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Shatavari: Potentials for galactogogue in dairy cows

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Shatavari is a medicinal plant used for a variety of serious diseases as also impotency of both the sexes. *Shatavari* is a general tonic and also a female reproductive tonic. *Shatavari* is used as main ayurvedic rejuvenative tonic for females. *Shatavari* roots are not only used as drug acting on all tissues but also as a powerful anabolic. It is good for eyes, muscles, reproductive organs, increases milk secretion and helps to regain vigour and vitality. Augmentation of milk production is a nationwide demand of rapidly growing population. Use of herbal galactogogue for safe milk production is a necessity because indiscriminate and prolonged use of feed additives, vitamins, minerals, hormones, drugs and synthetic compounds develop adverse effects which open a detrimental platform to normal health. Presently, many herbs such as *Leptadenia reticulata, Asparagus racemosus, Withania somnifera, Arundo donax, Cissampelos pareira, Foeniculum vulgare, Eclipta alba, Solanum nigrumon, Ipomea digitata, Tribulus terrestri, Lepidium sativum, Glycyrrhiza glabra, Cumunum cyminum, Cyterus rotundus, Nigella sativa, Foeniculum vulgare* and *Pulraria tuberose* are used for augmenting milk production. *Asparagus racemosus* (*Shatavari*) is very common in several polyherbal formulations such as Galog, Ruchamax, Payapro, Lactare, Leptaden and Calshakti Platina that are marketed for augmenting milk production in cows. In the present review an attempt has been made to substantiate the galactopoietic use of *Asparagus racemosus* and to advocate its scientific validation as galactogogue in dairy cows.

Keywords: *Asparagus racemosus*, Galactogogue, Biochemical effect, Validation

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Milk comprises of protein, carbohydrate, lipid, vitamins and minerals in different concentrations. It is considered as protein rich wholesome food for all age groups of people including infants and patients. The demand for milk in rapidly growing population of our country can be achieved by either importing high yield cows or by augmenting milk production of our indigenous breeds. The later is economical and risk less keeping in view the socio-economical status of our livestock farmers. Our country accounts for a lion's share in the world's livestock population. A little augmentation of milk production in each of our thickly populated dairy animals, would contribute significantly to the national figure for milk yield. Milk production is a complex physiological process involving physical and emotional factors with interaction of multiple hormones where prolactin is predominant among progesterone and oxytocin. Lactogenesis and milk ejection both are hormone origin. Secretion, regulation and action on target tissues of hormones are affected by stress. Therefore, care must be taken to make lactating animals stress free for better lactogenesis and milk ejection. On the way of augmentation of milk production, indiscriminate and prolonged use of feed additives, vitamins, minerals, hormones, drugs and synthetic compounds develop adverse effects which opens a detrimental platform to normal health[1] and sometimes farmers cannot afford for high cost. As per European Food Safety Authority (EFSA) guidelines, prolonged administration/over dosage of feed additives such as pro-biotics, anti-biotics, anti-fungal, anti-micotoxins and technological additives (Preservatives, anti-oxidants, emulsifier, acidity regulators and silage additives), sensory additives (Flavours, colourants), nutritional additives (Vitamins, amino acids and trace elements), zootechnical additives (digestibility enhancer, gut flora stabilizers, coccidio-stat and histo-monostats) can reduce productivity, immunological and reproductive performance in animals. On the other hand, herbal medication claims better action in controlling stress of different origin and in curing many serious ailments

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in man and animal. At present, development of herbal galactogogues is important in safe milk production. The constraints and limitations of allopathic medication have been greatly replaced by phyto-therapy and ayurvedic medicines because these are easily available, cost effective, have no side effects and do not leave residues in tissues, secretions, excretions and milk[2].

