REVIEW ARTICLE

INTERNATIONAL JOURNAL OF RESEARCH IN PHARMACEUTICAL SCIENCES

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# Phytochemical library of *Caralluma* genus

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*Article History:*

Received on: 13.07.2018
Revised on: 19.09.2018
Accepted on: 21.09.2018

*Keywords:*

Asclepiadaceae, *Caralluma,* Medicinal plants, Pharmacological activities, Phytochemical library

ABSTRACT

*Caralluma* is one of the prominent genus out of 200 genera and 2500 species of Asclepiadaceae family. *Caralluma* genus belongs to Asclepiadaceae and is widely distributed in Asia countries, Africa, Arabian Peninsula, Canary Islands and Southeast Europe. In folkloric medicine, as well as in Unani and Ayurvedic systems of medicine, the plants of *Caralluma* are being used for the treatment of diabetic patients and rheumatism. Tribals consider some of them as food during famines and also as a part of the traditional medicinal system. In India and Pakistan, *Caralluma* species have been used as emergency foods for the last few centuries. As allopathic medicines possess toxic nature and side effects, the use of plant-based medicine is becoming popular. This lead to a sudden enhancement in the production of herbal drugs. At present *Caralluma* is gaining much importance from researchers because it possesses array immunostimulating activities due to presence flavonoids and saponins and pregnane glycosides as active components. The present article thoroughly reviewed about various phytochemicals present in different species of *Caralluma*. Tabulated a list of phytochemicals isolated by various researchers from different plants of the *Caralluma* genus. Further, listed out the species on which enthusiastic researchers of this field can extend their investigation.

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ISSN: 0975-7538

DOI: https://doi.org/10.26452/ijrps.v9i4.1655

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## INTRODUCTION

Nature is the wonderful source of the compounds containing medicinal properties. Extraordinary chemical diversity can be found in millions of living species like animals, marine organisms, microorganisms and plants (Newman *et al.,* 2003; Bhanot *et al.,* 2011). The term natural product means it is a chemical substance found in living organisms *viz*., marine organism, plants and fermentation of microbes (Baker *et al.,* 2007). Natural products extraction and their uses are well known from ancient times since the discovery of fire (Chemat and Strube, 2015). Natural products are becoming a significant source for the development of new drugs and new chemical moieties. 60% of presently using anticancer agents is obtained from the plants/natural sources (Cragg *et al.,* 2011). All the chemical compounds of any biological system can be classified into two broad categories. The first category is the primary metabolites and the second category is secondary metabolites. The chemical substances which are meant for growth and development of living body are called as primary metabolites. They include amino acids, carbohydrates, lipids and proteins. The group of chemical substances other than primary metabolites those existing in a biological system are called as secondary metabolites. Presence of secondary metabolites in

living body gives the ability to face the challenges in its survival, during the time of its interaction with the surroundings (Harborne, 1993).

**Medicinal Plants**

According to WHO, the medicinal plant can be defined as a plant in which one or more of its parts include substances containing therapeutic applications or compounds which are responsible for semi-synthesis of pharmaceuticals. Since olden days medicinal plants are standing as valuable sources for therapeutic compounds, many of existing drugs till today are derived from plant based natural products or their derivatives (Newman and Cragg, 2012). Use of plants for humankind is older as the begin of mankind. Nowadays medicinal plants are gaining much importance from people who are living in urban areas in treating infections like typhoid fever and gonorrhoea. This is due to the inefficiency of modern medicines and increased resistance shown by various bacteria towards antibiotics, as well as high cost of prescribed drugs in the maintenance of health (Smolinski *et al.,* 2003; Van den Bogaard and Stobberingh, 2000). Unfortunately, all over the world modern health facilities available are not meeting the demands of the increased human population. Therefore it is demanding the further use of natural remedies in maintaining the health of humans. Various diseases like asthma, constipation, fever and hypertension were treated using traditional medicinal plants (Saganuwan, 2010).

**Phytochemicals**

The medically active components extracted from plants are also known as phytochemicals or phytoconstituents and were playing a vital role in protecting the plant from various diseases caused by pests and microbes (Doughari *et al.,* 2009; Nweze *et al.,* 2004). Phytochemical is a Greek word and it means plant-derived chemical. In recent times it is well known that phytochemicals are also playing a vital role in maintaining human health, particularly if they are taken as significant diet (Saxena *et al.,* 2013). Phytochemicals are widely distributed in foods like herbs, spices, legumes, vegetables and fungi (Mathai, 2000). Phytochemicals exist in various parts of plants like whole grains, seeds, flowers, fruits, stems, bark, leaves and roots (Costa *et al.,* 1999). Phytochemistry is one of the branches of chemistry that involves the study of the relationship between organic chemistry and natural products. The studies which are associated with phytochemistry are very significant and appropriate as it helps to gain the knowledge on a range of plant-based chemicals those are pharmacologically important **(**Temidayo, 2013). A number of phytochemicals were separated and characterized from certain sources like fruits (apples and grapes), vegetables (onion and broccoli), spices (turmeric), beverages (red wine and green tea), and from many other sources (Doughari *et al.,* 2009; Doughari and Obidah, 2008).

***Caralluma* Genus**

*Caralluma* genus belongs to Asclepiadaceae and is widely distributed in Asia (countries like Afghanistan, India, Iran, Pakistan and Sri Lanka), Africa, Arabian Peninsula, Canary Islands and Southeast Europe (Meve *et al.,* 2004; Gilbert 1990). In folkloric medicine, as well as in Unani and Ayurvedic systems of medicine, the plants of *Caralluma* are being used for the treatment of diabetic patients and rheumatism (Ramesh *et al.,* 1998). Tribals consider some of them as food during famines (Ahmad *et al.,* 1989) and also as a part of the traditional medicinal system (Abdul-Aziz Al-Yahya *et al.,* 2000). In India and Pakistan, *Caralluma* species have been used as emergency foods for the last few centuries (Gandhi, 1999). A spectrum of biological activities of *Caralluma* species can be expected due to the existence of pregnane glycosides, stigmasterol and other phytochemicals in them (Malladi *et al.,* 2017; 2018; Suresh Babu *et al.,* 2014). Presently *Caralluma* is gaining much importance from researchers because it possesses an array of immunostimulating activities due to the presence of various phytochemicals.

