INTRODUCTION OF FIVE WELL-KNOWN AYURVEDIC MEDICINAL PLANTS AS FEED ADDITIVE ON LIVESTOCK’S PERFORMANCE: A REVIEW

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ABSTRACT

According to the FAO, the lack of drugs to treat diseases and infections causes losses of 30 to 35% in the breeding sector of many developing countries, where poor animal health remains a major constraint to breeding. There are two principle reasons behind the changes in legislation on the use of in-feed antibiotic growth promoters. The first is to try to combat the development of microbial resistance to antibiotic drugs and the consequences on human health. The second is a response to consumer pressures to eliminate the use of all non-plant xenobiotic agents from the diets of animals, so natural resources of medicine like phyto-medicines can help smallholders in rural areas to manage their only income resources from diseases and mortality. This review introduces five most common ethno-veterinary plants named; Asparagus racemosus willld. (Shatavari), Leptadenia reticulata (Retz.) Wight & Arn. (Jivanti), Cuminum cyminum Linn. (Jeeraka), Nigella sativa L. (Kalajaji) and Pueraria tuberosa (Willd.) DC. (Vidarikanda) for eco-efficiently livestock production management to meet climate smart agriculture practices.

KEYWORDS: Medicinal plants, livestock, clean production, Asparagus racemosus, Leptadenia reticulata, Cuminum cyminum, Nigella sativa, Pueraria tuberosa
INTRODUCTION

It is estimated that there are 2, 50,000 species of higher plants on earth of which more than 80,000 are medicinal (Kumar and Joshi 1987). Recent studies have shown that medicinal plants (their extracts) with lower concentration of plant secondary metabolites are good candidates for achieving one or more beneficial impacts on ruminant’s performance (Teferedegne, 2000). Medicinal plants are generally considered as safe for human consumption (FDA, 2004) and these can be employed to modify rumen microbial fermentation. The extracts of leaves, fruits or roots of various plants are traditionally used as medicine and also have galactogouge property and recently these have been recognized as having antimicrobial and anti-methanogenic properties (Davidson and Naidu, 2000, Alexander, 2005, Malik, 2007) due to the presence of plant secondary metabolites such as saponins, terpenoids, phenylpropanoids, tannins and essential oils. Extensive grazing system is being practiced chiefly by the resource poor farmers. Under this system inaccessibility to the timely veterinary health care and the cost of treatment are the main constraints, affecting the productivity and sometimes viability of the system. Under these conditions it becomes essential to utilize the locally available resources as ethno-veterinary medicines to ensure general well-being and welfare of the animals (Mirzaei, 2010). World health organization has recognized the necessity for investigation and mobilization of ancient medicinal practice to fulfill the primary health care of the animals and realizes that the traditional system of medicine may play an important role in the development of livestock of the third world countries (WHO, 2008). There is a renewed interest, especially in developed countries, in using plants to treat livestock, pets, and humans (Cornel University, 2009).

Some of the herbal plants are reported to have beneficial effect on the production, reproduction and health of the animals (Medplant, 2008). Many herbs and plant extracts have antimicrobial activities against a wide range of bacteria, yeasts, and molds (Thompson, 1986; Voda et al., 2003). A knowledge of the chemical constituents of plants is desirable, not only for the discovery of therapeutic agents, but also because such information may be of value in disclosing new sources of such economic materials as tannins, oils, gums, precursors for the synthesis of complex chemical substances, etc.

Therefore keeping in mind aforesaid constraints and possible benefits, the present review was planned with the following objectives:

- To study the effect of herbal supplementation on feed intake and feed conversion efficiency of ruminant production management.
- To study the effect of medicinal plants supplementation on production performance of ruminant production management.

1. Herbals and their mode of action

The first world medical conference under the patronage of Anoushiravan, the King of ancient Iran was convened at 550 Christian Era in Cteciphon city. Hundreds of physicians from other countries were in attendance in this congress. Ferdowsi, Iranian Poet has versified this historical event in Shah Nameh, Ferdowsi’s book. Khosrow dispatched the famous Iranian physician, Borzoya (Borzouyeh) to India, who brought medical and scientific books, chess, herbal plants and Indian doctors with him (Mirzaei, 2010).

Herbs are more compatible with body because of their normal nature and having medicine homologues components together; and usually lack unwanted side effects; therefore they are most suitable, especially in cases of long consumption as well as in chronic diseases (Borimnejad, 2008).

