normal African green monkey kidney) and Hep-2 (human larynx epithelial carcinoma) cell and A-549 (human small cell lung carcinoma). The purified compound showed cytotoxicity towards cell cultures with CTC50 values of 387 mg/mL against normal Vero cell line, where as 156 and 394 mg/mL, against Hep-2 and A-549 cell lines respectively.

The crude methanolic extract of *I. aquatica* and its column fraction gave CTC50 values ranging from 41-332 mg/mL in Vero, 46 - 114 mg/mL in Hep-2 and 44 - 230 mg/mL in A-549 cell lines. The crude extract was more potent than that purified compound probably due to the combination of anthocyanins and other phenolic compounds (Prasad et al., 2005a,b).

I. asarifolia (Desr.) Roem. & Schult.

Four acylated anthocyanins were isolated of *I. asarifolia* (Pale et al., 1998; 2003). This species contain ergoline alkaloids such as chanoclavine I (2), ergine (4), ergobalansinine and lysergic acid α-hydroxyethylamide (Jenett-Siems et al., 2004). Chanoclacine I (**2**) is a psychotomimetic agent and ergine (**4**) presents hallucinogenic and psychotomimetic effects. *I. asarifolia* is a toxic plant in Northeastern Brazil affecting goats, sheep and cattle. The clinical signs of tremorgenic sydrome caused by this plans include depression, tremors of the head, incoordinated gait, and hypermetria (Medeiros et al., 2003).

Ipomoea batatas (L.) Lam.

Recent study showed that white-skinned sweet potato (WSSP) called Caiapo presents active ingredients that can prevent and improve symptoms of diabetes and hypoglycemia as well as, stimulate the imune response, such as phagocytosis and phagosome-lysosome and have antiinflammatory effects (Miyazaki et al., 2005). Study in normal rats as well as in streptozotocin induced insulin-deficient diabetic rats showed that WSSP have hipoglycemic activity and it increases blood insulin levels. WSSP suppressed the increase in blood glucose concentrations after glucose loading in normal rats and diabetic rats (Kusano et al., 1998; 2001; Kusano & Abe, 2000). The antidiabetic component was located almost exclusively in the cortex of WSSP and is a high-molecular weight compound (22000) presumed to be an acidic glycoprotein because it contained protein and sugar (Kusano & Abe, 2000). The study to investigate the tolerability, efficacy and mode of action of Caiapo extract on metabolic control in type 2 diabetic patients confirmed

the beneficial effects of Caiapo on plasma glucose as well as cholesterol levels (Ludvik et al., 2002; 2003; 2004). The polysaccharide PSPP (purified sweet potato polysaccharide) isolated from the roots of *I. batatas* improve the immune system when tested in rats and could be regarded as a biological response modifier (Zhao et al., 2005).

Other study confirmed than the extract from baked sweet potato showed potential cancer-preventing effects. Two fractions results of chromatography showed strong radical scavenging effects on DPPH radical coinciding with the high content of total phenolic compounds of them. These fractions suppressed strongly the proliferation of human promyelocytic leukemia cells (HL-60) with apoptosis inductions in a dependent manner. Besides, both of these fractions present antitumoral activity, when tested in mouse epidermal cell line (JB6) blocked the known tumor promoter called TPA (12-*O*-tetradecanoylphorbol-13-acetate) (Rabah et al., 2004). Extract of *I. batatas* caused marked dose-dependent growth inhibition in several human colon carcinoma cell lines with IC50 values in the range of 20-50 μg/mL for HCT 116, SW480, HT29 and SW837 cell lines. However, the IC50 value was more than 100 μg/mL when CaCo2 cells were tested (Kaneshiro, et al., 2005).

An indole-type alkaloid called Ipomine A was isolated of the hairy roots of *I. batatas* (Yuan et al., 2004). Calystegines B1 and B2 (**16** and **17**) that are potent inhibitors of rat lysosomal β-glucosidase (Haraguchi et al., 2003) besides A3, B3 and the alkaloid 2α, 7β-dihidroxinortropano were identified in the roots of *I. batatas* (Schimming et al., 1998, 2005a).

Study in rats has shown that *I. batatas* leave are a good source of polyphenols, antioxidants and displayed vascular relaxing properties. These effects have been reported to reduce the risk of cardiovascular disease (Runnie et al., 2004). From *I. batatas* leaves were isolated the isochlorogenic acids a, b and c (**24-26**), also found in *I. aquatica* and *I. pes-caprae*, whose biological activities already were described. Chlorogenic acid (**23**) and 3,4,5-tri-*O*-caffeoylquinic acid (**27**) were also found in *I. batatas*. These compounds are also inhibitors of HIV replication (Mahmood et al., 1993) and present hypoglycaemic (Okudaira et al., 2005), radical scavenging (Islam et al., 2003) and antimutagenic (Yoshimoto et al., 2002) activities. Chlorogenic acids were not detected in the root. The stem also contained three feruloylquinic acids and small amounts of at least four caffeoyl-feruloylquinic acids (Zheng & Clifford, 2008).

The roots of *I. batatas* contain the coumarins aesculetin (**35**) (Minamikawa et al., 1962), scopoletin (**34**) and umbelliferone (**36**) which have anti-coagulation properties and inhibit HIV replication (Cambie & Ferguson, 2003). Scopoletin (**34**) presents also hepatoprotective (Kang et al., 1998), antioxidant (Shaw et al., 2003), spasmolytic (Oliveira et al., 2001) and acetylcholinesterase (AchE) inhibitory (Lee et al., 2004) activities, as well as, inhibited proliferation by inducing apoptosis of human adrogen-independent protate adenocarcinoma cells (PC3) (Liu et al., 2001). Scopoletin (**34**) is a member of the phytoalexins of *I. batatas* (Lima & Braz-Filho, 1997).

