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## Traditional uses, Phytochemistry and Pharmacology of *Asparagus adscendens* Roxb.

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**ABSTRACT**

**Background:** Musali (*Asparagus adscendens* Roxb.) is a traditionally important medicinal plant of the family Asparagaceae. It is used worldwide to treat several ailments due to the presence of various bioactive constituents, mainly concentrated in the tubers of plants. It has been used since time immemorial as a popular drug for treating chronic leucorrhea, spermatorrhea, general weakness, diarrhea, dysentery, and pharmacological purposes like rejuvenation, aphrodisiac, etc. This review aimed to gather information on the traditional uses, phytochemistry, and pharmacology of *Asparagus adscendens* Roxb.

**Materials and Methods:** Primarily, classical literatures of Ayurveda, including *Brihat-trayi* (the greater triad), *Laghu-trayi* (the lesser triad), and *Nighantus* (lexicons), were reviewed for the terms “*Musali*” and “*Shweta Musali*.” Establishing an overview, library resources, and online collections of books and original research articles, other online databases such as Pubmed Central, Scopus, Embase, Web of Science, ERIC, IEEE Xplore, Science Direct, DOAJ, JSTOR, Henari, Google Scholar, and NepJoL were explored with search words like “*Musali*”, “*Safed Musali*”, “*Shweta Musali*” “*Asparagus adscendens*”, botanical characteristics, traditional and contemporary uses, pharmacognosy, phytochemical constituents, pharmacology, agriculture, and miscellaneous aspects. Ethnobotanical reports, wet laboratory experiments, pharmacognostic characteristics, phytoconstituents, and pharmacology (experimental works and clinical trials) are selected to include in this review. Evidence-based papers from indexed sources were also considered.

**Results and Discussion:** *Asparagus adscendens* has been used for the treatment of chronic leucorrhea, spermatorrhea, general weakness, diarrhea, dysentery, rejuvenation, and aphrodisiacs in Ayurveda by its various names and formulations since 1000 BC, the period of Agnivesa. This plant has great pharmacological actions such as a aphrodisiac, antioxidant, anthelmintic, antidiabetic, etc.

**Conclusion:** Musali has been a unique gift of nature to mankind since time immemorial. It is a major ingredient in many Ayurvedic formulations. It has several uses, including as a strong “*Rasayana*” (rejuvenator), a tonic and vitalizer that promotes health, a therapeutic remedy for prenatal and postnatal problems, a restorative agent that boosts immunity, and a strong aphrodisiac. It will take a number of scientific endeavors to investigate the pharmacological actions that are hidden and described in the classics. To assess the pharmacotherapeutics of *Asparagus adscendens* and provide a solid, evidence-based treatment, more clinical studies may be carried out.

**Key words:** *Musali*, *Asparagus adscendens* Roxb., *Shweta Musali*, *Safed Musali*, Aphrodisiac

## INTRODUCTION

Nepal is a biologically diverse country where herbs were used for the treatment of diseases as a tradition and is practiced till today. Traditional medicine is practiced in China, India, Pakistan, Sri Lanka, Thailand and Japan. Herbal medicines or extracts are found to be effective in several ailments due to their antimicrobial and antifungal activity. The genus *Asparagus* contains about 300 species; and has been moved to the family Asparagaceae from the family Liliaceae.<sup>1</sup> Several properties such as anti-inflammatory, anti-bacterial, anti-hepatotoxic, immunostimulant, anti-oxytocic and reproductive agents have been reported from the genus *Asparagus*.<sup>2</sup> It is good source of vitamins, low in starch and sodium contents. *Asparagus adscendens* Roxb. has different names with different geographical areas in India and Nepal by the name of *Safed musali* and *Seto Musali* respectively. The peeled and dried tuber of the plant is used as drug for the treatment of chronic leucorrhea, spermatorrhea, general weakness, diarrhea and dysentery.<sup>3</sup> The powder of *Musali* contains an abundant amount of carbohydrates and protein. It is also found to be effective in treatment of filariasis.<sup>4</sup> The aqueous extract from root of *Asparagus adscendens* has anti-diabetic since it inhibited starch digestion and also stimulated both action and secretion of Beta-cells.<sup>5</sup> In comparison to *Asparagus racemosus*, there is very less research on *Asparagus adscendens*. Hence, this review aimed to gather information on traditional uses, phytochemistry, and pharmacology of *Asparagus adscendens* Roxb.