Many herbs such as *Leptadenia reticulata*, *Asparagus racemosus*, *Withania somnifera, Arundo donax, Cissampelos pareira, Foeniculum vulgare* and extracts *of Eclipta alba* and *Solanum nigrumon* are incorporated in polyherbal formulations/ mixtures/ tablets like Galog (Indian Herbs), Ruchamax (Ayurvet), Payapro (Ayurvet), Leptaden (Alarsin Vet), Calshakti Platina (Intas Pharmaceuticals), Ricalex (Aphali Pharmaceuticals) and Lactare (TTK Pharma) to augment milk production[3]. The roots of a group of 10 herbs namely *Vetireria zizaniodes* (*Virana*), *Oryza rufipogon* (*Shali* or *Shashtika* or *red rice*), *Ligenaria siceraria* (*Ikshuvalika*), *Cynodon dactylon* (*Darbha*), *Desmostachya bibinnata* (*Kusha*), *Saccharum spontanum* (*Kasha*), *Ruta chalepenis* (*Gundra*) or *Cyperus rotudus* (*Bhadramustaka*), *Sesbania bispinosa* (*Itakata*), *Cymbopogon jwarancusa* (*Katrina*) traditionally claim their galactopoietic effect. Although, hundreds of plants have been screened for simulating effect on estrogen, oxytocin and other reproductive hormones in laboratory conditions and are used as galactogogue but yet the specific and potent galactopoietic effect of indivisual plant is far from validation.

Asparagus racemosus has been used as a medicinal herb both in ayurveda and in generic tradition for multiple ailments in human and animals both since time immemorial[4,5]. It acts as an adaptogen, anti-tussive, anti-oxidant, anti-bacterial, immune-modulative, digestive, cyto-protective, galactogogue, anti-oxytocic, anti-spasmodic, anti-diarrhoeal and sexual tonic[6]. The effects of its root on gastro-intestinal tract as a replacer of dopamine antagonist metoclopromide[7], on uterus as oxytocin-induced contraction blocker[8], on cholesterol metabolism as anti-oxidant and hepato-protectant[9,] and on immune system as immuno-modulant[10] are promising. Although, researches on galactogogue effect of its root has been carried out in human[11], rats[12] and Guinea pigs[13] but a few reports are available in lactating cows and buffaloes[14]. At present, most of the commercially available galactogogues contain *Asparagus racemosus* in combination with other plants where its lone effect is not transparent. The potent active principles of its root are to be studied systematically for specific purpose of augmentation of production in dairy animals. Scientific identification, isolation, validation, modification of specific lead (s) of *Asparagus racemosus* imparting galactopoietic effect would greatly benefit our farming community. In the present review attempts have been made to identify galactogogue properties of *Asparagus racemosus* in dairy animals so as to open an avenue for necessary validation of specific active principles of the herb root.

Hormonal regulation of milk ejection

Different types of touch of the teats such as, suckling by the calf, hand or machine milking, stimulate pressure and touch-sensitive receptors in the teat skin. Stimulation of these receptors induces nerve impulses which travel via segmental pathways in the CNS (Central Nervous System) to the PVN (Paraventricular Nulei) and SON (Supraoptic Nuclei) in the hypothalamus resulting in the release of the pituitary hormone oxytocin. Oxytocin is a nona-peptide consisting of nine amino acids and it is produced in the SON and PVN in the hypothalamus. Oxytocin is transported from the cell bodies of PVN and SON through the pituitary stalk *via* a carrier protein (neurophysin I). Then, it is released into the blood and transported to the udder where it attaches to the receptors on the myo-epithelial cells surrounding the alveoli. As a result the myoepithelial cells contract to expel milk. During this process, although, prolactin and cortisol are released in dairy cows but biological significance of their release is unclear. However, it has been indicated that prolactin can influence milk synthesis and together with growth hormone it might play an active role in maintaining milk secretion[15]. Cortisol is, among others, a catabolic hormone making amino acids and other fatty acids available for milk production. That suckling/milking is influencing the metabolism has further been indicated in monogastric animals, where suckling-induced release of the GI (gastrointestinal) hormones gastrin, somatostatin and CCK (cholecystokinin) has been observed. In dairy cows, during milking or routine milking or simultaneous feeding and milking influences the GI hormones[16]. Probably, stimulation of teats (during suckling or milking) activates the vagal nerves in order to adapt the feed intake and metabolism in the lactating animal. Hormones like gastrin and CCK have a

trophic effect on the gastric mucosa, whereby the suckling-induced release of these hormones affect the capacity in the GI tract during lactation.

