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REVIEW ARTICLE

ETHNOPHARMACOLOGICAL IMPORTANCE OF *Asparagus racemosus* : A REVIEW

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ABSTRACT

Tuberous plants are the vital source of medicinal drugs. Among these *Asparagus racemosus* is an important herb which is well known for its pharmacological applications. 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.

INTRODUCTION

Use of plants as a source of medicine has been inherited and is an important component of the health care system in India. India is one of the 12 mega biodiversity centers having 45,000 plants species, its diversity is unmatched due to the 16 different agro climatic zones, 10 vegetative zones and 15 biotic provinces. "The world Health Organization" estimates that up to 80 % of people still rely mainly on traditional remedies such as herbs to cure their disease. The World Health Organization (The World Health Report, 2003) has estimated that 80% of the population of developing countries being unable to afford pharmaceutical drugs relies on traditional medicines (Bopana and Saxena, 2007). In the Indian system of medicine, most practitioners formulate and dispense their own recipes (Sharma et al., 2005). 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 (Singh *et al.,* 2002). Potential plants for Ayurvedic medicines have been reported by Kumar (2008).

These plants are not only used for common diseases but also for fetal diseases. Among these plants Asparagus racemosus is an important medicinal plant which has been used world wide. The Asparagus genus (*Asparagaceae*) has over 300 species, which are widely distributed in temperate and tropical regions. *Asparagus racemosus* Willd. or "Satavar" is a creeper of the plant genus Asparagus.

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Its medicinal properties are reported in traditional systems of medicine such as Ayurveda, Siddha and Unani (Sharma, 1970). Ayurveda describes *Asparagus racemosus* as rasayana and galactogogue, which is used to treat various diseases such as ulcer, dyspepsia and debility. It contains adventitious root system with tuberous roots. These tuberous roots after proper processing and drying are used as ayurveda medicine, with the name of Shatavari. Its leaves are reduced to form cladodes. Branches contain spines on them. In Indian medicine it is well known as an antispasmodic, aphrodisiac, demulcent, diuretic, galactogogue and refrigerant. It is also used in the treatment of diarrhea, rheumatism, diabetes and brain complaints (Chadha 2003). During previous investigations influence of fertilizers on growth (Vijay and Kumar, 2005) and biochemical composition (Vijay, Kumar and Bhoite, 2009) and in vitro propagation of Asparagus racemosus (Kumar and Vijay , 2008) was studied.

Chemical constituent

A lot of chemical analysis has been carried out on the roots of *Asparagus racemosus*. The major reported constituent include steroidal saponins, shatavarin I (3-O-{[a-L-rhamnopyranosyl (1!2)][b-D-glucopyranosyl(1!4)]-b-D-glucopyranosyl}-26-O-(b-D-glucopyranosyl)- (25S)- 5b- furostan-3b, 22a, 26-triol), shatavarin II (no reported structure), shatavarin IV (3-O-{[a-L-rhamnopyranosyl (1!2)] [b-D-glucopyranosyl (1!4)]-b-D-glucopyranosyl}-(25S)-5b-spirostan-3b-ol) and glycoside-AR-4 (incomplete structure elucidation) with the two major ones being named shatavarins I and IV (Hayes *et al*., 2006). Shatawarin I is the major glycoside with 3 glucose and rhamnose moieties attached to sarsasapogenin, whereas

shatavarin-IV contains Alkaloids, proteins, starch and tannin. Isoflavones including 8-methoxy-5,6,4'-trihydroxyisoflavone 7-O-beta-D-glucopyranoside. Asparagamine, a polycyclic alkaloid. Racemosol, a cyclic hydrocarbon (9,10-dihydrophenanthrene).Polysaccharides, mucilage is present in the roots.

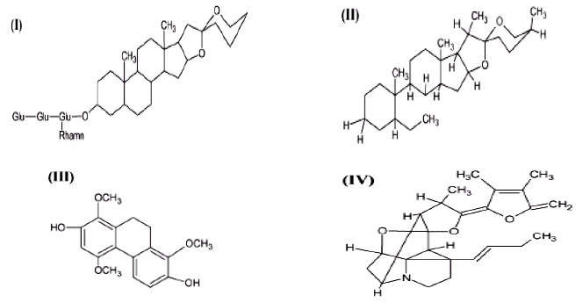

Fig1. Active principles of *Asparagus racemosus* (I) Shatavarin (II) Sarsasapogenin (III) Racemosol and (IV) Asparagamine

1. Toxicity profile of Asparagus racemosus

The LD50 is >1g/kg. No toxic effects or mortality were observed with doses ranging from 50mg/kg to 1g/kg for four weeks. Acute and subacute (15-30 days administration) toxicity studies did not detect any changes in vital organ function tests (Rege *et al*., 1999).

