Abstract
Use of plants as a source of medicine has been inherited and is an important component of the health care system in India. Among these plants *Asparagus racemosus* is an important medicinal plant which has been used worldwide. A lot of medicinally importance attributes have been assigned to this herb. It has been used by tribes located in distinct area of India from primeval time. Key component of this herb is saponins. Recent developments in transgenic research have opened up the possibility of the metabolic engineering of biosynthetic pathways to produce these high-value secondary metabolites. The present review is a pragmatic approach to accrue the findings on this very important herb.

Key words: *Asparagus racemosus*, Saponins, Ethnopharmacology, Disease.

Introduction
India's diversity is unmatched due to the presence of 16 different agro-climatic zones, 10 vegetation zones, 25 biotic provinces and 426 biomes. Of these, about 15000-20000 plants have good medicinal value. However, only 7000-7500 species are used for their medicinal values by traditional communities. In the Indian system of medicine, most practitioners formulate and dispense their own recipes (1). The age-old tribal knowledge of plants is an important aspect of ethno botanical research. The tribal tracts are the storehouse of information and knowledge on the multiple uses of plants (2). Potential plants for Ayurvedic medicines have been reported by Kumar (3).

These plants are not only used for common diseases but also for fetal diseases. The Asparagus genus (*Asparagaceae*) has over 300 species, which are widely distributed in temperate and tropical regions. Its medicinal properties are reported in traditional systems of medicine such as Ayurveda, Siddha and Unani (4). It is used in the treatment of diarrhea, rheumatism, diabetes and brain complaints (5). During previous investigations influence of fertilizers on growth (6) and biochemical composition (7) and \textit{in vitro} propagation of *Asparagus racemosus* (3) was studied.

Pharmacological applications of Asparagus racemosus

\textbf{Aphrodisiac}: An aphrodisiac is a substance that is used in the belief that it increases sexual desire.

The herbs have been traditionally used as Vajikaran Rasayana herbs because of their putative positive influence on sexual performance in humans. Aphrodisiac property of this herb was investigated by Pandey \textit{et al.},(8). Detectable level of Phytoecdysteroids in *Asparagus racemosus* Willd. seeds were revealed by Dinan \textit{et al.}, (9).
who did his research on 16 Asparagus species. Herbal preparation of Asparagus racemosus Willd. {lyophilized aqueous extracts of Asparagus racemosus Willd, Chlorophytum borivilianum Sant. F., Curculigo orchioides Gaertn, Dactylorhiza hatagirea (D. Don) Soo and Orchis latifolia Linn. (200 mg/Kg body weight) is formulated by Thakur et al., (10) treat heat induced testicular damage in mice. Administration of this recipe results in significant amelioration of sexual behavior and the mount, intromission and ejaculatory latencies were significantly reduced (11).

Cognitive disorders: Asparagus racemosus Willd. is a well-known nerve tonic in the Ayurvedic system of medicine. ‘Mentat’, an herbal psychotropic preparation containing Asparagus racemosus Willd has been found to be effective in the treatment of alcohol abstinence induced withdrawal symptoms such as tremors, convulsions, hallucinations and anxiety in ethanol administered rats (12) due to its anticonvulsant and anxiogenic action. Parihar and hamnani (13) investigated neuroprotective properties of extracts of Asparagus racemosus Willd, Convolvulus pleuricaus and Withania somnifera against free radicals induced damage in different brain regions in experimental animals. Strategies to rescue or protect injured neurons usually involve promoting neuronal growth and functions or interfering with neurotoxic processes.