**Sanskrit synonyms:** *Musali* has the meaning of curing disease by maintaining the *doshas*. *Talamuli*, *Talamulika* and *Talapatrika* has been coined because of resembling with that of *Tala*. *Deerghakandika* is the name behind having elongated tuber. *Bhootale* is the name because of similarity with ground palm. *Suvaha* is the name because of its fortunate flower. *Mahavrisya* and *Vrisyakanda* is due to having aphrodisiac property.

*Musali* is of two types. They are *Sweta musali* (*Asparagus adscendens*) and *Krishna Musali* (*Curculigo orchoides*).<sup>6</sup>

**Botanical Description:** *Asparagus adscendens* is sub-erect shrub of about 1.5 feet tall having stout stem and tuberous roots found in dense forests (Figure 1). It is a struggling type of shrub, multi-branched with thick, stout, straight and slightly curved spines at tip arising from stem and branches (Figure 2). It has lanceolate type of leaves, small white flowers which may be solitary or fascicled, single seeded fruit of approximately 0.8 cm diameter (Figure 5 & 6). Tubers may grow up to 10 inches deep. *Asparagus adscendens* is commonly available up to 1500 meters in tropical and subtropical regions.<sup>8</sup> In October, flowering starts followed by fruiting in the month of March (Figure 3 & 4). The plant becomes fully matured after three years; however, it starts flowering and fruiting after one year of planting. Crop is ready to harvest after 3 years of planting. The content of steroidal glycosides increases with the age of spears.<sup>9</sup>

**Classification:** The botanical name, sub species and vernacular names of the plant is given below.

### Scientific classification

Kindom: Plantae  
Division: Magnoliophyta  
Class: Liliopsida  
Natural order: Asparagales  
Family: Asparagaceae  
Sub-family: Asparagoideae  
Genus: *Asparagus*  
Species: *adscendens*  
Botanical name: *Asparagus adscendens* Roxb.

### Sub species

*Asparagopsis adscendens* (Roxb.) Kunth  
*Asparagus satawar* James A. Murray  
*Asparagus adscendens* (Roxb.) Kamble

### Local names

Nepali name: Musali  
Local name: Musali  
Abadhi name: Satawari  
Hindi Name: Safed Musali  
Urdu Name: Musli  
Gujarati Name: Dholi Musali  
Afghani Name: Sakakulae  
English name: White Musali, Asparagus  
Trade name: Pili Satava

## RESULTS AND DISCUSSION

**Traditional uses:** *Asparagus adscendens* is widely used in traditional medicine for treatment of different ailments. Its tuberous root is utilized in formulations that are polyherbal or polyherbo-minerals, either alone or in conjunction with other plants. Two significant *Musali* formulations are *Musali-paka* and *Musaliyadi yoga*. The ayurvedic qualities of *Musali* include the following *Gunas*: *guru* (heavy), *snigdha* (unctuous), *rasa* (taste): *madhura* (sweet), *vipaka* (biotransformation); *madhura* (sweet), *veerya* (potency); *sheeta* (cold) and *doshakarma* (pharmacotherapeutics), *kaphavardhaka* and *vatapittashamaka*. Additionally, it has been reported that *Musali* can be used to cure *Sukra-kshaya* (oligospermia), *Klaibya* (erectile dysfunction), *Mutrakrichha* (dysuria), *Puyameha* (gonorrhea), *Daurbalya* (weakness) and *Krishata* (lean & thinness).<sup>6</sup>