***Caralluma Adscendens***

*Caralluma adscendens* var. *gracilis* was found to contain a new pregnane glycoside (Figure 1) in diethyl ether fraction of ethanolic extract along with another known pregnane glycoside (Reddy *et al.,* 2011).

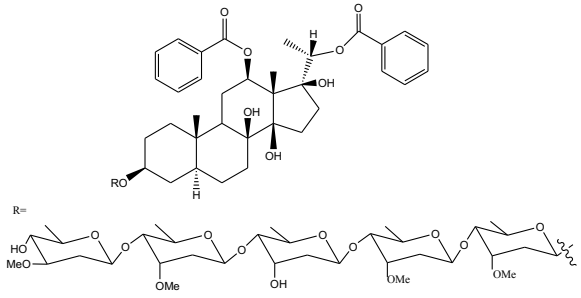



**Figure 1: Pregnane glycoside from *Caralluma adscendens var. gracilis***

***Caralluma Attenuata***

A pentacyclic triterpenoid (Figure 2) was isolated from the n-hexane extract of roots of Caralluma *attenuata* (Jayalakshmi *et al.,* 2016). Phytochemical investigation of *Caralluma attenuata root* extracts (butanone, ethylene acetate and n-butanol extracts) has shown the presence of saponins, flavonoids or flavonoid glycosides and ster-

oids/triterpenoids in *Caralluma attenuata* and absence of cardiac glycosides and alkaloids (Kiranmayee *et al*., 2015).

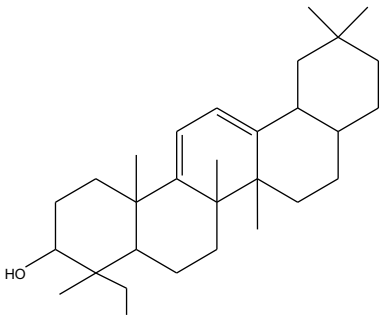


**Figure 2: Pentacyclic triterpenoid from *caralluma attenuate***

### *Caralluma Dalzielli*

Five new steroidal glycosides (Figure 3) (Caradalzieloside A-E) were isolated from $CHCl_3$/MeOH extract of *Caralluma dalzielii* by Oyama *et al*. (2007).

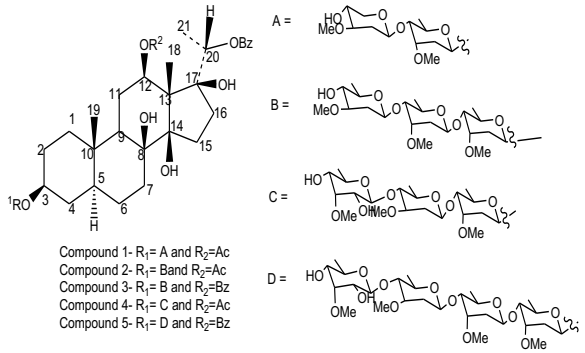



**Figure 3: Steroidal glycosides from *Caralluma dalzielii***

New pregnane glycosides (27 compounds) (Figure 4) were isolated from a methanolic extract of *Caralluma dalzielii* (De Leo *et al.,* 2005). High cytotoxic activities were shown by most of the extracts.

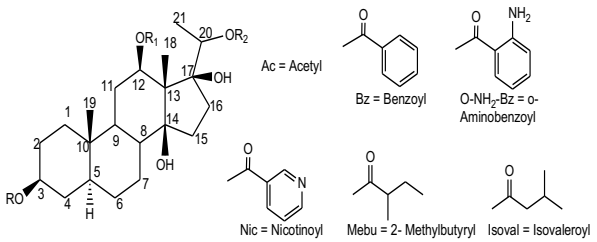



***Figure 4: New pregnane glycosides from Caralluma dalzielii***

### *Caralluma Fimbriata*

Six new pregnane glycosides (2-7) (Figure 5.a-c) and their aglycon were isolated from ether fraction of ethanolic extract of *Caralluma adscendens var. Fimbriata*. Also, another six pregnane glycosides (8-13) were isolated from the butanolic fraction (Kunert *et al.,* 2008).

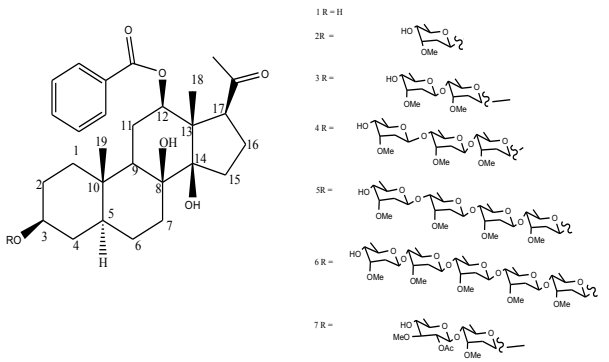


***Figure 5a: Pregnane glycosides (5-7) from Caralluma adscendens var. fimbriata***

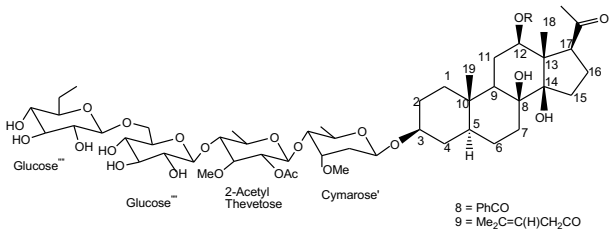



**Figure 5b: Pregnane glycosides (8 & 9) from *C. adscendens var. fimbriata***

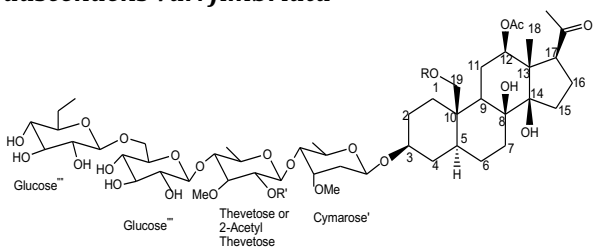



**Figure 5c: Pregnane glycosides (10-13) from *C. adscendens var. fimbriata***

Oleic acid (21.08%) and n-hexadecanoic acid (44.23%) were isolated from a methanolic extract of *Caralluma Fimbriata* Wall through GC-MS analysis (Priya *et al.,* 2011).