Vitamin C, caffeic acid and flavonoids, such as, rutin, quercetin (Guan et al., 2006), tiliroside, astragalin, rhamnocitrin, rhamnetin and kaempferol (Luo & Kong, 2005), cyanidins and peonidins (**45-54**) (Islam et al., 2002b; 2003; Terahara et al. 1999; Yang & Tsai, 1999; Lee et al., 1997; Goda et al., 1997; Odake et al., 1992; Tsukui et al., 1983) are also found in this species. The anthocyanins were stronger activity than ascorbic acid in the test *in vitro* DPPH radical-scavenging activity. Besides, these anthocyanins showed also antioxidative activity *in vivo* (Kano et al., 2005). Anthocyanidins occur, in general, in the periderm cell walls of the storage roots (Philpott et al., 2009).

The water extract from the roots of purple sweet potato Ayamurasaki variety inhibited strongly the mutagenicity of *Salmonella typhimurium*. However, an anthocyanin-deficient mutant of Ayamusasaki inhibited weakly the mutagenicity, suggesting that the anthocyanins pigments, which are abundant in the normal Ayamurasaki, decrease the mutagenic activity of the mutagens (Yoshimoto et al., 1999). The antimutagenicity of the anthocyanins isolated of sweet potatos with purple-colored flesh was also investigated using *Salmonella typhimurium*. A comparation of the results showed that the cyanidin-type anthocyanin was superior to the peonidin-type in ts antimutagenicity (Yoshimoto et al., 2001).

Other study showed that the diacylated anthocyanins such as the peonidin 3-*O*-(2-*O*-(6-*O*-*E*-feruloyl-β-D-glucopyranosyl)-6-*O*-*E*-caffeoyl-β-D-glucopyranoside)-5-O-β-D-glucopyranoside (**54**) isolated of the roots and leaves of *I. batatas* present postprandial anti-hyperglycemic effect when tested in rats through the retardation of maltase activity (Matsui et al., 2002).

Bioactive triterpenes were also found in *I. batatas*, such as, boehmeryl acetate (**106**) that age as an ovipositional stimulant for the sweet potato weevil, *Cylas formicarius elegantulus* Summers (Son et al., 1990), friedelin (**109**), that demonstrated good activity against *S. Aureus* compared with ampicillin and amoxicillin, and good antifungal activity against *Pseudallescheria boydii* (Kilham, 2004; Tan et al., 1995) and β-amyrin acetate (104) that showed pronounced antinociceptive properties in the writhing test and formalin test in mice (Tan et al., 1995; Krogh et al., 1999).

The $CHCl_3$ extract from the roots of *I. batatas* presented significant phytotoxicity and the active constituents isolated were a serie of resin glycosides

called simonins I-V (Baek et al., 1997; Noda et al., 1992). The major constituent simonin IV (**91**) presented phytotoxicity when tested pure (Pereda-Miranda & Bah, 2003). The extract of sweet potato exhibits still hepato-protective (Suda et al., 1997), antiinflamatory, antimicrobial, antihypertensive activities and has ultraviolet protection effects (Yoshimoto, 2001).

The roots of *I. batatas* when molded (infected with *Fusarium solani*) are toxics. Animals consuming molded sweet potatoes produce a characteristic and often lethal respiratory disease. Tests *in vitro* with the major constituents, called 4-ipomeanol (1-(3-fury1)-4-hydroxypentanone) (Boyd & Wilson, 1972) showed that this compound presents citotoxic activity (Krauss & Unterreitmeier, 2005). From the tubers of *Ipomoea batatas* were isolated nine new lipo-oligosaccharides, batatosides H–P. Of these, only batatosides L and O showed a weak inhibitory effect on the growth of Hep-2 cells, while the others proved to be inactive (Yin et al., 2009). From the tuber of *Ipomoea batatas* were also isolated two saponines. Their antioxidants activities tested by DPPH and FRAP assay were moderate in relation to commercial standards (Dini et al., 2009). Tuberous roots of *Ipomoea batatas* contain a large amount of storage protein being sporamin the major. The principal function of the storage proteins is nutritional resource for seed germination or tuber regrowth. Recent study showed that exist a linear relationship between trypsin inhibitor activity (Ti activity) and amounts of sporamin B (Sun et al., 2009).

Ipomoea bahiensis Willd. ex Roem. & Schult.

Four antimicrobial glycosides have been isolated from *Ipomoea bahiensis*. One of these compounds revealed significant activity against Sarcoma 180 in mice (Bieber et al., 1986).

Ipomoea cairica (L.) Sweet (Syn. *I. palmata* Forssk.)

Aqueous extract from *I. cairica* showed anti-RSV (respiratory syncytial virus) activity *in vitro* (Ma et al., 2002). The ethanolic extract of this plant presents an antinociceptive effect (Ferreira et al., 2006). The major constituents of the extract were the coumarins scopoletin (**34**) and umbelliferone (**36**) and the lignans, arctigenin, matairesinol and trachelogenin (Lima & Braz-Filho, 1997). Arctigenin (**103**) was the most cytotoxic and presents also antioxidant and antiinflammatory activities (Cho et al., 2004), as well as, inhibited the replication of human immunodeficiency virus (Eich et al., 1996). The essential oil of *I. cairica* possesses remarkable larvicidal properties. It could induce 100% mortality in the larvae of *Culex tritaeniorhynchus* (100 ppm), *Aedes aegypti* (120 ppm), *Anopheles stephensi* (120 ppm) and *Culex quinquefasciatus* (170 ppm) (Thomas et al., 2004). Indole alkaloids were isolated from the leaves of this specie (Sharda & Kokate 1979).

Ipomoea carnea Jacq. subsp. *fistulosa* (Mart. ex. Choisy) D.F. Austin (syn. *I. fistulosa* Mart. ex Choisy).