Inhibition of milk ejection

Milk ejection can also be inhibited. The disturbance of milk removal can be a consequence of peripheral inhibition of the reflex and inhibition at the level of the central nervous system. In practice inhibition can have enormous effects on milk production both in the short-term and long-term perspective. Under normal milking condition, peripheral inhibition of milk-ejection reflex is characterized by lack of the effect of oxytocin released from pituitary at the udder level. In experimental condition, administration of catecholamines blocks oxytocin receptors and inhibits the process of milk ejection. Catecholamines stimulate α-adrenergic receptors, causing the contraction of teat and cisternal area whereby the milk removal is inhibited in spite of a normal milking-related release of oxytocin. As long as milk is available in the cisterns the milk flow is not reduced. However, the effect of the inhibition of the ejection occurs when the milk travels from the alveolar area into the cistern through the contraction of milk ducts[17]. During central inhibition, the disturbed milk ejection reflex is due to lack of oxytocin release in response to pre-stimulation and milking. Normal milk ejection occurred after injections of physiological doses of oxytocin. Disturbance of milk removal has been observed in primiparous cows immediately after parturition, during oestrus and during milking in unfamiliar surroundings. Evidence of milking-related release of prolactin indicates the intact afferent pathways from the mammary gland to the hypothalamus. The basal concentrations of cortisol and β-endorphin are higher in the cows milked in unfamiliar compared to those milked in familiar surroundings. Elevated concentrations of these substances indicate that the cows were subjected to some kind of emotional stress. Elevated cortisol levels can be considered as a stress reaction in cows.

Galactogogues

The term ‘galactopoitic’ or ‘galactogogue’ refers to substances which augment established lactation but the term ‘galactopoietic’ is independent to describe hormone preparations which enhance milk production in lactating animal. Otherwise, medications exerting their effects through antagonism of dopamine receptors resulting in increased prolactin are galactogogues or lactogogues and are assisting initiation, maintenance, augmentation of maternal milk production. They act either by blocking hypothalamic dopaminergic receptors (metclopromide and domperidone) or by inhibiting dopamine-producing neurons. Progesterone falls and a full milk supply (lactogenesis) is initiated during parturition and expulsion of the placenta. Dopamine agonists inhibit and dopamine antagonists increase prolactin secretion which in turn increases milk production through interaction with the hypothalamus and anterior pituitary. Thereafter, prolactin levels gradually decrease but milk supply is maintained or increased by local feedback mechanisms. An increase in prolactin levels is badly needed to increase production but not to maintain milk flow. In this way, anterior pituitary is important for the development of mammary gland, initiation of lactation and production of milk. As explained in hormones regulation in stimulation and inhibition of milk ejection, it could be well expected that increased bioavailability of oxytocin, prolactin, cortisol and GI (Gastro-intestinal) hormones are the main tools for enhancement of milk production in lactating animals. Additionally the removal of the regulators for inhibition of milk ejection could also improve milk production.

Herbal supplements for milk production

Herbal galactogogues are originated from medicinal plants that are used to augment milk production in animals as well as in nursing mother. Several herbal galactogogues have galactogenic effect. Effective feed management along with use of herbal agents to potentiate lactogenesis is an avenue of good augment in production potential in dairy herd. Indigenous herbs possess safe galactogenic properties by acting through adreno-hypothalamo-hypophyseal-gonadal axis[18]. Herbs and its combinations are beneficial in udder, reproductive organ health and in sub clinical mastitis and agalctia cases where they improve milk production and serum immunoglobulin with a decline of Total Leukocyte Count (TLC), neutrophil and lymphocyte percent. Herbal feed additives increase milk yield and affect its composition by modifying rumen ecosystem. Supplementation of ***Lepidium sativum*** (***Methi***) increased in percent lactose and SNF (Solid Not Fat) without changing fat, protein and total solids percent in milk[19]. Table 1 enlists different herbs with a variety of chemical active principles, having galactogenic properties that can be used as herbal medicine for the purpose of milk let-down.