### *Caralluma Flava (Desmidorchis Flava)*

Four tetrasaccharide pregnane glycosides (desflavasides A-D) (Figure 6) were identified and characterized from the sap of *Desmidorchis Flava* (Raees *et al.,* 2016).

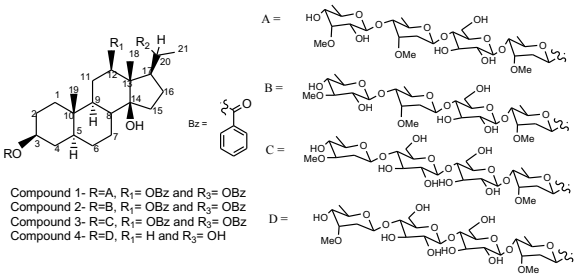



**Figure 6: Tetrasaccharide pregnane glycosides (desflavasides A-D) from *Caralluma flava***

A new pregnane glycoside (nizwaside) (Figure 7) was isolated from the sap of *Desmidorchis flava* and

it was proved as an effective anticancer agent against breast cancer cells like MDA, MB231compared to known cancer drug Doxorubicin (Hussain *et al.,* 2015). However, the antioxidant activity of nizwaside was found to be weak.

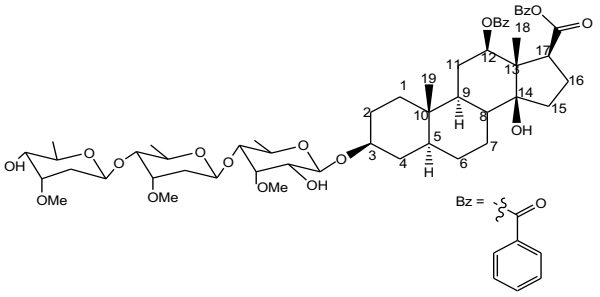



**Figure 7: Pregnane glycoside (nizwaside) from *Caralluma flava***

Two new pregnane glycosides (desmiflavasides A and B) (Figure 8) were isolated from the sap of *Desmidorchis flava* and desmiflavasides B proved to contain anti-proliferation activity against breast cancer cells at a concentration of 100 mg/mL and 75 mg/mL. On the other hand, urease enzyme inhibition, as well as antioxidant activities for them, were found to be weak (Raees *et al.,* 2015).

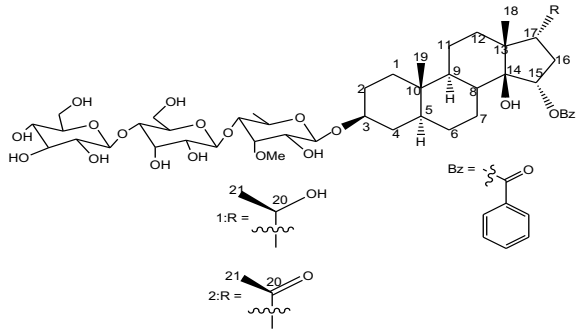



**Figure 8: Pregnane glycosides (desmiflavasides A and B) from *Caralluma flava***

### *Caralluma Indica/Boucerosia Indica*

Kunert *et al*. (2006) (Figure 9a & b) isolated novel steroidal glycosides *Caralluma* species. Stalagmoside I –V (1-5) are isolated from butanol fraction of *Caralluma stalagmifera* and indicoside I and II (7 & 8) are isolated from the ether fraction of *Caralluma indica.*

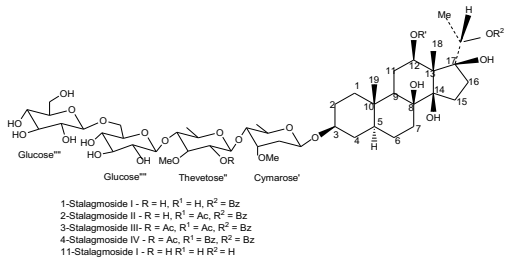



**Figure 9a: Stalagmoside I–IV from Caralluma stalagmifera**

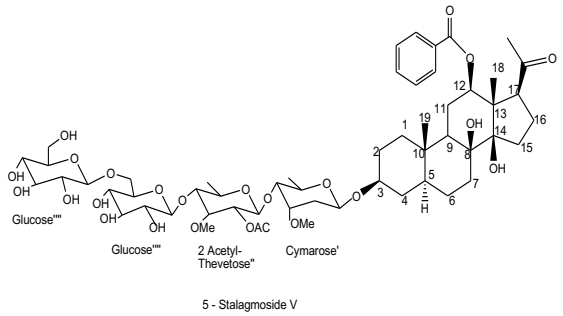
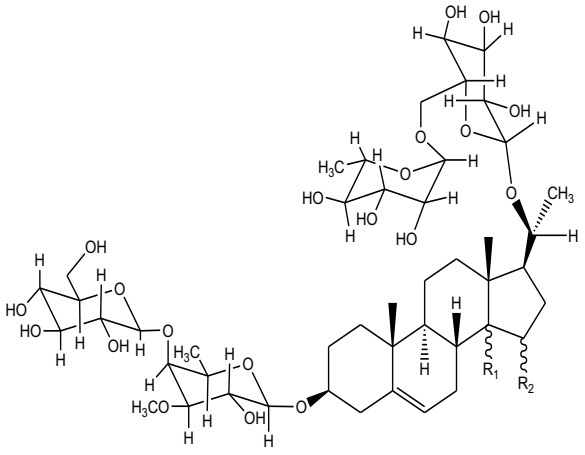