Galactogague: Asparagus racemosus Willd. root are one of the chief source of galactagogue. It has been shown to promote growth as well as increase in weight of mammary lobulo-alycolar tissue and milk yield in weaning rats by systemic administration of the alcoholic extract (14). The extract increased the weight of mammary glands in post partum and estrogen-primed rats. The alcoholic extract of Asparagus racemosus has been shown to increase the prolactin levels in female rats (14). Randomized controlled trial of Asparagus racemosus (Shatavari) as a lactogogue in lactational inadequacy was also studied by Sharma et al.(15). A. racemosus along with some other herbal substances in the form of a commercial preparation is reported to enhance milk output in women complaining of scanty breast milk, on 5th day after delivery (16). Patel and Kaniker (17) have also shown galactogogue effect of roots of Asparagus racemosus in buffaloes.

Immunoadjuvant and immunomodulator activity: The immunoadjuvant potential of Asparagus racemosus Willd. aqueous root extract was evaluated by Gautam et al., (18) in experimental animals immunized with diphtheria, tetanus, pertussis (DTP) vaccine. Gautam et al.,(19) have studied possible immunoregulatory effects of Asparagus racemosus Willd. In Administration of Asparagus racemosus, Sida cordifolia in combination with Levamisole was the more effective in producing immunomodulatory effect in immuno suppressed (by Cyclophosphamide) birds (19).

Antitussive activity: The plants have been used as antitussives agents due to their anti-inflammatory, antibiotic, antiviral, demulcents, expectorant and mucolytic properties, related with their ability to elaborate active principles such as aldehydes, alcohols, alkaloids, essential oils, glycosides, flavonoids, gums, ketones, lactones, mucilages, oleoresins, pectin, phenols, tannins and terpenoids. Asteraceae (Compositae), Lamiaceae (Labiatae), Boraginaceae, Rosaceae and Brassicaceae (Cruciferae), was the principal families reported, perhaps their secondary metabolites as i.e. sesquiterpenes and essential oils (20). The flowers, leaves, and aerial parts are most frequently used. The mainly common form of preparation is as decoction or infusion (tea) and the administration type is usually oral. The methanol extract of Asparagus racemosus root showed significant antitussive activity on sulfur dioxide induced cough in mice (21).
Adaptogenic activity: Adaptogenic drugs are those which are useful to counteract stressful factors by promoting non-specific resistance of the body (22). Antiulcerogenic action of an ayurvedic herbo-mineral formulation ‘Satavari mandur’ (SM) was investigated for its efficacy in the treatment of coldrestraint stress-induced gastric ulcer in rats (23). Rege et al., (24) administered orally the aqueous, standardized extract of *Asparagus racemosus* to experimental animals, following which they were exposed to a variety of biological, physical and chemical stresses. Bhattacharya et al., (25) undertook a study to investigate the adaptogenic activity of ‘Siotone’ (a herbal formulation consisting of Withania somnifera, Ocimum sanctum, *Asparagus racemosus* Willd., *Tribulus terrestris* and shilajit) against chronic unpredictable, but mild, foot shock stress induced perturbations in behaviour (depression), glucose metabolism, suppressed male sexual behaviour, immunosuppression and cognitive dysfunction in albino rats.

Anti-diarrhea activity: Diarrhea is increased fluidity, frequency or volume of bowel movements. It may be acute or chronic. Since the *Asparagus racemosus* Willd. root extract is composed of saponins, alkaloids, flavonoids, sterols and terpenes its root has been used traditionally in Ayurveda for the treatment of diarrhoea and dysentery. The plant extracts showed significant inhibitor activity against castor oil induced diarrhoea and PGE$_2$ induced enteropooling in rats. Both extracts also showed significant reduction in gastrointestinal motility in charcoal meal test in rats (26). It has been reported that asparagus decreases gastric emptying time (27). Nanal et al., (28) found Satavari to be extremely effective in the treatment of *Atisar* (diarrhoea), *Pravahika* (dysentery) and *Pittaj shool* (gastritis) as described in Ayurvedic texts such as *Sushruta Samhita* and *Sharangdhar Samhita*. Ethanol and aqueous extracts of *Asparagus racemosus* Willd. roots exhibited significant anti-diarrhoeal activity against castor oil induced diarrhoea in rats demonstrating an activity similar to loperamide(26). Other studies have shown that the methanolic extracts of asparagus root reduced intestinal propulsive movement, castor oil-induced diarrhoea and intestinal fluid accumulation (29).