Table 1—List of different herbs with a variety of chemical active principles, having galactogenic properties

Common name	Botanical name	Family	Parts used	Chemical constituents
Jivanti	*Leptadenia recticlata*	Asclpiadaceae	Root	Leptadenol, triacontane, cetyl alcohol, leptidin-1-stosterol
Shatavari	*Asparagus racemosus*	Liliaceae	Root	Shatavarin-I-IV, qucertin, rutin, hyperoside
Vidari kanda	*Ipomoea digitata*	Convolvulaceae	Tuberous root	Petrocarpanone, hydroxytuberosone, petrocarpene-anhydrotuberosin, 3-0, methyltuberosin
Shaptapushpa	*Anethum sowa*	Umbelliferae	Flower head	Anethole, estragol, fenchone, *B*-sitosterol

In addition, herbs such as *Trigonella foenum-graecum* (Fenugreek*)*, *Foeniculum vulgare* (Fennel), *Rubus idaeus* (Raspberry leaf/ Red Raspberry), *Utica diotica* (Nettle) and *Utica urens* (Nettle leaf), *Cnicus benedictus* (Blessed thistle), *Vitex agnus-castus* (Chaste berry), *Medicago sativa* (Alfalfa), *Cimicifuga resebosa* (Black cohosh), *Anethum graveolens (*Dill), *Galega officianalis* (Goat's Rue), *Silbanum marianum* (Milk thistle), *Leptadenia reticulata* (Mother's milk tea, *Jivanti*) and *Asparagus racemosus* (*Shatavari*) are recommended in ayurveda to be used for the purpose of milk production. The herb fenugreek, fennel, red raspberry, nettle, blessed thistle (Mediterranean weed), Cheste berry (Shrub) are said to possess normalizing effect on progesterone function of the pituitary gland and stimulate prolactin production in nursing mothers to increase milk supply. Alfalfa is used to increase appetite, vitality and it helps in water retention in animals whereas, Goat's rue has been reported to be an excellent galactogogue but Milk thistle leaves increase milk supply moderating estrogen levels. It has been reported that, Leptaden tablet containing *Shatavari* as a major component enhances milk production significantly in buffaloes, cows, goat and sheep and Payapro and Galactin in crossbred cows[20]. The milk production and persistency was significantly improved by supplementation of shatavari based herbal formulation Ruchamax in buffaloes[21] and Galog in crossbred cows[22] through optimization of rumen microflora function to improve the digestion and better utilization of feed in goats[23]. Therefore, Galog, Galactin, Leptaden, Payapro, Ruchamax, Calshakti Platina are widely manufactured by different pharmaceuticals to augment milk production with a safe guard to health status of the animal.

Herb *Shatavari*

The name *Shatavari* means 'curer of a hundred diseases' (shat: hundred and vari: curer) and is known as *Satavar*/*Shatavari*/*Shatamull*. It is a common species of asparagus under Liliaceae family distributed throughout India and in the Himalayas, with a height of 1-2 m tall tracking root in gravelly rocky soils high up in piedmont plains. It has small uniform pine needle like leaves, small white flowers and finger like clustered roots. Indiscriminate practice of deforestation, habitat destruction and non-scientific/destructive harvesting of medicinal herbs affect the population of herb for which it is now considered 'endangered' in its natural habitat.