2. *Pharmacological applications of* Asparagus racemosus

Aphrodisiac

An aphrodisiac is a substance that is used in the belief that it increases sexual desire. The name comes from *Aphrodite*, the Greek goddess of sensuality and love. Phytoestrogens are defined as any plant compound structurally and/or functionally similar to ovarian and placental oestrogens and their active metabolites (Whitten and Patisaul, 2001). Phytoestrogens affect the regulation of ovarian cycles and oestrous in female mammals and the promotion of growth, differentiation and physiological functions of the female genital tract, pituitary, breast and several other organs and tissues in both sexes. The interest in plant-derived oestrogens or 'phytoestrogens' has increased due to the realization that hormone replacement therapy is neither as safe nor as effective as previously envisaged (Cornwell *et al.,* 2004) .

Ethanopharmacological approach

The herbs have been traditionally used as Vajikaran Rasayana herbs because of their putative positive influence on sexual performance in humans. Detectable level of Phytoecdysteroids in *Asparagus racemosus Willd.* seeds were reveled by Dinan *et al.,* (Dinan *et al.,* 2001) who did his research on 16 *Asparagus* species. Aphrodisiac property of this herb was investigated by Pandey *et al.,* (Pandey *et al.,* 2005) The macroscopic findings revealed a prominence of the mammary glands, a dilated vaginal opening and a transversely situated uterine horn, proliferation in the lumen of the duct of mammary gland in the treated group of animals. The parenchyma of the genital organs showed abundant glycogen granules with dilated blood vessels and thickening of the epithelial lining. The oviduct in the treated group showed hypertrophied muscular wall, whereas the ovary revealed no effect of the drug. The results suggest an estrogenic effect of Shatavari on the female mammary gland and genital organs. 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.,* (Thakur *et al.,* 2008) 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 (Thakur *et al.,* 2009).

Cognitive disorders

Neurological and psychiatric disorders together account for more chronic suffering than all other disorders combined (Cowan and Kandel 2001). In Alzheimer's and Parkinson's diseases, ex-cito toxicity and oxidative stress are the major mechanisms of neuronal cell death. Therefore, to combat neurodegenerative disorders, there is a need for a compound that can retard or reverse this neuronal damage. In ongoing AD clinical trials, scientists are looking at many possible interventions, such as cardiovascular treatments, antioxidants, immunization therapy.

Ethanopharmacological approach

Asparagus racemosus Willd. is a well-known nervine tonic in the Ayurvedic system of medicine. Parihar and hamnani (2004) investigated neuroprotective properties of extracts of *Asparagus racemosus* Willd, *Convolvulus pleuricauas* 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. '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 (Kulkarni and Verma 1993) due to its anticonvulsant and anxiogenic action.

Galactogague

A galactagogue is a substance that promotes lactation in humans and other animals. It may be synthetic, plant-derived, or endogenous. Generally hormone replacement therapy is used to increase lactation but it is neither safe nor cheap (Singh and Goyal, 2004).

Ethanopharmacological approach

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 (Sabin *et al.,* 1968). The extract increased the weight of mammary glands in post partum and estrogen-primed rats. *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 (Sholapurkar 1986). Patel and Kaniker (Kaniker,1969) have also shown galactogogue effect of roots of *Asparagus racemosus* in buffaloes. A mixture 'Lactare', containing *Asparagus racemosus* Willd**.** its major component, has been reported to cause significant rise in serum prolactin levels (Ghosh et al., 1987). The alcoholic extract of *Asparagus racemosus* has been shown to increase the prolactin levels in female rats (Sabin et al., 1968). Randomized controlled trial of *Asparagus racemosus* (Shatavari) as a lactogogue in lactational inadequacy was also studied by Sharma *et al.,(* Sharma *et al.,*1996).

Immunoadjuvant and immunomodulater activity

Adjuvants are nonspecific substance acting to enhance the immune response to an antigen with which it is administered. Adjuvants are mostly pharmacological agents of drug or biological origin used to modify the antigenicity of immunization components, i.e., to stimulate or depress the immune response or to inhibit or enhance specific subclasses of immunocytes. Adjuvants augment, or modulate the immune response at either the cellular or humoral level. Like immunoadjuvant which increase or decrease immune response by binding to specific protein, immunomodulater bind at allosteric site of enzyme and modulate immune response, thus immunomodulater may be defined as a substance, biology or synthetic, which can stimulate, suppress or modulate any of the components of the immune system including both innate and adaptive arms of the immune response (Agrawal and Singh 1999). Therefore scientist attempts to extend the reported immunopotentiating activity of botanical immunomodulators for their possible applications in immunotherapeutics and immunochemical industry.