**Figure 9b: Stalagmoside V from Caralluma stalagmifera**

### *Caralluma Lasiantha/Boucerosia Lasiantha*

*Caralluma lasiantha* (syn. *Boucerosia lasiantha*) belongs to the family Asclepiadaceae and its local name is Kundeti Kommulu (in Telugu)/Sirumankeerai (in Tamil) (Arinathan *et al.,* 2007). *Caralluma lasiantha* is succulent inhabit and is used as an indoor ornamental plant (Reddy *et al.,* 2012). It grows wild in Anantapur, Chittoor and surrounding places of Andhra Pradesh, India. To reduce the body heat, fresh rootless *Caralluma lasiantha* (a dose of 10 g, twice a day for three days) is used in India (Vikneshwaran *et al.,* 2008). Malladi *et al.* (2017) reviewed the role of *Caralluma lasiantha* in traditional Indian medicine. Two new bisdesmosidic $C_{21}$ pregnane steroidal glycosides (lasianthosides-A and B) (Figure 10) were isolated from the n-butanol fraction of ethanolic extract of *Caralluma lasiantha* (Qiu *et al.,* 1999). A flavones glycoside (luteolin-4-O-neohesperiodoside) (Figure 11) was isolated from a methanolic extract of *Caralluma lasiantha* (Ramesh *et al.,* 1999b). Stigmasterol and $C_{21}$ Pregnane Steroid (3β,14β-dihydroxy-14β-pregn-5-en-20-one) were isolated from the less polar solvent extracts (Malladi *et al.,* 2017 a,b).



Lasianthoside-A $-R_1$, $R_2 = \Delta^{14\text{-}15}$, Lasianthoside-B – $R_1 = \beta$-OH, $R_2$ = H

**Figure 10: Lasianthosides A and B from Caralluma lasiantha**

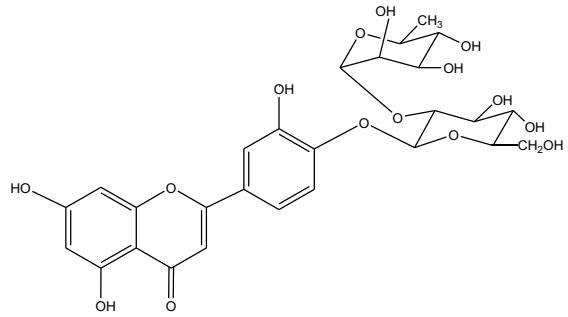


**Figure 11: Luteoline-4-O-neohesperiodoside from *Caralluma lasiantha***

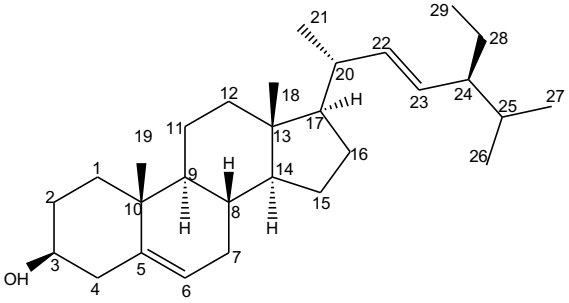


**Figure 12: Stigmasterol**

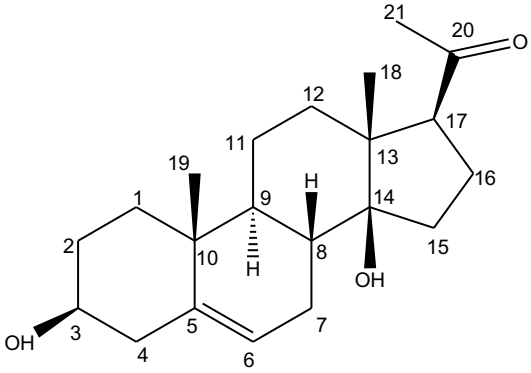


**Figure 13: 3β,14β-dihydroxy-14β-pregn-5-en-20-one**

### *Caralluma Negevensis*

Two megastigmane glycosides (1 & 2) (Figure 14), as well as two new flavone glycosides (3 & 4), were isolated from a methanolic extract of *Caralluma negevensis* (Bader *et al.,* 2003).

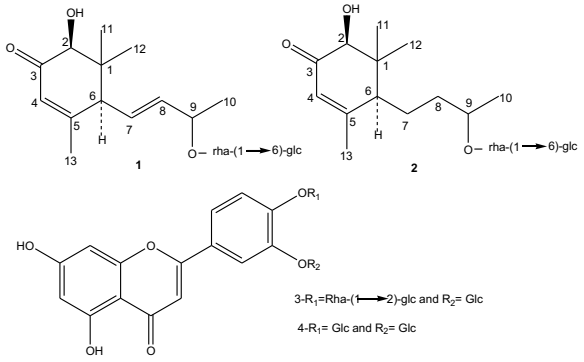



**Figure 14: Megastigmane glycosides (1 & 2) from *Caralluma negevensis Caralluma Negevensis***

New pregnane glycosides (1-20) (Figure 15a and b) were isolated from chloroform and methanol extracts of *Caralluma negevensis* (Braca *et al.,* 2002). Compounds 1-16 were found to contain bouncer in aglycon moiety, compounds 17-19 were shown to contain the calogenin structure and 20th compound contain 5α-dihydrocalogenin moiety.

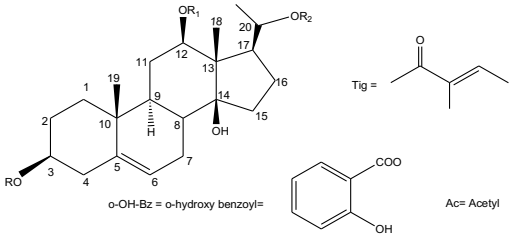



**Figure 15a: Pregnane glycosides (1-16) from *Caralluma***

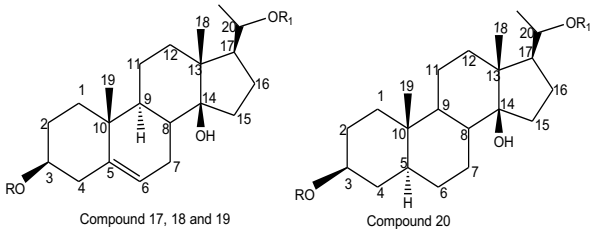



**Figure 15b: Pregnane glycosides (17-20) from *Caralluma negevensis***

### *Caralluma Nilagiriana*

Phytochemicals of *Caralluma nilagiriana* was evaluated by using UV-VIS and FTIR spectroscopic techniques (Renuka *et al.,* 2016). GC-MS analysis on ethanolic extract of *Caralluma nilagiriana* shows the presence of active components like alkaloids, flavonoids, phenolic compounds, steroids, terpenoids and tannins (Ranganathan *et al.,* 2014). Rutin, a bioflavonoid present in the ethanolic extract of shoots of *Caralluma nilagiriana* was determined by high-performance thin layer chromatography (HPTLC) (Renuka *et al.,* 2014).