Biochemical constituents of *Shatavari*

The genus Asparagus comprises about 300 species of herbs and various parts these plants are rich sources of sapogenins and saponins. The chemical composition of its root contains different components of polyphenols and flavonoids including the active principles of Shatavarin, Sarsasapogenin, Racemosol and Asparagamine[24]. Active constituents/ principles are the specific components/ organic bio-molecules responsible to manifest the desired effect. The major chemical constituents include steroidal saponins (Shatavarins I–IV) of roots. Shatavarin-I is the major glycoside with 3 glucose and rhamnose units whereas Shatavarin-IV is a glycoside of sarsasapogenin having two molecules of rhamnose and one molecule of glucose. Quercetin, rutin (2.5% dry basis) and hyperoside are found in the flowers and fruits, while diosgenin and quercetin-3, glucuronide are present in the leaves. Besides, isoflavone, 8-methoxy-5, 6, 4 tri-hydroxy-isoflavone 7-O-D-glucopyranoside[25] and polycyclic alkaloid (Asparagamine), 9, 1-dihydrophenenthrene derivative[26] sarsasapogenin and kaempferol are also present in roots. The root also claims for two new steroidal saponins, shatavaroside A and B together with a saponin, filiasparoside-C[27] (Table 2).

Table 2—Biochemical constituents of *Asparagus racemosus*

Components	Measures	Authors
Polyphenols (mg %)	88.2	38, 39
Flavonoids (mg %)	06.7	
Vitamin C (mg %)	42.4	
Ash (%)	6.5 - 7.4	40, 9
Protein (%)	4.6 – 6.1	
Total Carbohydrate (%)	36.8 – 47.5	
Galactose (%)	54.0	41
Glucose (%)	28.0	
Rhamnose (%)	4.0	
xylose (%)	5.0	
Arabinose (%)	8.0	
Others (%)	1.0	

Medicinal uses

Asparagus racemosus is mainly recommended in ayurveda for prevention and treatment of gastric ulcers, dyspepsia and as a galactogogue besides its action in nervous disorders, inflammation, liver diseases and certain infectious diseases[9]. The methanol extract of its root exhibits anti-bacterial property against infectious diseases caused by *Escherechia coli, Shigella dysenteriae, Shigella sonnei, Shigella flexneri, Vibrio cholera, Salmonella typhi, Salmonella typhimurium, Pseudomonas putida, Bacillus subtilis* and *Staphylococcus aureus* due to presence of the constituent 9, 10 dihydrophenanthrene[28]. It is an important traditional digestive tonic for diarrhea, dysentery, dyspepsia and indigestion. Feeding herbal formulation containing 25% *Shatavari* significantly enhances dry matter intake (DMI) by 10.97% in buffaloes[29] and in cows at the rate of 100g on alternate day[30] and100g/day/animal and its saponin reduces infectious protozoan counts in one year calves[31] due to detergent effect on the cell membranes. Alcoholic and aqueous extracts of *Asparagus racemosus* root has hepatoprotective, antimicrobial and immuno-modulatory property against pathogenic bacteria, helminthes, virus, fungi and protozoa[28]. Systemic administration of alcoholic extract of *Asparagus racemosus* in weaning rats increases weight of the mammary glands, inhibits involution of lobulo-alveolar tissue and maintains milk secretion due to the action of released corticoids and prolactin[12]. A significant increase in milk yield is also observed in guinea pigs and goats after feeding lactate through increased growth of mammary glands, alveolar tissues and acini and by galactogogue effect in buffaloes[13].

Toxic effect

Herbal drugs mostly do not manifest side effects with the recommended doses below LD_{50}. The LD_{50} of phytochemicals of *Shatavari* root is <1gm/kg bw so laboratory animals do not exhibit adverse effects up to a dose of 1gm even on continuous feeding for 30 days but adverse effects are reported with higher doses and longer duration of feeding[32]. Doses of 50-2000 mg and up to 5 gm/kg bw of oral methanolic extract of *Asparagus racemosus* root do not change mortality, gross organic structures, physiological and biochemical parameters in normal rats. But, a dose of 1000 mg/kg bw/ day for 60 days exhibits teratological disorders in terms of resorption of fetuses, swelling in legs, intrauterine growth retardation with small placental size, smaller litter size, decrease in body weight gain, and delay in various developmental processes in pregnant Charles Foster rats[33].