Fig 1: Whole plant



Fig 2: Leaves

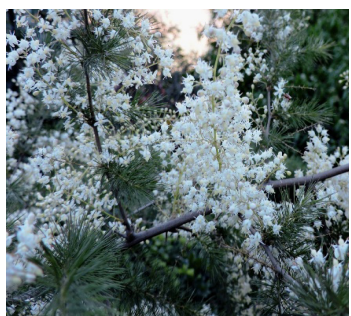


Fig 3: Flowers



Fig 4: Fruits



Fig 5: Tubers



Fig 6: Seeds

*Musali* has been mentioned several times in Ayurvedic literatures for the treatment of various ailments. The *Charaka Samhita* states that *Dhumapanaa yoga*, which includes *Talamuli (Musali)* as one of its main ingredients, is a medical smoking composition intended to relieve *Kasa*<sup>10</sup> (cough). Six yogas (formulations) of *Talapatri (Musali)* are discussed in the *Sushruta Samhita*. Treatment for *Asmari*<sup>11,12</sup> (renal calculi), *Granthi*<sup>13</sup> (tumor), *Vyanga*<sup>14</sup> (facial melanoma), and *Swasa*<sup>15</sup> (asthma) has been recommended. *Ashtanga Hridayam* prescribes the use of *Musali*, in combination with other medicinal herbs to create *kshara* (alkalis), which is used to cure ailments like *Arbuda*<sup>16</sup> (tumors), *Mutraghata*<sup>17</sup> (anuria), *Karna-roga*<sup>18</sup> (ear disorders), and *Kshudra-roga*<sup>21</sup> (minor diseases). In the *Sharangadhara Samhita*, *Acharya Sharangadhara* detailed

the several medicinal applications of *Musali*. In the *Samhita*, *Musali* is mentioned for treating *Klaibya*<sup>20,21</sup> (erectile dysfunction); and for treating *Arsha* (piles), *Vatakaphaja grahani* (sprue), *Swasa* (dyspnoea), *Kasa* (cough), *Kshaya* (consumption), *Pliha* (splenic enlargement), *Shlipada* (filariasis), *Shotha* (oedema) and *Prameha*<sup>22</sup> (diabetes). Similarly, *Musali* along with other herbs is used to treat *Sannipataja jwara*.<sup>23,24</sup>

*Musali* is *snigdha* (unctuous) and *Madhura* (sweet), so it is *Kapha vardhaka* and *Vata-pitta shamaka*. In the realm of Ayurveda, this herb is quite significant. It has spermatogenetic and diuretic properties. According to literature, *Sweta Musali* is used to treat a wide range of illnesses. It has been suggested in *Ashtanga Hridaya* to treat skin-related illnesses and to improve the complexion of the skin. Its aphrodisiac (*vrishya*) action has been documented in several *Nighantus*, demonstrating its significance in male infertility. Because of its *Vrishya guna*, it can thus be utilized as a general male tonic. Therefore, in general, it can be said that *Satavari (Asparagus racemosus)* is a general tonic for females. In addition, it enhances digestion and builds muscular and body strength.

**Phytochemistry:** *Asparagus adscendens* is rich in chemical constituents. It has great health benefits due to the presence of several active compounds. Many attempts have been made to extract and characterize several chemical compounds (Table 1).

**Tuber contents:** In a previous study on a sample of *Asparagus adscendens* tuber shows that total ash, acid insoluble ash and water-soluble ash value were 2.0%, 0.25% and 1.3% respectively, and bitterness value was negligible. From nutritional point of view, it contains 30.65% carbohydrates and 0.76% protein.<sup>25</sup>

**Pharmacological Activities:** *Musali* is considered as a wonder drug because of the following pharmacological properties.