Ethanopharmacological approach

The immunoadjuvant potential of *Asparagus racemosus* Willd. aqueous root extract was evaluated by Gautam *et al.,* (2009) in experimental animals immunized with diphtheria, tetanus, pertussis (DTP) vaccine. Immunostimulation was evaluated using serological and hematological parameters. Oral administration of decoction of powdered root of A. racemosus has been reported to produce leucocytosis and predominant neutrophilia along with enhanced phagocytic activity of the macrophages and polymorphs (Goyal, Singh *et al.,* 2003). *Asparagus racemosus* Willd. was found to be significantly reduced the mortality of experimental animals while survival rate was comparable to that of the group treated with a combination of metronidazole and gentamicin (Thatte et al., 1987). In immune system helper T cells (Th) are most important part of cell mediated immunity (Th1) and humoral immunity (Th2) and these cells are produced only in childhood and after a certain age when its number start to decrease it create problems. Alcoholic extract has been found to enhance both humoral and cell mediated immunity of albino mice injected with sheep red blood cells as particulate antigen (Muruganadan, 2000).Therefore Modulation of Th1/Th2 immunity is emerging as one of biological targets for such immunostimulants (Romagnani, 2000).Gautam et al.,, (2009) have studied possible immunoregulatory effects of *Asparagus racemosus* Willd. ethanolic (ARE) extract on murine Th1/Th2 immunity using sheep red blood cells as antigenic stimulus. Treatment with ARE resulted in significant increase of CD3+ and CD4/CD8+ percentages suggesting its effect on T cell activation. ARE treated animals showed significant up-regulation of Th1 (IL-2, IFN-g) and Th2 (IL-4) cytokines suggesting its mixed Th1/Th2 adjuvant activity. In Administration of *Asparagus racemosus, Sida cordifolia* in combination with Levamisole was the more effective in producing immunomodulatory effect in immunosuppressed (by Cyclophosphamide) birds (Tekade 2008).

Anti-tussive activity

Anti-tussive means those drugs which are capable of relieving or suppressing coughing. The plants have been used as anti-tussives 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 (Waizel-Bucay and Waizel-Haiat 2009).

Ethanopharmacological approach

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 (Waizel-Bucay and Waizel-Haiat 2009). 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 (Mandal et al., 2000).

Adaptogenic activity

The term adaptogen is used by herbalists to refer to a natural herb product that is proposed to increase the body's resistance to stress, trauma, anxiety and fatigue. In the past, they have been called rejuvenating herbs, qi tonics, rasayanas, or restoratives. All adaptogens contain antioxidants, but antioxidants are not necessarily adaptogens and that is not proposed to be their primary mode of action (Winston 2007). Mechanisms of action for adaptogenic activity seem to fall into 3 categories: those that act to regulate the stress response via the neuro-endocrine HPA axis, those that act as antioxidants and those that either inhibit or enhance CNS activity. Anti-inflammatory and enzyme inhibition or stimulation was also reported albeit rarely.

Ethanopharmacological approach

Adaptogenic drugs are those which are useful to counteract stressful factors by promoting non-specific resistance of the

body (Brekhman and Dardimov 1969). Adaptogens are presumed to increase the resistance of the body to stress by modulating stress mediators such as corticosteroids, catecholamines, and nitric oxide (Rege et al., 1999).The stress indices for evaluation were gastric ulceration, adrenal gland and spleen weights, ascorbic acid and corticosterone concentrations of adrenal cortex and plasma corticosterone levels (Bopana and Saxena 2007). The prevention and management of stress disorders poses a major clinical challenge. Benzodiazepines (BDZs) appear to be effective only against acute stress and not chronic stress. Also, the prolonged use of BDZs exasperates physical dependence on it and increases the tolerance thereby limiting the utility of the medication. Under such circumstances, plant derived agents could induce an increase in non-specific resistance. Rege *et al*., (1999) 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. 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 (Datta and Goel 2002). Bhattacharya *et al.,* (Bhattacharya 2004) undertook a study to investigate the adaptogenic activity of 'Siotone' (a herbal formulation consisting of Withania somnifera, Ocimum sanctum, *Asparagus racemosus* Willd. , *Tribulus terristris* 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. A study with partial results released in October 2009 suggests diarrhea is now estimated to cause 3 times more deaths than previously thought, at 1.1 million annually for people aged 5 and over, up from 300,000 assumed in a 2002 study (Bhatnagar et al., 2010). According to UNICEF, diarrhea kills some 1.5 million children under the age of 5 annually. Mainly diarrhea is of 6 types Secretary, Osmotic, Exudatic, Motility, Inflammatory, and Dysentery. Principal causes of diarrhea are bacteria, virus, parasites and food intolerance. At present Loperamide and Bismuth subsalicylate are used as antidiarrheal drug. Loperamide works by slowing down the speed of fluids moving through intestines (bowels). Bismuth subsalicylate works by balancing the way fluid moves through intestines. It also reduces inflammation and keeps certain bacteria and viruses that cause diarrhea from growing in the stomach and intestines. Probiotics, particularly *Bifidobacterium infantis***,** *Sacchromyces boulardii***,** *Lactobacillus plantarum* and combination probiotics, are also used to control bowel movements.