Effect of *Shatavari* on blood metabolites

Blood metabolites are the true reflection of body metabolism with special reference to effect of exogenous materials on digestion, assimilation and fate of nutrients. Glucose is considered as the chief metabolic fuel responsible for positive energy balance in support of normal growth, maintenance and production. Although, 40-60 mg/dl of glucose is essential and indispensable in ruminants but they derive majority of their metabolic energy from Volatile Fatty Acid (VFA). Supplementation of saponin significantly increases Rumen VFA profile, microbial efficiency, propionate, glucose, insulin and hexokinase, glucose-6-phosphate and fructose-1-6-biphosphate during prepartum/gestation[34]. The

concentration of plasma protein at any given time is a function of lactation and nutritional status in dairy cows. In some cases it may increase just after parturition but subsequently it decreases due to drain of blood protein into colostrums. The concentration of plasma albumin varies significantly between breeds of lactating cows and is affected by stage of lactation where it is lower around parturition with an increase gradually up to 2 week post partum. Besides, udder health of the animal is also one of the factors to change blood albumin concentration in dairy animals. Feed and its composition, season, parity and stage of lactation are the factors affecting plasma urea concentration. The higher ruminal degradation of protein may cause hepatic failure and degeneration and adversely affect fertility and lactation. For nutritional manipulation supplementation of saponin containing herb reduces protein degradation and ammonia nitrogen production in rumen. The normal plasma total and circulating cholesterol in dairy cattle depends on genetic grade of breed nature of diet, time since feeding, age, breed, pregnancy, and stage of lactation. The total cholesterol level is low at parturition and it increases with advancement of lactation and crosses the normal level in crossbred cows.

Effect on milk production

Supplementation of *Shatavari* root increases weight of mammary glands and adrenal glands with release of pituitary ACTH (Adreno Cortico Tropic Hormone) due to well developed lobulo-alveolar tissues in mammary gland by a direct action through pituitary or pituitary-adrenal axis resulting in the secretion of prolactin and ACTH. Peri-parturient secretion of prolactin is essential for maximal synthesis of milk in the post partum period. Prolactin plays a critical role in mammary cell differentiation, a key biochemical steps involved in lactogenesis. The mammogenic property of ***Asparagus racemosus*** on udder may be attributed for enhanced milk production in goat[14]. The number of secretory cells is maximum at the initiation of lactation where milk production is more. After peak lactation, the differentiation state of the tissue is maintained constant throughout declining lactation and the loss of secretory cells accounts for the decrease in milk yield. Moreover, daily/alternate day supplementation of ***Asparagus racemosus*** is economical viable to increase income by Rs 7.49/ day/animal[35] and liter cost of milk production. ***Asparagus racemosus*** in combination with other herbs in Ricalex and Lactare tablets increases milk production in females[11] and alcoholic extract of its root enhances milk secretion in weaning rats[12] and maintains milk production in estrogen primed rats by releasing corticoids and prolactin. Besides, administration of ***Asparagus racemosus*** root also enhances milk production in Guinea pigs, goats and buffaloes[14]. The steroidal saponins, shatavaroside

Table 3—Effect of *Asparagus racemosus* on different blood parameters

Metabolites	Component	Subject	Effect	Authors
Glucose	Ethanolic root extract (250mg/ kg bw)	Albino rats	Hypoglycemic effect	42
	Root powder (100g/ animal on alternate day)	Lactating cross bred cows	Glucogenic effect	
	Polyphenols and flavonoids of root @5mg% daily for 60 days	Lactating cross bred cows	Hypoglycemic effect (18.2%)	43
Total protein, albumin and globulin	Root powder (100g/ animal on alternate day)	Lactating cross bred cows	No effect	
	Asparagus racemosus based herbal formulation	Gravid rats	No effect	44
	Aqueous Saponin of *Asparagus adscendens* roots	Lactating cows	Enhances total protein post ruminally	45
Urea	*Asparagus racemosus* and its saponin	Lactating cows	No effect	46, 37
Cholesterol and other lipids	Root powder (5-10 %)	Gravid rats	hypolipidaemic and hypocholesterolic effect	47, 48
	Saponin of *Asparagus racemosus*	Rats, gerbils and men	Reduces LDL and Cholesterol	43, 47
Calcium	Polyphenols and flavonoids of root @5mg% daily for 60 days	Lactating crossbred cows	Hypercalcemic effect (08.4%)	43
Phosphorus	Polyphenols and flavonoids of root @5mg% daily for 60 days	Lactating crossbred cows	Hyperphosphorusemic effect (13.14%)	43