**1. Anti-amnesiac activity:** *Asparagus adscendens (Safed musali)* is used as a nerve tonic and remedy for memory impairment. *Musali* has anti-amnesiac effect in scopolamine induced amnesia in rats. The nootropic effect of *Asparagus adscendens* was evaluated by

*Asparagus adscendens* extracts by *in-silico* and *in-vivo* approach. It shows excellent effect. The extracts (50, 100 & 200 mg/kg, i.p.) were used for 15 days as pretreatment which showed a significant decrease in reference memory error, working memory error, and retrieval latency in radial arm maze. In mice, it also reduced acetylcholinesterase and oxidative stress parameters in the hippocampus and cortex. Hence, it has nootropic effect through anti-acetylcholinesterase and antioxidant activities.<sup>30</sup>

**Table 1.** Chemical structures of chemical compounds found in *Asparagus adscendens*.

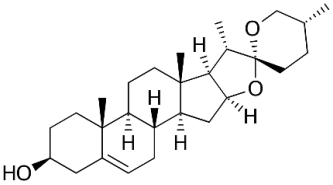
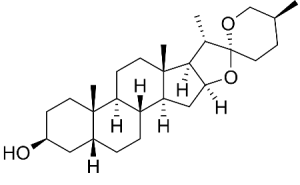
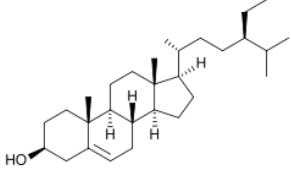
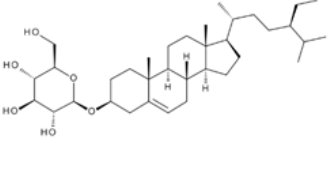
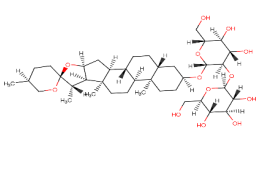
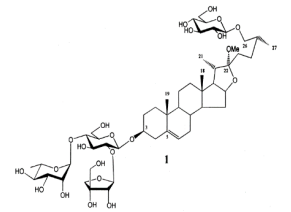
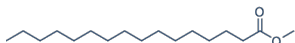
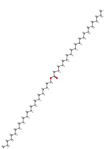


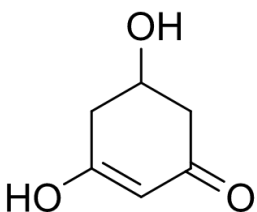
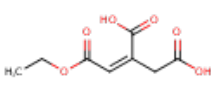
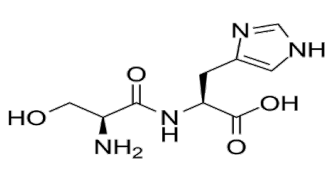
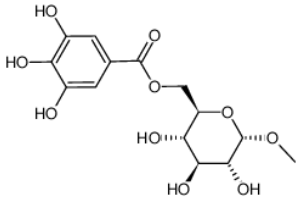
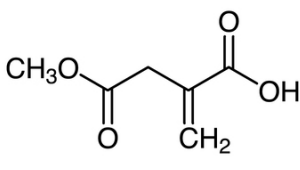
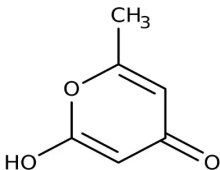
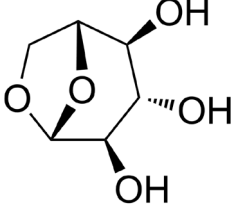
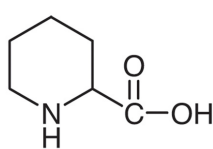
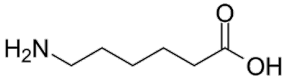
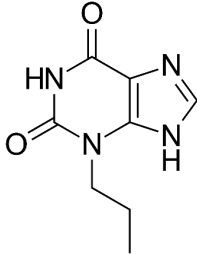
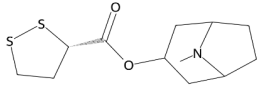
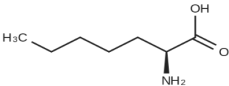
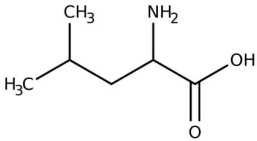
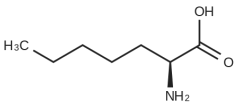
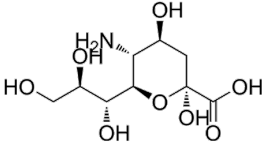
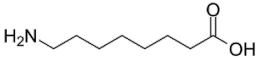
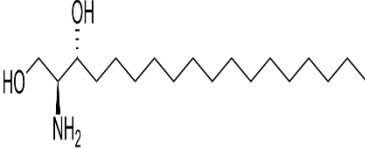
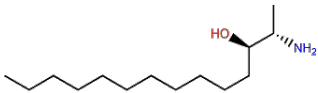
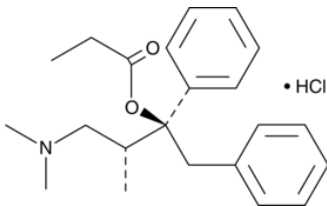
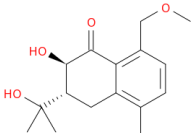
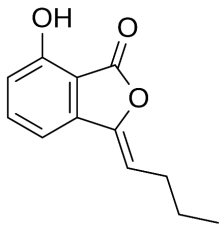
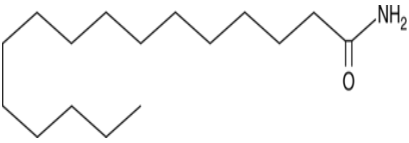
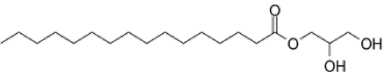
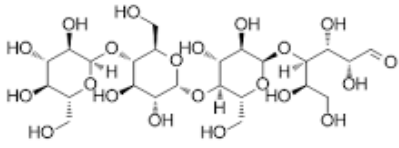
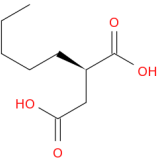
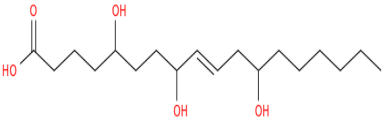
		