### *Caralluma Pauciflora*

Two pregnanes (Figure 16) were isolated from diethyl ether fraction of ethanolic extract of *Caralluma pauciflora* along with known compounds like carumbelloside-III and dihydro russelioside (Reddy *et al.,* 2011).

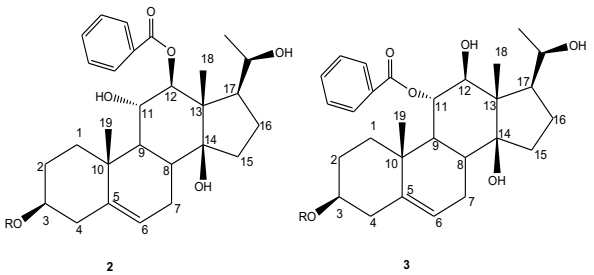



**Figure 16: Two pregnanes (compound 2 and 3) from *Caralluma pauciflora***

### *Caralluma Penicillata*

Four acylated pregnane glycosides (Figure 17) were identified from the methanolic extract of *Caralluma penicillata* (Abdallah *et al.,* 2013).

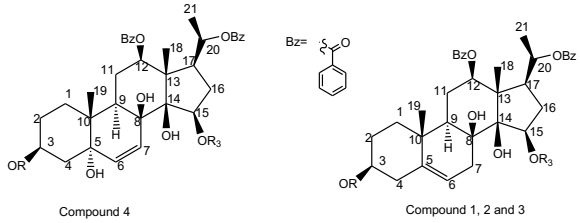



**Figure 17: Four acylated pregnane glycosides from *Caralluma penicillata***

$C_{15}$ oxypregnane glycosides (penicillosides A–C) (Figure 18) were isolated from chloroform fraction of ethanol extract of *Caralluma penicillata* (Abdel-Sattar *et al.,* 2001).

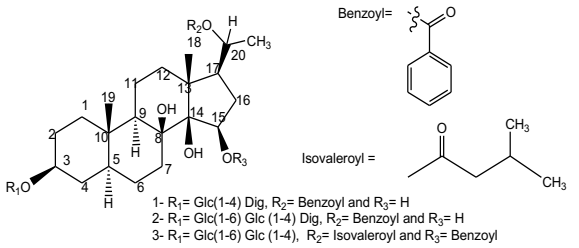



**Figure 18: $C_{15}$ oxypregnane glycosides (penicillosides A–C) from *Caralluma penicillata***

### *Caralluma Quadrangular*

Russelioside B (Figure 19), a pregnane glycoside isolated from the n-butanol fraction of methanol extract of *Caralluma quadrangular* was recommended for managing of diabetes based on its potent antihyperlipidemic effect (Abdel-Sattar *et al.,* 2016).

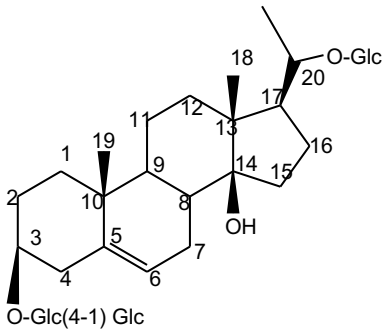



**Figure 19: Russelioside B from *Caralluma quadrangular***

### *Caralluma Retrospiciens*

A polyoxy pregnane glycoside (retrospinoside 1) (Figure 20) was identified from the n-butanol fraction of methanol extract *Caralluma retrospections* (Elsebai and Mohamed, 2015).

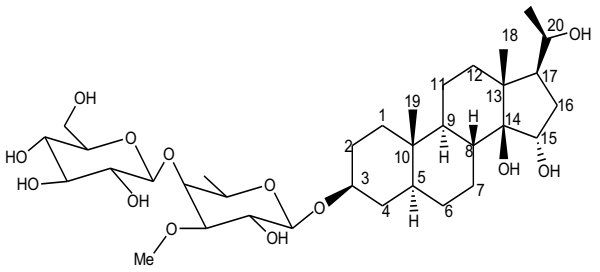


**Figure 20: Polyoxy pregnane glycoside (retrospinoside 1) from *Caralluma retrospiciens***

Six polyoxy pregnane glycosides (Figure 21a, b) were extracted from ether extracts of *Caralluma retrospiciens* and all of them exhibited cytotoxic property but compound-2 shown high cytotoxic activity (Halaweish *et al.,* 2004).

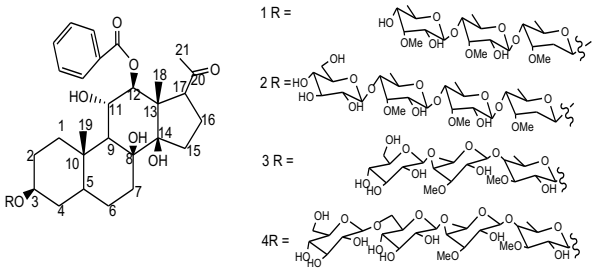



**Figure 21a: Polyoxy pregnane glycosides (1-4) from *Caralluma retrospiciens***

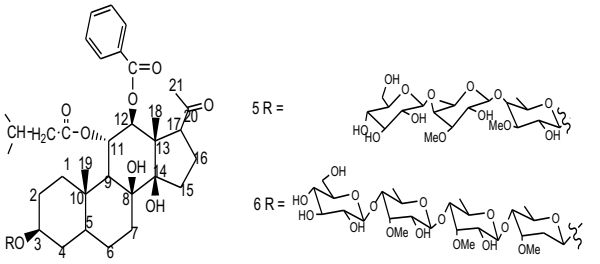



**Figure 21b: Polyoxy pregnane glycosides (1-4) from *Caralluma retrospiciens***

### *Caralluma Russeliana*

Two triterpenoids (3 and 4), two sterols (5 and 6) and two pregnane glycosides (1 and 2) (Figure 22.a-c) were isolated from the chloroform extract of *Caralluma russeliana* (Abdel-Mogib and Raghib, 2013).

