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A Precious Remedial Plant Asteracantha longifolia (Nees.) – Comprehensive Review

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ABSTRACT

Asteracantha longifolia was widely used in the Indian system of medicine for the treatment of various disorders. It has been utilized to treat for Premeham (Diabetes), Athisaram (Dysentery). Writing review on Asteracantha longifolia was done by means of electronic hunt in Google, Pub Med, Google Scholar, Science Direct, Web of Science, Shodhganga, Examine.Com and a Library look. Results uncovered that a particular organic portrayal of the plant is as yet not accessible. Since ethnobotanically the plant is of much significance, science of the plant yet should be completely investigated. These multiple uses can be explained by its several active compounds. The phytochemical studies on Asteracantha longifolia have revealed the mainly presence of Flavonoids, alkaloids, fatty acids, enzymes, minerals, polyphenols, phytosterols, vitamins, proanthocyanins, mucilage, amino acids, carbohydrates, hydrocarbons, terpenoids and glycosides, etc. Several pharmacological studies on Asteracantha longifolia extracts have been reported in the literature mainly Anti-microbial activity, Hepatoprotective activity, Anti-cancer activity, Anti-diabetic activity etc. The present review is therefore, an effort to give a detailed survey of the literature on traditional, phytochemical and pharmacological properties of Asteracantha longifolia.

Keywords: Medicine, Asteracantha longifolia, Ethnobotancial, Phytochemical, Pharmacological uses

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INTRODUCTION

Traditional medicine, on the contrary of pharmacotheraphy, can be effectively available and prepared to utilize particularly in tropical nations, so it has a vital part in first line approach. For instance, in Burkina Faso, 90% of individuals want to utilize traditional medicine [1]. Over the most recent couple of years, there has been an exponential development in the field of herbal medicine, and these medications are picking up prominence both in developing nations in light of their characteristic root and less side effects [2]. Natural prescriptions have been generally practiced all through the world from old time. These prescriptions are protected and condition agreeable. About 80% of the total populace relies on conventional frameworks of medicinal services. In India, more than 9500 natural therapeutic plants and furthermore 8000 higher plants have been utilized as a part of the Indian medicinal businesses (3,4).

Among different medicinal plants, *Asteracantha longifolia* Nees (Family Acanthaceae) is developing as a supernatural occurrence herb with a verifiable foundation since numerous scientists uncovered its wide range of pharmacological potential. *Asteracantha longifolia* Nees [Syn. *Hygrophila auriculata* (Schum), *Hygrophila schulli* (Ham.) MR & SM Almeida, *Hygrophila spinosa* T. Anders, *Barleria auriculata* Schum and *Barleria longifolia* Linn) Heine Acanthaceae] is a therapeutic plant which is utilized as a part of a few ailments. It is a broadly herb regularly found in moist places of banks of tanks, ditches and paddy fields all through India, Sri-Lanka, Burma, Malaysia, and Nepal. The plants are depicted in the ayurvedic writing as Ikshura, Ikshagantha and Kokilasha having eyes like the Kokila or the Indian Cuckoo. It is arranged in the ayurvedic arrangement of pharmaceutical as Seethaveryam, Mathuravipaka and is utilized for the treatment of various conditions including Premeham (Diabetes) and Athisaram (Dysentry) (5-9).

Phytochemical investigations of plant parts different extracts confirmed that the presence of Flavonoids, Alkaloids, Triterpenes and Sterols *etc.* (10-12). Pharmacological investigations have revealed its Anti cancer activity (13-16), Antioxidant activity (17), Antidiabetic activity (65), Antibacterial activity (18-20), Anthelmintic activity (20), Hepatoprotective activity (21-26) *etc.* In this way, we planned to arrange a

forward and exhaustive survey that covers the present information on morphology, phytochemistry, biological effects and traditional uses controlled by *Asteracantha longifolia*.

MATERIAL AND METHODS

The authors sought and downloaded the distributed papers identified with *Asteracantha longifolia* from 1887-2017 from the distinctive databases like Google, Pub-Med, Google Scholar, Science Direct, Web of Science, Shodhganga, Examine.com and a Library look. The articles in which in any event dynamic isn't in English were not considered for this examination. We extricated and assembled the data which is identified with its Phytochemistry and Pharmacology under the distinctive subheadings. All identified chemical compounds were enlisted in tabular form. So far, we realize that this will be first review paper in science direct database of *Asteracantha longifolia*. Biological activities gave by (figure 11).

Plant Profiles

Asteracantha longifolia is an important medicinal herb with multi-dimensional therapeutic significance **Scientific Classification**

The scientific classification of <i>Asteracantha longifolia</i> is demonstrated as follows [27]						
Kingdom	:	Plantae				
Division	:	Tracheophyta				
Class	:	Magnoliopsida				
Super order	:	Asteranae				
Order	:	Lamiales				
Family	:	Acanthaceae				
Genus	:	Asteracantha				
Species	:	longifolia Nees				
Vernacular Na	mes					
The vernacular	Names	s of Asteracantha longifolia is described a follows [28-29]				
Language		: Common name				
English		: Long- leaved Barlevia				
Sanskrit		: Iksura, Kokilasha				
Bengali		: Kuliyakhara				
Gujarati		: Ekharo				
Hindi		: Talmakhana, Talmalkhana				
Kannada		: Kolavalike				
Oriya		: Koillekha				
Malyalam		: Nirmuli , Vayalculli				
Marathi		: Talimakhana				
Tamil		: Golmidi,Nirmulli				
Urdu		: Talmakhana				
Kashmiri		: Talimakhana, Talmakhan				
Synonyms						

Asteracantha longifolia Nees, Hygrophila auriculata (Schumach.) Heine. Hygrophila spinosa T. Anders, Barleria auriculata Schum, Barleria longifolia Linn) [28].

Habitat and Distribution

Asteracantha longifolia Nees is a wild herb. It is commonly found in moist places, Banks of Rivers, Ditches and paddy fields. And this plant throughout India, Sri-Lanka, Myanmar, Indonesia, Burma, Africa, Malaysia and Nepal. [30-33].

Botanical Description

The plant is a sub shrub annual herb and stout, usually growing in marshy places along water courses. The stem is reddish brown and the shoot has 8 leaves and six thorns at each node. The leaves subsessile, occur in whorls, the outer pair of leaves are larger, oblong lanceolate, scalerous, and margins are minutely dentate, sub sessile, thorns strong straight or curved. Spines yellowish brown, 2-3 cm long. Flowers yellowish brown Occur in axillary whorls, bract and bracteoles leafy. Calyx four lobed, lobes unequal. Corolla, -5 petals gamopetalous, unequally 2- lipped, middle lobe of the lower lip with yellow palate; corolla purple colored. Stamens - four, in two pair, filaments unequal; anthers divergent; ovary two celled; four ovules in each cell. Fruit dehiscent capsule two celled, linear oblong, compressed about 8 cm long, pointed, 4-8 seeded. Seed ovate, flat or compressed, 0.2-0.25 cm long and 0.1-0.15 cm wide, hairy but appearing smooth; when soaked in water immediately get coated with mucilage, light brown: taste slightly bitter and odor not distinct [34-37].

TRADITIONAL USES

A.longifolia extensively used in traditional system of medicine for various ailments and this plant finds mention in Ayurvedic treatise like "Sushruta Samhita" and "Charka Samhita" as Rasayan or rejuvenator. The word Rasayana is composed of two words "Rasa" meaning "elixir" and "Ayana" meaning house. The word therefore signifies property of the plant that helps to rejuvenate the system. It is classified in ayurvedic system as Seethaveeryam, Mathuravipaka. It is used for the treatment of diabetes, dysentery etc. (1) Jaundice, (2) Dropsy, (3) Rheumatism, (4) Hepatic obstructions, (5) Dissolution of gallstones, (6) Kidney stones, (7) Liver dysfunction, (8) Edema, (9) Gout, (10) Diseases of Urinogenital tracts,(11) Inflammation, (12) Pain, (13) Malaria, (14) Impotence, (15) Aphrodisiac, (16) The seeds are used as ingredients in various aphrodisiacs and tonic confections, and in The treatment of blood disorders, biliousness, gonorrhoea, spermatorrhea and fever. The Seeds are ground into a paste and given in buttermilk to cure diarrhea. AKSIR-ULIMRAZ, a preparation having Talamkhana (seeds) as one of the ingredients, is used to prevent leucorrhea, (17) The ashes of the plant are also used against dropsy and gravel, (18) A Tincture of the whole plant is beneficial in urinary affections, dysuria, and painful. Micturition, (19) A root decoction drunk to combat rheumatism, gonorrhea, and hepatic obstruction, (20) The leaves are diuretic, sweet, tonic, aphrodisiac, hypnotic and useful in the treatment of cough, diarrhoea, thirst, urinary calculi, urinary discharges, inflammations, (21) Spermatorrhoea [38-51]. The plant parts have been used in several ayurvedic preparations are shown on Table-1.

PHYTO CHEMICAL ANALYSIS & CHEMICAL COMPOSITION

The plant contains a diversity of biologically compounds such as alkaloids, waxy substances, gum, phytosterols, fatty acids, minerals, polyphenols, proanthocyanins, mucilage, alkaloids, enzymes, amino acids, carbohydrates, hydrocarbons, flavonoids, terpenoids, vitamins, glycosides, Reducing sugars, Essential Oils, gums *etc.* Minerals like Calcium, Magnesium, Potassium, Iron, Copper, Zinc, Manganese, Cobalt and Chromium present in various part of this plant.

The chemical constituents, structure (**Figure** 2-10) and their biological activities of *A.longifolia* are shown in Table 2.

PHYSICO-CHEMICAL ANALYSIS OF ASTERACANTHA LONGIFOLIA

The Physico-chemical characters of powderd drug of *Asteracantha longifolia* such as Alcohol soluble extractive, Water soluble extractive, Total ash, Acid insoluble ash, Water – soluble ash, Loss on drying, swelling index, Foreign matter are present [34].

Alcohol soluble extractive - 5.12 %

Water soluble extractive	- 24.96%
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Total ash	- 9.90 %
Acid insoluble ash	- 1.48%
Water – soluble ash	- 8.35%
Loss on drying	- 6.30 %
Swelling index	- 2.0 %
Foreign matter	- 1.10%
O I	C A

8. In-vitro culture of Asteracantha longifolia

Ethyl methyl sulfonate EMS treated leaf explants were growth in MS medium fortified with BA and NAA added. Were analyzed at morphological, phytochemical and molecular level measured. And then RAPD analysis involving 30 primers generated 185 amplified products. Compared to control plant getting on good result [52]. The chromosome number of *Astercantha longifolia* (L.) Nees- A medicinal herb-found to be 2n = 2x = 32. Karyotype analysis revealed eight ($6Am + 4B_{sn}+4C_{st}+4Dm+4Esm+4Fst+2Gt+4H_{sm}$). The chromosome length varied from 1.43 to 3.32 pm. The karyotype was symmetric in nature with TF% = 32.8. Meiotic analysis showed the gametic number n= 16 consistently with an average of 15.65 ± 0.65 n and 0.7 ± 0,981. The meiocytes revealed predominance of ring bivalents (10.05 ± 0.76) over rod bivalents (5.6 ± 0.68), which had mostly terminalised chiasmata with terminalization coefficient of 0.89. Anaphase-I segregation showed normal 16:16 separation to two poles, although univalents in the form of laggards were often observed. Pollen stainability was $80.3\pm8.63\%$ indicating the partial heterozygosity in constituent genome of *A. longifolia* [53].