Anti ulceric activity: In Ayurveda, *Asparagus racemosus* Willd. has also been mentioned for the treatment of ulcerative disorders of stomach and Parinama Sula, a clinical entity akin to the duodenal ulcer diseases (30). Nanal et al., (28) studied the effect of *Asparagus racemosus* Willd. on *Amlapitta* (hyperacidity), *Grahani* (ulcerative colitis), *Parinam shool* (septic ulcer) and *Vataj shool* (spastic colon) and observed an amelioration of symptoms. Singh et al.,(31) showed that Shatavari promptly and persistently relieve the pain and burning sensation as well as other dyspeptic symptoms due to duodenal ulcer. The juice of fresh root of *Asparagus racemosus* Willd. has been shown to have definite curative effect in patients of duodenal ulcers Mangal et al., (32) had done his study on human and found that *Asparagus racemosus* Willd. treatment increase lifespan of gastric mucosal epithelium cells as well as secretion and viscosity of gastric mucus. Antiulcerogenic action of an ayurvedic herbo-mineral formulation ‘Satavari mandur’ (SM) was investigated for its efficacy in the treatment of coldrestraint stress-induced gastric ulcer in rats (23). *Asparagus racemosus* Willd. along with *Terminalia chebula* reported to protect gastric mucosa against pentagastrin and carbachol induced ulcers, by significantly reducing both severity of ulceration and ulcer index (33). In another study by Sairam et al.,(34), the methanolic extract of fresh roots of *Asparagus racemosus* showed significant protection against acute gastric ulcers induced by cold restraint stress, acetic acid, pylorus ligation, aspirin plus pylorus ligation and cysteamine induced duodenal ulcers. Bhatnagar Vital medicine *Asparagus racemosus* willd
et al., (35) evaluated the anti-ulcer effect of *Asparagus racemosus* Willd. on indomethacin induced ulcers in rats. *Asparagus racemosus* has been found to be effective in dyspepsia, being associated with anti-ulcerogenic activity (36).

**Anti depressant:** Depression is a common chronic recurrent syndrome, often refractive to drug treatment affecting quality of life and overall productivity (37).

EuMil, is a herbal formulation comprising the standardised extracts of *Withania somnifera* (L) Dunal, *Ocimum sanctum* L, *Asparagus racemosus* Willd and *Emblica officinalis* Gaertn., the results indicate that EuMil has significant adaptogenic and anti-stress, activity, against a variety of behavioral, biochemical and physiological perturbations, induced by unpredictable stress, which has been proposed to be a better indicator of clinical stress than acute stress (38). Singh et al.,(37) administered orally the methanol, standardized extract of *Asparagus racemosus* roots to rats, following which they were exposed to a variety of biological, physical and chemical stresses. The results show that methanolic extract of *Asparagus racemosus* decreases immobility in forced swimming test and increases avoidance response in learned helpless indicating antidepressant activity. Same result previously received by Rege et al., (24).

