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PHYTOCHEMISTRY, PHARMACOLOGICAL STUDIES AND FORMULATIONS OF SAPONINS FROM *ASPARAGUS RACEMOSUS*: A PHYTOPHARMACOLOGICAL REVIEW

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ABSTRACT
World's maximum population rely on herbal medicine for their good health. The most vitally important therapeutic herbal plants in the health care system is *Asparagus racemosus* (Shatavari) which belongs to family Liliaceae. It is an ayurvedic plant which is well known for its various therapeutic activities. In Ayurveda, Shatavari is reviewed to be a female tonic, powerful Pathya that, improves immunity, promotes longevity and mental health. The roots of Shatavari are used as aphrodisiac, stomachic, tonic and intestinal astringent in Ayurvedic medicine. It helps to balance Tridoshas in Traditional system of Medicine, improve the reproductivity as well as digestive health. It decreases the stress level, controls high cholesterol and thus helps in treating diabetes mellitus. *Asparagus racemosus* holds a wide range of secondary metabolites which include steroids, flavonoids and essential oils. It has a group of steroidal saponins which includes (Shatavarin I-IV) Shatavarin I, Shatavarin IV, Shatavarin V, Immunoside and Schidigerasaponin D5. These steroidal saponin present in Shatavari are mainly responsible for different Therapeutic activities. The important therapeutic properties of saponins include Anti-cancerous, Hypoglycemic and Anti-oxidant activity, Immuno- modulatory activity, Anti-inflammatory and Anti-bacterial activity. It is also used as a nutritional supplement. Different formulations such as Nano formulations containing saponin from *Asparagus racemosus* are utilized in day-to-day life. This review summarizes the role of Shatavari in human health.

KEYWORDS: *Asparagus racemosus*, Formulation, Phytochemistry, Shatavarin, Steroidal saponin.

INTRODUCTION

Various Traditional Systems of medicine plays an important role in meeting the global health care needs. Herbal Plants and their by-product are a significant source of pharmaceuticals. There are countless herbal drugs/ plants which possess plenty of benefits for the human beings. Medicinal plants employ an important place in the spiritual, socio-culture of India and in many countries of Asia, Africa and East Europe.

The most unique herb is Shatavari. Its biological name of the herb is *Asparagus racemosus* which belongs to family Liliaceae. Shatavari is known to be as "100 spouses", because it has the capacity to increase fertility. In Ayurvedic system of medicine, this amazing herb is known as the "Queen of herbs". Shatavari is the main Ayurvedic regenerative tonic for the female, as Withania is for male. (Alok *et al*., 2013) *Asparagus racemosus* contains a mechanism to treat disorder of women's health. *A. racemosus* is an Ayurvedic Pathya which impart immunity, increase durability, improve mental function and prevent Ageing. The therapeutic use has been reported in India, British Pharmacopoeia and traditional medical systems like Ayurveda, Unani, Siddha. In Unani system of medicine, its roots are used to treat liver and renal issue as well as gonorrhoea.

It contains various Phyto-active constituents such as polyphenols, flavonoids, saponins, and minerals. (Guo *et al*., 2022) Saponins are non-volatile substances and contain surface-active compounds that are widely dispersed in nature. They possess soap like property and produces foams when shaken in aqueous solutions. They are naturally occurring molecule which has high molecular weight. It contains Aglycone nucleus and a Glycone part. (Ashour *et al*., 2019)

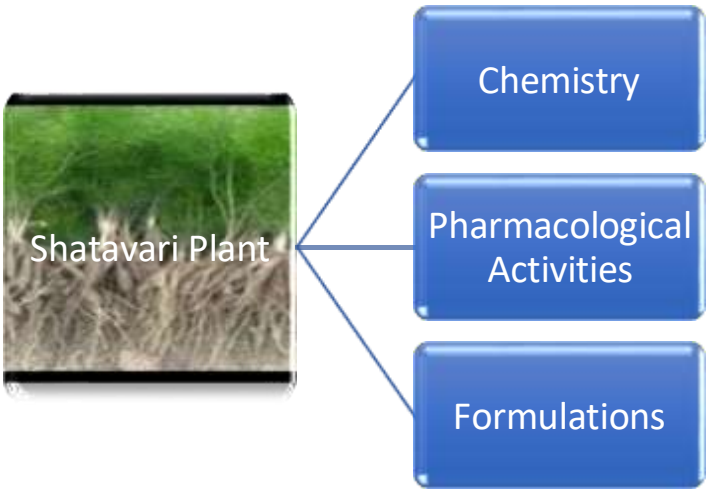


Figure 1. Overview of the Article

Plant profile: Shatavari is the common name of *Asparagus racemosus* Willd which belongs to family Liliaceae. There are about 300 species of Asparagus found in all over the world in which around 22 species are reported in India. First and foremostly, it was grown in India but later developed in all over the world including Sri Lanka, Australia, tropical Africa, Southern China etc. (Panchal *et al*., 2022) *Asparagus racemosus* has therapeutically been used in different systems of medicine as well as in Indian and British pharmacopoeias. *A. racemosus* is regarded as a 'Pathya' that is restoration which helps in slowing the process of ageing and thus, helps to live longer with good stability and immunity. (Singla *et al*., 2014)

Plant Description: (Varade *et al*., 2015)

Synonym: Shatamuli, Shatavar.

Biological source: Shatavari consists of dried roots and leaf of the plant *Asparagus racemosus* which belongs to family Liliaceae.