One of the most important determinants of research conducted is the availability of funding. There are three areas in which it is most likely that appreciable goat research funding opportunities will be available in the foreseeable future: biotechnology, medical research and food safety. For example there may be genetic engineering techniques developed for inserting specific genes into animals to overcome many human health problems or to study specific disease problems.
Ethno-veterinary is a science that involves the popular practical knowledge used to treat and prevent animal diseases. Although a number of ethno biological inventories concerning the use of medicinal plants and animals in human health have been realized, the ethno-veterinary medicine is poorly described. This scarce description of the ethno-veterinary medicine resources is in stark contrast to the problems of livestock rearing, where the lacking regular access to essential medicines greatly hampers productivity. According to the FAO (Mirzaei, 2010), the lack of drugs to treat diseases and infections causes losses of 30 to 35% in the breeding sector of many developing countries, where poor animal health remains the major constraint to breeding (Daba and Abdel-Rahman, 1998).

Several forms of organic farming are being successfully practiced in diverse climate, particularly in rain fed, tribal, mountains and hill areas of the India. Much of the Natural plant products with economic importance like herbs, medicinal plants by default come under this category (Mirzaei, 2010). Livestock raisers and healers everywhere have traditional ways of classifying, diagnosing, preventing and treating common animal diseases. Many of these "ethno-veterinary" practices offer viable alternatives or complement to conventional, western style veterinary medicine especially where the latter is unavailable or inappropriate. The non-nutrient bioactive principles in plants are essentially the secondary metabolites. They are differing from the ubiquitous primary metabolites (i.e., carbohydrates, proteins, fats, nucleic acids) in that their distribution is limited. Plant secondary metabolites are a natural resource that is largely unexploited in conventional animal production system. Essential oils are complex mixture of secondary metabolites consisting of low-boiling point, phenylpropanes and terpenes. They are particularly associated with plants defined as herbs and spices (Greathead, 2003).

Recent and continuing changes to legislation controlling the use of animal feed additives have stimulated interest in bioactive secondary metabolites as alternative performance enhancers. There are two principle reasons behind the changes in legislation on the use of in-feed antibiotic growth promoters. The first is to try to combat the development of microbial resistance to antibiotic drugs and the consequences on human health. The second is a response to consumer pressures to eliminate the use of all non-plant xenobiotic agents from the diets of animals. Some herbal essential oils like carvacrol and thymol oils have been reported to inhibit the growth of E. coli, decrease the intracellular ATP concentration of E. coli, and while simultaneously increase the extracellular ATP concentration. It is the lipophilic character of essential oils that enables them to disrupt cell walls, as they consequently accumulate in membranes (Greathead, 2003). The rumen protozoa are proteolitic and actively ingest rumen bacteria. They are considered to be the most important cause of bacterial protein turnover in the rumen and therefore can have a major effect on the efficiency of rumen N metabolism (Wallace and McPherson, 1994).

In general, gram-positive bacteria appear to be more susceptible to inhibition by plant essential oil compounds compared with gram-negative bacteria (Davidson and Naidu, 2000). This effect has been related to the presence of an outer membrane on gram-negative organisms, which endows them with a hydrophilic bacterial surface that acts as a strong impermeability barrier (Nikaido, 1994). Essential oils are steam-volatile or organic-solvent plant extracts, used traditionally by man for many centuries for the pleasant odour of the essence, its flavour or its antiseptic and/or preservative properties. The word ‘saponin’ is derived from the Latin word sapo (soap) and traditionally saponin-containing plants have been utilized for washing. Saponins, like essential oils, cover a wide variety of chemical compounds and, also like essential oils, man has made use of their properties for centuries (Hostettmann and Marston, 1995; Wallace, 2004).
The sensitivity of ciliate protozoa towards saponins may be explained by the presence of sterols in protozoal, but not in bacterial, membranes (Williams and Coleman, 1992). Thus, the sterol-binding capability of saponins most probably causes the destruction of protozoal cell membranes (Hostettmann and Marston, 1995). Plants and their extracts have important potential as manipulators of rumen fermentation for productivity and health benefits (Jiménez-Peralta et al., 2011; Salem et al., 2011). They have specific effects on members of the rumen microflora and fauna that can be beneficial to animal productivity and health (Wallace, 2004). Gastrointestinal parasitism has been classified as a major health and welfare problem for ruminants. Parasitism, especially by helminth parasites, impairs health by causing inappetance, diarrhea, and anemia and in severe cases, death (Athanasiadou et al., 2001).