Diosgenin <sup>26</sup>	Sarsasapogenin <sup>26</sup>	$\beta$ Sitosterol <sup>26</sup>
		
Sitosterol $\beta$ -D-glucoside <sup>27</sup>	spirostanol glycoside <sup>27</sup>	Furostanol glycosides <sup>27</sup>
		
Methyl palmitate <sup>28</sup>	tetracosyl tetracosanoate <sup>28</sup>	Palmitic Acid <sup>28</sup>
		
Stearic acid <sup>28</sup>	Dihydrophloroglucinol <sup>29</sup>	Ethyl aconitate <sup>29</sup>
		
His-Ser-OH <sup>29</sup>	Methyl 6-O-galloyl-beta-D-glucopyranoside <sup>29</sup>	Methylitaconate <sup>29</sup>
		
4-Hydroxy-6-methylpyran-2-one <sup>29</sup>	Levoglucosan <sup>29</sup>	DL-pipecolic acid <sup>29</sup>

Table 1 Continue...

		
Aminocaproic acid <sup>29</sup>	Enprofylline <sup>29</sup>	Brugine <sup>29</sup>
		
2-amino-heptanoic acid <sup>29</sup>	L-Leucine <sup>29</sup>	2-amino-heptanoic acid <sup>29</sup>
		
Neuraminic acid <sup>29</sup>	8-Amino Caprylic acid <sup>29</sup>	C16 Sphinganine <sup>29</sup>
		
Xestoaminol C <sup>29</sup>	p-Hydroxynorpropoxyphene <sup>29</sup>	Emmotin A <sup>29</sup>
		
3-butylidene-7hydroxyphthalide <sup>29</sup>	Palmitic amide <sup>29</sup>	1-Monopalmitin <sup>29</sup>
		
Maltotetraose <sup>29</sup>	Nonic Acid <sup>29</sup>	5,8,12-trihydroxy-9-octadecenoic acid <sup>29</sup>

**2. Antioxidant activity:** Free radicals are highly reactive in nature due to presence of unpaired electrons in atomic or molecular orbit. During metabolic processes, free radicals named reactive nitrogen species (RNS) and reactive oxygen species (ROS) are released. Vital biomolecules like lipids, proteins and DNA gets degenerated due to excess accumulation of free radicals. Antioxidants reacts with free electrons of free radicals and prevents biomolecules from being damaged. There must be balance between anti-oxidants and oxidants in order to maintain healthy life. *Asparagus adscendens* is rich in antioxidants. The effect of antioxidant enzymes (catalase, superoxide, dismutase) was also increased due to the diet containing *Musali*.<sup>31</sup>