Ethanopharmacological approach

Diarrhea symptoms vary from mild to fatal. As today loperamide and bismuth subsalicylate have been used widely but both drugs can cause some side effects like abdominal pain, constipation, dizziness, nausea, blackened stools, ringing sound in ear (called tinnitus). Therefore there is a need arise to discover such type of drug which have wide action spectrum and cure diseases without side effects. It have studied that saponins extract from *Geranium incanum* leaves (Amabeoku 2009),*Cylico discus* bark (Kouticheu *et al.,* 2006) and *Paullina pinnata* leavescontain anti diarrhea activity. 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. Nanal *et al.,* (1974) 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 (Venkatesan *et al.,* 2005). 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 (Venkatesan *et al.,* 2005). It has been reported that asparagus decreases gastric emptying time (Dalvi *et al.,* 1990). Other studies have shown that the methanolic extracts of asparagus root reduced intestinal propulsive movement, castor oil-induced diarrhoea and intestinal fluid accumulation (Nwafor *et al.,* 2000).

Anti ulceric activity

Ulcers are sores on the lining of digestive tract (Peptic ulcer), oral cavity (Oral ulcer and Aphthous ulcer), cornea (Corneal ulcer), valves of the veins (Venous ulcer) and genital area (Genital ulcer). Most ulcers are caused by an infection. The infection is caused by a bacterium called *Helicobacter pylori*. The usual treatment for peptic ulcers is endoscopic therapy to control active bleeding, drug therapy to suppress stomach acid (for example, proton-pump inhibitor [PPI] and H2 blockers) and protecting the injured area so it can heal. Non-steroidal anti-inflammatory drugs such as ibuprofen (iso-butyl-propanoic-phenolic acid), Misoprostol (synthetic prostaglandin E_1 (PGE_1) analogue) and Ketoprofen ((RS) 2-(3-benzoylphenyl)-propionic acid) used widely for treatment of ulcers. But long term use of anti-inflammatory drug can cause various serious side effects like constipation, diarrhea, sores in the mouth, headache, dizziness, nervousness, drowsiness etc (Sung et al., 2010). Therefore new researches have been aimed to evaluate drug composition without side effects.

Ethanopharmacological approach

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 (Goyal *et al.,* 2003). Singh *et al*.,(1986) 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 (Kishore *et al.,* 1980). Nanal *et al.,* (1974) 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. Mangal *et*

al., (2006) 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 (Datta and Goel 2002). In another study by Sairam *et al.,(*2003), 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. In this study it was concluded that the healing of gastric ulcers could be attributed to the effect of the *Asparagus racemosus* Willd. extract on the mucosal defensive factors rather than the offensive ones. Also, the increase in the gastric emptying time aggravates duodenal ulcers and the ability of *Asparagus racemosus* Willd. to limit this gastric emptying time may also be the reason for the duodenal anti-ulcer activity. Bhatnagar *et al*., (2005) evaluated the anti-ulcer effect of *Asparagus racemosus* Willd. on indomethacin induced ulcers in rats. They found a significant reduction in the ulcer index, free acidity, and volume of gastric secretion and total acidity which was comparable to the standard drug Ranitidine. In addition they observed an increase in the antioxidant defense. Previously, extracts from *Asparagus racemosus* Willd. have been shown to exert potent antioxidant effects *in vitro* against membrane damage induced by free radicals produced by gamma radiation in rat liver mitochondria (Kamat *et al.,* 2000). Both the crude extract as well as the purified aqueous fraction was found to inhibit lipid peroxidation and protein oxidation significantly which was comparable to that of the established antioxidants glutathione and ascorbic acid though the mechanisms responsible for the anti-oxidant properties are still unclear. *Asparagus racemosus* has been found to be effective in dyspepsia, being associated with anti-ulcerogenic activity (De *et al.,* 1997). *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 (Dahanukar *et al.,* 1983). The antisecretory and antiulcer activity of *Asparagus racemosus* Willd. (methanolic extract) and its action against indomethacin (a non-steroidal anti-inflammatory drug) plus pyloric ligation (PL)-induced gastric ulcers in rats have studied. The results of this study suggest that *Asparagus racemosus* Willd. causes an inhibitory effect on release of gastric hydrochloric acid and protects gastric mucosal damage.