Pharmacological studies, conducted on rats, with the non-alkaloidal and non-saponifiable fraction isolated from the leaves of *I. carnea* showed the depressant activity of this species on the Central Nervous System (Ehattacharya & Ray, 1975).

In study for screening the HIV-1 RT inhibitory potential of medicinal plant, at a concentration of 200 µg/mL, crude water extracts of *I. carnea* subsp. *fistulosa* (aerial parts), proved to be strongly active with 98,95% of inhibition (Woradulayapinij et al., 2005). Other study for evaluation of immunomodulatory activity of this species on peritoneal cells of rats suggest that low dosages of *I. carnea* induced enhanced phagocytosis activity and hydrogen peroxide production by macrophages (Hueza et al., 2003a). The extract of *I. carnea* subsp. *fistulosa* presents antiinflammatory activity when tested in rats (Gorzalczany et al., 1996). The extract from the leaves of this species was tested *in vitro* against the adenocarcinoma de colon (L-HT29C) and human lymphocyte (L-THP) and presented no cytotoxicity (Lamidi et al., 2000).

Polyhydroxylated alkaloids were isolated from flowers, leaves and seeds of *I. carnea* subsp. fistulosa and characterized as 2-*epi*-lentiginosine (**14**), swainsonine (**15**), calystegines B1 (**16**), B2 (**17**), C1 (**18**) and B3 (**19**) and *N*-methyl-*trans*-4-hydroxy-L-proline (Haraguchi et al., 2003). When tested in rats, the calystegines B1 (**16**), B2 (**17**) and C1 (**18**) were potent inhibitors of lysosomal β-glucosidase and calystegine B3 (**19**) showed a moderate inhibitory activity toward α and β-lysosomal mannosidases. The compounds 2-*epi*-lentiginosine (**14**) and swainsonine (**15**) showed a potent inhibitory activity toward rat lysosomal α-mannosidase. The inibitions of this enzimes result in lysosomal accumulation of undegraded oligosaccharides, vacuolation and cell death (Haraguchi et al., 2003; Ikeda et al., 2003). From leaves of this specie were isolated agroclavin (**1**) and dihydrolysergol (Umar et al., 1980).

I. carnea e *I. carnea* subsp. *fistulosa* cause serious intoxication of livestock. The animals, such as cattle, sheep, and goats (Górniak et al., 2010) presents intoxication clinically characterized by inappetence, soft feces, and weight loss, disorders of behaviors and consciousness, incoordinated gait, head shaking and death (Haraguchi et al., 2003; Daló & Moussatché, 1978; De Balogh et al., 1999). The toxic principles of this plant

have been identified as the alkaloids swainsonine (**15**) and calystegines B1 (**16**), B2 (**17**), C1 (**18**) and B3 (**19**) (Hueza et al., 2005, Haraguchi et al., 2003). The studies suggest that calystegines may act as coadjuvants of swainsonine in *I. carnea* toxicosis (Ikeda et al., 2003; Hueza et al., 2005). Other study showed that when administrated to pregnant rat toxic principle of *I. carnea* to pass through the placenta promoted decreased body weight, thymus atrophy and spleen enlargement in pups (Hueza et al., 2003b). *Ipomoea carnea* also promotes changes in lymphocyte distribution of young rats (Pípole et al., 2010). From latex of *I. carnea* was found a new chitinase, a digestive enzyme that break down glycosidic bonds in chitin (Patel et al., 2009; 2010). Caffeoyl derivatives were isolated from the seeds of *Ipomoea fistulosa* (Sattar et al., 1995). The aqueous extract of I. carnea Brazillian presented 0.09% swainsonine, 0.11% calystegine B2, 0.14% of calystegine B1, 0.06% calystegine C1 and the no proteic imino acid *N*-methyl-*trans*-4-hydroxy-L-proline (Schwarz et al., 2004).

Ipomoea corymbosa (L.) Roth ex Roem. & Schult.

I. corymbosa (*Rivea corymbosa*) is known by psychomimetic active principles of its seeds, the ancient Aztec drug "ololiuqui". In the seeds of this species were found alkaloids of the ergot type, such as, d-lysergic acid amide or LSA, also called ergine (**4**), as the major component in ololiuqui seeds as well as, the following minor alkaloids: chanoclavine I (**2**), elymoclavine (**3**), D-isolysergic acid amide also called erginine or isoergine (**5**) and lysergol (**11**) (Hoffmann, 1971). LSA or ergine (**4**) is a close analogue of best-know syntetic LSD (lysergic acid diethylamide). Hallucinogenic activity of LSA occurs with 2-5 mg, while LSD occurs at the microgram level (Halpern, 2004; Hoffmann, 1971). Elymoclavine (**3**), erginine (**5**) and lysergol (**11**) are also known to be psychoactive in humans (Hoffmann, 1963; Hoffmann & Tscherter, 1960; Hoffmann & Cerletti, 1961; Der Marderosian & Youngken Jr, 1966; Steinegger & Heimann, 1966; Ferrari, 1979).

Ipomoea digitata L.

The ether-sol. fraction of *I. digitata* presented hypotensive and muscle relaxant activity when tested in frogs, dogs, rats and rabbit (Tewati & Mishra, 1965). A glycoside called paniculatin isolated from the tubers of *I. digitata*, showed a stimulant effect on myocardium and respiration, a vasoconstrictor and bronchoconstrictor effect, a spasmogenic effect on smooth muscles of gut, as well as, it elevated the blood pressure, and also presented oxytocic activity (Matin et al., 1969a; 1969b). Other constituents isolated from the roots of this plant are taraxerol, taraxerol acetate, *N*-butyl-β-D-fructopyranoside, octadecyl (*E*)-*p*-coumarate and the coumarins umbelliferone, scopoletin, scopolin (Dai et al., 2000) and scoparone (Rao et al., 1984). Scopoletin (**34**) and taraxerol (**110**) inhibited AChE (acetylcholinesterase) activity. This enzyme is responsible for the metabolic hydrolysis of the neurotransmitter acetylcholine. AchE inhibitors are important for the treatment of Alzheimer's disease. Memory impairments in this patients result from a deficit of cholinergic functions in the brain (Lee et al., 2004).