Khanday [54] researched concerned to develop a rapid system for regenerating shoots and callus from mature shoot tip explants of *Asteracantha longifolia*. Effective shoot and callus regeneration was observed by using several concentrations of cytokinins and auxins with MS medium. This result of this experiment plant tissue culture may prove to be a helpful method to develop a rapid system of regeneration for production of medicinally important plant products.

Biological activities

Asteracantha longifolia is an important medicinal plant due to the wide range of pharmacological effects consolidated from traditional use for centuries and reported in literature. An review of several scientific reports of the most important biological activities of *Asteracantha longifolia* in the following paragraphs. 1st scientific article of this plant published on 1887 [55].

Anti-cancer activity

The anti-tumor activity of seeds of *A.longifolia* against experimental hepatocarcinogenesis in rats. They also stated that the seeds significantly ameliorated the activities of antioxidant enzymes glutathione peroxidase and catalase in a dose dependent manner [13]. The petroleum ether extract of the roots of *H*. spinosa exhibited anti-tumour activity in Ehrlich ascites carcinoma and sarcoma-180 bearing mice (14). An hydroalcohlic extract of whole plant of *H. spinosa* at a dose of 300mg/kg body weight showed significant anti-tumour activity against 7,12-dimethylbenz(a)anthracene (DMBA) induced mammary tumours in female rats comparable with tamoxifen as a standard drug (15).

The effect of *H. auriculata* on carbohydrate metabolizing enzymes in N-nitrosodiethylamine induced hepatocellular carcinoma in rats. The methanolic extract of *H. auriculata* (200mg/kg) produced significant decrease in hexokinase, phosphogluco-isomerase, aldolase, while increased glucose-6phosphatase in the plasma and liver of carcinoma bearing rats at the end of the treatment period (28 days). However, the changes in the above parameters were comparable with control. Thus, methanolic extract of *H. auriculata* reverted the altered carbohydrate metabolizing enzymes which is associated with biochemical changes of hepatomas to near normal in HCC bearing rats due to the presence of polyphenols and flavonoids (16). The Ethanolic extract of fruits A.longifolia getting good result of anti-cancer activity (56). An petroleum ether extract of Aerial part of A.longifolia showed significant mammary tumor activity and antioxidant activity against 7, 12-Dimethylbenz (a) anthracene (DMBA) in Sprague Dawley rats (57). Antioxidant activity

Anti-oxidant activity in screened 28 different plant species of Nepalese medicinal plants including seeds of A. longifolia used traditionally in indigenous system of medicine to treat inflammatory diseases for the inhibitory effect on lipid peroxidation and reported that the plant inhibited lipid peroxidation with an IC50 value of 20 ug/mL (58). Free radical scavenging potential of aqueous, alcoholic and different fraction of whole plant of *H. auriculata* was evaluated by using 1,1'-diphenyl-2-picryl-hydrazyl (DPPH), deoxyribose degradation against OH•, nitric oxide and lipid peroxidation radical assays. Vitamin E was used as a standard for the study. The results of study revealed the n-butanol fraction exhibited the potent free radical scavenging activity in dose dependant manner and comparable to the standards vitamin E (59).

The alcoholic extract of seeds of *H. auriculata* exhibited strong scavenging effect on 2, 2-diphenyl-2-picryl hydrazyl (DPPH) free radical, superoxide, nitric oxide radical and ABTS radical scavenging assay. The free radical scavenging effect of *H. auriculata* extract was comparable with that of the reference antioxidants. The obtained data of the study suggests that the extract of *H. auriculata* seed have potent antioxidant activity against free radicals, prevent oxidative damage to major biomolecules and afford significant protection against oxidative damage (60). The antioxidant activities of this plant methanolic extract of leaves revealed good radical scavenging activities and reducing power activities which were found to increase with the increasing concentration of the extract. Carried out by good result of DPPH free radical scavenging assay, ABTS++ radical cation scavenging assay OH+ radical scavenging assay, NO+radical scavenging assay, Fe2*chelation assay, Fe3*reducing power assay and phosphomolybdenum reduction assays (61). An in vitro antioxidant activity of aqueous extract of Root using FTC and TBA Methods. The extract exihibit significant antioxidant activity (22). The Aqueous extract of whole plant exihibit good radical scavenging activity (62). The A.longifolia methanolic extract whole plant gives good result of free radical scavenging activity (63). The antioxidant activity of the leaves aqueous extract studied. The extract exhibit strong antioxidant activity (64). The antioxidant and antidiabetic activity the aerial parts hydroalcoholic extract from A.longifolia were studied. The 2 organs liver and kidney exhibited strong antioxidant activity using the GSH, GPx, CAT, SOD Assays (66).

An Aqueous extract of leaves were studied antioxidant and antidiabetic activities. The good antioxidant properties exhibited on organs (65). The methanolic extract of flowers of presence of high flavonoid content. Antioxidant activity of flowers same extract examined by nitric oxide radical scavenging and DPPH assays for various concentrations. All over the flower extract potent high radical scavenging activity (67).

Anti-microbial activity

The anti-microbial property of ethanolic extract of leaves, stem, fruits and root of *H. auriculata* against Staphylococcus aureus, Pseudomonas aeroginosa, Bacillus subtilis, Escherachia coli, Candida albicans and *Mycobacterium smegmatis* and reported that the leaves exhibited active anti-microbial activity against *S*.

aureus, B. subtilis, C. albicans and M.smegmatis (18). An anti-microbial property of ethanolic extract of leaves, stem, fruits and roots of H. auricalata against Staphylococcus aureus, Pseudomonas aeroginosa, Echterachia coli, Candida albicans, Tricophyton mentagraphytes and Mycobacterium canis and reported that the leaves exhibited active anti-microbial activity against S. aureus, C. albicans, M. canis and T.mentagraphytes, stem exhibited activity against C. albicans, M. canis and T. mentagraphytes (19).The antibacterial activity of petroleum ether, chloroform, alcoholic and aqueous extracts of leaves of H. spinosa against Escherachia coli, Staphylococcus aureus, Bacillus subtilis and Pseudomonas aeroginosa evaluated by disc-diffusion methods. The chloroform and alcoholic extract exhibited significant antibacterial activity, whereas the aqueous extract has moderate effect and petroleum ether extract was showed least action against the microorganismS (20).

The 200 µg/ml crude methanol extract showed higher inhibition zone than crude aqueous extract against *S. aureus, S. pneumoniae, E. coli* and *P. aeruginosa*. The total Antifungal activity was highest for methanol extracts of against *S. aureus*. These results support this view as methanol extracts had comparatively more inhibition action than aqueous extracts. And then methanol extracts of this plant possess broad spectrum of antibacterial activity against the test bacteria species (68). Antimicrobial activity of the ethanolic extract of the *Hygrophila auriculata* leaf was 50, 100, & 200µl of the extract studied against five bacterial pathogens such as *Escherichia Coli, Citrobacter divergens, Enterobacter faecalis, Klebsiella pnemoniae and serratia marcescens*. And various fungal pathogens such as *Aspergillus niger, aspergillus flavus, Aspergillus fumigatous, Rhizobus inducum and Fusarium sps.* The well diffusion method using various microorganisms. The effects of x- ray on the extract were also screened, where higher dosages gave maximum activity compared to lower and normal. This study gives a new route to discovery of new drug with and without x- ray interaction (69).

The antibacterial activity of methanol extract of *Abutilon indicum, Hygrophila spinosa and Mimosa pudica* were studied by agar well diffusion method *in vitro*. The various bacterial pathogens was used this examination such as *Escherichia coli, Pseudomonas aeruginosa, Staphylococcus aureus, Bacillus cereus, Proteus vulgaris, Enterococcus faecalis, Klebsiella pneumoniae, Vibrio cholerae, Salmonella typhi* and *Salmonella paratyphi*. The methanol extract of these medicinal plants have showed significantly inhibit on different bacterial pathogens. Concluded this examination the methanol extracts was found to be more effective and compared with the standard antibiotics Kanamycin (70).

Eleven bacterial endophytes were isolated from surface sterilized leaf, stem and root tissues. These bacterial endophytes produced enzymes like catalase, amylase, gelatinase, nitrate reductase and lipase. The bacterial isolates belonged to the genera *Bacillus, Paenibacillus, Pseudomonas, Ralstonia, Staphylococcus, Micrococcus* and *Acidomonas*. The bacterial endophytes of *H. spinosa* give a definite stamp on their antimicrobial activity against *E. coli* and *K. pneumoniae* followed by *S. aureus*. Two isolates, *Paenibacillus* HGS 202 and *Acidomonas* HGR 302 obtained from Stem and root segments respectively showed antimicrobial activity against *B. subtilis, B.cereus, E. coli, K. pneumoniae* and *S. aureus*. This research shows the identified 11 bacterial endophytes harbored by the leaves, stem and root of *H. spinosa* which demonstrated antibacterial activity against Gram-positive as well as Gram-negative bacterial strains (71).

The antibacterial and antifungal activity of *H. schulli* seven various solvent extracts leaf and root of hexane, chloroform, dichloromethane, ethyl acetate, acetone, methanol and water. This plant extracts against bacterial and fungal pathogens. Different concentrations of cold methanolic extracts were tested against *S. epidermidis* and *K. pneumoniae* and they showed the highest inhibition zones of 27 mm and 26 mm respectively at 400 mg/ml. The results revealed that the leaf extracts of *H. schulli* have promising antibacterial activity than the root extracts. The leaf and root extracts did not show antifungal activity against the tested fungal pathogens (72). Diethyl ether extract of *Hygrophila auriculata* Plant shows antimicrobial activity against the tested organisms in the order of *S.epidermidis* (22mm), *E.coli* (17mm), *Corneybacterium* (12mm), *Vibrio cholerace* (9mm), *E.fecalis* (20mm), *Salmonalla typi* (19mm). In case of fungi, antimicrobial activity against tested organisms was in the order of *C.albicans* (11mm) and *A.niger* (9mm). Maximal antibacterial activity is observed against *S.epidermidis* while maximal antifungal activity is against *Candida albicans*. This examination shows for *Hygrophila auriculata* extract against for *S.epidermidis* 22mm inhibition of good result (73). The antibacterial activity of *Asteracantha longifolia* whole plant chloroform against extract against various bacterial pathogenes showed significant inhibit activity (Egami *et al.*, 1998).

Aqueous and methanolic extract of whole plant showed significant activity against different bacterial and fungal pathogens (74). Antibacterial activity of aqueous and methanol extracts from 4 medicinal plants such as *Asteracantha longifolia*, *Brachira sp, Trichodesma indicum*, *Abutilon indicum* against *Staphylococcus aureus*. The good results exhibit of *Asteracantha longifolia* extract potent inhibit of

Staphylococcus aureus. This study used method by Disc diffusion method and importantly measured MIC (75).