The complexity and the bioactivity of plant secondary metabolites have the potential to reduce the likelihood that microorganisms or parasites will develop resistance, and their effectiveness is such that concentrations as low as 0.1 g/kg feed may be sufficient (Salem et al., 2010). In some cases they may already be components of feedstuffs nevertheless, issues such as toxicity, photosensitivity, residues, taint, allergenicity and cost effectiveness still need to be addressed before these compounds will gain widespread acceptance in the agricultural industries. Furthermore their use as prepared compounds will need to be agreed by the registration authorities within the countries in which they will be used or in which the products from livestock will be sold and consumed (Acamovic and Brooker, 2005).

Scientific validation and use of ethnoveterinary medicine can play a role in poverty reduction by improving productivity of animals through convenient, accessible and economical use of their practices. The fact that medicinal plants are predominantly harvested in an unregulated manner undermines the whole industry and yield from the wild is wholly unpredictable. Supplies are at the mercy of the weather, pests, and other uncontrollable variables. Farming these species would help even out the supply, regularize the trade, provide certifiable products of uniform quality, and make available to rural areas new sources of income. This would also indirectly help in poverty alleviation (Iqbal et al., 2005).

2. Distribution, use and effects of herbals bioactive

2.1. Shatavari (Figure 1)

Shatavari, Asparagus racemosus Willd. (Asparagaceae) is recommended in Ayurvedic (the system of traditional medicine native to India) texts for prevention and treatment of gastric ulcers, dyspepsia and as a galactogogue. A. racemosus has also been used successfully by some Ayurvedic practitioners for nervous disorders, inflammation, liver diseases and certain infectious diseases. A study of ancient classical Ayurvedic literature claimed several therapeutic attributes for the root of A. racemosus (Sanskrit:- Shatavari) and has been specially recommended in cases of threatened abortion and as a galactogogue. Root of A. racemosus has been referred as bitter-sweet, emollient, cooling, nervine tonic, constipating, galactogogue, aphrodisiac, diuretic, rejuvenating, carminative, stomachic, antiseptic and as tonic. Beneficial effects of the root of A. racemosus are suggested in nervous disorders, dyspepsia, diarrhoea, dysentery, tumors, inflammations, hyperdipsia, neuropathy, hepatopathy, cough, bronchitis, hyperacidity and certain infectious diseases (Goyal et al., 2003).

The genus Asparagus (with about 300 species) is a rich source of sapogenins and saponin, from various parts of the plant (Lacaille-Dubois, 2000). It has been reported that Shatavari supplementation induced leucocytosis with predominant neutrophil associated with stimulation of phagocytic and bactericidal capacity of neutrophils and macrophages (Thatte and Dhanukar, 1989). Shatavari root has growth promoter property. Calves supplemented with Shatavari root decoction at the rate of 100 mg/kg for a varying period of 4 weeks to 8 months showed 81.19 % weight gain as compared to 67.9% in control. It did not have any adverse
effect on the progeny of the treated animals. The growth promoting effect can be ascribed to its adaptogenic property (Sharma, 1996). Supplementation of Shatavari root powder at 5 and 10% level reduces the plasma and hepatic lipid (cholesterol) levels and also decreases lipid peroxidation, also Shatavari supplementation increases dry matter intake significantly in lactating crossbred cows (Tiwari et al., 1993; Barhane and Singh, 2002).

Fig.1 Tubers of Asparagus racemosus Willd.

Fig.2 Habit of L. reticulata (Retz.) Wight & Arn

Fig.3 & 4 Seeds and Habit of Nigella sativa L.

Fig.5 Fruits of Cuminum cyminum Linn.

Fig. 6 Tubers of Pueraria tuberosa (Willd.) DC.

Photo Courtesy: Dr. Harisha C R (Fig.1 & 6); Dr. Hari Venkatesh K R (Fig.3, 4, 5); ayurvedamaruthuvam.blogspot.com (Fig.2)
Supplementation of Shatavari fresh root of at the rate of 500 g per day with concentrate at the time of milking significantly increased milk yield of buffaloes (Patel and Kanitkar, 1969). Feeding herbal formulation containing 25% Shatavari enhanced milk production (25.1%) over control group, also significant improvement in daily milk yield in buffaloes and crossbred cows, but response of supplementation of Shatavari in buffaloes is higher than cows, but the reason was not explained (Mahantra et al., 2003; Somkuwar et al., 2005; Tanwar et al., 2008). The dose of Shatavari in dairy animal based on body weight or dry matter intake is not well standardized. Supplementation of Shatavari 100 g/day/animal and 50 g/day/animal irrespective of body weight have been found to increase milk production in crossbred cows (Tanwar et al., 2008; Mishra et al., 2008). However, It was found that supplementation of Shatavari (100 g on alternate day/animal) in freshly calved crossbred cows did not improve milk production. Similar result was also in lactating goats. In addition, supplementation of Shatavari root powder 100 g plus 10 g Aloe dried pulp powder to cows following artificial insemination per animal/day improved conception rate (Barhane and Singh, 2002; Hedge et al., 2002; Vihan, 1988).