Fig. 2: *Asparagus racemosus* (Varade *et al*., 2022)

Table 1. Vernacular name:(Abhijeet *et al*., 2019; Bahisht *et al*., 2020)

S.no.	Language	Name
1.	Hindi	Satavar
2.	Marathi	Shatavari
3.	Telugu	Pillipichara
4.	Bengal	Shatamuli
5.	Gujrati	Satavari, Ekalkanto
6.	Kannad	Majjige gadde, Callagadda
7.	Tamil	Satavali
8.	Madhya Pradesh	Satmooli, Narbodh
9.	Rajasthan	Satawar
10.	Oriya	Mohajolo, Chhotaru

Table 2. Scientific Classification: (Panchal *et al*., 2022)

Kingdom	**Plantae**
Division	Angiosperms
Class	Monocots
Order	Asparagales
Family	Asparagaceae / Liliaceae
Genus	*Asparagus*
Species	*racemosus*
Common Name	Shatavari

Organoleptic Properties: (Sagar *et al*., 2022)
Asparagus racemosus is a Shrub which grows at a height of about 1-2 metres. The features of plant parts are as follows:

1) **Leaves**: It is small and uniform in size and has a needle like structure.
2) **Flowers**: It has white colour flowers with Short spikes.
3) **Roots**: The roots are of Tuberous in shape. It is 10-30cm long and 0.1-0.5cm thick.
4) **Fruits**: The size of the berry is 0.4-0.6cm. It has a pea like structure and contains seeds.

Habit and Habitat: It grows in low altitudes in shade and in tropical climates throughout Asia, Java, Australia and Africa. *A. racemosus* is common throughout Sri Lanka, India and the Himalayas. (Uzma *et al*., 2023). It grows at a height of 1- 2 m. and prefers to take root in rocky soils high up at 1300-1400 m elevation. Out of several species of Asparagus grown in India, *A. racemosus* is most commonly used in indigenous medicine.

Cultivation and Collection: It includes different steps: (Joshi, 2016)

1) Propagation Method
2) Climate and soil.
3) Manure and fertilization method in growing Shatavari
4) Irrigation methods in Growing Shatavari
5) Intercultural methods in Growing Shatavari
6) Pest and diseases control measures in Growing Shatavari
7) Harvesting Technique in growing Shatavari.
8) Post harvesting technique in Growing seeds.
9) Yield of Shatavari.

1) PROPAGATION METHOD: The propagation is done by different ways: (Sharma *et al*., 2021)

a) By using the seeds
b) By using the vegetative propagation.

a) Seed propagation: The seeds are sown in the beds which are raised up-to the height of 5cm in the month of April. After the first irrigation, the germination starts and it takes approx. 8-10 days for germination of seeds. The process is done in the month of June. There-after, the seedlings are transplanted at a distance of 60cm * 60cm supported by bamboo stakes at a height of 45cm. The seed rate should be 400-600kg/ acre. Seeds must be treated by cow urine for 24 hrs before planting.

b) Vegetative propagation: The propagation can be done by taking the upper and base part of the tree. Then, after some days the grafted plant root produces 2-3 tuberous roots. For grafting the plants 1cm of irrigation is required. After the process sprouts comes in 8-10 days after Transplanting.

2) CLIMATE AND SOIL: According to scientist, Shatavari can grow in tropical, subtropical and hot climate. It has the capacity to capture and store moisture in dry soils. Usually this plant prefers to grow in light, medium and heavy soils. But black well drained and fertile soil is good for cultivation and the temperature required is 25-40°C. (Joshi, 2016)

3) MANURE AND FERTILIZATION METHOD IN GROWING SHATAVARI

a) For an acre of land 52kg of Urea and 200kg of super Sulphur Phosphate and also 66kg of muriate of potash is required.
b) The nutrient requirement for an acre of land is Nitrogen, Phosphorus and potash.
c) Bio-pesticides are also used to prevent the soil from different borne diseases like Datura, Cow's urine and Chitrakmool.

4) IRRIGATION METHODS IN GROWING SHATAVARI: This plant requires low irrigation for cultivation. The Shatavari plant requires annual rainfall of about is 800-1200mm. The first irrigation is provided at the time of plantation. The second irrigation is done at the time of seeding establishment. During the winter season, the irrigation can be done for every 30 days interval. (Chavhan *et al*., 2023)

5) INTERCULTURAL METHODS IN GROWING SHATAVARI: (Chavhan *et al*., 2023)

a) **Pruning**: The unwanted materials like stem, leaves and dead twigs can be removed. This will help the plat for

getting the air inside the plant.
b) **Weeding**: The weeding should be done regularly or else these weeds will cause pests or diseases to the plant. The weeding can be done manually or by using the chemicals like weedicides or herbicides.

c) **Intercopping**: In General, the Shatavari is grown as a monocrop, but we can inter space the orchards that have light interception can be grown along with the Shatavari. Stalking material is needed for the plants, as these shrubs serve for with the help of support.

6) Pest and diseases control measures in Growing Shatavari: There are no particular pests and diseases that affect the Shatavari herb.

7) Harvesting Technique in growing Shatavari: After transplanting the plant from the nursery to the main field. It takes approx. 20-30months for the roots to get mature. The maturity of the plant depends upon soil and climatic conditions. The harvesting is done in the month of March-May. The harvesting is done by using the Kudali. Fully ripen seeds are used for the preparation of Medicines. (Ilager *et al*., 2022)

8) Post harvesting technique in Growing seeds: (Pathan, 2022)

a) **Peeling**: Peeling is done in boiling conditions and air dried.
b) **Drying**: The optimum temperature for drying is 40°C.
c) **Sorting**: The herbs should be sorted as per the grades.
d) **Grading**: The grading is done as per the colour and quantity.
e) **Packing**: Then they should be packed in air tight bags for storage and also for the transportation purposes.
f) **Further Processing**: Then the roots which are ripen are further processed in the powder, Ghulam and Ghritam.