Antidiabetic activity

An hypoglycaemic activity of aqueous extracts of whole plant of *A. longifolia* and started that the extract significantly lowers the not eat blood glucose level. Significantly recovers the levels of glucose tolerance of rats at a therapeutic dose equivalent to 5 g/kg of starting material (**76**). *H. auriculata* ethanolic extract of the aerial parts of selected doses of 100 and 250 mg/kg body weight for 3 weeks displayed significant reduction in blood glucose, thiobarbituric acid reactive substances (TBARS) and hydroperoxide in both liver and kidney. Chemically diabetis induced by streptozotocin in rats. The ethanolic extract of aerial parts of *H. auriculata* treated rats for significantly increased the glutathione (GSH), glutathione peroxidase (GPx), glutathione *S*-transferase (GST) And catalase (CAT) in the drug-treated group, which is comparable to the control group. The of *H. auriculata* ethanolic extract treated rats and glibenclamide-treated rats also showed decreased lipid peroxidation that is associated with increased activity of superoxide dismutase (SOD) and catalase. This study indicated *H. auriculata* ethanolic extract of aerial parts of possessed significant anti-diabetic activity beside with potent antioxidant possible in diabetic conditions (66).

An *H. spinosa* chloroform, ethyl acetate and alcoholic roots extracts of tested for their antidiabetic activity in alloxan-induced diabetic rats. The ethyl acetate and alcoholic extracts at a dose level of 200 mg/kg, p.o. have shown significant anti-diabetic activity (77). *A.longifolia* aqueous extract of leaves showed significant antidiabetic activity against alloxan (65). Antidiabetic activity of methanolic extract of *H.auriculata* exhibit potent antidiabetic activity chemically induced by Streptozotocin (STZ) at a dose of 50 mg/kg body weight. Additionally, acute toxicity test of this extract showed no mortality and no changes of morphology (78). Antidiabetic activity of *A.longifolia* methanol and aqueous extract of leaves Diabetic condition chemically induced by Alloxan. Methanol extract by oral administration diabetic condition rats reduced blood glucose levels in both acute and sub-acute toxicity study. This result showed this plant extract significant showed antidiabetic activity (79).

Anthelmintic activity

An anthelmintic activity of *H. spinosa* petroleum ether, chloroform, alcoholic and aqueous extracts of leaves of against *Pherithima posthuma* as a test worms in various concentration (10-100 mg/ml) were tested in the bioassay, which involved determination of time of death of the worms and time of paralysis worms. The alcoholic extract showed the significant anthelmintic activity at higher concentration 100 mg/ml compare to chloroform and aqueous extracts (**20**).

Anti-nociceptive activity

An *H. auriculata* aqueous extracts at the aerial parts and roots of at the selected dose of 200mg/kg p.o exhibited significant potent antinociceptive activity in animal model against of induced thermally by analgesia in mice (**22**). The *H.spinosa* Petroleum ether, choloroform, alcoholic and aqueous extracts of the leaves of were potent for analgesic activity. The chloroform, alcoholic and aqueous extracts at dose of 200 and 400 mg/kg of body weight significantly inhibited the abdominal constriction produced by acetic acid and also increased the pain threshold of mice and towards the dose dependent manner comparable to the standard drug aspirin (100 mg/kg of body weight) (**80**).

Anti-inflammatory and antipyretic activity

Anti-inflammatory and antipyretic activities of the *H. spinosa* petroleum ether, chloroform, alcoholic and aqueous extracts of the leaves. The anti-inflammatory activity of the various extracts was studied based on their effects on carrageenan-induced paw oedema in rats while antipyretic activity was evaluated on the basis of their effect on Brewer's yeast induced pyrexia in rats. Chloroform and alcoholic extracts exhibited significant anti-inflammatory and antipyretic activities. On the other hand, petroleum ether and aqueous extracts did not show anti-inflammatory and antipyretic effect. Anti-inflammatory activities highly produced by the chloroform and alcoholic extract dose at 400 mg/kg body weight (26). Antipyretic activity of the alcoholic extract of leaves and roots of *H. spinosa* using Brewer's yeast-induced pyrexia in rats. Both the extracts significantly reduced the increased rectal temperature and exhibited potent antipyretic action in animal model at a dose of 200 and 400 mg/kg body weight (81).

Antiinflammatory and analgesic properties ethanol and hexane extract of the seeds of *H. schulli*. Carrageenan-induced paw oedema, Eddy's hot plate test, tail immersion method were used. Results of this study clearly showed of the extract able to reduced carrageenan induce the paw oedema. *H. schulli* seed extract two models pain threshold capacity, and producing analgesic. Conclude of this study extracts potent Anti-inflammatory and Anti-nociceptive effects (82). The chloroform extract of aerial part of *H.auriculata* was screened for different study like acute toxicity study, analgesic activity by Methods of thermal (hot plate) and chemical methods (acetic acid induced writhing) and anti-inflammatory activity was assessed on the basis of effect on formalin induced- arthritis (paw edema) in rats and measured by

slide calipers method. This study was concluded *H.auriculata* chloroform extract of aerial part exhibited analgesic and anti-inflammatory effects by central and peripheral mechanism (59).

An Separate terpenoid fraction (TF) from alcohol (70%) extract of the *Hygrophila auriculata* whole plant of and assessment of its anti-inflammatory activity. HPTLC results of TF was performed for the estimation of Lupeol. Chemically Edema was induced in Wistar albino rats by Carrageenan into the right hind paw after 1 h of TF administration (100 and 200 mg/kg oral). Septic shock was induced by intraperitoneal administration of LPS (100 mg/kg) in rats. Author used by parameters blood serum analysis of blood biochemical parameters and extra parameters analyzed such as interleukins (IL-1b and IL-6), tumor necrosis factor (TNF-a), superoxide dismutase (SOD), lipid peroxidation (LPO), and nitric oxide (NO). Auto Dock 4.2 was used for molecular docking. The Result of this experiment TF significantly (p50.005) restored the serum levels of cytokines, LPO (7.77 \pm 0.034 versus 4.59 \pm 0.059 nmole of TBARS), NO (9.72 \pm 0.18 versus 4.15 \pm 0.23 mmol nitrite/mg of wet tissue), and SOD (4.89 \pm 0.036 versus 7.83 \pm 0.033 Unit/mg protein) compared with the LPS-challenged rats. The results findings suggest that TF of *Hygrophila auriculata* possesses great promise as an anti-inflammatory agent which may be due to its antioxidant effect. Molecular docking results could be exploited for lead optimization and development of suitable treatment of inflammatory disorders (83).

The ethanol extract of whole plant of *Asteracantha longifolia* exhibit significant analgesic activity. Chemically formalin induced pain and acetic acid induced writhing test in mice. Anti-inflammatory effects were determined by ear swelling induced by croton oil, xylene induced ear edema, leukocyte migration induced by carrageenan, cotton pellet induced granuloma formation. Crude ethanol extract Exhibit a significant inhibition of ear swelling caused by croton oil and xylene in mice. Extract decreased leukocyte migration induced by carrageenan, also inhibited the weight of granuloma induced by a cotton pellet, as well as the formalin-induced pain extract caused significant inhibition of abdominal constrictions caused by acetic acid. Likewise, the extract also showed moderate analgesic activity on the hot plate pain threshold in mice. These results concluded the plant may contain bioactive compounds possessing anti-inflammatory and analgesic activities (84).

Antimotility activity

Antimotility activity was assessed by charcoal meal feeding method and atropine sulphate at a dose of 0.1 mg/kg (i.p.) was used as the standard drug. The alcoholic extracts of leaves of *H. spinosa* at a dose of 400mg/kg body weight significantly decreased by distance travelled on charcoal meal through the gastrointestinal tract. These results indicated that the plant extracts showed significant Antimotility activity (20).

CNS activity

Phyto compound analysis of the petroleum ether extract of root of *H. spinosa* reported for the presence of active constituents like lupeol and lupenone. Both compounds reported that the i.p. administration of crude petroleum ether extract in mice potentiated the sedative-hypnotic action of chlorpromazine, diazepam, phenobarbitone, chlordiazepoxide and protected against strychnine induced convulsions **(85)**.

Diuretic activity

Diuretic activity of aqueous, alcoholic extract and various fraction of alcoholic extract of whole plant of *H. auriculata* was evaluated. The diuretic effect was examined by treating different groups of Wistar Albino rats with single (200 mg/kg) oral doses of alcoholic extract/fractions. Furosemide (10 mg/kg) was used as positive control in the study. Out of the different fractions and extract, the n-butanol fraction (200 mg/kg) significantly and markedly increased the urine output. The pattern of diuresis induced by the n-butanol fraction was shown almost similar to that produced by the Furosemide (86). Diuretic activity of the alcoholic extract of seeds of *H. auriculata* (300 mg/kg and 500 mg/kg p.o.) were investigated by calculating the total urine output over 24hrs and electrolytes (sodium, potassium and chloride) estimation in Wistar rats (n=6). Frusemide (20 mg/kg, p.o), a high ceiling diuretic served as positive control and normal saline (25 ml/kg, p.o) as placebo control. The alcoholic extract of *H. auriculata* showed significant diuretic properties. Increase in urine volume was significant only at 500mg/kg (87).

Erythropoietic activity & Haematinic effect

The erythropoietic activity ethanolic extract of *A. longifolia* at the doses of 100 mg/kg and 200 mg/kg body weight, i.p., demonstrated a significant (P<0.05) increase in erythrocyte count, haemoglobin count, serum iron and serum protein *etc.* This study estimated by spectrophotometric method. The ethanolic extract of *A. longifolia* effectively restored on hematological parameters, serum iron and serum protein and normalized the microcytic (smaller in size), anisocytosis (disturbed shape) and hypochromic RBCs (**88**). An ethanolic extract of aerial parts of *H. spinosa* at the dose of 100 and 200 mg/kg/p.o significantly increased the haemoglobin, haematocrit and RBC in anaemic male rats. In this examination shows the ethanolic extract of aerial parts significant potent haematinic activity (89). Pre flowering and flowering leaf extract of *Asteracantha longifolia* potent haematinic activity. Observed by Haematological

parameters, blood biochemical parameters, micro elements in serum was observed. The results suggested the plant possess hematinic effects in rats (90).

Hepatoprotective Activity

H. auriculata methanolic extract of the seeds of at the dose of 200 mg/kg. p.o. showed potent hepatoprotective activity against paracetamol and thioacetamide induced liver damage in rats (21). An Aqueous extract of the roots of *H. auriculata* at the dose of 150 mg/kg/p.o. exhibited potent Hepatoprotective activity-against carbon tetrachloride induced liver damage in rats. And in vitro antioxidant activity has done by the assays of FTC, TBA. Significant potent the aqueous extract of hepatoprotective activity (22). The aqueous extract of *A. longifolia* was tested for hepatoprotective activity against carbon tetra chloride and paracetamol induced acute hepatotoxicity in mice. Plant Extract showed significant hepatoprotective activity by reducing carbontetra chloride and paracetamol induced changes in biochemical parameters that were evident by enzymatic examination. The plant extract may interfere with free radical formation, *A. longifolia* elicited significant hepatoprotective activity against carbon tetra chloride and paracetamol, comparable with standard drugs (23).