**Anticancer:** *Asparagus racemosus* is well known for its immunomodulator activity (18), phytoestrogenic properties and use as a hormone modulator (39). Treatment with *Asparagus racemosus* Willd. *Tinospora cordifolia*, *Withania somnifera*, and *Picrorhiza kurrooa* significantly inhibited ochratoxin A-induced suppression of chemotactic activity and production of inflammatory cytokines interleukin (IL)-1 and tumor necrosis factor (TNF)-alpha by macrophages (40). Moreover *Asparagus racemosus* Willd. induced excess production of TNF-α when compared with controls. The crude saponins obtained from asparagus shoots were found to have antitumor activity. It inhibited the growth of human leukemia HL-60 cells in culture and macromolecular synthesis in a dose and time-dependent manner (41). Total extract, polar and non-polar extracts, and their formulations, prepared from medicinal plants mentioned in Ayurveda, namely, *Withania somnifera* (Linn Dunal) (Solanaceae), *Tinospora cordifolia* (Miers) (Menispermaceae), and *Asparagus racemosus* (Willd.) (Liliaceae) exhibited various immunopharmacological activities in cyclophosphamide (CP)-treated mouse ascitic sarcoma (42). Rao (43), studied inhibitory action of DMBA induced mammary carcinogenesis. Agrawal et al., (44) proved that the aqueous extract of the roots of *Asparagus racemosus* has the potential to act as an effective formulation to prevent hepatocarcinogenesis induced by treatment with diethylnitrosamine. Anti-cancer activity of asparagus extract was also proved by Seena et al., (45). There are several studies that indicate a lower rate of breast cancer in populations with a high exposure to phytoestrogens (46) which is found predominantly in asparagus However; contradictory studies also exist regarding this evaluation. Studies found no association between phytoestrogens and breast cancer (47).

**Antilithiatic effect:** Antilithiatic effect of *Asparagus racemosus* Willd on ethylene glycol-induced lithiasis in male albino Wister rats was studied by Christina et al., (48). Oral administration of *Asparagus racemosus* ethanolic extract reduce oxalate, calcium and phosphate ions in urine which are the main cause of renal stone formation (49). An in vitro assay technique was set up to determine the phagocytic and microbicidal activity of a monocyte-macrophage cell line using Candida species as test organisms. The utility of candidicidal assay in experimental and clinical studies was discussed by Rege and Dahanukar(50).

**Antiparasitic effect:** Antiplasmodium activity is identified by kigondu et al.,(Kigondu, Rukunga
et al. 2009). Sairam et al., (51) have reported antilucregenic activity of methanolic extract of fresh roots of AR in the cold restraint stress (CRS), pyloric ligation, aspirin plus pyloric ligation induced gastric ulcer models and cysteamine induced duodenal ulcer model. AR was found to be effective in the CRU, AL, and cysteamine induced ulcer models, but was ineffective in PL and ASP models. Effectiveness of *Asparagus racemosus* ethanol extract compare to the methanol and distill water extract of the same plant was reveled by S.Alok et al., (52). It was found that the ethanolic extract of *Asparagus racemosus* Willd. had an inhibitory potential on lithiasis induced by oral administration of 0.75% ethylene glycolated water to adult male albino Wistar rats for 28 days. The ethanolic extract, significantly reduced the elevated level of calculogenic ions in urine and it elevated the urinary concentration of magnesium, which is considered as one of the inhibitors of crystallization (52).

**Antiparasitic activity:** The alcoholic extract of the root was found to possess *in vitro* antibacterial activity against *Staphylococcus aureus* and *Escherichia coli*. However, the aqueous extract was found to be inactive (53). The hexane, aqueous and alcoholic extracts of the root at concentration of 200 mg /ml were devoid of any *in vitro* antibacterial activity against *Bacillus subtilis*, *Escherichia coli*, *Proteus vulgaris*, *Salmonella typhimurium*, *Pseudomonas aeruginosa* and *Staphylococcus aureus* using the agar well diffusion test (54). The juice of the root showed fungitoxicity against three plant fungi viz., *Helminthosporium sativum* (60.7%) *Colletotrichum falcatum* (58.2) and *Fusarium oxysporum* (60.7%) (55). The root bark showed marked antibacterial, against eight bacteria viz., *Micrococcus pyogenes* var. *aureus*, *Bacillus subtilis*, *Diplococcus pneumoniae*, *Streptococcus pyogenes*, *Escherichia coli*, *Salmonella typhosa*, *Vibrio comma* and *Shigella dysenteriae*; antitubercular against two mycobacteria *Mycobacterium phlei* and *Mycobacterium 607* and antifungal actions against four fungi viz., *Microsporum gypseum*, *Trichophyton mentagrophytes*, *Candida albicans* and *Helminthosporium sativum* (56). The methanol fraction of the leaves using the disc diffusion test at a concentration of 4000 and 5000 ppm was found to inhibit *Proteus vulgaris* while it was devoid of any activity against *Escherichia coli*, *Klebsiella aerogenes* and *Pseudomonas aerogenes* (57) fresh juice of the plant showed antibacterial activity against *Staphylococcus* (56). The extract of the plant showed moderate toxicity against *Rhizoctonia solanii* (58).