Ipomoea hederacea Jacq.

Methanolic extract of *I. hederacea* showed a strong cytotoxic potential when tested in in cultured human lung (A549) and colon (Col 2) cancer cells (Nam & Lee, 2000). *I. hederacea* seeds contained chanoclavine I (**2**), elymoclavine (**3**), lysergol (**11**) and penniclavine (**12**) known to be psychoactive and isopenniclavine (Abou-Chaar, 1967).

Ipomoea hederifolia L.

From *I. hederifolia* were identified the active calystegines B1 (**16**) and B2 (**17**) (Haraguchi et al., 2003) besides A5 (Schimming et al., 1998). Moreover, several pyrrolizidine alkaloids of the ipanguline-type were isolated from *I. hederifolia* (Jenett-Siems et al., 1993; 1998).

I. horrida Huber

From the aerial parts of *I. horrida* were identified 7,4'-di-*O*-methylkaempferol and 7,3',4'-tri-*O*-methylquercetin (Barbosa-Filho et al., 1996).

Ipomoea imperati (Vahl) Griseb.

Methanol-water extract from the leaves of *I. imperati* showed local and systemic anti-inflammatory actions in mice and rats, respectively. This extract also presented antispasmodic activity on the isolated ileum, inhibiting histamine and acetylcholine. In the acute toxicity assay, 1 mg/kg of *I. imperati* methanol-water extract caused no mortality in mice after 24 h (Paula et al., 2003). Ipomoea imperati prevented the formation of gastric lesions in 78% ($p<0.05$) when compared with the negative control tween 80 (Miyahara et al., 2011). Ethanol extract, lipid and aqueous fraction of I. imperati significantly inhibited the abdominal constriction in mice induced by acetic acid; increased the sleeping time evoked by pentobarbital sodium and showed a significant activity by inhibiting formalin-induced paw edema in mice (Paula-

Zurron et al., 2010).

Ipomoea indica (Burm.) Merr. (*I. congesta* R. Br.)

Methanolic extract from the seeds of *I. indica* (*I. congesta*) presented biological activity against Herpes Simplex-1 (Locher et al., 1995). Methanolic and aqueous extracts from the seeds of this species were also investigated for anti-bacterial activity against *Streptococus pyogenes, Staphylococus aureus, Pseudomonas aeruginosa* and *Escherichia coli.* However, they did not present activity (Locher et al., 1995). Acetonitrile extract from the seeds of *I. indica* (*I. congesta*) was evaluated for its ability to inhibit the growth of three species of fungi, *Microsporum canis, Epidermophyton floccosum* and *Trichophyton rubrum. I. indica* (*I. congesta*) showed activity against *Microsporum canis* and *Epidermophyton floccosum* at a concentration of 1000 µg/mL but no growth inhibition was observed against *Trichophyton rubrum* (Locher et al., 1995). The glycoside called ipolearoside, with significant activity against Walker carcinosarcoma 256 in rats, has been isolated from ethanol extracts of the whole plants of *I. leari* Paxt. (*I. indica*) (Sarin et al., 1973).

Ipomoea involucrata P. Beauv.

Petroleum ether and ethanol extracts of *I. involucrata* were were subjected to biological screening using *Klebsiella* spp., *Escherichia coli, Pseudomonas aeruginosa* and *Staphylococcus aureus.* The extracts inhibited the growth of both Gram-positive and Gram-negative organisms (Ejimadu & Ogbeide, 2001). Aqueous ethanolic extract of *I. involucrata* showed a true antiviral activity against herpes simplex virus type 1 (HSV 1) and a virucidal activity against VSV T2 (Vesicular stomatitis virus T2) SF A7 (Semliki forest virus A7) and MV-EA (Measles virus strain Edmonston A) (Sindambiwe et al., 1999).

Ipomoea leptophylla Torr.

The crude organic extract (MeOH-CH_2Cl_2) of *I. leptophylla* presented 92% inhibition at 150 µg/mL against *M. tuberculosis in vitro.* Bioassay-guided fractionation of this extract resulted in the isolation of two resin glycosides called leptophyllins A and B. However, these compounds presented weak or no activity when tested in the anti-tuberculosis assay. Upon the basis of the activity of the extract it appears that there may be other minor metabolites that contribute to the extract's anti-tuberculosis activity (Barnes et al., 2003).

Ipomoea lonchophylla J.M. Black

In Austrália occurs the "dumb lamb syndrome" that causes mortallity among newly born lambs. It is believe that this disease occurs during gestation when the female feed toxic species. *I. lonchophylla* J. Black has been implicated in this disorder. One fraction from *I. lonchophylla* was toxic to mice but no tests have so far been carried out to determine whether this toxic fraction contribute to intoxication and death among newly born lambs. The toxic fraction contained an inseparable mixture of resin glycosides (Macleod et al., 1997).

Ipomoea muelleri Benth.

Several ergoline alkaloids, known to be psychoactive in humans, were isolated from the seeds of *I. muelleri,* such as agroclavine (**1**), chanoclavine I (**2**), elymoclavine (**3**), ergine or LSA (**4**), erginine or isolysergic acid amide (**5**), ergometrine (**8**), festuclavine (**10**), lysergol (**11**), penniclavine (**12**), as well, isopenniclavine, α-dihydrolysergol, Isolysergol, isosetoclavine, setoclavine, molliclavine, isolysergamide, *N*-(1-hydroxyethyl) chanoclavine II and ergometrinine (Der Marderosian et al., 1974; Hoffmann, 1963). Agroclavine (**1**) and festuclavine (**10**) were shown to be effective antimicrobial compounds and had significant cytostatic activity to a mouse lymphoma cell line. Agroclavine (**1**) was also effective at inhibiting *E. coli* multiplication (Panaccione, 2005). Ergometrine or ergonovine (**8**) has potent uterine againstction activity and is used as an oxytocic and in treating postpartum hemorrhages. Bleeding is reduced because of its vasoconstrictor effects (Dewick, 2002).