The *A. longifolia* whole plant slurry was tested against Ccl₄ induced liver damage in rats. The plant showed significant Hepatoprotective activity by reducing carbontetra chloride induced changes in biochemical parameters that were evident by enzymatic examination. The whole plant slurry of *A. longifolia* showed significant hepatoprotective activity against carbon tetra chloride, comparable with a known standard drug Silymarin (24). An antihepatotoxicity of the ethanolic extract of *H. spinosa* roots was carried out using CCl4 induced antihepatotoxic in albino rats. Standard drug for Silymarin used this examination at the dose of 25 mg/kg, p.o and extract showes significant Hepatoprotective activity (25). *H. spinosa* Aqueous extract of the roots at the dose of 200mg/kg/p.o. showed potent Hepatoprotective activity of *Hygrophila auriculata* ethanolic extract of whole plants against chemically induced by mercury chloride. HgCl₂ (1 ml/kg b.w, i.p) caused liver damage and oxidative stress. This plant extract protect the liver. Evidenced by analysis of blood biochemical parameters, lipid peroxidation and antioxidant enzymes. These results suggested by ethanolic extract of whole plant showed significant liver protective activity and antioxidant activity (91).

An Hepatoprotective activity of *Hygrophila auriculata* total alkaloid fraction of the methanol extract of leaves showed significant Hepatoprotective activity in male albino wistar rats and Hep-liverG2 Cell line. Liver damaged by Ccl4. Liver damage determined by MTT Assay by in vitro. Cell viability measured by dose dependent increase then observed protect the cell line. In vivo Hepatoprotective activity done by Blood biochemical parameters and histopathological analysis of liver. These results exhibit total alkaloid fraction of *H.auriculata* methanolic extract of leaves potent Hepatoprotective activity (92). The Hepatoprotective effect of aqueous crude extract of leaves *Hygrophila auriculata* exhibit significant Hepatoprotective activity against ccl4. Phytochemical analysis of this extract presence of flavonoids and polypenoid compounds. Hepatotoxicity induced by ccl4. Blood biochemical parameters increased then extract reduced blood biochemical parameters. Viz MDA, GSH, Protein, Bilirubin, SGOT, ALP and SGPT. This results concluded by the extract potent Hepatoprotective activity (93). An methanolic extract of whole plant *Hygrophila auriculata* showed hepatocellular protective activity chemically liver damage or tumour produced by N-Nitrosodiethylamine Albino wistar strain rats . After 28th day analysis for total proteins and nucleic acids assayed compared to control groups. These results concluded methanolic extract *H.guriculata* reverted the altered level of total proteins and nucleic acids which is regulated variously during tumour growth and associated with development of hepatomas to near in HCC bearing rats due to the presence of polyphenols and flavonoids in the extract (94).

Photochemical analysis of aqueous extract of *A. longifolia* leaves indicates the presence of flavonoids, tannins, glycosides, phenol, steroids, alkaloids, quinone, saponin, and Coumarin. Carbon tetrachloride (CCl4) induced hepatotoxicity in male albino wistar rats was administered orally at a dosage of 20 mg/kg body weight. The aqueous extract *A. longifolia* (150 mg/kg body weight orally administered. Standard drug used for this study Silymarin (20 mg/kg body weight orally administered. The result of this research *A. longifolia* significantly restored the liver markers, lipid profile, and antioxidant markers on in CCl4 induced Wistar albino rats. *A.longifolia* leaves extract possess significant hepatoprotective and antioxidant activity, probably due to its Phytochemicals (95).

Nephroprotective activity

H. spinosa ethanolic extract of whole plant at the dose of 50 and 250 mg/kg/p.o. significantly exihibit gentamicin induced nephrotoxicity. Extract Showed free radical scavenging activities to confirm the therapeutic activity of this plant extract (96). Ingale *et al.*, (97) researched *Hygrophila spinosa* methanolic extract pretreatment significantly reduced blood urea and serum creatinine levels elevated by Cisplatin administration. Furthermore, *Hygrophila spinosa* methanolic extract significantly attenuated Cisplatin

induced increase in MDA and decrease in reduced GSH, and CAT and SOD and GSH peroxidase activities in renal and, histopathological examination showed that methanolic extract markedly ameliorated Cisplatin induced renal tubular necrosis. Hence, these results indicate that the aerial parts of *Hygrophila spinosa* are able to nephroprotective activity.

Toxicity Studies

This research used by female rats. This sex animals having sensitive activity compare with male animals. An acute toxicity test carried out by OECD guidelines. This research was done by dose defended manner. The plant extract gives orally stepwise procedure fixed doses of 5, 50,300 and 2000 mg/kg for 14 days observed. Result of the experiment plant extract not showed significant changes in the body weight, food, water consumption and did not produce any death. Other biochemical parameters are good. This examination exhibit methanolic extract of leaves benefits for further pharmacological activities (98). Rajina (99) examined the alcoholic extract of seeds acute toxicity test of the plant extract was carried out the OECD guidelines. Sub acute toxicity study of 28 day duration was carried out in three different doses of 100 mg/kg, 250 mg/kg and 500 mg/kg orally no significant variation in hematologic and biochemical parameters and in relative organ weight with doses of 100, 250 and 500mg/kg body weight. Histopathology showed the presence of slight necrosis in seminiferous tubules at dose of 500mg/kg. It may be concluded that the alcoholic extract of *Asteracantha longifolia* seeds is safe for oral administration at low and moderate doses while high dose (500mg/kg) is not absolutely free from toxic effects.

Aphrodisiac activity

Ethanolic extract of seeds of *A. longifolia* was administered administered wistar rats for a period of 28 days and the action compared with control rats. Observation of rats in body and organ weight, sexual behaviour, histo-architecture, fructose levels of seminal vesicles. Parameters of sexual behaviour was measured by determining parameters such as mount frequency (MF), intromission Latency, mount latency (ML) and post-ejaculatory latency. *A. longifolia* ethanolic extract of seeds Showed announced anabolic effects in treated animals, by evidenced by increased by the body weight and reproductive organ weights. And gain by spermatogenesis due to Treated rats. Results of this experiment treated rat's reduction of ML, increase in MF and enhanced attractability towards females. A significant increase in the sperm count as well as fructose levels of seminal vesicles was considered. Concluded of this experiment extract showed increase the sexual behaviour (100).

Alkaloid enriched fraction of *Hygrophila spinosa* extract showed In-vitro and In-vivo Experiment in this study significant increase the sperm count and sexual organs weight. This outcomes showed alkaloids enriched fraction of seeds potent aphrodisiac activity by invitro and in vivo models (101). An *Asteracantha longifolia* seed chemically on Cadmium chloride induced micrometry changes in testis of albino rats by means of an ocular micrometry. The results of this study of oral administration of *A. longifolia* seed powder significantly improved the micrometrical changes in testis and accessory sex organs, reducing the severity of CdCl2 toxicity in male rats (102).

Therapeutic activity

Asteracantha longifolia extract was partially purified by using Method of alcohol precipitation. Acute toxicity study in rats gives good result, observed by blood serum biochemical parameters analyzed this extract causes any death in rats. And histological study is good. Extract was studied for its therapeutic activity in the human when administered orally. Oral administration of 0.1 ml of PALE (equivalent to 5 ml of original extract) was found to increase haemoglobin and lymphocytes and reduce neutrophils in the blood. The effect was not short term as this profile persisted for as long as 6–8 months, indicating that PALE is an excellent herbal medicament for improving the quality of blood in the human (**103**). 45 patients Gall stone patients selected and 3 groups 15 patients each group. The *Asteracantha longifolia* dose gives to 300 mg B.I.D For 90 days. Observed the patients Discomfort, Pain, Nausea vomiting, Flatilent dyspepsia, Tenderness, Referred pain, Recurrent Fever, Itching. Results of this study the plant reduce the gall stone (104).



 •	Laves
	Nodes

Figure 1. Asteracantha longifolia

SOME COMPOUNDS STRUCTURES IDENTIFIED IN Asteracantha longifolia





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Figure 4. a) Tetradecanoic acid, b) Ellipticine from A. longifolia



Figure 5. a) 2-3 Dihydrobenzofuran, b) Lupeol from A. longifolia



Figure 6. a) Phytosterol, b) β –carotene from *A. longifolia*



Figure 9. a) Hentriacontane, b) Apigenin 7-0-glucuronide from A. longifolia



Figure 10. a) Apigenin-7 –O-glucoside, b) 2-propanone from A. longifolia



Figure 11. Collection of Articles in Biological Activities

Test 1- Anticancer Activity, Test 2- Antioxidant, Test 3- Antimicrobial, Test 4- Antidiabetic, Test 5- Antihelmintic, Test 6- Anti nociceptive, Test 7- Anti-inflammatory and Anti pyretic, Test 8- Anti motility, Test 9- CNS, Test 10-Diuretic, Test 11- Erythropoietic, Test 12- Hepatoprotective, Test 13- Nephroprotective, Test 14- Toxicity, Test 15- Aprodisiac, Test 16- Therapeutic activity in Human

S.No	Product	Name of Company	Treatments	Reference (Web) &
				References
1	Lukol	Himalaya Health Care Pvt. Ltd.	Pelvic inflammatory disease, Non-specific leukorrhea	105; 106
2	Speman	Himalaya Health Care Pvt. Ltd.	Infertitlity	105; 106
3	Speman Vet	Himalaya Health Care Pvt. Ltd.	Oligozoospermia, Low sperm count	105
4	Confindo	Himalaya Health Care Pvt. Ltd.	Spermatorrhea, Sexual Disorder	105; 106
5	Tentex Royal	Himalaya Health Care Pvt. Ltd.	Erectile dysfunction	105; 106
6	Biogest	Trihealth Care, Kerala Ayurveda Pharmacy division	Chronic disease, Common upper respiratory tract infections	106; 107
7	Rasanagugul	Trihealth Care, Kerala Ayurveda Pharmacy division	Arthritis	106; 107
8	Breastone	Vedic Biolabs Pvt. Ltd.	Breast enlargement	108 ; 106
9	Neogara	Aravindh herbal labs (P) Ltd.	Impotence & Sexual Disorder	109
10	Microlactin	Victoria Health Care Ltd.	Joint Problems	106; 110
11	Spertone	Atra Pharmaceuticals Pvt. Ltd	Erectile dysfunction & Sexual disorder	111
12	Profert-M	Alopa herbal (P)Ltd.	Male infertility, Oligospermia, Asthenospermia, Teratospermia	112
13	Goutnil- Natural	Rajavel Diabetes Centre	Gout, Stiffness of joints, Alternative drug for Allopurinal, Control uric Acid	113;106
14	Trivite-X	Sri Jain ayurvedic Pharmacy	Male infertility	114
15	Nervin	Herbomed store	Nerve related problem, Reduced blood sugar & Cholesterol	115
16	Virilon Fort	Sas Pharma (P.) Ltd.	Erectile dysfunction	116
17	Arjit Liniment (oil & spray)	Capro Labs Exports India Pvt. Ltd.	Arthritis	117;106
18	Cardiraksh	Capro Labs Exports India Pvt. Ltd.	Hypertension and Relieves stress	117;106

Table: 1. Use of Asteracantha longifolia plant parts for herbal preparation by several Ayurvedicpharmaceutical company