Anti depressant

Depression is a common chronic recurrent syndrome, often refractive to drug treatment affecting quality of life and overall productivity (Singh *et al.,* 2009). Most antidepressant medications increase the levels of one or more of the monoamines (the neurotransmitters) serotonin, norepinephrine and dopamine in the synaptic cleft. Reduction in brain serotonin (Drevets, 2001; Anguelova and Turecki, 2003) has been reported to be one of the most important etiological factors for genesis of depression and the most widely used antidepressants namely selective serotonin reuptake inhibitors (SSRIs such as sertraline, escitalopram, fluoxetine, paroxetine, and citalopram) act by inhibiting serotonin reuptake into the presynaptic cell, increasing the level of serotonin available to bind to the postsynaptic receptor (Schreiber *et al.,* 1995). Further noradrenergic and dopaminergic systems are reported to be involved and act in tandem with the serotonergic system (Millan *et al.,* 2000; Koch *et al.,* 2002). Beside SSRIs 'atypical' antidepressants have been used like bupropion (Rush *et al.,* 2006) and Venlafaxine. But regular use of these drugs may cause some serious side effects like Seizures, confusion, hallucinating (seeing things or hearing voices that do not exist), irrational fears, fever, rash or blisters, itching etc.

Ethanopharmacological approach

Ayurvedic rasayanas are those drugs, which prevent ageing, increase longevity, impartimmunity, improve mental functions and add vigor and vitality to the body (Sharma, 1970). Anti stress drugs such as Benzodiazepines (BDZs) appear to be effective only against acute stress and not chronic stress. Also, the prolonged use of BDZs exasperates physical dependence on it and increases the tolerance thereby limiting the utility of the medication. Under such circumstances, plant derived agents could induce an increase in non-specific resistance (Bopana and Saxena 2007). Singh *et al*.,(2009) 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., (1999). Using a model of cisplatin induced alterations in gastrointestinal motility; the ability of this extract to exert a normalizing effect, irrespective of direction of pathological change was tested.

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 (Muruganandam, 2002).

Anticancer

Cancer is of two types benign and malignant. Any agent which may chemically modify DNA known as carcinogen. Most of the medicine used today are immunosuppressant, cytotoxic, and exert variety of side effects that are particularly evident in cancer chemotherapy. The deleterious effects of ionizing radiation in biological systems are mainly mediated through the generation of reactive oxygen species (ROS) in cells as a result of water radiolysis (Kamat *et al.,* 2000). ROS/RNS are free radicals which posses' carcinogen activity (Cerutti, 1994) release by radiation treatment. Among them, particularly, the highly damaging hydroxyl radical (•OH) can cause injury by reacting with bio-molecules (Breen and Murphy 1995). Hydroxyl radical attack upon DNA generates a whole series of modified purine and pyrimidine bases many of which are known to be mutagenic. Therefore, there is a constant need for the development of effective, non-toxic, radical scavengers

that can protect humans against free-radical genetic damage induced by radiation and other agents.

Ethanopharmacological approach

Rasayana are the medicine useful in strethening the immune system (Patwardhan *et al.,* 1990). Immunomodulation is a procedure, which can alter the immune system of an organism by interfering with its function, which primarily implies stimulation of non-specific system (Neelam *et al.,* 2001). Immunosupression implies mainly to reduce resistance against infections, stress and may occur on account of environmental or chemotherapeutic factors. *Asparagus racemosus* is well known for its immunomodulater activity (Gautam *et al.,* 2009), phytoestrogenic properties and use as a hormone modulator (Mayo, 1998). 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 (Dhuley, 1998). 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 (Shao and Huang 1996). 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 (Diwanay, 2004). Rao (1982), studied inhibitory action of DMBA induced mammary carcinogenesis. Agrawal *et al.* (2008) 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.,* (1993). There are several studies that indicate a lower rate of breast cancer in populations with a high exposure to phytoestrogens (Beral, 2003) which is found predominantly in asparagus However; contradictory studies also exist regarding this evaluation. Studies found no association between phytoestrogens and breast cancer (Weinstein *et al.,* 1993).