9) Yield of Shatavari; The percentage yield calculated from a single plant is 500-600g of fresh root. But the average obtained from on 1-hectare land is about 12000-14000 kg of fresh roots. If they are dried, the yield was found to be 1000-1200kg of dried root.

Shatavari is utilized as traditional herbal medicine as it contains different biologically Phyto active compounds namely saponins (Leary, 2023) polyphenols, flavonoids and minerals. It also carries heavy metals and minerals and plays an important role in determining quality and potency. (Guo *et al*., 2022)
Saponins are secondary metabolites which plays a vital role in the protection of plants against microorganism.(Guo *et al*., 2022) Saponins whose name was taken from a Soapwort plant (Saponaria), which has the ability to produce a soapy layer and foam when agitated in an aqueous medium. In ancient times, its roots are used as soap. Saponins are marked by soap-like foaming properties and the sweet or bitter taste of the saponin rely upon the type of saponin (Porte *et al*., 2022) They are naturally present in many herbal plants and also in vast range of plant-based foods (soybean, oat, spinach, tea, Allium species, asparagus, potato, etc.).

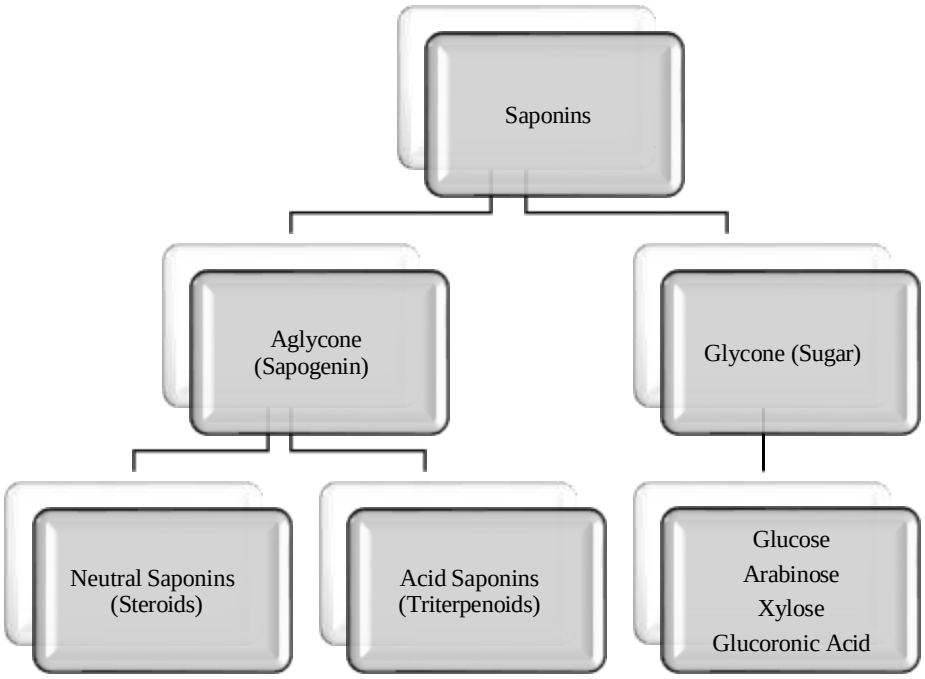


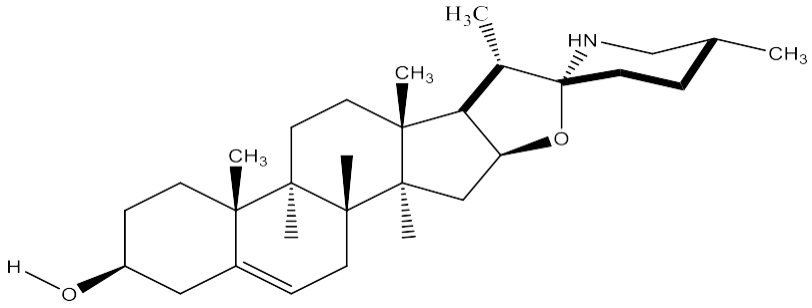
Fig. 3 Chemistry of Saponins

Saponins are a class of naturally appearing bio-organic compounds and their chemical structure contains a central core (genin or aglycone) of a steroid (Thu *et al*., 2021) or tri-terpenic nature and a series of sugar chains (one, two, or three) that is attached to different points giving rise to different saponin such as mono-, bi-, or tri-desmosidic saponins. The aglycone part shows lipophilic character, while the sugar chains are hydrophilic in nature. This amphiphilic property of saponins is effective as emulsifying and foaming agents. (Hamdi *et al*., 2024)

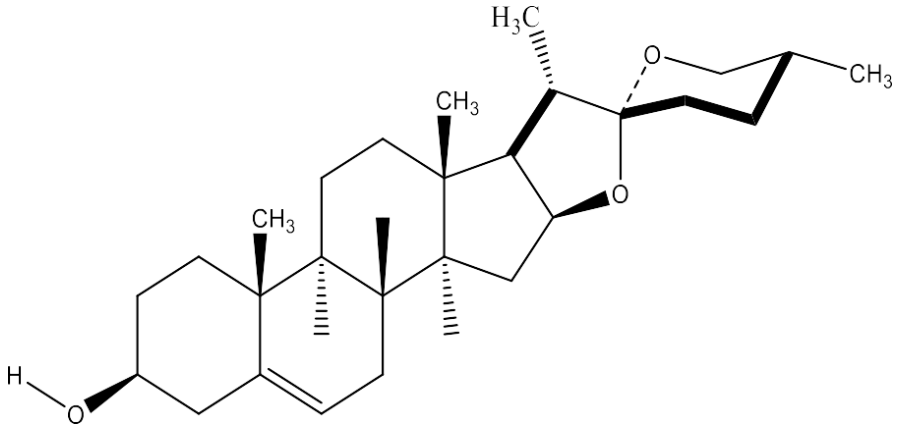
Based on the type of Sapo-genin, it is further divided into three major parts:

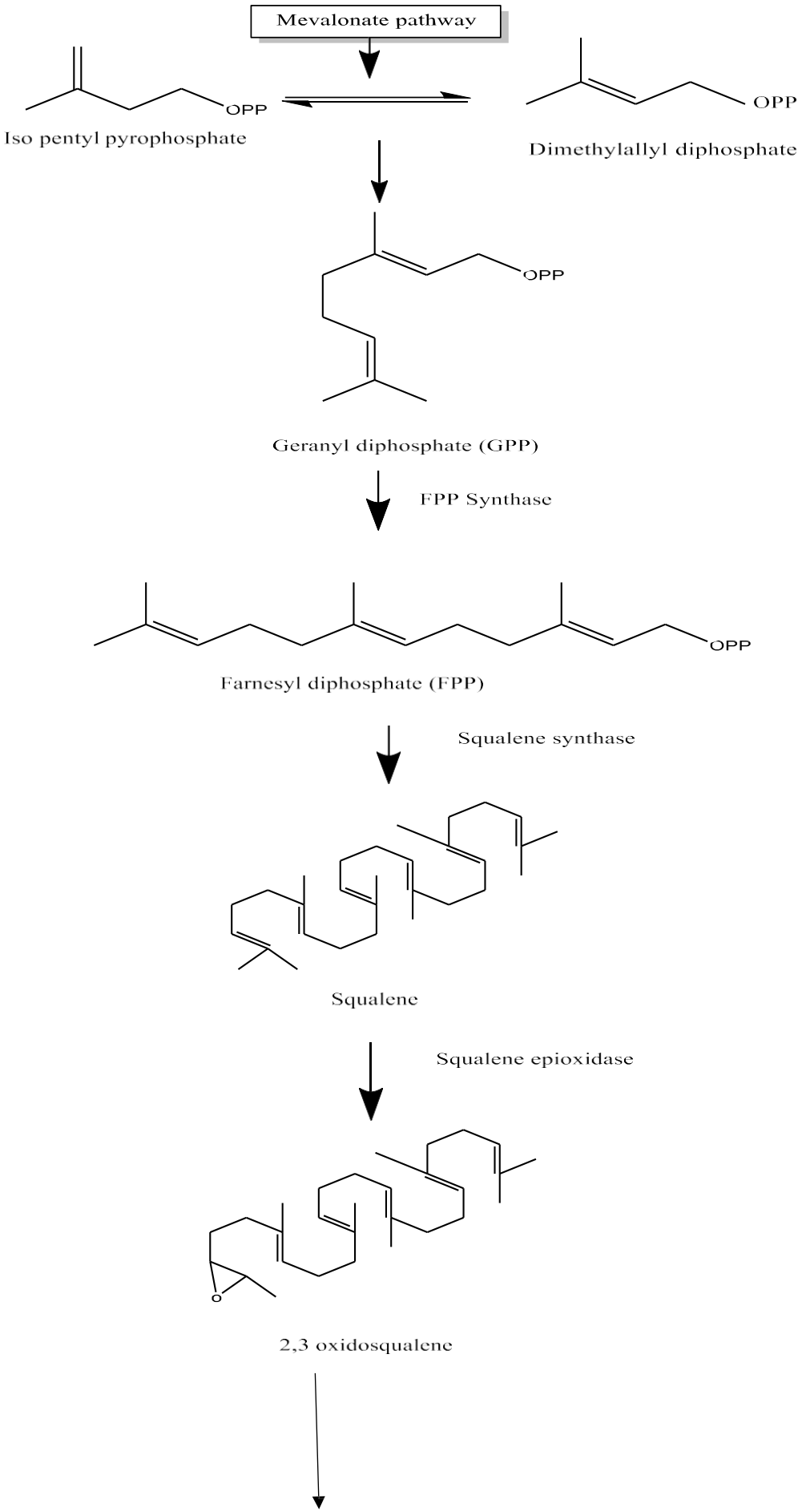
1. Alkaloid glycosides
2. Saponin glycosides
3. Triterpenoid glycosides.(Porte *et al.*, 2022)