		Isolated	Biological activities of Phyto constituent	
S.N o	Constituent	from part of plant		Reference
1	Myristic acid	Seed	Antidiabetic activity, Antimicrobial activity,Antioxidant, hypercholesterolemic,cancer- preventive, cosmetic, Nematicid.	(49; 38; 122; 123 ; 124; 156;
2	Dalmitic acid(n	Sood	Antiovidant hunocholosterolomic nomaticida	157; 175)
2	Hexadecanoic acid)	Seeu	pesticide, lubricant, antiandrogenic, flavor, hemolytic 5-alpha reductase inhibitor,Anti-inflammatory,potent mosquito larvicide	123; 124; 125; 126; 127; 128; 158; 159; 160; 161)
3	Linoleic acid(9,12- Octadecadienoic acid (Z,Z)-)	Seed	Anti-inflammatory, Hypocholesterolemic, Cancer preventive, Hepatoprotective, Nematicide Insectifuge, Antihistaminic Antieczemic, Antiacne, 5-Alpha reductase inhibitor Antiandrogenic, Antiarthritic, Anticoronary, Insectifuge	(36; 49; 38; 122; 123; 124; 126; 127; 128; 162)
4	Oleic acid	Seed	Antibacterial	(36; 38; 122; 123; 124; 126; 127; 158; 163)
5	Xylose	Seed	No activity reported	(36; 125; 127; 129)
6	Glucuronic acid	Seed	No activity reported	(36; 125; 126)
7	Asteracanthine	Seed	No activity reported	(9; <u>128</u> ; 130; 133)
8	Asteracanthicine	Seed	No activity reported	(9; 36; <u>128</u> ; 130; 133)
9	Rhamnose	Seed	No activity reported	(125)
10	Arabinose	Seed	Antivirus activity	(125; 129)
11	Histidine	Seed	No activity reported	(36; 122; 131)
12	Phenylalanine	Seed	No activity reported	(36; 122; 131)
13	Lysine	Seed	Formation of sperm cells, transition nuclear proteins and protamine in spermiogenesis, Crucial regulatory role in cell differentiation and organismal development.	(36; 131; 165; 166; 167; 168; 186)
14	Polysaccharides	Seed	Antiviral activity, anti-tumor, immune enhancement and antioxidation	(36; 170; 171)
15	Mannose	Seed	Stimulating insulin secretion, Treating or preventing urinary tract infections, Blocking colonization, Promoting the growth of intestinal probiotics ,Synthesis of immune stimulatory agents, antitumor agents, vitamins, and d-mannitol	(130; 172)
16	Asterol I-IV	Seed	Anti fungal activity	(128; 133; 173)
17	Stearic acid	Seed	5-α reductase inhibitor, hypo cholesterolemic, suppository, cosmetic, lubricant, surfactant & softening agent, perfumery, propecic, flavour.	(128; 174)
18	Lupeol	Seed	Antioxidant, Anti-topoisomerase, Antitumor, Anti- inflammatory,Antimicrobial,Antimalarial,Antihypergl ycemic, Antitumor, Diuretic	(128; 176; 177; 194)
19	Stigmasterol	Seed	Anti-hepatotoxic, anti-inflammatory, anti-nociceptive, anti-ophidic, anti-viral, cancer preventive, ovulant, sedative,Antimicrobial	(128; 178; 194)
20	β- sitosterol	Seed	Antidiabetic Activity, Antimicrobial, Anti inflammatory, Anticancer, Antiasthma, Diuretic, Hepatoprotective activity	(128; 46; 179; 194)

Table 2: The Chemical Constituents of Asteracantha longifolia and Their Biological Activities