**3. Anti-fertility activity:** It was found to have 28% anti-fertility activity in albino rats when its seed powder was used along with equal quantity of gum acacia at dose of 175mg/Kg administered daily.<sup>32</sup>

**4. Anti-filarial activity:** *Asparagus adscendens* showed anti-filarial activity. The aqueous and alcoholic extract of *Asparagus adscendens* was found to be effective against *Setaria cervi* during *in vitro* studies. The spontaneous movement of whole worm as well as nerve and muscle were inhibited. The required concentration was 1/4 for aqueous and 1/3 for alcoholic extract for inhibition of movement of nerve muscle preparation due to cuticular permeability barrier. Death of microfilariae was caused by both aqueous as well as alcoholic extracts, LC<sub>50</sub> and LC<sub>90</sub> being 8 and 16 ng/ml for aqueous, 3 and 12 ng/ml for alcoholic extracts respectively.<sup>4</sup>

**5. Anti-diabetic activity:** The aqueous extracts from rhizome of *Sweta Musali* stimulated the insulin secretion (from BRIN-BD11 cells at levels of 5 mg/ml and above). It also enhances glucose uptake and retards starch digestion. In 3T3-L1 adipocytes, *Musali* has direct effect on glucose uptake. It has similar action as that of insulin at a concentration of 5 mg/ml. In *in-vitro* model consisting of digestive enzymes ( $\alpha$ -amylase and  $\alpha$ -glucosidase), the potentiality of *Asparagus adscendens* was assessed to inhibit starch digestion, in which it shows 21% reduction in starch digestion.<sup>5</sup>

**6. Anti-depressant activity:** The hydro-ethanolic extract from tuber of *Asparagus adscendens* showed anti-depressant effect on mice through modulation of monoaminergic system and regulating hypothalamic-pituitary-adrenal axis with amelioration of oxidative stress. Mice was pretreated with *Asparagus adscendens* extracts (25, 50, and 100 mg/kg/day; *i. p.*) and with vehicle, imipramine (15 mg/kg/day; *i. p.*) for 14 days. The level of corticosterone was decreased, and levels of monoamines were increased.<sup>33</sup>

**7. Anti-microbial activity:** The antimicrobial effect of steroidal saponins extracted from tubers of *Asparagus adscendens* was highly significant against *B. anthracis* and was moderately significant against *S. agalactiae*, *S. aureus*, *Aspergillus niger*, *Proteus vulgaris* and *Aspergillus flavus*. The lesser effects were seen on *Pseudomonas aeruginosa*, *Salmonella richmond*, *Corynebacterium pyogenes*, *Pasteurella sp.* and *Hemophilus*

*influenza*. However, it showed no effects on *E. coli*, *klebsiella pneumonia*, *B. subtilis*, *Penicillium digitatum*, *Salmonella pullorum*, *Salm stanely*, *Aspergillus fumigatus*, *Fusarium sp.* and *Rhizopus stolonifera*. The methanol extracts and solid phase extractions from tubers of *Musali* showed significant antibacterial effect against gram negative bacteria than gram positive bacteria.<sup>34</sup>

**8. Anti-helminthic activity:** The larval mobility of *Meloidogyne incognita* was revealed by the presence of Asparanin A and B. Thus, it shows nematocidal effect.<sup>35</sup>

**9. Anti-cancerous activity:** Studies shows that tuber of *Asparagus adscendens* is effective in prevention of fore stomach and skin cancer in mice. The test study shows significant reduction in incidence of tumour at test dose of 2, 4 and 6% (w/v).<sup>36</sup> It has been used in prevention and treatment of various form of cancers. The methanol extracts and all solid phase extracts from *Musali* shows cytotoxicity against cancer causing cells due to the presence of saponins and aglycones.<sup>37</sup>

**10. Pharmacological activities of phytoconstituents of *Asparagus adscendens*:** *Musali* contains several bioactive compounds. Some of them exhibit the following pharmacological actions presented in table 2.