Antilithiatic effect

Kidney stones are one of the most painful and common disorders of the urinary tract. Depending on where they are located, kidney stones are known as urinary calculi, urinary tract stone disease, renal calculi, nephrolithiasis, ureterolithiasis and urolithiasis. Kidney stones are small, solid crystals that develop when salts or minerals in urine become solid inside the kidneys or uterus. Kidney stones can be due to underlying metabolic conditions, such as renal tubular cidosis (Moe, 2006), Dent's disease (Lloyd *et al.,* 1996), hyperparathyroidis and medullary sponge kidney (Ginalski *et al.,* 1991). There are two drugs have been used Ketorolac (Toradol), an injectable antiinflammatory drug and Tamsulosin may be used to help facilitate the passage of stones into the bladder. Tamsulosin may cause side effects like Sleepiness, difficulty falling asleep or staying asleep, weakness, back pain, diarrhea, runny or stuffy nose, pain or pressure in the face, sore throat, cough, fever, chills, or other signs of infection, blurred vision and difficulty ejaculating. Ketorolac may cause side effects like fever, blisters, yellowing of the skin or eyes, excessive tiredness, unusual bleeding or bruising, lack of energy, nausea, loss of appetite, pain in the upper right part of the stomach, flu-like symptoms etc.

Ethanopharmacological approach

Antilithiatic effect of *Asparagus racemosus* Willd on ethylene glycol-induced lithiasis in male albino Wister rats was studied by Christina *et al.,* (2005). Oral administration of *Asparagus racemosus* ethanolic extract reduce oxalate, calcium and phosphate ions in urin which are the main cause of renal stone formation (Chitme *et al*., 2010). 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 optimal doses for MDP, Metronidazole, *Asparagus racemosus* and Tinospora cordifolia were found to be 100 micrograms, 300 mg/kg, 200 mg/kg and 100 mg/kg respectively. Patients with cirrhosis were screened for defects in monocyte function. The depressed monocyte function (20.58 +/- 5% phago and 41.24 +/- 12.19% ICK; $P < 0.05$) was observed indicating a compromised host defense. The utility of this candidicidal assay in experimental and clinical studies was discussed by Rege and Dahanukar(1993). The aqueous extract of the root was lethal or inhibitory, *in vitro* studies to hatching of Meloidogyne javanica and M. arenaria. A 1% solution of the active material contained in the nematicide, Nemaphos O-O-diethyl-O-2-pyrazinyl phosphothionate suppressed hatching in dilutions up to 10000 times and was comparable to the activity of 1 ml undiluted plant extract 10 g/100 ml (Swarup and Sharma, 1967). Sairam *et al*., 2003 have reported antiulcerogenic 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*., 2008. 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 (Alok *et a*l., 2008).

Antiparasitic activity

Parasitism is a type of symbiotic relationship between organisms of different species where one organism, the parasite, benefits at the expense of the host. In general, parasites are much smaller than their hosts, show a high degree of specialization for their mode of life, and reproduce more quickly and in greater numbers than their hosts. Parasites

reduce host fitness in many ways, ranging from general or specialized pathology (such as castration), impairment of secondary sex characteristics, to the modification of host behavior. Actions against parasite depend on type of parasite and mode of infection. Drugs are design according to these parasites to cure diseases. Some of the antiparasitic drugs are DL-Propranolol, Nitrobenzamides, Diclazuril/Clazuril, Febrifugine, Halofuginone, Halogenated Hydrocarbons, Hetolin, Cyclosporin A, Quinuronium sulfate (= Acaprine), Amicarbalide, Paraherquamide, Benzimidazoles (Albendazole, Mebendazole, Triclabendazole) Nifutimox.etc. These drugs are isolated from plants as well as from microorganism. And former source is cheapest among all, thus from ancient time people have been used plants as antiparasitic agent.

Ethanopharmacological approach

Anticandidal activity of *Asparagus racemosus Willd.* against six species of candida (*Candida albicans, Candida tropicalis, Candida krusei, Candida guillermondii, Candida parapsilosis* and *Candida stellatoida)* had evaluated by Uma *et al.* (2009). *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.* (2000). *Asparagus racemosus* extract activity against leishmania and plasmodium has also been demonstrated. (Kigondu et al., 2009). The alcoholic extract of the root was found to possess *in vitro* antibacterial activity against *Staphylcoccus aureus* and *Escherichia coli*. However, the aqueous extract was found to be inactive (George et al., 1947). 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 (Ahmad *et al.,* 1998). 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%) (Singh and Shanna, 1978).