21	Sugar Lactore D			(122)
21	Sugar-Lactose, D-			(152)
	galactose,		No activity reported	
	D-mannose,			
	D-glucose,			
	Arabinose	Seed		
	D-fructose,			
	Xylose,			
	Sucrose.			
	Amino Acid-			
	Serine,		No activity reported	
	Glycine.		5 1	
	Threonine			
	Proline			
	Valine			
	Tyrosine			
	Clutamic acid			
	Methionine			
22				
22	l'etradecanoic acid,		Antioxidant, hypercholesterolemic, cancer-	(1/5)
			preventive, cosmetic	
			No activity reported	
				(70)
	Diundecylphthalte,		Inhibits the formation of sickled cells in the blood.	(73)
	2-		Antimicrobial, Preservative	(100)
	furancarboxaldenydes			(180)
	Hydroxyl methyl,		Antitumor and anti-human immunodeficiency virus	
	Ellipticine,		activities	
	2-hydroxycyclo		No activity reported	
	Pentadecane,	The Whole	No activity reported	(181)
	1-Octadecene,	Plant	No activity reported	
	Queretin,		Anti-microbial,	(182)
	2-3Dihydrobenzofuran		Anti-inflammatory	
23	Lupeol	Aerial Part,	Antioxidant, anti-topoisomerase, antitumor, anti-	(9; 136; 36;
	-	Root,	inflammatory, Antimicrobial, Antimalarial,	38; 126;
		-		
		Leaf. Stem.	Antihyperglycemic.Anticancer.Diuretic.	127: 134:
		Leaf, Stem, Whole	Antihyperglycemic,Anticancer,Diuretic, Chemopreventive	127; 134; 135: 137:
		Leaf, Stem, Whole Plant,	Antihyperglycemic,Anticancer,Diuretic, Chemopreventive	127; 134; 135; 137; 138: 85:
		Leaf, Stem, Whole Plant, Seed	Antihyperglycemic,Anticancer,Diuretic, Chemopreventive	127; 134; 135; 137; 138; 85; 139: 140:
		Leaf, Stem, Whole Plant, Seed	Antihyperglycemic,Anticancer,Diuretic, Chemopreventive	127; 134; 135; 137; 138; 85; 139; 140; 141: 142:
		Leaf, Stem, Whole Plant, Seed	Antihyperglycemic,Anticancer,Diuretic, Chemopreventive	127; 134; 135; 137; 138; 85; 139; 140; 141; 142; 176; 177;
		Leaf, Stem, Whole Plant, Seed	Antihyperglycemic,Anticancer,Diuretic, Chemopreventive	127; 134; 135; 137; 138; 85; 139; 140; 141; 142; 176; 177; 194)
24	Stigmacterol	Leaf, Stem, Whole Plant, Seed	Antihyperglycemic,Anticancer,Diuretic, Chemopreventive	127; 134; 135; 137; 138; 85; 139; 140; 141; 142; 176; 177; 194) (9: 36; 126;
24	Stigmasterol	Leaf, Stem, Whole Plant, Seed Aerial Part,	Antihyperglycemic,Anticancer,Diuretic, Chemopreventive Hepatoprotective activity, anti-inflammatory, anti-	127; 134; 135; 137; 138; 85; 139; 140; 141; 142; 176; 177; 194) (9; 36; 126; 127; 134;
24	Stigmasterol	Leaf, Stem, Whole Plant, Seed Aerial Part, Leaf, Stom	Antihyperglycemic,Anticancer,Diuretic, Chemopreventive Hepatoprotective activity, anti-inflammatory, anti- nociceptive, anti-ophidic, anti-viral, cancer	127; 134; 135; 137; 138; 85; 139; 140; 141; 142; 176; 177; 194) (9; 36; 126; 127; 134; 135; 127;
24	Stigmasterol	Leaf, Stem, Whole Plant, Seed Aerial Part, Leaf, Stem	Antihyperglycemic,Anticancer,Diuretic, Chemopreventive Hepatoprotective activity, anti-inflammatory, anti- nociceptive, anti-ophidic, anti-viral, cancer preventive, ovulant, acdative Antimicabial Antipationa Divertia	127; 134; 135; 137; 138; 85; 139; 140; 141; 142; 176; 177; 194) (9; 36; 126; 127; 134; 135; 137; 129, 130;
24	Stigmasterol	Leaf, Stem, Whole Plant, Seed Aerial Part, Leaf, Stem Whole	Antihyperglycemic,Anticancer,Diuretic, Chemopreventive Hepatoprotective activity, anti-inflammatory, anti- nociceptive, anti-ophidic, anti-viral, cancer preventive, ovulant, sedative,Antimicrobial,Antiasthma,Diuretic	127; 134; 135; 137; 138; 85; 139; 140; 141; 142; 176; 177; 194) (9; 36; 126; 127; 134; 135; 137; 138; 139; 170; 104)
24	Stigmasterol	Leaf, Stem, Whole Plant, Seed Aerial Part, Leaf, Stem Whole plant	Antihyperglycemic,Anticancer,Diuretic, Chemopreventive Hepatoprotective activity, anti-inflammatory, anti- nociceptive, anti-ophidic, anti-viral, cancer preventive, ovulant, sedative,Antimicrobial,Antiasthma,Diuretic	127; 134; 135; 137; 138; 85; 139; 140; 141; 142; 176; 177; 194) (9; 36; 126; 127; 134; 135; 137; 138; 139; 178; 194)
24	Stigmasterol	Leaf, Stem, Whole Plant, Seed Aerial Part, Leaf, Stem Whole plant Root	Antihyperglycemic,Anticancer,Diuretic, Chemopreventive Hepatoprotective activity, anti-inflammatory, anti- nociceptive, anti-ophidic, anti-viral, cancer preventive, ovulant, sedative,Antimicrobial,Antiasthma,Diuretic <u>No activity reported</u>	127; 134; 135; 137; 138; 85; 139; 140; 141; 142; 176; 177; 194) (9; 36; 126; 127; 134; 135; 137; 138; 139; 178; 194) (85)
24 25 26	Stigmasterol Lupenone Hygrosterol	Leaf, Stem, Whole Plant, Seed Aerial Part, Leaf, Stem Whole plant Root	Antihyperglycemic,Anticancer,Diuretic, Chemopreventive Hepatoprotective activity, anti-inflammatory, anti- nociceptive, anti-ophidic, anti-viral, cancer preventive, ovulant, sedative,Antimicrobial,Antiasthma,Diuretic <u>No activity reported</u> <u>No activity reported</u>	127; 134; 135; 137; 138; 85; 139; 140; 141; 142; 176; 177; 194) (9; 36; 126; 127; 134; 135; 137; 138; 139; 178; 194) (85) (143)
24 25 26 27	Stigmasterol Lupenone Hygrosterol Phytosterol,	Leaf, Stem, Whole Plant, Seed Aerial Part, Leaf, Stem Whole plant Root Root	Antihyperglycemic,Anticancer,Diuretic, Chemopreventive Hepatoprotective activity, anti-inflammatory, anti- nociceptive, anti-ophidic, anti-viral, cancer preventive, ovulant, sedative,Antimicrobial,Antiasthma,Diuretic <u>No activity reported</u> <u>No activity reported</u> Anti-inflammatory, antibacterial, antifungal, antivelegetitum and activity of Material	127; 134; 135; 137; 138; 85; 139; 140; 141; 142; 176; 177; 194) (9; 36; 126; 127; 134; 135; 137; 138; 139; 178; 194) (85) (143) (38; 185)
24 25 26 27	Stigmasterol Lupenone Hygrosterol Phytosterol,	Leaf, Stem, Whole Plant, Seed Aerial Part, Leaf, Stem Whole plant Root Root	Antihyperglycemic,Anticancer,Diuretic, Chemopreventive Hepatoprotective activity, anti-inflammatory, anti- nociceptive, anti-ophidic, anti-viral, cancer preventive, ovulant, sedative,Antimicrobial,Antiasthma,Diuretic <u>No activity reported</u> <u>No activity reported</u> Anti-inflammatory, antibacterial, antifungal, antiulcerative and antitumoral activities. Moreover,	127; 134; 135; 137; 138; 85; 139; 140; 141; 142; 176; 177; 194) (9; 36; 126; 127; 134; 135; 137; 138; 139; 178; 194) (85) (143) (38; 185)
24 25 26 27	Stigmasterol Lupenone Hygrosterol Phytosterol,	Leaf, Stem, Whole Plant, Seed Aerial Part, Leaf, Stem Whole plant Root Root	Antihyperglycemic,Anticancer,Diuretic, Chemopreventive Hepatoprotective activity, anti-inflammatory, anti- nociceptive, anti-ophidic, anti-viral, cancer preventive, ovulant, sedative,Antimicrobial,Antiasthma,Diuretic <u>No activity reported</u> <u>No activity reported</u> Anti-inflammatory, antibacterial, antifungal, antiulcerative and antitumoral activities. Moreover, these molecules show ability to lower blood	127; 134; 135; 137; 138; 85; 139; 140; 141; 142; 176; 177; 194) (9; 36; 126; 127; 134; 135; 137; 138; 139; 178; 194) (85) (143) (38; 185)
24 25 26 27	Stigmasterol Lupenone Hygrosterol Phytosterol,	Leaf, Stem, Whole Plant, Seed Aerial Part, Leaf, Stem Whole plant Root Root	Antihyperglycemic,Anticancer,Diuretic, Chemopreventive Hepatoprotective activity, anti-inflammatory, anti- nociceptive, anti-ophidic, anti-viral, cancer preventive, ovulant, sedative,Antimicrobial,Antiasthma,Diuretic <u>No activity reported</u> <u>No activity reported</u> Anti-inflammatory, antibacterial, antifungal, antiulcerative and antitumoral activities. Moreover, these molecules show ability to lower blood cholesterol Because of its positive biological effects,	127; 134; 135; 137; 138; 85; 139; 140; 141; 142; 176; 177; 194) (9; 36; 126; 127; 134; 135; 137; 138; 139; 178; 194) (85) (143) (38; 185)
24 25 26 27	Stigmasterol Lupenone Hygrosterol Phytosterol,	Leaf, Stem, Whole Plant, Seed Aerial Part, Leaf, Stem Whole plant Root Root	Antihyperglycemic,Anticancer,Diuretic, Chemopreventive Hepatoprotective activity, anti-inflammatory, anti- nociceptive, anti-ophidic, anti-viral, cancer preventive, ovulant, sedative,Antimicrobial,Antiasthma,Diuretic <u>No activity reported</u> <u>No activity reported</u> Anti-inflammatory, antibacterial, antifungal, antiulcerative and antitumoral activities. Moreover, these molecules show ability to lower blood cholesterol Because of its positive biological effects, Food and Drug Administration (FDA) and European	127; 134; 135; 137; 138; 85; 139; 140; 141; 142; 176; 177; 194) (9; 36; 126; 127; 134; 135; 137; 138; 139; 178; 194) (85) (143) (38; 185)
24 25 26 27	Stigmasterol Lupenone Hygrosterol Phytosterol,	Leaf, Stem, Whole Plant, Seed Aerial Part, Leaf, Stem Whole plant Root Root Root	Antihyperglycemic,Anticancer,Diuretic, Chemopreventive Hepatoprotective activity, anti-inflammatory, anti- nociceptive, anti-ophidic, anti-viral, cancer preventive, ovulant, sedative,Antimicrobial,Antiasthma,Diuretic <u>No activity reported</u> <u>No activity reported</u> Anti-inflammatory, antibacterial, antifungal, antiulcerative and antitumoral activities. Moreover, these molecules show ability to lower blood cholesterol Because of its positive biological effects, Food and Drug Administration (FDA) and European Union (EU) proposed to include free phytosterols in	127; 134; 135; 137; 138; 85; 139; 140; 141; 142; 176; 177; 194) (9; 36; 126; 127; 134; 135; 137; 138; 139; 178; 194) (85) (143) (38; 185)