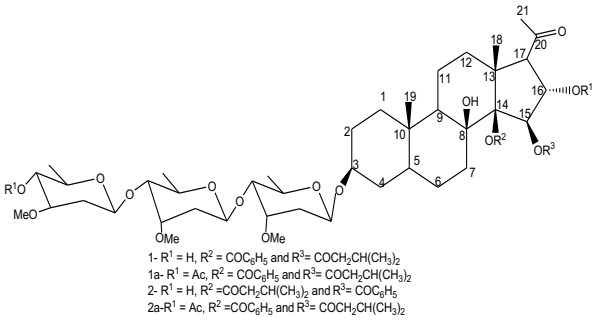



**Figure 22a: Pregnane glycosides (1 and 2) from *Caralluma russeliana***

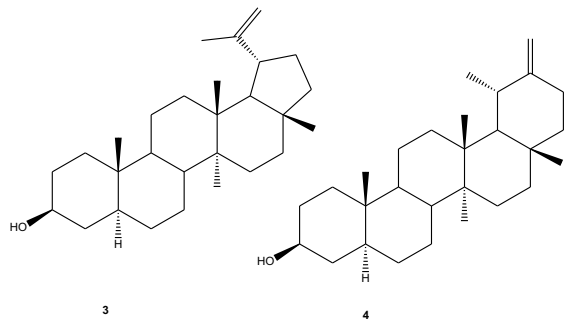


**Figure 22b: Pregnane glycosides (1 and 2) from *Caralluma russeliana***

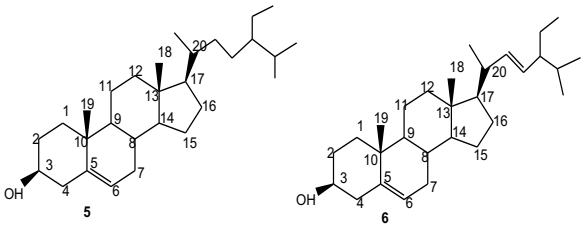


**Figure 22c: Sterols (5 and 6) from *Caralluma russeliana***

Four acylated pregnane glycosides (russeliosides E–H) (Figure 23) were extracted from chloroform extracts of *Caralluma russeliana* (Abdel-Sattar *et al.,* 2007).

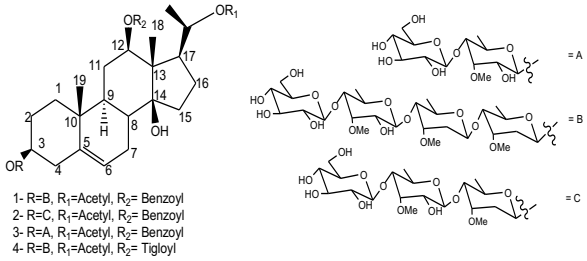



**Figure 23: Acylated pregnane glycosides (russeliosides E–H) from *Caralluma russeliana***

A known flavone glycoside and four pregnane glycosides (Figure 24) were extracted from *Caralluma russeliana* in its n-butanol fraction of ethanol extract (Abdul-Aziz Al-Yahya *et al.,* 2000).

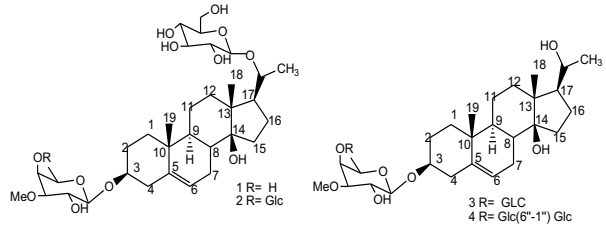



**Figure 24: Pregnane glycosides (russeliosides E–H) from *Caralluma russeliana***

### *Caralluma Sinaica*

*Caralluma sinaica* yielded six pregnane glycosides along with seven pregnanes and three flavonoids (Figure 25) from its chloroform extract (Al-Massarani *et al.,* 2012). Quinone reductase induction was evaluated for all these isolated compounds.

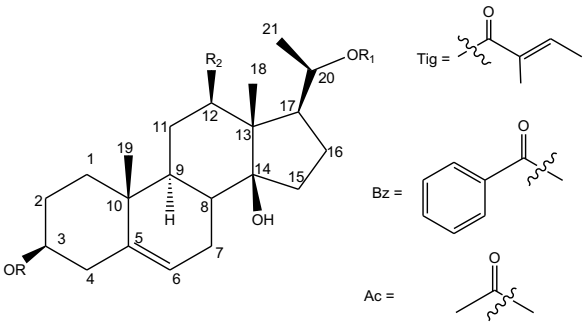



**Figure 25: Pregnane glycosides, pregnanes and flavonoids from *Caralluma sinaica***

### *Boucerosia Truncato Coronato/Caralluma Truncato-Coronato*

Phytochemical constituents present in ethanolic extracts of *Caralluma truncato coronato* were studied by GC-MS analysis by Kalimuthu *et al*. (2013). The results obtained have shown the presence of furan, 2-butyltetrahydro- (0.57%), β-sitosterol (1.89%), acetic acid, 5-(dimethyle-6-oxocyclohexylidene)-3-methyl-pent-3-enyl ester (3.78%), β-tocopherol (4.91%), squalene and lupeol (5.67%), vitamin E (9.45%) and thunbergol (68.05%).