Table 4—Effect of *Asparagus racemosus* on milk yield

Dosage	Subject	Effect	Authors
Alcoholic extract of *Asparagus racemosus* root (I/M)	Post partum estrogen primed rats	Increases weight of mammary glands and adrenal glands	49
Asparagus racemosus root @ 500g per day/ animal	Buffaloes andcrossbred cows	Increases milk yield	29, 36
Asparagus racemosus root @50-100g/ day/ animal	Crossbred cows	Increases milk production	35
Asparagus racemosus root @100g on alternate day/ animal	Crossbred cows and goats	No effect	30, 50
Polyphenols and flavonoids of *Asparagus racemosus* root @ 5 mg/ cow/ day	Crossbred cows	Increases milk yield by 27.54%	43

A and B together with filiasparoside-C of *Shatavari* root act on pituitary and adrenal gland to releases ACTH and prolactin. These hormones enhance differentiation of mammary cells to increase their number even after peak lactation and thereby increase the milk production[27].

Effect on milk composition

The major components in milk are lactose, protein, water soluble vitamins and minerals in the aqueous phase and fat and fat soluble vitamins in the lipid phase. Milk from dairy cows consists of more than 80% water and the contents of lactose, protein and fat can vary to a small extent. The composition of milk varies between breeds, age, feeding regime, health status, and stages of the lactation, energy balance during dry period and early lactation and health status of udder. Herbs and its metabolites modify the rumen ecosystem and their supplementation can change the normal composition of milk. The milk fat, protein, SNF and total solids are non-significantly higher on post partum *Shatavari* supplementation in lactating cows and buffaloes[33,35,36]. The average values for total cholesterol content in milk fat ranges from 220 to 387 mg/dl with variation due to stage of lactation where exotic breeds count for higher values. Cross bred cows exhibit the highest cholesterol in milk fat on day 1 after parturition which gradually declines on subsequent days. The highest value is recorded in winter season followed by summer and autumn. *Shatavari* by virtue of its hypocholesterolemic effect significantly reduces blood cholesterol level[37] and thereby milk fat cholesterol is diminished. Tables 3 & 4 represent effects of *Asparagus racemosus* on different blood constituents and effects on milk yield, respectively.

Conclusion

The traditional knowledge with its holistic and systems approach supported by experimental base can serve as an innovative and powerful discovery engine for newer, safer and affordable medicines. Different plant species mentioned in the ancient texts of ayurvedic and other Indian systems of medicines may be explored with the modern scientific approaches for better leads in the healthcare. Hence, the present review is focused an overall out line of *Asparagus racemosus* used in ayurvedic drug scenario and its future prospects for scientific investigation as galactogogue. Since most drugs containing *Asparagus racemosus* that are available in the market are in the form of polyherbal formulations, it is difficult to attribute a particular medicinal action of *Shatavari* component of the drug solely. Several pre-clinical and clinical studies on different biochemical parameters have been studied but less is known about its pharmacognosy, chemistry, pharmacology and clinical therapeutics to conclude about its galactogogue effect. Therefore, further research is imperative to probe into the actual mode of action responsible for the galactogogue effect. Clearly, more research is needed to define the effect of phytoestrogens from *Asparagus racemosus* and at the same time standardizing and characterizing formulations and/or isolated phytoestrogens is imperative. During past years the use of oxytocics in augmenting milk yield in dairy cows and buffaloes has been warned by several researchers that the consumption of milk from oxytocic animals may generate several health hazards. The lactogenic effects of *Shatavari* if validated scientifically with little untoward effect, it would be a great gift for pharmaceuticals, farmers and milk consumers. In addition, developing an understanding of the effects of phytoestrogens from *Shatavari*

as opposed to human oestrogens also holds great promise for further research.

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