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* (Bhawasar *et al.,* 1965). 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* (Perumal *et al.,* 1998). The fresh juice of the plant showed antibacterial activity against *Staphylococcus* (Bhawasar *et al.,* 1965). The extract of the plant showed moderate toxicity against *Rhizoctonia solaniI* (Renu. 1983).

Antidiebetic activity

Diabetes is a metabolic disorder**.** It is a condition in which a person has a high blood sugar (glucose) level as a result of the body either not producing enough insulin, or because body cells do not properly respond to the insulin that is produced. Where in human body does not produce or properly uses insulin, a hormone that is required to convert sugar, starches, and other food into energy. There are three types of drugs have been used for the treatment of diabetes are Sulfonylureas (such as Glipizide, and Glyburide), Biguanides (such as metformin), Thiazolidinediones (such as Starlix® and Prandin®), Alpha glucosidase inhibitors (such as Precose®). Metformin improves hyperglycemia primarily through its suppression of hepatic glucose production (Kirpichnikov et al., 2002). Metformin decreases hepatic gluconeogenesis by interfering with respiratory oxidation in mitochondria. It suppresses gluconeogenesis from several substrates, including lactate, pyruvate, glycerol, and amino acids. In addition, metformin increases intramitochondrial levels of calcium (Ca^{++}), a modulator of mitochondrial respiration. In insulin-sensitive tissues (such as skeletal muscle), metformin facilitates glucose transport by increasing tyrosine kinase activity in insulin receptors and enhancing glucose transporter (GLUT) trafficking to the cell membrane. Metformin inhibits fatty acid (FA) production and oxidation, thereby reducing fatty acid–induced insulin resistance and hepatic glucose production.

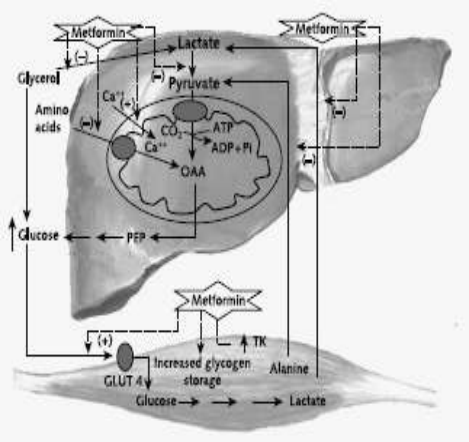

Fig 2: Mechanism of metformin

Some people have developed a life-threatening condition called lactic acidosis while taking metformin. Symptoms of lactic acidosis are weakness, increasing sleepiness, slow heart rate, cold feeling, muscle pain, shortness of breath, stomach pain, feeling light-headed, and fainting. On the other hand Glipizide mechanism of action is produced by blocking potassium channels in the beta cells of the islets of langerhans. By partially blocking the potassium channels, it will increase the time the cell spends in the calcium release stage of cell signaling leading to an increase in calcium. The increase in calcium will initiate more insulin release from each beta cell. But some side effects are also associated with this drug are Pain, insomnia, paresthesia, anxiety, depression, nausea, dyspepsia, constipation and vomiting, rhinitis, pruritus, polyuria etc. therefore scientists are looking forward production of cheap drugs with lesser side effects.