### *Caralluma Tuberculata*

Two steroidal glycosides (pregnane glycoside and androstan glycoside) (Figure 26) were found in ethyl acetate extract of *Caralluma tuberculata* and exhibited moderate cytotoxic activity against three human breast cancer cell lines (Waheed *et al.,* 2011).

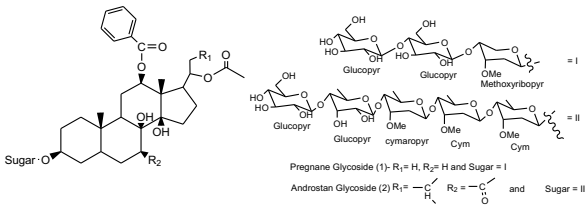



**Figure 26: Steroidal glycosides from *Caralluma tuberculata***

Five pregnane glycosides (caratuberside A-E) and preganan glycoside-russelioside (Figure 27) were isolated from chloroform fraction of MeOH extract of *Caralluma tuberculata*. The isolated pregnane glycosides exhibited antimalarial, antitrypanosomal and cytotoxic potentials (Abdel-Sattar *et al.,* 2008).

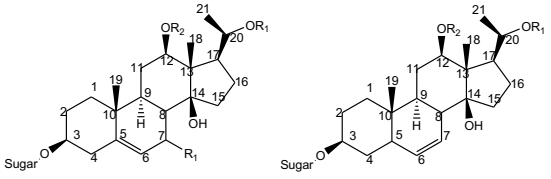


**Figure 27: Pregnane glycosides (caratuberside A-E) from *Caralluma tuberculata***

### *Caralluma Umbellata*

Kalyani *et al*. (2013) (Figure 28) isolated a novel pregnane glycoside from ether eluates of methanol and benzene fractions of ethanolic extract of roots of *Caralluma umbellata*.

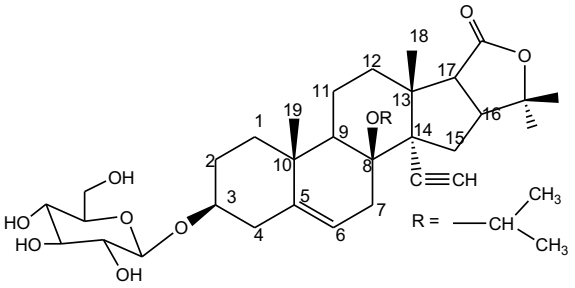


**Figure 28: Pregnane glycoside from *Caralluma umbellata***

Presence of thirty-two compounds was found in a phytochemical analysis of leaves of *Caralluma umbellata* by Jerome Jeyakumar *et al*. (2013). The extracted phytochemical compounds include terpenoids, flavonoids, tannins, phenols, glycosides sterols and saponins. Two new pregnane compounds (CRUR I and CRUR II) (Figure 27) were isolated from the roots of *Caralluma umbellata* (Kishore *et al.,* 2010).

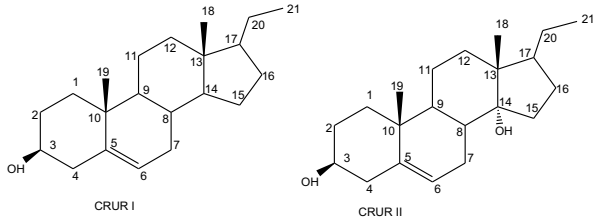



**Figure 29: Pregnane compounds from *Caralluma umbellate***

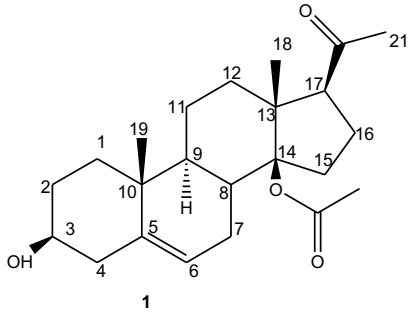


**Figure 30: Pregnane steroid from *Caralluma umbellate***

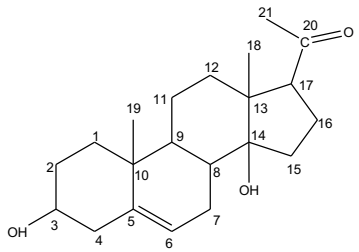


**Figure 31: $C_{21}$ steroid from *Caralluma umbellata***

Steroidal glycosides were found in different solvent fractions of ethanol extract of *Caralluma umbellata.* The isolated steroidal glycosides are bourcergenin (new pregnene type steroid) from toluene fraction, carumbelloside-VI (bisdesmosidic glycoside) from n-butanol fraction, and carumbellosides I–IV (new tetroxides of boucergenin) from toluene fraction (Kunert *et al.,* 2009). A new pregnane steroid (Figure 28) containing formyl group was isolated and characterized from *Caralluma umbellata* stems along with three known steroidal compounds (Babu *et al.,* 2008).

A $C_{21}$ steroid (Figure 31) was isolated from the toluene fraction of ethanol extract of *Caralluma umbellata* from the whole plant (Ramesh et al., 2005).

### *Caralluma Wissmannii*

Two pregnane glycosides (5, 6) along with five known compounds (viz., β-sitosterol, stigmasterol, luteolin 3',4'–di-O-β-D-glucopyranoside, 3,4-seco-up-20-(29)-en-3-oic acid methyl ester and lupeol) (Figure 30.a and b) were isolated in the phytochemical investigation on *Caralluma wissmannii* (Dawidar *et al.,* 2012).