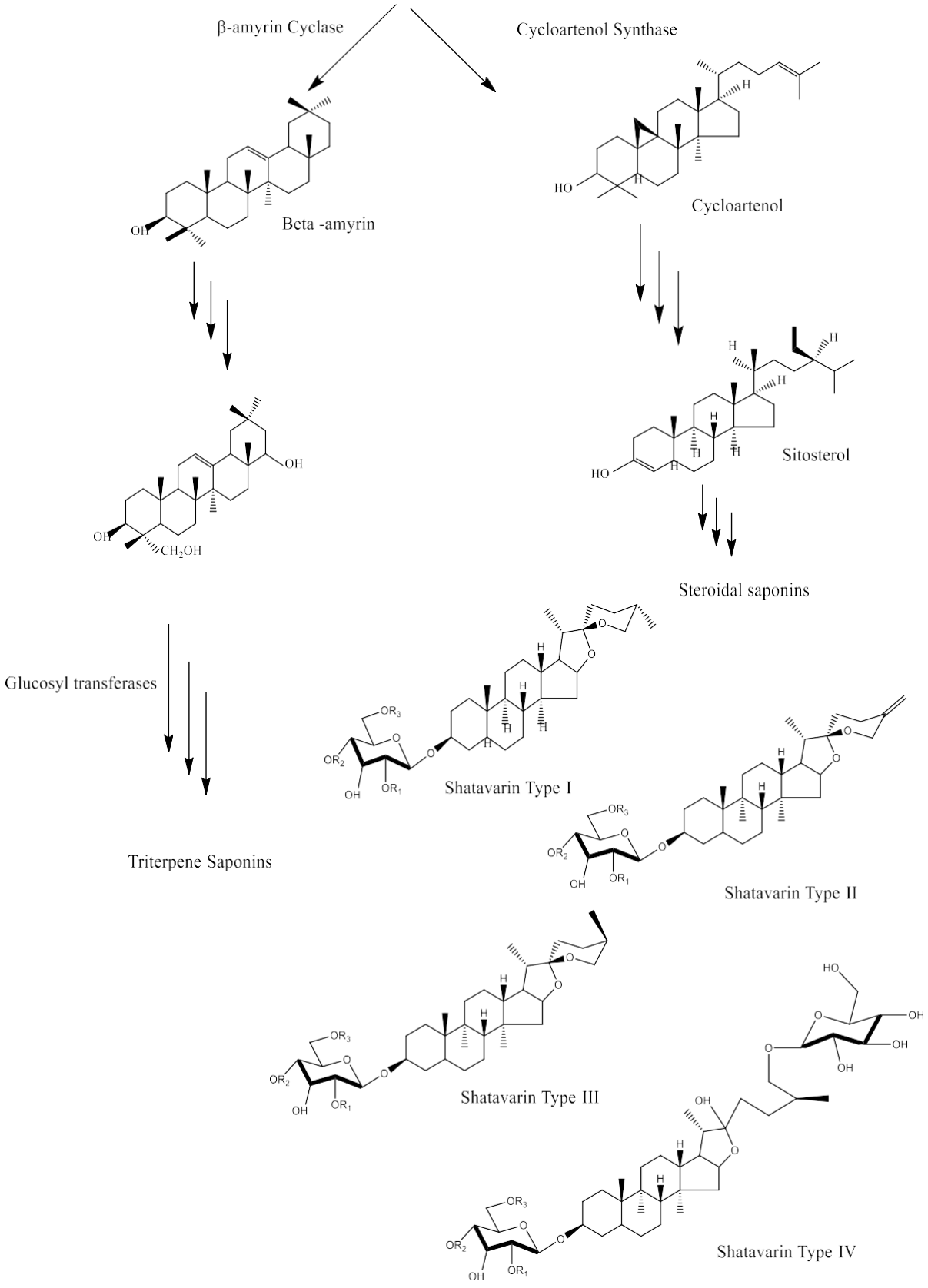
1. Alkaloid glycosides: It is the sub- class of Sapogenins. It contains a piperidine ring which possess a steroidal-like structure. In reference, to the structural differences between steroid, alkaloid glycosides and triterpenoid, it is observed that triterpenoid saponins has no spiro-carbon atom whereas both steroid and alkaloid aglycone have no carboxylic group.



2) Steroidal glycosides: Steroidal glycosides bears two hetero rings which is furan ring and pyran ring. Steroidal saponins are modified triterpenoids. They are used as precursors for the partial synthesis of sex hormones.

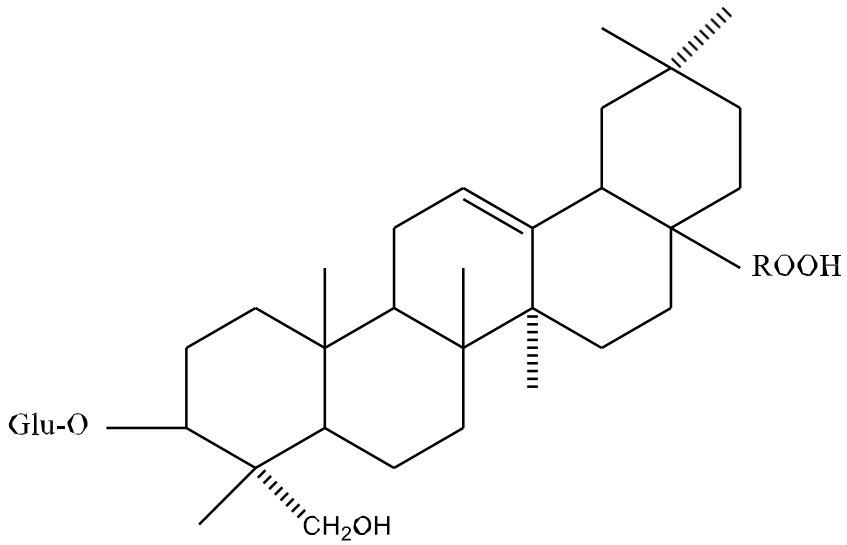



Mevalonate pathway
OPP
Iso pentyl pyrophosphate
OPP
Dimethylallyl diphosphate
OPP
Geranyl diphosphate (GPP)
FPP Synthase
OPP
Farnesyl diphosphate (FPP)
Squalene synthase
Squalene
Squalene epioxidase
O
2,3 oxidosqualene



Biosynthetic pathway of Terpenoids present in *Asparagus racemosus*

3) Triterpenoid glycosides: This type of saponins is broadly dispersed in the plant kingdom. **Triterpenes** are a class of terpenes composed of six isoprene units i. e. three terpene units. Squalene, is the precursor to all steroids This type of glycosides contains one carboxyl group, one hydroxyl group and four oxygen atoms. One atom is ether-linked oxygen and the two atoms is ester-linked oxygen. (Ashour *et al*., 2019)



It is further sub classified into Mono-desmosidic triterpenoid glycosides and Bi-desmosidic triterpenoid glycosides: According to the number of sugar moieties attached to the aglycone part.