Ipomoea muricata (L.) Jacq.

The seeds of *I. muricata* presented analgesic and antiseptic properties (Ysrael, 2003). The indolizidine alkaloidal ipalbine, ipalbidine, ipalbinium and ipomine were isolated from the seeds (Exconde et al., 2004). Analgesic properties have been attributed for ipalbidine (**13**) (Honda et al., 2003; Dawidar et al., 1977). Antimicrobial and antifungal compounds were also identified (Ysrael, 2003). The indolizidine alkaloid caled *E*-ipomine were also isolated in the seeds of *I. muricata* (Dawidar et al., 1977) besides cafeic acid, (Misra & Tewari, 1952), muricatins A and B (Misra & Tewari, 1953), muricatins I-VIII (Noda et al., 1985; 1988a; 1988b) and muricatics acids A, B and C (Noda et al., 1988c). Of these, cafeic acid (**22**) presents antioxidant and antimutagenic activities (Yoshimoto et al., 1999) and muricatin A in doses of 20-40 mg/kg to anesthetized dogs produced a fall in blood pressure with subsequent

rise to the original level. Muricatin B presented no pharmacological activity (Chaudhary et al., 1957).

Ipomoea murucoides Roem. & Schult.

From the roots of *I. murucoides* (cazahuate) were isolated the glycoresins called murucins 1-5. Murucin 1 (**64**) presents marginal activity (ED50 5.0 µg/mL) against ovarian carcinoma (OVCAR-5) cells, but was inactive (ED50 >20.0 µg/mL) against colon carcinoma (HCT-15) and cervical carcinoma (UISO-SQC-1) cells. Murucins 2-5 were inactive against all three of these cell lines (León et al., 2005). From flowers of *Ipomoea murucoides* were isolated five lipophilic tetrasaccharide called murucoidins XII-XVI. These compounds were tested for in vitro antibacterial and resistance modifying activity against strains of *Staphylococcus aureus* possessing multidrug resistance efflux mechanisms. Only murucoidin XIV showed antimicrobial activity against SA-1199B a norfloxacin-resistant strain that over-expresses the NorA MDR efflux pump (Chérigo et al., 2009).

Ipomoea nil (L.) Roth

Ethanol extract from the roots of *I. nil* (*Pharbitis nil*) induce growth inhibition and apoptosis of human gastric cancer cells (AGS) (Ko et al., 2004). From this species were also isolated peonidins (Saito et al., 2005) and the anthocyans HBA (**56**) that presents protective effects against UV-B (Mori et al., 2005). A spermidine alkaloid, N1, N10-ditigloylspermidine were isolated from the seeds of *I. nil* (Schimming et al., 2005b).

Ipomoea obscura (L.) Ker Gawl.

Methanolic seed extract of *I. obscura* afforded indole alkaloids, such as ipobscurines B-D (Jenett-Siems et al., 2003). Active calystegins B1 (**16**), B2 (**17**), C1(**18**) and B3 (**19**), besides calistegin B4, and were also isolated of this species (Asano et al., 2001; Schimming et al., 1998).

Ipomoea orizabensis (G. Pelletan) Ledeb. ex Steud.

I. orizabensis produced strong activity against sarcoma 37 (Belkin et al., 1952). From the roots of this species were isolated several glycoresins: scammonine I (**57**) a complex glycolipid active against methacillin-resistant staphylococci (Mitscher & Telikepalli, 1992), scamonin II (**58**) and orizabins V a VII (**69-71**) which are weakly cytotoxic (ED50 4-20 µg/mL) against human oral epidermoid carcinoma (KB) (Hernandez-Carlos et al., 1999), orizabins I-IV (**65-68**) useful as laxatives (Noda et al., 1985; 1987), orizabin VIII (**85**) that presents weak cytotoxicity against colon carcinoma and orizabins IX-XXI (**72-84**) which exhibited citotoxic activity (ED50 1-5 µg/mL) against oral epidermoid carcinoma (KB) but exhibited a weak cytotoxicity against colon carcinoma (HCT-15), squamoux cell cervix carcinoma (SQC-1) and ovarium cancer (OVCAR) cell lines (ED50 4-20 µg/mL) (Pereda-Miranda & Hernández-Carlos, 2002). These glycolipids contain an intramolecular macrocyclic lactone (Noda et al., 1990).

Ipomoea operculata Mart. et Spix. (*syn. Operculina macrocarpa* (L.) Urb.)

Several glycoresins called operculins I-XVIII were isolated from the roots of *I. operculata.* However its biological activities were not evaluated (Ono et al., 1989; 1990; 1991; 1992a).

Ipomoea parasitica (Kunth) G. Don

The petroleum ether extract from the seeds of *I. parasitica* (HBK) Don. were isolated a unique members of a class of glycoresin (Smith et al., 1964). From seeds of this species were identified lysergol and elymoclavine besides other ergoline alkaloids (Amor-Prats & Harborne, 1993a).

Ipomoea pes-caprae (L.) R. Br.

This specie is known as salsa-da-praia or batateira-da-praia in Brazil (Souza et al., 2000) and Railroad vine, bay hops or beach morning-glory in North America (Pereda-Miranda et al., 2005). To identify potential migraine therapeutics, *I. pes-caprae* was screened to detect inhibitors of platelet (^{14}C) 5-hydroxytryptamine (5-HT) release. Studies showed that the methanolic extracts of *I. pes-caprae* was potent inhibitors of platelet (14C)5-HT release, even after the addition of PVP (polyvinyl pyrrolidone) to remove polyphenolic tannins that precipitate proteins (Rogers et al., 2000).