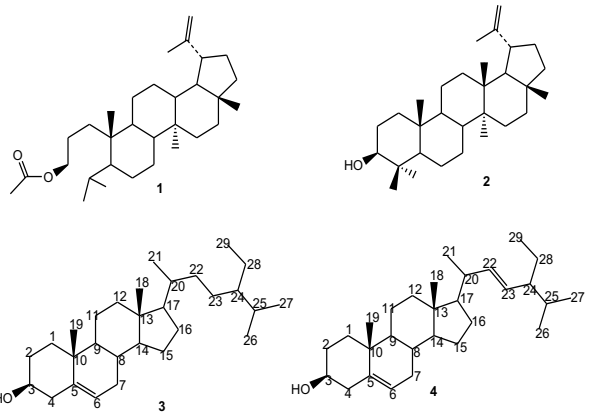


**Figure 32a: (1) 3,4-seco-lup-20(29)-en-3-oic acid methyl ester, (2) lupeol (3) β-sitosterol and (4) stigmasterol from *Caralluma wissmannii***

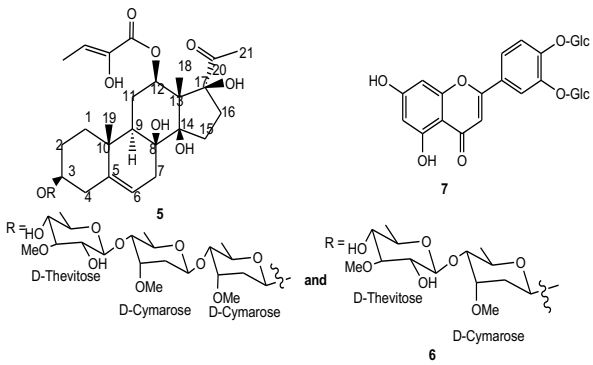



**Figure 32b: (5, 6) Pregnane glycosides and (7) Luteolin 3',4'–di-O-β-D-glucopyranoside from *Caralluma wissmannii***

**Table 1: A list of phytochemicals isolated from different plants of the *Caralluma genus***

| Name of the phytochemical | Name of the plant | Reference |
|---|---|---|
| Flavone glycoside, | *Caralluma arabica* | Kamil et al., 1999 |
| Luteoline-4'-O-neohesperiodo- | *Caralluma umbellata* | Ramesh et al., 1999b |
| side | *Caralluma lasiantha* | Ramesh et al., 1999b |
| | *Caralluma attenuata* | Ramesh et al., 1998, 1999b |
| | *Caralluma tuberculata* | Rizwani et al., 1990 |
| Flavones glycosides and megastigmane glycosides | *Caralluma negevensis* | Bader et al., 2003 |
| Pregnane glycosides | *Caralluma quadrangula* | Abdel-Sattar et al., 2016 |
| | *Caralluma flava (Desmidorchis flava)* | Raees et al., 2015, 2016 |
| | *Caralluma flava (Desmidorchis flava)* | Hussain et al., 2015 |
| | *Caralluma retrospiciens* | Elsebai and Mohamed, 2015 |
| | *Caralluma umbellata* | Kalyani et al., 2013 |
| | *Caralluma wissmannii* | Dawidar et al., 2012 |
| | *Caralluma adscendens var. gracilis* | Reddy et al., 2011 |
| | *Caralluma adscendens var.fimbriata* | Kunert et al., 2008 |
| | *Caralluma dalzielli* | De Leo et al., 2005 |
| | *Caralluma negevensis* | Braca et al., 2002 |
| | *Caralluma russeliana* | Al-Yahya et al., 2000 |
| | *Caralluma retrospiciens* | Halim and Khalil., 1996 |
| | *Caralluma umbellata* | Lee-Juian et al., 1994 |
| | *Boucerosia aucheriana* | Tanaka et al., 1990 |
| | *Boucerosia aucheriana* | Hayashi et al., 1988 |
| | *Caralluma tuberculata* | Ahmad et al., 1988 |
| Acylated Pregnane glycosides | *Caralluma quadrangula* | Abdallah et al., 2013 |
| | *Caralluma sinaica* | Al-Massarani et al., 2012 |
| | *Caralluma tuberculata* | Abdel-Sattar et al., 2008 |
| | *Caralluma russeliana* | Abdel-Sattar et al., 2007 |
| Pregnane glycoside diesters | *Caralluma russeliana* | Abdel-Mogib and Raghib, 2013 |
| Oxy Pregnane glycosides | *Caralluma pencillata* | Abdel-Sattar et al., 2002 |
| | *Caralluma pencillata* | Abdel-Sattar et al., 2001 |
| Polooxy Pregnane glycosides | *Caralluma retrospiciens* | Halaweish et al., 2004 |
| Steroidal glycosides | *Caralluma umbellata* | Kunert et al., 2009 |
| | *Caralluma stalagmifera* | Kunert et al., 2006 |
| | *Caralluma dalzielii* | Oyama et al., 2007 |
| | *Caralluma lasiantha* | Qiu et al., 1999 |
| | *Caralluma umbellata* | Qiu et al., 1997 |
| | *Caralluma indica* | Kunert et al., 2006 |
| Acylated steroidal glycosides | *Caralluma tuberculata* | Waheed et al., 2011 |
| Pregnane steroids/pregnanes | *Caralluma umbellata* | Ramesh et al., 2005 |
| | *Caralluma pauciflora* | Reddy et al., 2011 |
| | *Caralluma umbellata* | Kishore et al., 2010 |
| | *Caralluma umbellata* | Babu et al., 2008 |
| Pregnane ester aglycones | *Caralluma retrospiciens* | Khalil, 1995 |
| Triterpenoid | *Caralluma attenuata* | Jayalakshmi et al., 2016 |
| Terpenoids | *Caralluma europaea* | Formisano et al., 2009 |
| β-sitosterol, lupeol | *Caralluma wissmannii* | Dawidar et al., 2012 |
| | *Caralluma adscendens var. gracilis* | Reddy et al., 2011 |
| | *Caralluma truncato-coronata* | Kalimuthu et al., 2013 |
| Rutin | *Caralluma nilagiriana* | Renuka, 2014 |

In continuation to the above list of phytochemicals collection, efforts of various researchers on their study pertaining to different species of *Caralluma* are compiled in Table-1.

## CONCLUSION

*Caralluma* is a genus used as traditional medicine and is a potential source for phytochemicals with medicinal uses. Thorough literature collection shows few species of *Caralluma* are explored for

isolation of phytochemicals from them. Enthusiastic researchers in this field can extend their investigation for further exploration of many other species (like *Caralluma acutangula*, *Caralluma Arabica*, *Caralluma cicatricose*, *Caralluma edulis*, C*aralluma Europaea*, *Caralluma longidens*) for phytochemicals present in them.

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