A) Mono-desmosidic triterpenoid glycosides : It carries a single sugar chain.

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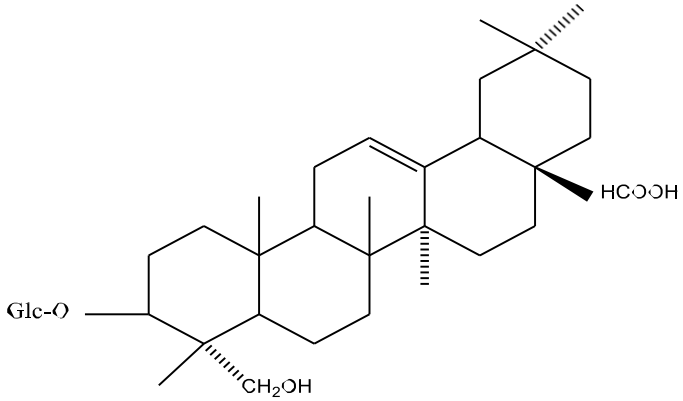
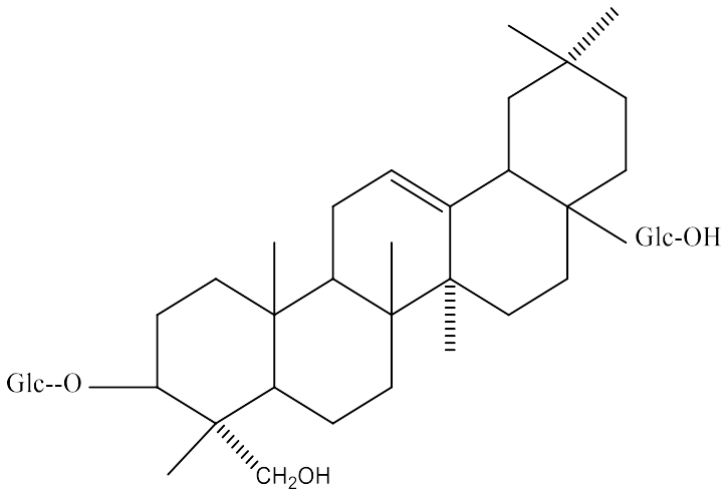


Monodesmosidic Triterpenoid Saponin

B) Bi-desmosidic triterpenoid glycosides: It carries two sugar chains and both the chains are linked through different positions. (Ashour *et al*., 2019)



Bi-desmosidic Triterpenoid Saponin

The main Chemical constituents present in the roots of *Asparagus racemosus* are steroidal saponins i.e. (Shatavarins I-IV) (Panchal *et al*., 2022)

- The primary glycoside attached to sarsapogenin is Shatavarin I which contains 3- glucose and rhamnose moieties. (Panchal *et al*., 2022)
- Shatavarin IV contains two rhamnose molecules and one glucose group that belongs to the sarsasapogenin family. (Srivastava *et al*., 2018)

In Some studies, It is found that Asparagus also contains other Phyto-active constituents which includes flavonoids, tannin, resin, essential oils, asparagine, arginine and tyrosine. It also contains some metals such as Zinc, copper, cobalt and manganese along with potassium selenium, calcium and magnesium.(Panchal *et al*., 2022) A novel compound named kaempferol and racemosol which is a derivative is also isolated from the ethanolic root extract of *Asparagus racemosus* .

As saponins exhibit defence mechanism against micro-organism, they are included in a group of protective molecules in plants which are known as Phyto-protectant. Although *Asparagus racemosus* contains steroidal saponins and steroidal sapogenins as the important metabolites with different pharmacological studies. For e.g. Antioxidant activity (Taepongsorat, 2018), Immunomodulatory activity and anti-inflammatory properties (Srivastava *et al.*, 2018), neuromodulatory activity (Jagdish, 2021)Shatavarin IV as an anticancer drug (Hamdi *et al*., 2024), Anti-Parkinson's activity (Ashok Giri *et al*., 2020). The saponins present in Shatavari shows other activities such as antibacterial (Jadhav, 2018)antiviral, antioxytocic, antispasmodic activity, anti-diabetic activity(El Barky *et al*., 2017) and antifungal activities. (Pandiyan *et al*., 2022).

New saponin-based combination supportives were used to vitalize balanced immune responses. (Palanisamy *et al*., 2023)

Table 3. Comparative analysis of drugs containing Saponin

Drugs	Type of Saponin	Key Saponins	Receptor binding	Mode of action	Therapeutic uses	References
Shatavari (*Asparagus racemosus*)	Steroidal	Shatavarin I–IV	Estrogen receptors (ER-α, ER-β)	Hormonal modulation, adaptogenic	Female reproductive health, galactagogue, adaptogen	Arora *et al*., 2024
Ginseng (*Panax ginseng*)	Triterpenoid	Rg1, Rb1, Rh1	GPCRs, ion channels, steroid receptors	Neuroprotective, immunomodulatory	Fatigue, cognition, immunity, metabolic disorders	Yang *et al*., 2023
Liquorice (*Glycyrrhiza glabra*)	Triterpenoid	Glycyrrhizin	Mineralocorticoid receptor (indirect)	Enzyme inhibition → pseudo-aldosteronism	Peptic ulcers, inflammation, and viral infections	Titiek *et al*., 2024; Semwal et al., 2025
Yam (*Dioscorea Deltiodea*)	Steroidal	Dioscin	Apoptotic proteins (Bcl-2, Caspase-3)	Caspase activation	Anticancer (preclinical), steroid precursor	Wang *et al*., 2025; Chen *et al*., 2014
Horse chestnut (*Aesculus hippocastanum)*	Triterpenoidal	Escin	Vascular endothelial mediators	Anti-edema, venotonic	Chronic venous insufficiency, edema	Yan *et al*., 2024; Chougule *et al*., 2023
Quillaja (*Q. saponaria)*	Triterpenoidal	QS-21	Toll-like receptors (TLR-2, TLR-4)	Vaccine adjuvant action	Vaccine adjuvant (malaria, COVID-19, shingles	Morais *et al*., 2025; Wang , 2021