Study in mice indicated that both methanolic extract and two fractions (ethyl acetate and aqueous) exhibited antinociceptive activity against two classical models of pain, neurogenic and inflammatory. This study justifies at least in part, the traditional use of this plant to treat dolorous process (Souza et al., 2000). Some constituents isolated from *I. pes-caprae,* such as, quercetin 3-O-β-D-glucofuranoside (**55**), β-amyrin acetate (**104**) α-amyrin acetate (**105**), betulinic acid (**107**) and glochidone (**108**) showed pronounced antinociceptive properties in mice. These data confirm the previous work concerning the antinociceptive action of the

hydroalcoholic extract of *I. pes-caprae* and support, at least in part the traditional use of this plant for the treatment of dolorous processes (Krogh et al., 1999).

I. pes-caprae exhibited insulinogenic, hypoglycemic (Khan et al., 1994), anti-haemolytic (Pongprayoon et al., 1991a) antispasmodic (Pongprayoon et al., 1989; 1992a), antiinflammatory (Pongprayoon et al., 1992b) and anti-histamine (Wasuwat, 1970) activities.

The crude extract of *I. pes-caprae* reversibly inhibited the contractions induced by several spasmogens in a concentration-dependent manner (Pongprayoon et al., 1989). Bioassay guided fractionation of this extract resulted in isolation of the isoprenoids *E*-phytol and β-damascenone. The antispasmodic potencies of these compounds were found to be in the same range as that of papaverine, a known spasmolytic agent (Pongprayoon et al., 1992a). However, similar study with the plant collected in Brazil showed differece in terms of the chemical composition and did not showed antispasmodic activity when tested on isolated guinea-pig ileum and rat duodenum (Emendorfer et al., 2005).

From the leaves of *I. pes-caprae* were isolated the isochlorogenic acids a, b and c (**24-26**) which were also found in other species of *Ipomoea*, such as *I. batatas* and *I. aquatica* whose biological activities already were described. Beyond that, others quinic acid esters (**28-32**) were also isolated from the leaves of this species (Teramachi et al., 2005). Isochlorogenic acids a, b and c (**24-26**) as well the quinic acid esters (**28-32**) presented collagenase inhibitory activity and showed almost no citotoxicity (Teramachi et al., 2005). The development of compounds with collagenase inhibitory activity is an effective method for preventing aging of the skin. During ageing occurs reduction of the collagen of the skin due to its decomposition by action of the enzyme called colagenase. Compounds that inhibit this enzyme will avoid then the reduction of the collagen and consequently will maintain elasticity of the skin (Teramachi et al., 2005).

I. pes-caprae showed to be clinically effective toward dermatitis caused by venomous jellyfishes (Wasuwat, 1970). The crude extract of this plant showed an inhibitory effect on prostaglandin synthesis *in vitro*. Bioassay-guided separation of the extract led to the isolation of four active compounds: 3,4-dihydro-8-hydroxy-3-methyl-isocoumarin (**40**), eugenol (**41**), 4,4,7-trimethyl-1,4-dihydro-2-hydroxy-1-naftalenone (**42**) and 4-vinyl-guaiacol (**43**). The influence of these compounds on the formation of prostaglandins may partly explain a previously observed anti-inflammatory effect of the crude extract of *I. pes-caprae* (Pongprayoon et al., 1991b.) and supports the popular use of this plant to cure inflammations (Souza et al., 2000).

The cytotoxic potential of six lipophilic glycosides isolated from the aerial parts of *I. pes-caprae*, namely, pescaproside A (**86**), pescapreins I-IV (**87-90**) and the known stoloniferin III was evaluated against four human cancer cell lines. All compounds exhibited weak cytotoxicity (ED50 5-20 µg/mL) against nasopharyngeal (KB), colon (HCT-15), squamous cell cervical (SQC-1 UISO) and ovarian (OVCAR) carcinomas (Pereda-Miranda et al., 2005). From flowers of *I. pes-caprae* were isolated three linear hetero-pentasaccharides of jalapinolic acid, pescapraeins XVIII-XX, which displayed resistance-modifying activity against strains of *Staphylococcus aureus* possess multidrug efflux pumps (Escobedo-Martínez et al., 2010). The thin layer chromatography for the hydroethanolic solutions indicated the presence of isoquercitrin, being more evident from the leaves (Barni et al., 2009).

Ipomoea purga

The $CHCl_3$ and MeOH extracts of *I. purga* showed a significant inhibitory effect (ED50 <4 µg/mL) against the human nasopharingeal carcinoma and breast cancer cell cultures (Pereda-Miranda & Bah, 2003). The resin of *I. purga* of strong purgative effect is known as jalapa and consists of two fraction, one insoluble in ether called convolvulin and other soluble called jalapin (Costa, 2002). Treatment of convolvulin with sodium methoxide has yielded a β-D-quinovoside. It consist of one molecule of D-quinovose glycosidically linked to molecule of methyl 11-hydroxytetradecanoate (Singh & Stacey, 1973). Alkaline hydrolysis of jalapin yields volatile acids, tyglic, acetic, propionic, isobutiric, isovaleric, valeric and methyl-ethyl-acetic, beside jalaponic acid. It by acid hydrolysis yields the oses glucose, fucose and rhamnose, as well as, jalapinolic acid or 11-hydroxypalmitic acid (Costa, 2002).

Ipomoea purpurea (L.) Roth.