24 25 26 27	Stigmasterol Lupenone Hygrosterol Phytosterol,	Leaf, Stem, Whole Plant, Seed Aerial Part, Leaf, Stem Whole plant Root Root Root	Antihyperglycemic,Anticancer,Diuretic, Chemopreventive Hepatoprotective activity, anti-inflammatory, anti- nociceptive, anti-ophidic, anti-viral, cancer preventive, ovulant, sedative,Antimicrobial,Antiasthma,Diuretic <u>No activity reported</u> <u>No activity reported</u> Anti-inflammatory, antibacterial, antifungal, antiulcerative and antitumoral activities. Moreover, these molecules show ability to lower blood cholesterol Because of its positive biological effects, Food and Drug Administration (FDA) and European Union (EU) proposed to include free phytosterols in conventional foods and established labeling	127; 134; 135; 137; 138; 85; 139; 140; 141; 142; 176; 177; 194) (9; 36; 126; 127; 134; 135; 137; 138; 139; 178; 194) (85) (143) (38; 185)
24 25 26 27	Stigmasterol Lupenone Hygrosterol Phytosterol, Maltose	Leaf, Stem, Whole Plant, Seed Aerial Part, Leaf, Stem Whole plant Root Root Root	Antihyperglycemic,Anticancer,Diuretic, Chemopreventive Hepatoprotective activity, anti-inflammatory, anti- nociceptive, anti-ophidic, anti-viral, cancer preventive, ovulant, sedative,Antimicrobial,Antiasthma,Diuretic <u>No activity reported</u> <u>No activity reported</u> Anti-inflammatory, antibacterial, antifungal, antiulcerative and antitumoral activities. Moreover, these molecules show ability to lower blood cholesterol Because of its positive biological effects, Food and Drug Administration (FDA) and European Union (EU) proposed to include free phytosterols in conventional foods and established labeling guidelines.	127; 134; 135; 137; 138; 85; 139; 140; 141; 142; 176; 177; 194) (9; 36; 126; 127; 134; 135; 137; 138; 139; 178; 194) (85) (143) (38; 185)
24 25 26 27	Stigmasterol Lupenone Hygrosterol Phytosterol, Maltose	Leaf, Stem, Whole Plant, Seed Aerial Part, Leaf, Stem Whole plant Root Root Root	Antihyperglycemic,Anticancer,Diuretic, Chemopreventive Hepatoprotective activity, anti-inflammatory, anti- nociceptive, anti-ophidic, anti-viral, cancer preventive, ovulant, sedative,Antimicrobial,Antiasthma,Diuretic <u>No activity reported</u> <u>No activity reported</u> Anti-inflammatory, antibacterial, antifungal, antiulcerative and antitumoral activities. Moreover, these molecules show ability to lower blood cholesterol Because of its positive biological effects, Food and Drug Administration (FDA) and European Union (EU) proposed to include free phytosterols in conventional foods and established labeling guidelines.	127; 134; 135; 137; 138; 85; 139; 140; 141; 142; 176; 177; 194) (9; 36; 126; 127; 134; 135; 137; 138; 139; 178; 194) (85) (143) (38; 185)
24 25 26 27	Stigmasterol Lupenone Hygrosterol Phytosterol, Maltose	Leaf, Stem, Whole Plant, Seed Aerial Part, Leaf, Stem Whole plant Root Root Root	Antihyperglycemic,Anticancer,Diuretic, Chemopreventive Hepatoprotective activity, anti-inflammatory, anti- nociceptive, anti-ophidic, anti-viral, cancer preventive, ovulant, sedative,Antimicrobial,Antiasthma,Diuretic No activity reported No activity reported Anti-inflammatory, antibacterial, antifungal, antiulcerative and antitumoral activities. Moreover, these molecules show ability to lower blood cholesterol Because of its positive biological effects, Food and Drug Administration (FDA) and European Union (EU) proposed to include free phytosterols in conventional foods and established labeling guidelines. No activity reported	127; 134; 135; 137; 138; 85; 139; 140; 141; 142; 176; 177; 194) (9; 36; 126; 127; 134; 135; 137; 138; 139; 178; 194) (85) (143) (38; 185)
24 25 26 27 28	Stigmasterol Lupenone Hygrosterol Phytosterol, Maltose β-carotene	Leaf, Stem, Whole Plant, Seed Aerial Part, Leaf, Stem Whole plant Root Root Root	Antihyperglycemic,Anticancer,Diuretic, Chemopreventive Hepatoprotective activity, anti-inflammatory, anti- nociceptive, anti-ophidic, anti-viral, cancer preventive, ovulant, sedative,Antimicrobial,Antiasthma,Diuretic No activity reported No activity reported Anti-inflammatory, antibacterial, antifungal, antiulcerative and antitumoral activities. Moreover, these molecules show ability to lower blood cholesterol Because of its positive biological effects, Food and Drug Administration (FDA) and European Union (EU) proposed to include free phytosterols in conventional foods and established labeling guidelines. <u>No activity reported</u>	127; 134; 135; 137; 138; 85; 139; 140; 141; 142; 176; 177; 194) (9; 36; 126; 127; 134; 135; 137; 138; 139; 178; 194) (85) (143) (38; 185)
24 25 26 27 28	Stigmasterol Lupenone Hygrosterol Phytosterol, Maltose β-carotene	Leaf, Stem, Whole Plant, Seed Aerial Part, Leaf, Stem Whole plant Root Root Root	Antihyperglycemic,Anticancer,Diuretic, Chemopreventive Hepatoprotective activity, anti-inflammatory, anti- nociceptive, anti-ophidic, anti-viral, cancer preventive, ovulant, sedative,Antimicrobial,Antiasthma,Diuretic <u>No activity reported</u> <u>No activity reported</u> Anti-inflammatory, antibacterial, antifungal, antiulcerative and antitumoral activities. Moreover, these molecules show ability to lower blood cholesterol Because of its positive biological effects, Food and Drug Administration (FDA) and European Union (EU) proposed to include free phytosterols in conventional foods and established labeling guidelines. <u>No activity reported</u> Antioxidant activity, Anti-inflammatory activity,Induction of xenobiotic metabolizing	127; 134; 135; 137; 138; 85; 139; 140; 141; 142; 176; 177; 194) (9; 36; 126; 127; 134; 135; 137; 138; 139; 178; 194) (85) (143) (38; 185) (144; 145; 186)
24 25 26 27 28	Stigmasterol Lupenone Hygrosterol Phytosterol, Maltose β-carotene	Leaf, Stem, Whole Plant, Seed Aerial Part, Leaf, Stem Whole plant Root Root Root	Antihyperglycemic,Anticancer,Diuretic, Chemopreventive Hepatoprotective activity, anti-inflammatory, anti- nociceptive, anti-ophidic, anti-viral, cancer preventive, ovulant, sedative,Antimicrobial,Antiasthma,Diuretic No activity reported No activity reported Anti-inflammatory, antibacterial, antifungal, antiulcerative and antitumoral activities. Moreover, these molecules show ability to lower blood cholesterol Because of its positive biological effects, Food and Drug Administration (FDA) and European Union (EU) proposed to include free phytosterols in conventional foods and established labeling guidelines. <u>No activity reported</u> Antioxidant activity, Anti-inflammatory activity,Induction of xenobiotic metabolizing enzymes, Induce cell cycle arrest and	127; 134; 135; 137; 138; 85; 139; 140; 141; 142; 176; 177; 194) (9; 36; 126; 127; 134; 135; 137; 138; 139; 178; 194) (85) (143) (38; 185) (144; 145; 186)
24 25 26 27 28	Stigmasterol Lupenone Hygrosterol Phytosterol, Maltose β-carotene	Leaf, Stem, Whole Plant, Seed Aerial Part, Leaf, Stem Whole plant Root Root Root	Antihyperglycemic,Anticancer,Diuretic, Chemopreventive Hepatoprotective activity, anti-inflammatory, anti- nociceptive, anti-ophidic, anti-viral, cancer preventive, ovulant, sedative,Antimicrobial,Antiasthma,Diuretic <u>No activity reported</u> <u>No activity reported</u> Anti-inflammatory, antibacterial, antifungal, antiulcerative and antitumoral activities. Moreover, these molecules show ability to lower blood cholesterol Because of its positive biological effects, Food and Drug Administration (FDA) and European Union (EU) proposed to include free phytosterols in conventional foods and established labeling guidelines. <u>No activity reported</u> Antioxidant activity, Anti-inflammatory activity,Induction of xenobiotic metabolizing enzymes, Induce cell cycle arrest and apoptosis,Inhibit chemically induced neoplastic	127; 134; 135; 137; 138; 85; 139; 140; 141; 142; 176; 177; 194) (9; 36; 126; 127; 134; 135; 137; 138; 139; 178; 194) (85) (143) (38; 185) (144; 145; 186)
24 25 26 27 28	Stigmasterol Lupenone Hygrosterol Phytosterol, Maltose β-carotene	Leaf, Stem, Whole Plant, Seed Aerial Part, Leaf, Stem Whole plant Root Root Root	Antihyperglycemic,Anticancer,Diuretic, Chemopreventive Hepatoprotective activity, anti-inflammatory, anti- nociceptive, anti-ophidic, anti-viral, cancer preventive, ovulant, sedative,Antimicrobial,Antiasthma,Diuretic <u>No activity reported</u> <u>No activity reported</u> Anti-inflammatory, antibacterial, antifungal, antiulcerative and antitumoral activities. Moreover, these molecules show ability to lower blood cholesterol Because of its positive biological effects, Food and Drug Administration (FDA) and European Union (EU) proposed to include free phytosterols in conventional foods and established labeling guidelines. <u>No activity reported</u> Antioxidant activity, Anti-inflammatory activity,Induction of xenobiotic metabolizing enzymes, Induce cell cycle arrest and apoptosis,Inhibit chemically induced neoplastic transformation by the stimulation of cell	127; 134; 135; 137; 138; 85; 139; 140; 141; 142; 176; 177; 194) (9; 36; 126; 127; 134; 135; 137; 138; 139; 178; 194) (85) (143) (38; 185)