Fig. 4 Pharmacological activity

Cytotoxic property

Saponins are the main class of secondary metabolites present in Asparagus. (Singh *et al*., 2018). From the different study's researcher claim that the Steroidal saponin (Shatavarin I and IV) which are present in Shatavari roots shows different activities including antitumor activities against different kind of tumours, such as mammary carcinoma, oesophageal cancer, cervix cancer, colon cancer, leukaemia, gastric carcinoma, prostate cancer, lung cancer, ovarian cancer, and glioblastoma. Saponins present in *A. racemosus* shows the apoptotic action (Podolak *et al*., 2023) and has the ability to tumour cell death. (Thakur *et al*., 2021). In many researches, it is observed that the isolated shatavarin IV from Asparagus exhibits potent cytotoxicity. It is observed that when a mice having tumour is treated with Shatavarin orally at a prescribed for specific days, it results in significant decrease in tumour volume, body weight, viable tumour cell count, and increased non-viable cell count as compared to controlled group. (Mitra *et al*., 2012; Onlom *et al*., 2017) Therefore, the novel chemotherapeutic agents become an urgent need for benefit and better survival.(Biswas *et al*., 2018)

Anti-inflammatory activity

When the body response against injury or infection, it is termed as Inflammation. It takes place when the body releases chemicals that generate an immune response to fend off infection or heal damaged tissue. It is the response of the host to stimuli which takes place due to the pro-inflammatory cytokines such as IL1-β, TNF-α, and IL-6 produced by immune cells which recruited to wound sites (Tiwari *et al*., 2017). It is observed in some studies that the niosomal gel which contains *Asparagus racemosus* lowers the inflammation in carrageenan-induced paw oedema model. After 30 min of induction of oedema, niosomal gel caused a significant anti-inflammatory effect compared to control group at the respective time. As the time increases the extract ultimately shows a maximum inhibitory effect. The standard drug was 1% Diclofenac gel, which produced a significant reduction of paw oedema compared to that of the control group (Hegdekar *et al*., 2023). The steroidal saponin plays an important role against inflammatory mediators derived from macrophages.

Reproductive Effect:

This drug is effective in improving the reproductive problems which occur in females like uterine bleeding amenorrhea, irregularities in menstrual cycle dysmenorrhea, menopause and pelvic inflammatory disease like endometriosis and sexual dysfunction It is also used as fertility booster. (Akhter *et al*., 2024) . *A. racemosus* contains saponins which inhibit the oxytocic action on uterine musculature and keep up the unconstrained uterine movement in Menstrual cramps. It decreases the chances of infertility and helps in contraction during foetus development. hence decreases the chances of miscarriage and also helps to balance the hormonal level. (Thakur *et al*., 2021).

Antidiabetic activity

Now a days, Diabetes is a common condition that affects people of all ages. (Hamdi *et al*., 2024) There are several forms of diabetes. Type 2 is the most common. It shows numerous complications which includes, neuropathy, retinopathy and peripheral vascular disease. (Champati *et al*., 2023). Saponins from *Asparagus racemosus* lowers the blood glucose level via different mechanisms which includes activation of glycogen synthesis, modulation of insulin signalling, reconstruction of insulin action, suppression of the activity of disaccharides and suppression of gluconeogenesis. The saponins which are isolated from the roots of *Asparagus racemosus* are furoasparoside (A-F) some flavonoids and glycosides. The therapeutic action of the isolated saponins were examined by In-vitro and in–vivo methods via Streptozotocin -induced diabetes in rats and mice. It is observed that Furoasparoside E decreases the blood glucose level in type 2 diabetes. Now, the study indicates that furoasparoside E is beneficial in the management of type 2 diabetes. (Pandey *et al*., 2022).

Antibacterial:

Different research study showed that Shatavarin-IV is used in formulation of vaccines. It possesses better adjuvant activity against some bacteria's by providing effective responses at the desirable dose. (Palanisamy *et al*., 2023) Therefore, the antibacterial activity exhibited by this plant extract may be due to the presence saponins. Results have shown that *Asparagus racemosus* contains saponins which shown antibacterial activity at concentrations of 25 mg ml^{-1}, 50 mg ml^{-1} and 100 mg ml^{-1} respectively. At these concentrations, the extract inhibited the growth of various bacteria's and produced percentage inhibition ranging from 72.4% to 86.5%. Therefore, *Asparagus racemosus* contain potential antimicrobial components that may be of great use for the development of pharmaceutical industries as a therapy against various diseases. (Kumaran *et al*., 2015)

Antioxidant

Oxidative stress or Oxidative reactive species acts as sources of many pathogenesis diseases. Steroidal saponin also acts as an antioxidant. (Akhtar *et al*., 2024). The aqueous extract of *Asparagus racemosus* root possess anti stress activity in a mouse via inhibiting the effect of inflammatory cytokines mainly interleukin and tumour necrosis factor. (Champati *et al*., 2023)**.** In few researches, it is observed that the methanolic root extract of *A. racemosus* contains maximum antioxidant components which can scavenge free radicals and different Reactive oxygen species under In vitro conditions. (Behera, 2018)