A glycoresin called ipopurpuroside was isolated from *I. purpurea*. It consists of glucose, rhamnose and 6-deoxy-D-glucose glycosidically linked to ricinoleic acid. The acyl group removed by alkaline hydrolysis was identified as methylbutyric acid (Navarro-Ruiz et al., 1978). Others glycoresins called marubajalapins I-XV were isolated from the jalapin fraction of the serial part (leaves and stems) of *Pharbitis purpurea* (*I. purpurea*) (Ono et al., 1992b). From the flowers of this species were isolated cyanidins and pelargonidins (Saito et al., 1995; 1996; 1998). The compound 3-*O*-(2-*O*-(6-*O*-*E*-caffeoyl-β-D-glycopyranosyl))-(6-*O*-*E*-caffeoyl)-β-D-glycopyranosyl)-5-*O*-β-D-glycopyranoside-cianidin (**46**), also isolated from *I. batatas* and *I. asarifolia*, showed antioxidant activity (Kano et al., 2005). In study for investigation of new souces of ergoline alkaloids within the genus *Ipomoea, I. purpurea* was alkaloid-negative

species, although previous reports indicated presence of ergoline alkaloids. Maybe because *I. purpurea* is often confused with *I. tricolo*r an alkaloid-positive species (Amor-Prats & Harborne, 1993b).

Ipomoea squamosa Choisy

From the leaves of *I. squamosa* were isolated the glycoresins called ipomoeassins A-E (**59- 63**). All the isolates showed citotoxic activity against human ovarian (A2780) cancer cell line. Ipomoeassins A-C and E were moderately active (IC50 from 0.5 to 3.3 μM). While Ipomoeassin D (**62**) (IC50 0,035 μM) which differs from C (**61**) (IC50 2,9 μM) only by an acetyl group, is almost two orders of magnitude more active than C. However, the derivative fully acetylated was less active. These observations suggest that relatively minor structural variations may make significant differences to cytotoxicity (Cao et al., 2005).

Ipomoea stans Cav.

This specie is known as tumbavaquero in Mexico. Study realized in rats with aqueous extract from the roots of *I. stans* indicated the presence of active substances which can exert a vasorelaxant effect, making them possibly effective for the treatment of clinical disturbances where high smooth muscle tension is the main symptom. This study supports the popular use of *I. stans* as an antispasmodic agent (Perusquia et al., 1995). Other study demonstrated anticonvulsant effect of aqueous, hydroalcohol and chloroform extracts from *I. stans* root in rats (Gonzalez Ramirez et al., 1985). MeOH extract of *I. stans* showed high antioxidative activity in the tests of inhibition of autoxidation, DPPH scavenging activity, and superoxide anion-scavenging activity (Choi et al., 1998). Ethyl acetate extract from Ipomoea stans roots showed central nervous system depressant activity (Herrera-Ruiz et al., 2007).

From a fraction of *I. stans*, with pronounced cytotoxicity towards three human tumor cell lines and with specific antibiotic activity against two bacterial strains, were isolated and identified three glycoresins fraction (Reynolds et al., 1995). In other study, were isolated from the roots of *I. stans* the glycoresins called stansins 1-5. These compounds were subjected to a cytotoxic assay using cultured cells representative of colon (HCT-15) cervical (UISO-SQC-1) and ovarian (OVCAR-5) carcinomas. Among these compounds, to be detached, stansin 5 (**92**) that presents citotoxic activity against ovarian (ED50 1,5 μg/mL) and cervical (ED50 4,0 μg/mL) carcinomas (León et al., 2004). Others glycoresins also isolated of *I. stans* were scammonic acid A and orizabin XX (Enriquez et al., 1992). But its biological activities were not reported. The coumarin scopoletin (**34**) was also isolated from roots of *I. stans* (Noda et al., 1994).

Ipomoea stolonifera (Cirillo) J.F. Gmel. (I. imperati (Vahl) Griseb.)

Methanol-water extract from the leaves of *I. stolonifera* (*I. imperati* Vahl Griseb.) showed local and systemic anti-inflammatory actions in mice and rats, respectively. This extract also presented antispasmodic activity on the isolated ileum, inhibiting histamine and acetylcholine. In the acute toxicity assay, 1 mg/kg of *I. imperati* methanol-water extract caused no mortality in mice after 24 h (Paula et al., 2003). From the ether-soluble resin glycoside fraction was isolated twelve glycoresins called stoloniferins I-XII were isolated in the pure state from the whole plants of *I. stolonifera,* but its biological activities were not reported (Noda et al., 1994; 1998).

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Ipomoea subincana Meisn.

The results obtained showed that *I. subincana* is a potential source of bioactive compounds with immunosuppresive activity since the fractions 1 and 9 isolated from chloroform extract exhibited respectively 93,18 and 91,21% of nitric oxide Inhibition and respectively 98,69 e 53,90% of lymphoproliferation inhibition. The fractions 8 and 9 from chloroform extract were strongly lethal towards brine shrimp nauplii since exhibited LC50 respectively of 9,3 and 43,0 mg/L. The fraction 6 from the ethyl acetate extract showed 49,6% of antioxidant activity surpassing the activity of the standard commercial antioxidant, galato de propila (39,6%). From the chloroform extract of aerial parts of *I. subincana* were isolated scopoletin (**34**) and methyl 3,5-di-*O*-*E*-caffeoyl-quinate (**32**) whose biological activities already were described. Besides others compound as lupeol, β-sitosterol, vanillin, vanillic acid, aromadendrane-4 β,10α-diol, 3-β-*O*-β-D-glycopiranosyl-sitosterol, cinamic acid, methyl caffeate, ethyl caffeate, methyl-3,4-dimethoxycinnamate, stigmasterol, α-amyrin, β-amyrin, *trans n*-icosyl-*p*-coumarates, *cis n*-docosyl-*p*-coumarates, *trans n*-nonadecyl *p*-coumarates, *trans n*-henicosyl *p*-coumarates,

trans-*n*-docosyl-*p*-coumarates, *trans*-*n*-tricosyl-*p*-coumarates, tyrosol and the novel glycolipid subincine and the new ceramides (2S*,2'R*,3S*,4R*,11*E*)-*N*-(2'-hydroxyhenicosanoyl)-2-amino-nonadec-11-ene-1,3,4-triol (2S*,2'R*,3S*,4R*,8E)-*N*-(2'-hydroxytricosanoyl)-2-amino-nonadec-8-ene-1,3,4-triol, whose biological activities not were determined. From the ethyl acetate extract were isolated quercetin, 3-*O*-β-D-glycopiranosyl-quercetin, methyl 4-*O*-*E*-feruloyl-5-*O*-*E*-caffeoyl-quinate and methyl 3,5-di-*O*-*E*-caffeoyl-quinate (**32**) (Meira et al., 2008; Meira, 2008).