			function by stimulating the killing activity of	
29	Luteolin	leaf	Anti-inflammatory activity Neuroprotective effects	(9.186)
2)	Lucom	icai	Antioxidant Free radical scavenging activity luteolin	(),100)
			inhibits the production of tumor necrosis factor	
			interleukin-6 and inducible nitric ovide in	
			lipopolysaccharide (LPS)-induced human and mouse	
			macrophages luteolin protects against LPS-induced	
			lethal toxicity by reducing leukocyte infiltration in the	
			lung and liver of mice decrease in immune cells and	
			cytokine levels in bronchoalveolar lavage fluid in	
			ovalhumin antigen-sensitized asthmatic mice	
			Luteolin decreased serum inflammatory mediators	
			and improved symptoms in children with autism	
			spectrum disorders Luteolin events not only BOS	
			scavenging effect but also immune cell regulating	
			activities	
30	Luteolin-7-rutinoside	leaf	No activity reported	(9)
		Tour		
31	Ascorbic acid	leaf	Antiscorbutic, Antioxidant activity	(36; 145;
				188)
	NT:	1 6		(0(100)
32	Nicotinic acid	leaf	Antiatheroscierotic effects, Anti-Inflammatory	(36; 189)
22	Vonnilia asid	losf	Elevering agent Anti inflammatory	(124,100)
33	vannine acid	leal	Flavoring agent, Anti-Inflammatory	(134;190)
			activity, nepatopi otective activity, Anti-contic activity	
	Surringic acid		Antiovidant anti inflammatory anticarcinogonic	(101)
	Syringic actu		antiplatolet and anticoagulant effects	(191)
	Anigonin		anuplatelet and anticoaguiant effects	
	Apigenin		Antiovidant anticarcinggenic and snasmolytic	(198)
			activities and can reduce high blood pressure	(190)
	05			
		Diant	No activity non-outod	126,1761
34	25-0x0-		No activity reported	(30, 140)
34	hentriacontanyl	Aerial	No activity reported	(30, 140)
34	hentriacontanyl acetate	Aerial parts	Anti	(30, 140)
34	hentriacontanyl acetate Betulin	Aerial parts Aerial part,	Anti-	(36; 126;
34	hentriacontanyl acetate Betulin	Aerial parts Aerial part, Root	Anti- inflammatory,Antimicrobial,Anticancer,Diuretic,Che	(36; 146) (36; 126; 137; 139; 146: 192)
34	hentriacontanyl acetate Betulin	Aerial parts Aerial part, Root	Anti- inflammatory,Antimicrobial,Anticancer,Diuretic,Che mopreventive	(36; 126; 137; 139; 146; 192)
34 35 36	hentriacontanyl acetate Betulin Hentriacontane	Aerial parts Aerial part, Root Leaf, Stem	Anti- inflammatory,Antimicrobial,Anticancer,Diuretic,Che mopreventive Anti-inflammatory, Antitumor and Antimicrobial	(36; 126; 137; 139; 146; 192) (38;
34 35 36	hentriacontanyl acetate Betulin Hentriacontane	Aerial parts Aerial part, Root Leaf, Stem	Anti- inflammatory,Antimicrobial,Anticancer,Diuretic,Che mopreventive Anti-inflammatory, Antitumor and Antimicrobial activities.	(36; 126; 137; 139; 146; 192) (38; 136;Khajuria et al. 2017)
34 35 36 37	25-0x0- hentriacontanyl acetate Betulin Hentriacontane	Aerial part, Root Leaf, Stem	Anti- inflammatory,Antimicrobial,Anticancer,Diuretic,Che mopreventive Anti-inflammatory, Antitumor and Antimicrobial activities.	(36; 126; 137; 139; 146; 192) (38; 136;Khajuria <i>et al.</i> , 2017) (36: 138)
34 35 36 37 38	25-0x0- hentriacontanyl acetate Betulin Hentriacontane 3-methylnonacosane	Aerial parts Aerial part, Root Leaf, Stem Aerial part	Anti- inflammatory,Antimicrobial,Anticancer,Diuretic,Che mopreventive Anti-inflammatory, Antitumor and Antimicrobial activities. No activity reported	(36; 126; 137; 139; 146; 192) (38; 136;Khajuria <i>et al.</i> , 2017) (36; 138) (26: 138)
34 35 36 <u>37</u> 38	25-0x0- hentriacontanyl acetate Betulin Hentriacontane 3-methylnonacosane 23-ethylcholesta-11(2) 23 (24)-dien-3 n-ol	Aerial parts Aerial part, Root Leaf, Stem Aerial part Aerial part	Anti- inflammatory,Antimicrobial,Anticancer,Diuretic,Che mopreventive Anti-inflammatory, Antitumor and Antimicrobial activities. <u>No activity reported</u> No activity reported	(36; 126; 137; 139; 146; 192) (38; 136;Khajuria <i>et al.</i> , 2017) (36; 138) (36; 138)
34 35 36 <u>37</u> 38 39	25-0x0- hentriacontanyl acetate Betulin Hentriacontane 3-methylnonacosane 23-ethylcholesta-11(2) 23 (24)-dien-3 p-ol Maltose	Aerial part, Aerial part, Root Leaf, Stem Aerial part Aerial part	Anti- inflammatory,Antimicrobial,Anticancer,Diuretic,Che mopreventive Anti-inflammatory, Antitumor and Antimicrobial activities. No activity reported No activity reported	(36; 126; 137; 139; 146; 192) (38; 136;Khajuria <i>et al.</i> , 2017) (36; 138) (36; 138)
34 35 36 37 38 39	23-0x0- hentriacontanyl acetate Betulin Hentriacontane 3-methylnonacosane 23-ethylcholesta-11(2) 23 (24)-dien-3 p-ol Maltose	Aerial parts Aerial part, Root Leaf, Stem Aerial part Aerial part Aerial part	Anti- inflammatory,Antimicrobial,Anticancer,Diuretic,Che mopreventive Anti-inflammatory, Antitumor and Antimicrobial activities. No activity reported No activity reported No activity reported	(36; 126; 137; 139; 146; 192) (38; 136;Khajuria <i>et al.</i> , 2017) (36; 138) (36; 138) (136)
34 35 36 37 38 39 40	Acetate hentriacontanyl acetate Betulin Hentriacontane 3-methylnonacosane 23-ethylcholesta-11(2) 23 (24)-dien-3 p-ol Maltose Methly1-8-n	Aerial parts Aerial part, Root Leaf, Stem Aerial part Aerial part Aerial part Aerial part Plant,	Anti- inflammatory,Antimicrobial,Anticancer,Diuretic,Che mopreventive Anti-inflammatory, Antitumor and Antimicrobial activities. No activity reported No activity reported No activity reported No activity reported	(36; 126; 137; 139; 146; 192) (38; 136;Khajuria <i>et al.</i> , 2017) (36; 138) (36; 138) (136) (136)
34 35 36 37 38 39 40	Acetate hentriacontanyl acetate Betulin Hentriacontane 3-methylnonacosane 23-ethylcholesta-11(2) 23 (24)-dien-3 p-ol Maltose Methly1-8-n hexyltetracosanoate	Aerial parts Aerial part, Root Leaf, Stem Aerial part Aerial part Aerial part Plant, Aerial part	Anti- inflammatory,Antimicrobial,Anticancer,Diuretic,Che mopreventive Anti-inflammatory, Antitumor and Antimicrobial activities. No activity reported No activity reported No activity reported No activity reported	(36; 126; 137; 139; 146; 192) (38; 136;Khajuria <i>et al.</i> , 2017) (36; 138) (36; 138) (136) (36; 146)
34 35 36 37 38 39 40 41	25-0x0- hentriacontanyl acetate Betulin Hentriacontane 3-methylnonacosane 23-ethylcholesta-11(2) 23 (24)-dien-3 p-ol Maltose Methly1-8-n hexyltetracosanoate β -sitosterol	Aerial parts Aerial part, Root Leaf, Stem Aerial part Aerial part Aerial part Aerial part Plant, Aerial part Root,	Anti- inflammatory,Antimicrobial,Anticancer,Diuretic,Che mopreventive Anti-inflammatory, Antitumor and Antimicrobial activities. No activity reported No activity reported No activity reported No activity reported Antidiabetic Activity, Antimicrobial, Anti	(36; 126; 137; 139; 146; 192) (38; 136;Khajuria <i>et al.</i> , 2017) (36; 138) (36; 138) (136) (136) (36; 146) (140; 141;
34 35 36 37 38 39 40 41	25-0x0- hentriacontanyl acetate Betulin Hentriacontane 3-methylnonacosane 23-ethylcholesta-11(2) 23 (24)-dien-3 p-ol Maltose Methly1-8-n hexyltetracosanoate β-sitosterol	Aerial parts Aerial part, Root Leaf, Stem Aerial part Aerial part Aerial part Aerial part Plant, Aerial part Root, Stem, Leaf	Anti- inflammatory,Antimicrobial,Anticancer,Diuretic,Che mopreventive Anti-inflammatory, Antitumor and Antimicrobial activities. No activity reported No activity reported No activity reported No activity reported Antidiabetic Activity, Antimicrobial, Anti inflammatory, Anticancer, Antiasthma, Diuretic,	(36; 126; 137; 139; 146; 192) (38; 136;Khajuria <i>et al.</i> , 2017) (36; 138) (36; 138) (136) (136) (36; 146) (140; 141; 142; 194)
34 35 36 <u>37</u> 38 39 40 41	25-0x0- hentriacontanyl acetate Betulin Hentriacontane 3-methylnonacosane 23-ethylcholesta-11(2) 23 (24)-dien-3 p-ol Maltose Methly1-8-n hexyltetracosanoate β -sitosterol	Aerial part, Aerial part, Root Leaf, Stem Aerial part Aerial part Aerial part Plant, Aerial part Plant, Stem, Leaf Stem, Leaf Seed	Anti- inflammatory,Antimicrobial,Anticancer,Diuretic,Che mopreventive Anti-inflammatory, Antitumor and Antimicrobial activities. No activity reported No activity reported No activity reported No activity reported Antidiabetic Activity, Antimicrobial, Anti inflammatory, Anticancer, Antiasthma, Diuretic, Hepatoprotective activity	(36; 126; 137; 139; 146; 192) (38; 136;Khajuria <i>et al.</i> , 2017) (36; 138) (36; 138) (136) (36; 146) (140; 141; 142; 194)
34 35 36 37 38 39 40 41 42	25-0x0- hentriacontanyl acetate Betulin Hentriacontane 3-methylnonacosane 23-ethylcholesta-11(2) 23 (24)-dien-3 p-ol Maltose Methly1-8-n hexyltetracosanoate β-sitosterol Apigenin 7-0- glucuronido	Aerial parts Aerial part, Root Leaf, Stem Aerial part Aerial part Aerial part Aerial part Plant, Aerial part Root, Stem, Leaf Seed Flower	Anti- inflammatory,Antimicrobial,Anticancer,Diuretic,Che mopreventive Anti-inflammatory, Antitumor and Antimicrobial activities. No activity reported No activity reported No activity reported No activity reported Antidiabetic Activity, Antimicrobial, Anti inflammatory, Anticancer, Antiasthma, Diuretic, Hepatoprotective activity No activity reported	(36; 126; 137; 139; 146; 192) (38; 136;Khajuria <i>et al.</i> , 2017) (36; 138) (36; 138) (36; 138) (136) (136) (136) (140; 141; 142; 194) (9; 36; 127; 134: 125)
34 35 36 37 38 39 40 41 42 42	25-0x0- hentriacontanyl acetate Betulin Hentriacontane 3-methylnonacosane 23-ethylcholesta-11(2) 23 (24)-dien-3 p-ol Maltose Methly1-8-n hexyltetracosanoate β -sitosterol Apigenin 7-0- glucuronide	Aerial parts Aerial part, Root Leaf, Stem Aerial part Aerial part Aerial part Aerial part Plant, Aerial part Root, Stem, Leaf Seed Flower	Anti- inflammatory,Antimicrobial,Anticancer,Diuretic,Che mopreventive Anti-inflammatory, Antitumor and Antimicrobial activities. No activity reported No activity reported No activity reported No activity reported Antidiabetic Activity, Antimicrobial, Anti inflammatory, Anticancer, Antiasthma, Diuretic, Hepatoprotective activity No activity reported	(36; 126; 137; 139; 146; 192) (38; 136;Khajuria <i>et al.</i> , 2017) (36; 138) (36; 138) (136) (136) (36; 146) (140; 141; 142; 194) (9; 36; 127; 134; 135) (9: 26: 127;
34 35 36 37 38 39 40 41 42 43	25-0x0- hentriacontanyl acetate Betulin Hentriacontane 3-methylnonacosane 23-ethylcholesta-11(2) 23 (24)-dien-3 p-ol Maltose Methly1-8-n hexyltetracosanoate β-sitosterol Apigenin 7-0- glucuronide Apigenin-7-0-	Aerial parts Aerial part, Root Leaf, Stem Aerial part Aerial part Aerial part Aerial part Plant, Aerial part Root, Stem, Leaf Seed Flower Flower	Anti- inflammatory,Antimicrobial,Anticancer,Diuretic,Che mopreventive Anti-inflammatory, Antitumor and Antimicrobial activities. No activity reported No activity reported No activity reported No activity reported Antidiabetic Activity, Antimicrobial, Anti inflammatory, Anticancer, Antiasthma, Diuretic, Hepatoprotective activity No activity reported Liver dysfunction (hepatitis and icterus), anti- inflammatory diuretic antichaumatic and anti-	(36; 126; 137; 139; 146; 192) (38; 136;Khajuria <i>et al.</i> , 2017) (36; 138) (36; 138) (36; 138) (136) (136) (136) (140; 141; 142; 194) (9; 36; 127; 134; 135) (9; 36; 127; 124; 125;
34 35 36 37 38 39 40 41 42 43	25-0x0- hentriacontanyl acetate Betulin Hentriacontane 3-methylnonacosane 23-ethylcholesta-11(2) 23 (24)-dien-3 p-ol Maltose Methly1-8-n hexyltetracosanoate β -sitosterol Apigenin 7-0- glucuronide Apigenin-7 –0- glucoside	Aerial parts Aerial part, Root Leaf, Stem Aerial part Aerial part Aerial part Aerial part Plant, Aerial part Plant, Stem, Leaf Stem, Leaf Stem, Leaf Stem Flower	Anti- inflammatory,Antimicrobial,Anticancer,Diuretic,Che mopreventive Anti-inflammatory, Antitumor and Antimicrobial activities. No activity reported No activity reported No activity reported No activity reported Antidiabetic Activity, Antimicrobial, Anti inflammatory, Anticancer, Antiasthma, Diuretic, Hepatoprotective activity No activity reported Liver dysfunction (hepatitis and icterus), anti- inflammatory, diuretic, antirheumatic, and anti- diabatic drug	(36; 126; 137; 139; 146; 192) (38; 136;Khajuria <i>et al.</i> , 2017) (36; 138) (36; 138) (36; 138) (136) (136) (36; 146) (140; 141; 142; 194) (9; 36; 127; 134; 135) (9; 36; 127; 134; 135; 195)
34 35 36 37 38 39 40 41 42 43	25-0x0- hentriacontanyl acetate Betulin Hentriacontane 3-methylnonacosane 23-ethylcholesta-11(2) 23 (24)-dien-3 p-ol Maltose Methly1-8-n hexyltetracosanoate β-sitosterol Apigenin 7-0- glucuronide Apigenin-7 –0- glucoside	Aerial parts Aerial part, Root Leaf, Stem Aerial part Aerial part Aerial part Aerial part Plant, Aerial part Plant, Stem, Leaf Stem, Leaf Stem, Leaf Stem Flower	Anti- inflammatory,Antimicrobial,Anticancer,Diuretic,Che mopreventive Anti-inflammatory, Antitumor and Antimicrobial activities. No activity reported No activity reported No activity reported No activity reported Antidiabetic Activity, Antimicrobial, Anti inflammatory, Anticancer, Antiasthma, Diuretic, Hepatoprotective activity No activity reported Liver dysfunction (hepatitis and icterus), anti- inflammatory, diuretic, antirheumatic, and anti- diabetic drug	(36; 126; 137; 139; 146; 192) (38; 136;Khajuria <i>et al.</i> , 2017) (36; 138) (36; 138) (36; 138) (136) (36; 146) (140; 141; 142; 194) (9; 36; 127; 134; 135) (9; 36; 127; 134; 135; 195)
34 35 36 37 38 39 40 41 42 43	25-0x0- hentriacontanyl acetate Betulin Hentriacontane 3-methylnonacosane 23-ethylcholesta-11(2) 23 (24)-dien-3 p-ol Maltose Methly1-8-n hexyltetracosanoate β -sitosterol Apigenin 7-0- glucuronide Apigenin-7 –0- glucoside	Aerial parts Aerial part, Root Leaf, Stem Aerial part Aerial part Aerial part Aerial part Plant, Aerial part Plant, Stem, Leaf Seed Flower	Anti- inflammatory,Antimicrobial,Anticancer,Diuretic,Che mopreventive Anti-inflammatory, Antitumor and Antimicrobial activities. No activity reported No activity reported No activity reported No activity reported Antidiabetic Activity, Antimicrobial, Anti inflammatory, Anticancer, Antiasthma, Diuretic, Hepatoprotective activity No activity reported Liver dysfunction (hepatitis and icterus), anti- inflammatory, diuretic, antirheumatic, and anti- diabetic drug	(36; 126; 137; 139; 146; 192) (38; 136;Khajuria <i>et al.</i> , 2017) (36; 138) (36; 138) (136) (36; 146) (140; 141; 142; 194) (9; 36; 127; 134; 135) (9; 36; 127; 134; 135; 195) (147; 196)
34 35 36 37 38 39 40 41 42 43 44	25-0x0- hentriacontanyl acetate Betulin Hentriacontane 3-methylnonacosane 23-ethylcholesta-11(2) 23 (24)-dien-3 p-ol Maltose Methly1-8-n hexyltetracosanoate β -sitosterol Apigenin 7-0- glucuronide Apigenin-7 –0- glucoside 2-propanone,	Aerial parts Aerial part, Root Leaf, Stem Aerial part Aerial part Aerial part Aerial part Plant, Aerial part Plant, Stem, Leaf Seed Flower Flower	Anti- inflammatory,Antimicrobial,Anticancer,Diuretic,Che mopreventive Anti-inflammatory, Antitumor and Antimicrobial activities. No activity reported No activity reported No activity reported No activity reported Antidiabetic Activity, Antimicrobial, Anti inflammatory, Anticancer, Antiasthma, Diuretic, Hepatoprotective activity No activity reported Liver dysfunction (hepatitis and icterus), anti- inflammatory, diuretic, antirheumatic, and anti- diabetic drug	(36; 126; 137; 139; 146; 192) (38; 136;Khajuria <i>et al.</i> , 2017) (36; 138) (36; 138) (36; 138) (136) (36; 146) (140; 141; 142; 194) (9; 36; 127; 134; 135) (9; 36; 127; 134; 135; 195) (147; 196)
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	Cyclopentane,		No activity reported	
	1-Propane,		No activity reported	
	2-Butanol		No activity reported	
45	Hydroxyl,	Aerial Part	No activity reported	
	Terminal Methylene,		No activity reported	(148)
			No activity reported	
	3β hydroxyl,		No activity reported	
			No activity reported	
	Isoprophy1,			
	Lup-20(29)-en-			
	3β,28-diaol (Betuline)			
46	Stigmast-5-en-3β-ol	Leaves	Anti-Inflammatory, Antipyretic, Anti-ulcer,	(151;197)
	(β-Sitosterol)		Antiarthritic	

AUTHORS' CONTRIBUTIONS

Muthulingam contributed to design of the study, supervised the research and manuscript editing, Veerakumar helped the preparation of the manuscript, performed the searching, data collection and prepare manuscript drafting. All authors read and confirmed the final version of the manuscript for publication.

CONFLICT OF INTERESTS

The authors declare no conflict of interest.

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