The presence of saponin in Shatavari root has been written up (Jadhav and Bhutani, 2006). Besides saponin, root extract of Shatavari contain flavonoids (6.7 mg/100ml), polyphenol including tannin (88.2 mg/100ml) and Vitamin-C (42.4 mg/100ml), the presence of phyto-components in Shatavari root such as phyto-sterols (0.79%), saponin (8.833%), polyphenols (1.692%), flavonoids (0.476%) and total ascorbic acid (0.762%) were also estimated (Velavan et al., 2007; Visavadiya and Narasimhacharya, 2007). Herbal formulations containing extracts of A. racemosus may be recommended for use as positive immuno-modulator in normal and immuno-compromised broiler chicks. It also indicated the determinative roles of herbal feed additives in effective augmentation of humoral and cell mediated immune responses providing better protection level against infections (Kumari et al., 2012a). Another study showed that herbal preparations of A. racemosus root extract can be beneficially used as an effective feed supplement in poultry for its encouraging results in relation to total body weight gain and feed conversion efficiency. It can also be used potentially before mass vaccination of the chicks for its property of immuno-modulation like levamisole. (Kumari et al., 2012b)

### 2.2. Jivanti (Fig. 2)

Jivanti, Leptadenia reticulata (Retz.) Wight & Arn., (Apocynaceae), well known for its tonic, restorative and stimulant property in the Indian system of medicine. This plant is distributed in the Southern parts of India. L. reticulata is a much-branched twining shrub. The bark is yellowish brown, corky, deeply cracked; the leaves are ovate-cordate, coriaceous glabrous above, more or less finely pubescent beneath; the flowers are in many-flowered cymes, greenish yellow; the follicles are sub-woody and turgid. The main constituents reported are stigmasterol, β–ioterol, flavonoids, pregnane glycosides and proteins. Presence of triterpenes and steroids were also reported. Aerial parts of L. reticulata are reported to contain tocopherol and possess several pharmacological activities such as galactogogue, antimicrobial and anti-inflammatory activity (Sathiyaranayanan et al., 2007).

Jivanti is considered a stimulant and tonic in Ayurvedic system (is the system of traditional medicine native to India). Its medicinal use dates back to 4500 to 1600 B.C, as mentioned in the Atharvaveda. Its lactogenic effect has been reported in various domestic animals (Dadarkar et al., 2005). Jivanti and a cocktail of herbs namely galog is a proprietary product of Indian Herbs Research & Supply Co, are known for their lactogenic properties since the times of Atharva veda Charak Samhita (old literature in India). L. reticulata has been shown to increase milk production without affecting milk composition (Anjaria and Gupta, 1967). Galog is an herbal preparation which contains L. reticulata as the main component and it may be attributed to certain metabolic changes in the body tissues and the mammary gland, where the absorbed nutrients are utilized more effectively (Thakur, 1977).
2.3. Kalajaji (Kalonji) (Fig. 3 & 4)

Kalajaji, *Nigella sativa* L. (Ranunculaceae), commonly known as black seed or black cumin, is used in folk medicine as a natural remedy for a number of diseases such as asthma, hypertension, diabetes, inflammation, cough, bronchitis, headache, eczema, fever, dizziness and gastrointestinal disturbances. Furthermore, modern pharmacological and toxicological studies have demonstrated that crude extracts of the seeds and some of its active constituents (volatile oil and thymoquinone) might have protective effect against nephrotoxicity and hepatotoxicity induced by either disease or chemicals. *N. sativa* oil has also antipyretic, analgesic, anti-inflammatory, antimicrobial, and antineoplastic activity (Ali and Blunden, 2003). Thymoquinone, active constituent of *N. sativa* seeds, is a pharmacologically active quinone, which possesses several properties including analgesic and anti-inflammatory actions (Houghton et al., 1995). Protection against chemical induced carcinogenesis (Hassan and El-Dakhakhny, 1992; Worthen et al., 1998), and the inhibition of eicosanoids generation (Houghton et al., 1995). Moreover, it has been reported that thymoquinone prevents oxidative injury in hepatocytes induced by carbon tetrachloride or tert-butyl hydroperoxide in various *in vitro* (Daba and Abdel-Rahman, 1998) and *in vivo* (Mansour et al., 2001; Nagi et al., 1999) hepatotoxicity models, as well as acetic acid-induced colitis in rats (Mahgoub, 2001). It has been suggested that thymoquinone may act as an antioxidant agent and prevent the membrane lipid peroxidation in hepatocytes (Mansour et al., 2002).