Table 1. Description Asparagus racemosus

S.nu.	Therapeutic use of *Asparagus racemosus*	Proposed mechanism of action	References
1.	Aphrodisiac	Plant compound structurally and/or functionally similar to ovarian and placental oestrogens.	Thakur *et al.*, 2009; (Pandey, Sahay *et al*., 2005); Dinan *et al*., 2001(Dinan,Savchenko *et al.,* 2001; Dinan L 2001)
2.	Alzheimer's disease	• Antioxidative mechanism • Regulate neurotransmitters • Neuritis regeneration	Parihar and hamnani (2004)
3.	Galactogague	Activate adenohypophysis (anterior pituitary gland) to produce prolactin	Sharma *et al*., 1996 Ghosh *et al*.,1987 Patel and Kaniker 1969 Sabin *et al*., 1968
4.	Immunoadjuvant and immunomodulater activity	• Modify the antigenicity of immunization components. • Activate T cells • Up-regulation of Th1 (IL-2, IFN-g) and Th2 (IL-4) cytokines.	Gautam *et al*.,2009 Tekade *et al*., 2008 Singh and Goyal, 2004 Gautam *et al*., 2004 Romagnani, 2000 Thatte *et al*.,1987
5.	Antitussive activiy	Anti-inflammatory property	Waizel and Waizel, 2009 Mandal *et al*., 2000
6.	Adaptogenic activity	Modulate stress mediators (corticosteroids, catecholamines, and nitric oxide)	Bopana and Saxena 2007 Bhattacharya *et al.,* 2004 Datta *et al.,* 2002 Panossian *et al*.,1999
7.	Anti-diarrhea activity	• Balancing the way fluid moves through intestines • Anti bacterial and anti viral activity • Reduce inflammation	Venkatesan *et al*., 2005 Nwafor *et al*., 2000 Dalvi *et al*., 1990 Nanal *et al*., 1974
8.	Antiulceric activity	Inhibit lipid peroxidation and protein oxidation. Antioxidant activity	Singh *et al*.,2009 Mangal *et al*., 2005 Bhatnagar *et al*., 2005 Goyal and singh,2003 Sairam *et al.,* 2003 Datta *et al*., 2002 Bhatnagar *et al*., 2005 Kamat *et al*., 2000
9.	Anti depressant	• Serotonin reuptake inhibitors • Antioxident activity • Increase GABA level in the brain • Immunomodulater activity	Bopana and Saxena, 2007 Muruganandam *et al*.,2003 Sharma, 2001 Rege *et al*., (1999
10.	Anticancer 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	Gautam *et al*.,2009 Agrawal *et al*., 2008 Diwanay *et al*., 2004 Neelam *et al*., 2001 Dhuley, 1997 Shao *et al*.,1996 Beral 1993
11.	Antilithiatic effect	*Asparagus racemosus* ethanolic extract reduce oxalate, calcium and phosphate ions in urin which are the main cause of renal stone formation.	Chitme *et al*.,2010 S.Alok *et al*.,2008 Christina *et al*., 2005 Sairam *et al*.,2003 Rege and Dahanukar1993 Swarup and Sharma, 1967
12.	Antiparasitic activity	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.	Uma *et al*., 2009 Kigondu *et al.,* 2009 Mandal *et al*.,2000 Perumal Samy *et al*., 1998] Singh and Sharma, 1978 Bhatnagar *et al*., 1961 George *et al*., 1947
13.	Antidiebetic activity	Hypoglycaemic activity Increased intracellular Ca (2+)	Hannan *et al*., 2007 Booth *et al*., 2006 Balami,N.P., 2004 Kar et al, 2003 Rana *et al*., 1999 Gray & Flatt 1997
14.	Anti anemic	Vitamin K coagulate blood Folic acid produce new blood cells	Dr.Satish Kulkarni,2009

Ethanopharmacological approach

Diabetes mellitus (DM) is a major cause of disability and hospitalization that presents a significant burden on societies worldwide (Booth *et al.,* 2006). The recent explosion in the area of herbal medicine has lead to a resurgence of nutritional, clinical and scientific interest in the potential of plant treatments for diabetes across the world (Swanston-Flatt *et al.,* 1991; Gray and Flatt 1997). 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 (Kar *et al.,*

2003). *Asparagus racemosus* is consistently used by the tribal communities for the treatment of diabetes (Rana *et al.,* 1996; Rana *et al.,* 1999) 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*., (2007). Hannan *et al*., (2007) revealed that constituents of *A. racemosus* root extracts have wide-ranging stimulatory effects on physiological insulinotropic pathways. They found that ethanol extract and each of the hexane, chloroform and ethyl acetate partition fractions concentration-dependently stimulated insulin secretion in isolated perfused rat pancreas, isolated rat islet cells and clonal beta-cells. And it also increased intracellular Ca (2+), consistent with the observed abolition of insulin secretory effects under Ca (2+) -free conditions. 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 (Kar *et al.,* 1999).

Anti anemic

A condition in which there is a reduction in the number of circulating red blood cells per cubic millimeter, the amount of hemoglobin per 100 milliliters, or the volume of packed red cells per 100 milliliters of blood. It exists when hemoglobin content is less than that required to provide the oxygen demands of the body. Anemia is not a disease; it is a symptom of various diseases. Anemia is classified on the basis of mean corpuscular volume and by etiological (causes) factors. Anemia may result from excessive blood loss, excessive blood cell destruction, or decreased blood cell formation. Due to excessive blood cell destruction: treatment of specific hemolytic disorder. Due to decreased blood cell formation: replacement therapy to combat the specific deficiency (iron, vitamin B12, folic acid, ascorbic acid).

Ethanopharmacological approach

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*), Yashtimadhuk (*Glycerrhiza 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 (Jetmalani and Gaitonde, 1969).

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.

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