Ipomoea tyrianthina Lindl.

From this specie were isolated tyrianthins A and B two new partially acylated glycolipid ester-type heterodimers which showed significant in vitro relaxant effect on aortic rat rings. Scammonic acid A was determined as the glycosidic acid in both monomeric units. Also, these compounds were able to increase the release of GABA and glutamic acid in brain cortex, and displayed weak antimycobacterial activity (León-Rivera et al., 2009).

Ipomoea tricolor Cav.

The chloroform extract of *I. tricolor* showed effective chemical property for suppressing the growth of other plants. Bioactivity-directed fractionation of the crude extracts of *I. tricolor* led to the identification of the glycoresins mixture as the active fraction. Further chromatographic analysis of this fraction yielded tridolorin A (**93**) as the main constituent responsible for the phytotoxicity (Pereda-Miranda & Bah, 2003; Bah & Pereda-Miranda, 1996; Pereda-Miranda et al., 1993). Tricolorin A (93) showed antimicrobial activity against *Staphylococcus aureus* and strong citotoxic activity against human breast cancer (ED50 2,2 μg/mL). All member of the tricolorin series (tricolorin A-J) (**93-102**) exhibited a weak cytotoxicity against colon carcinoma, squamous cell cervix carcinoma and ovarium cancer cell lines (ED50 4-20 μg/mL). But a stronger effect was observed agains oral epidermoid carcinoma (KB, ED50 1-5 μg/mL) (Pereda-Miranda & Bah, 2003).

From *I. tricolor* were isolated several ergoline alkaloids such as, agroclavine (**1**), chanoclavine I (**2**), elymoclavine (**3**), ergine (**4**), ergocristine (**6**), ergotamine (**7**), ergometrine (**8**), penniclavine (**12**), besides, dihydrolysegol, isolysergol, ergometrinine, ergostine, and noragroclavine (Botz et al., 1991; Hahn, 1990). Althought all of the natural ergoline alkaloids increase the motor activity of the uterus; ergometrine (**8**) is most active and also less toxic than ergotamine (7). Ergotamine (**7**) presents also vasoconstritor activiy and is useful in the treatment of migraine headaches (Madlom, 2002).

Coumarin (**33**) and scopoletin (**34**) were also isolated of this species (Shah et al., 1972). The biological activity of scopoletin, also found in *I. batatas, I. cairica* and *I. digitata*, already were described. The coumarin (33) presents antiedema properties and is also imunoestimulant and exhibit citotoxic activity (Bruneton, 2001).

Ipomoea violacea L.

From *I. violacea* were isolated several ergoline alkaloids, such as, chanoclavine I (**2**), elymoclavine (**3**), egine (**4**), erginine (**5**), ergometrine (**8**), lysergol (**11**), penniclavine (**12**), besides, chanoclavine II and ergometrinine (Stanescu et al., 1973; Weber & Ma, 1976). The main ergoline alkaloid in the seeds of *I. violacea* is ergine (**4**). The total alkaloid content of *I. violace*a seed is approximately five times as great as that of the seeds of *I. corymbosa* (*Rivea corybosa*) (Hoffmann, 1971). Calystegins B1 (**16**) and C1 (**18**) were also isolated of this species (Schimming et al., 1998).

Conclusion

The plants of the genus *Ipomoea* have long been used in folk medicine for the treatment of a wide variety of pathological conditions, including their use to treat inflammatory and algesic processes, kidney ailments, constipation, colic and digestive disorders. In recent years, the scientific interest in plants of *Ipomoea* genus has increased greatly. Substantial progresses on chemistry and pharmacological properties of this genus have showed it. Some species showed antimicrobial, analgesic, spasmolitic, spasmogenic, hypotensive, psychotomimetic and anticancer activities. Pharmacological studies have confirmed some uses in folk medicine. For example, antinociceptive action of *I. pes-caprae* that supported, at least in part, the traditional use of this plant for the treatment of dolorous processes. Other study realized in rats with aqueous extract from the roots of *I. stans* indicated the presence of active substances which can exert a vasorelaxant effect confirming the popular use of *I. stans* as an antispasmodic agent. Although, an extensive amount of research work has been done on some plants of genus *Ipomoea* to date, a large number of species are still partially studied such as, *I. parasitica, I. operculata* (syn. *Operculina macrocarpa*), *I. lonchophylla, I. involucrata, I. hederacea, I. bahiensis*. Consequently, a broad field of future research remains possible in which the isolation of new active principles from these species would be of great scientific merit.

Glycolipds, phenolics compounds and alkaloids are of particular interest as many are highly potent bioactives and perhaps responsible for most of activities

shown by the plants of this genus. A detailed study is required to understand the structure–activity relationship of these constituents. Many plant extracts of *Ipomoea* showed biological activity. However, the particular constituent responsible for the activity has not always been isolated in further process. Furthermore, some plant extracts were only preliminarly studied for their *in vitro* activities, so, the advance clinical trial of them deserves to be further investigated.

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