Neurodegenerative Parkinson's disease

Different studies have found that Shatavarin-IV acts as anti-Parkinsonism and as anti-aging by using models (Abduljawad *et al*., 2022). It increases expression of stress genes by antioxidant property which contribute in the modulation of oxidative damage and improves lifespan. Shatavarin-IV boosts longevity by decreasing down the oxidative stress as well as oxidative damage. This study is a progressive step in exploring the anti-Parkinsonism potential and anti-aging of bioactive compound Shatavarin-IV in C. elegans. (Smita *et al*., 2017)

Immunomodulatory activity

The immunomodulatory effect was exhibited by the steroidal saponins (shatavaroside A and shatavaroside B) which is isolated from *Asparagus racemosus* using polymorphonuclear leucocyte function test (Sharma *et al*., 2012). The research was further determined by using more sensitive assays such as nitro blue tetrazolium and nitrous oxide assays. Nano concentration of the steroidal saponins were used for the activity and it showed active response and thus it can be used as potent immunostimulants. (Shen *et al*., 2024)

Phyto-saponins stimulate the receptor and activate the signalling pathway, that leads to the recruitment of cells which promote their proliferation and differentiation, at the same time a series of cytokines are produced to regulate the immune response of the body. (Shen *et al*., 2024)

Hypolipidemic activity:

The increase in Cholesterol along with Reactive oxygen species increases the serum lipid levels is a root cause of coronary artery disease and atherosclerosis. The roots of Shatavari have shown reduction in cholesterol levels and thus it is used for anti-hypercholesterolemia activity. In a research study, hypercholesterolemia was induced in albino rats via diet in which cholesterol and bile salts was given in a regular basis. After that, *A. racemosus* powder was given to albino rats for 4 weeks and it is observed that it decreased the level of total plasma lipid and total cholesterol in comparison to standard drug. The steroidal saponin which are present in Shatavari root increased the concentration of (Superoxide Dismutase activity) SOD and ascorbic acid in high Cholesterol rats and showed Hypolipidemic activity. (Guo *et al*., 2022)

Formulations containing saponin from Shatavari:

Emulsion: The emulsion which contains Shatavari root extract shows therapeutic effect on usage. Different Study indicates that formulations containing saponins from Shatavari root extract maintains their stability after entrapping the extract within HPβCD. Moreover, the effectiveness of the entrapped extract on prevention of wrinkle progression was observed. (Rungsang *et al*., 2015)

Nano-formulation: Nano-formulation is now being extensively utilized in the development of innovative drug delivery systems for various routes of administration. The constitutional and botanical diversities and strength of the saponins isolated from *Asparagus racemosus* along with their use in the production of stable Nano-formulations made them a perfect candidate for future drug discovery of new pharmaceutically active agents.(Sobhy *et al*., 2022)

The plant extract enriched with biologically active compounds including Saponin was encapsulated into Nano-formulations such as liposomes, suspension, or alternatively adsorbed onto the surface of metal-based nanoparticles to act as a targeted drug delivery system to target the plant extract to diseased organ. (Amina *et al*., 2020)

The Phyto- pharmaceuticals reported in *Asparagus racemosus* extracts can reserve the biological activity of the nanoparticles but do not show any harmful effect on the environment and as well as humans. (Sobhy *et al*., 2022).

Liposomes:

The Study concluded that *A. racemosus* extracts containing saponins as the major constituents which includes Shatavarin are formulated in the form of formulation. i.e. liposomes and used for tyrosine inhibitory activity. (Therdphapiyanak *et al*., 2013) They also have significant applications as natural surfactants and foaming agents

for soaps and shampoos in cosmetic industry. The extract also exerts health properties, as it has an inhibitory effect on pancreatic lipase activity. (Hamdi *et al*., 2024)

Table 4. Some formulations with their composition: (Hamdi *et al*., 2024; Therdphapiyanak *et al*., 2013; Rungsang *et al*., 2015).

Formulation	Key component	Particle size	Purpose
Polymeric nanoparticles	PLGA/ chitosan	120-280nm	Sustained release, stability
Liposomes	Phosphatidylcholine + cholesterol	150-220nm	Enhanced absorption
Phytosomes	Phospholipid–saponin complex	200nm	Improved permeability
Solid lipid nanoparticles	Glyceryl monostearate	180-250nm	Oral bioavailability

CONCLUSION

The present study concluded that herbal drugs are more effective as compared to conventional medicine. This review represents detailed Pharmacognosy of *Asparagus racemosus* . Its method of cultivation and collection. The saponin isolated from Shatavari has two major parts: the Aglycone and a Glycone part. The Saponins which carry one sugar moiety are termed as mono-desmosidic and the one which carry two sugar moieties are termed as bi-desmosidic. According to the number of carbon atoms present, it is further sub divided into triterpenoid glycoside, steroidal glycoside and alkaloid glycosides. It also contains steroids, flavonoids and essential oils. It contains a group of steroidal saponins (Shatavarin I-IV) i.e. Shatavarin I, Shatavarin IV Shatavarin V, Immunoside and Schidigerasaponin D5. The steroidal saponin are mainly responsible for different therapeutic activities of *A. racemosus* which includes Cytotoxic property, Anti-inflammatory activity, Reproductive activity, Antidiabetic activity, Antibacterial activity, Antioxidant activity, Neurogenerative Parkinson's disease, Immunomodulatory activity, Hypolipidemic activity. The present study was designed to evaluate the different Pharmacological activity and several formulations which includes Emulsion and Nano- formulations containing saponin from Shatavari and are used to treat variety of diseases.

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Conflict of Interest

The authors declare no conflict of interest.

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