**11. Side Effects:** While *Musali* doesn't have any negative consequences when taken under medical supervision, if it is used carelessly, the body may experience the following side effects. This herb might lead to unintended weight gain if used in excess of the prescribed dosage. *Musali* is difficult to digest when taken in excess since it is *snigdha* (unctuous) and *madhura* (sweet) in nature. Long-term use of it may cause a decrease in appetite since it suppresses hunger.<sup>52</sup>

*Musali* is *snigdha* (unctuous) and *Madhura* (sweet), so it is *Kapha vardhaka* and *Vata-pitta shamaka*. In the realm of Ayurveda, this herb is quite significant. It has spermatogenetic and diuretic properties. According to literature, *Sweta Musali* is used to treat a wide range of illnesses. It has been suggested in *Ashtanga Hridaya* to treat skin-related illnesses and to improve the complexion of the skin. Its aphrodisiac (vrishya) qualities have been documented in several Nighantus, demonstrating its significance in male infertility. Because of its *Vrishya guna*, it can thus be utilized as a general male tonic. Therefore, in general, it can be said that *Satavari* (*Asparagus racemosus*) is a general tonic for females. In addition, it enhances digestion and builds muscular and body strength.

Beside these, further studies are also required related to the *Sweta Musali* as it can be used as a general tonic by anyone. Several studies and clinical trials are performed using tuber and its extracts but study on leaves, fruits, seeds aren't done in satisfactory numbers although they contain much abundant active compounds.



**Table 2:** Pharmacological action of chemicals extracted from *Asparagus adscendens*

S.N.	Chemical compound	Pharmacological actions
1.	Diosgenin	Anti-inflammatory activity, <sup>38</sup> anti-cancerous activity, <sup>39</sup> anti-amebic activity, <sup>40</sup> effects on metabolic syndrome, <sup>41</sup> anti-diabetic, <sup>42-46</sup> antioxidative and hypolipidemic effect <sup>47</sup>
2	Sarsasapogenin	Anti-inflammatory activity, <sup>48</sup> anti-cancer activity, <sup>49</sup> antidiabetic activity, <sup>50</sup> anti-osteoclastogenic activity, <sup>51</sup> treats precocious puberty, <sup>52</sup>
3	β Sitosterol	Anti-inflammatory and anti-cancer activities, <sup>53</sup>
4	spirostanol glycoside	Hemostatic and antimicrobial activities, <sup>54</sup>
5	Methyl palmitate	Anti-inflammatory activities, <sup>55</sup> vasodilation activity, <sup>56</sup>
6	Palmitic Acid	Anti-bacterial effect, <sup>57</sup>
7	Stearic acid	Neuroprotective effect, <sup>58</sup>
8	Aminocaproic acid	Antifibrinolytic effect <sup>59</sup>
9	Brugine	Anti-cancerous effect <sup>60</sup>
10	L-Leucine	Anti-diabetic and pharmaconutrient <sup>61</sup>

## CONCLUSION

*Musali* is a unique gift of nature to mankind since the time immemorial. It is a major ingredient of many Ayurvedic formulations and used as a potent '*Rasayana*' (rejuvenator), a vitalizer and health promoting tonic, a curative for pre-natal and post-natal problems, a restorative for immunity-improvement and as a potent aphrodisiac. *Asparagus adscendens* Roxb. is controversial plants in texts. Several varieties confuse the existence of plant; however, *Asparagus adscendens* seems righteous reviewing *rasa*, *guna*, *virya*, *vipaka*. This plant has great pharmacological actions like antifertility, antioxidant, anthelmintic, antidiabetic activities, etc.

As it has tremendous properties which can be utilized for health improvement of human beings, thus the need of the hour is comprehensive training and education in sustainable means of farming and preserving this priceless gem of the plant kingdom. Several scientific interventions are to be made in order to explore the concealed pharmacological activities mentioned in classics.

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