Ethanolic extract of *Artemisia herba-alba* (Makhloffi A et al., 2012), *N. Sativa*, *Punica granatum* possessed the most outstanding *in vitro* antibacterial activity, with maximum inhibition zone of 18–22.4 mm. The lowest minimum inhibitory concentration value was measured in *Punica granatum* as 0.01 mg/ml against methicillin-resistant *Staphylococcus aureus*. The results showed that the ethanolic extract had better antibacterial effect than the aqueous extract and the anti-staphylococcal activity of the ethanolic extract of plants against methicillin-resistant *S. aureus*, was better than methicillin-sensitive *S. aureus* strains (Dadarkar et al., 2005). Treated Fe (III) solution with extract of *N. sativa* as well as two other active biological reductants, hydroquinone and hydroxyl ammonium chloride and found that *N. sativa* is a stronger reducing agent than hydroxyl ammonium chloride and weaker than hydroquinone (Tawab and Fatima, 2006). Treatment protocols in rats with *N. sativa* inhibited reactive oxygen species production induced by experimental autoimmune encephalomyelitis indicated by diminished levels of malondialdehyde of both brain and medulla spinalis tissues and nitric oxide in brain only. When *N. sativa* was given alone to the rats, no changes were shown in brain, medulla spinalis, and serum oxidant/antioxidant parameters. In conclusion, *N. sativa* may protect brain and medulla spinalis tissues against oxidative stress induced by the experimental autoimmune encephalomyelitis. In addition, *N. sativa* display its antioxidant and regulatory effects via inflammatory cells rather than the host tissue (brain and medulla spinalis) for the experimental autoimmune encephalomyelitis in rats (Ozugurlu et al., 2005).

2.4. Jeeraka (Jeera) (Fig. 5)

*Jeeraka*, *Cuminum cyminum* Linn. (Apiaceae) is a wild grassy plant with 15–50 cm height, widely used ingredient in Indian food. It has been used for a very long time in traditional medicine in the treatment of diarrhea, dyspepsia and gastric disorders, and as an antiseptic agent. *C. cyminum*, originates from the Greek kymo (Sayyah, 2002; Banerjee and Mukhopadhyay, 2003).

Cumin has been used as a preservative in spicy foods and other food products. It is known to inhibit the growth of some fungi in the putrefaction of foods and to control mildew disease. The plant possibly originates from the Mediterranean area, perhaps Egypt and Syria. Nowadays it grows extensively in Turkey and Iran. It seems to have been cultivated in Palestine for a very long time. Cumin bears fruit two months after seeding and is harvested when the plants begin to whiten and the seeds lose their
yellow coloring (Banerjee and Mukhopadhyay, 2003).

2.5. Vidarikanda (Fig. 6)

Vidarikanda, Pueraria tuberosa (Willd.) DC. (Leguminosae), one of the important plants used in Indian medicine, is commonly known as Vidarikand. The tuberous roots of P. tuberosa are used to relieve symptoms of dysmenorrhoea (often begin immediately following ovulation), dysfunctional uterine bleeding and menopausal syndrome. It possesses spasmolytic, anti-inflammatory, anti-implantation, anti-hyperglycaemic, oestrogenic and contraceptive properties. Studies have been conducted on the chemistry and therapeutic effect of various parts of the plant. Phyto-compounds like β-sitostreol, stigmasterol, daidzein, puerarin, puerarone and coumestan, isoflavone C-glycoside-4,6-diacetylpuerarin (root), pterocarptuberosin (roots and tubers), puetuberosanol and hydroxytuberosone have been isolated and characterized from the species (Devaiah and Venkatasubramanian, 2008).

CONCLUSION

It is concluded that Ayurveda has been practiced for thousands of years in India with great success. Uses of medicinal plant for human being is already well documented and support its therapeutic use as a multi-purpose medicinal agent. But, only a few studies have been done on dairy animals particular for dairy goat, these herbs which are of pharmacological and chemical type. But, growing human awareness and demand of chemical residues free and clean milk, there is a need to carry bio-chemical work and more detailed studies on dairy animals. Utilization of phytomedicines will not only improve the reproductive efficiency and health of our animals but also support the farmer’s income through production of more milk per animal.

REFERENCES


FDA 2004. Food and Drug Administration, USA


http://medplant.nmsu.edu/2008


Kumari R, Tiwary B K, Prasad A, Ganguly S. 2012 b Asparagus racemosus willd. root extract as herbal nutritional supplement


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