Anticandidal activity of *Asparagus racemosus* Willd. against six species of candida (*Candida albicans*, *Candida tropicalis*, *Candida krusei*, *Candida guillermondii*, *Candida parapsilosis* and *Candida stellatoidea*) had evaluated by Uma et al., (59). *Asparagus racemosus* extract showed high degree of inhibition against candida in compare to any other antibiotics. Antibacterial activity of *Asparagus racemosus* was studied against *Escherichia coli*, *Shigella dysenteriae*, *Shigella sonnei*, *Shigella flexneri*, *Vibrio cholerae*, *Salmonella typhi*, *Salmonella typhimurium*, *Pseudomonas putida*, *Bacillus subtilis* and *Staphylococcus aureus* by Mandal et al., (60). *Asparagus racemosus* extract activity against leishmania and plasmodium has also been demonstrated (61).

**Antidiebetic activity:** More than 100 medicinal plants are mentioned in the Indian system of medicines including folk medicines for the management of diabetes, which are effective either separately or in combinations (62). *Asparagus racemosus* is consistently used by the tribal communities for the treatment of diabetes (63,64) as well as in modern medicine. As describe above metformin drug for diabetes increase Ca++ level in mitochondria, same mechanism was evaluated by Hannan et al., (65)
### Table 1: Ethnopharmacological Importance of *Asparagus racemosus* (Willd.)

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Therapeutic use of <em>Asparagus</em></th>
<th>Proposed mechanism of action</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Aphrodisiac</td>
<td>Plant compound structurally and/or functionally similar to ovarian and placental oestrogens.</td>
<td>10,8,9</td>
</tr>
<tr>
<td>2.</td>
<td>Alzheimer’s disease</td>
<td>Antioxidative mechanism: Regulate neurotransmitters · Neuritis regeneration</td>
<td>13</td>
</tr>
<tr>
<td>3.</td>
<td>Galactogague</td>
<td>Activate adenohypophysis (anterior pituitary gland) to produce prolactin</td>
<td>13,68,17</td>
</tr>
<tr>
<td>4.</td>
<td>Immunoadjuvant and immunomodulator activity</td>
<td>Modify the antigenicity of immunization components.· Activate T cells· Up-regulation of Th1 (IL-2, IFN-g) and Th2 (IL-4) cytokines.</td>
<td>18,19,24,70</td>
</tr>
<tr>
<td>5.</td>
<td>Antitussive activity</td>
<td>Anti-inflammatory property</td>
<td>20,21</td>
</tr>
<tr>
<td>6.</td>
<td>Adaptogenic activity</td>
<td>Modulate stress mediators (corticosteroids, catecholamines, and nitric oxide)</td>
<td>69,25</td>
</tr>
<tr>
<td>7.</td>
<td>Anti-diarrhea activity</td>
<td>Balancing the way fluid moves through intestines· Anti bacterial and anti viral activity· Reduce inflammation</td>
<td>79</td>
</tr>
<tr>
<td>9.</td>
<td>Anti depressant activity</td>
<td>Serotonin reuptake inhibitors· Increase GABA level in the brain</td>
<td>Antioxidant</td>
</tr>
<tr>
<td>10.</td>
<td>Anticancer activity</td>
<td>Immunomodulator activity: Enhance production of inflammatory cytokines interleukin (IL)-1 and tumor necrosis factor (TNF)-alpha by macrophages· Inhibited the growth of human leukemia HL-60 cells</td>
<td>69,72,41,46,44,73</td>
</tr>
<tr>
<td>11.</td>
<td>Antilithiatic effect</td>
<td><em>Asparagus racemosus</em> ethanolic extract reduce oxalate, calcium and phosphate ions in urin which are the main cause of renal stone formation.</td>
<td>34,48,49,50</td>
</tr>
<tr>
<td>12.</td>
<td>Antiparasitic activity</td>
<td>Inhibition of parasite through antiparasitic agents which break parasite resistance system. Biochemical of this plant act by two ways:· Destruction of metabolic pathways of parasite· Disturb physical resistance system of parasite.</td>
<td>21,35,50,57,61</td>
</tr>
<tr>
<td>13.</td>
<td>Antidiabetic activity</td>
<td>Hypoglycaemic activityIncreased intracellular Ca (2+)</td>
<td>65,74,75,76</td>
</tr>
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</table>
revealed that constituents of *A. racemosus* root extracts have wide-ranging stimulatory effects on physiological insulinotropic pathways. The dried ethanolic extract 250 mg per kg body weight and the inorganic parts 90 mg pure ash/kg body weight of the root revealed hypoglycaemic activity in a single dose effect on the oral glucose tolerance test GTT in fasting albino rats (66).

**Anti anemic**: Ayurvedic treatment of aplastic anemia is basically directed at treating the immune dysfunction and improving normal bone marrow production. Immuno-modulatory herbal medicines like Ashwagandha (*Withania somnifera*), Shatavari (*Asparagus racemosus*), Bala (*Sida cordifolia*), Nagbala (*Sida humilis*), Yashthinadhu (*Glycrrhiza glabra*), Guduchi (*Tinospora cordifolia*) and Punarnava (*Boerhaavia diffusa*) are used. Asparagus is high in folic acid, which is essential for the production of new red blood cells and may therefore be helpful in preventing anemia. It is a rich source of folate and vitamin K. folate helps to get rid of the problem of anemia. Vitamin K is found to play a role in regulating the process of blood coagulation. *Shatavari churna* with milk or *shatavarisidhdha ghrut* (medicated ghee) is recommended for women suffering from anemia especially due to the loss of blood through periods. Hence, *asparagus* is a vital drug to cure anemia.

**Antioxytocic**: The alcoholic extract of the root exhibited antioxytocic activity. The saponin-glycoside A4, mp 191-95° C in doses of 20-50 µg/ml produced a specific and competitive block of the pitocin syntocinon-induced contraction of rat, guinea pig and rabbit uteri *in vitro* as well as in situ. The saponin also blocked the spontaneous uterine motility. It was also found that the hypotensive action of syntocinon in cat was unaffected by previous administration of saponin A4 (67).

**Conclusion**: From the above description (concluded in Table 1), it may be concluded that *Asparagus racemosus Willd.* could be a useful natural herb which posses no side effects compare to allopathic drugs and can be used to cure many fatal dieses like cancer, gonorrhea, piles, diabetes etc. There are many unraveled applications of this herb remain uninvestigated in relatively newer areas of its function. Hence, phytochemicals and minerals of these plants will enable to exploit its therapeutic use. The drug is without having any serious toxicity or side effects known till date and thus can be safely used in humans for acute and chronic treatment regime.

In order to have a excellent medicine it is very necessary to coordinate the quality of raw materials, in process materials and the final products, it has become essential to develop reliable, specific and sensitive quality control methods using a combination of classical and modern instrumental method of analysis. *In vitro* induction of stress response is in progress to increase secondary metabolites in this plant using various abiotic and biotic elicitors. This would help in conservation of this species and provide pharmaceutical component in less time and cheap cost.

**References**


Manorma Sharma et al


Manorma Sharma et al


