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Review on pharmacological actions of medicinal plants used in ethnoveterinary practices in Namakkal district of Tamil Nadu

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Abstract
Ethnoveterinary medicine has been very crucial for the animal healthcare of most developing countries, but it has not yet been well documented. The aim of the study is to document the ethnoveterinary practices followed in Namakkal district, Tamil Nadu, India and to review the scientific background of the ethnoveterinary recipe used for treating animals based on the existing literatures. The ethnoveterinary practices were documented from traditional ethnoveterinary practitioners through a questionnaire and its scientific background was reviewed through the existing literatures. Ethnoveterinary recipe for animal conditions like poisonous bite, reduced milk secretion, downer cow, Foot and Mouth disease, anorexia and decreased weight gain due to intestinal parasitism, dystocia, infertility, upper respiratory tract infections, ephemeral fever and habitual abortion were recorded. A total of 16 recipes were documented. By reviewing the literatures, it was found that the herbs used were having various pharmacological properties like antibacterial, antifungal, anthelmentic, immunostimulant, wound healing, anti-inflammatory, analgesic etc., which scientifically supports the use of these herbs for the treatment of various animal ailments.

Keywords: Ethnoveterinary practices; Documentation; Namakkal; Tamilnadu; Foot and Mouth disease

Introduction
India is one of the twelve mega biodiverse countries of the world having rich vegetation with great emporia of ethno botanical wealth (Pal, 2000). Application of medicinal plants as a source of drugs in treating human and animal diseases has been a traditional practice. Ethnoveterinary medicine has become well known worldwide as an elemental factor of primary health care, as it has been the blessing for marginalized and poor communities (Banumathi and Vaseeharan, 2015) [5]. Ethnoveterinary medicine often provides cheaper options compared with allopathic drugs, the products are locally available and more easily accessible and they also free of resistance problems. These reasons offer an inclined response over the field of ethnoveterinary research and development. But the knowledge of ethnoveterinary practices is declining due to improper documentation and oral passage of herbal heritage verbally. Documenting the indigenous knowledge is important for conservation and utilization of biological resources. The possible benefit of plant derived medications constitutes a rewarding area of research, particularly in countries such as India which have a rich biodiversity of natural plant resources. The characteristics and the intensity of the ethnoveterinary systems differ greatly among individuals, societies, and regions. The documentation of ethnoveterinary medicine from regions having a rich ethnographic and biodiversity would be of great significance. If the pharmacological background of the ethnoveterinary recipe is known, it will lead to further research and drug development. Hence the ethnoveterinary practices followed for important animal disease conditions in Namakkal district of Tamil Nadu, India was documented and the pharmacological properties of the plants used were reviewed through the existing literatures.

Materials and Methods
The ethnoveterinary practices were documented from the traditional ethnoveterinary practitioners through a questionnaire. Namakkal district is bounded by Salem on the north, Karur on the south, Trichy and Salem on the east and Erode on the West. The Geographical area of the district is 3363, 35 Km which lies between 11.00 and 11.360 North Latitude and 77.280 and 78.300 East Longitude. It consists of 7 taluks namely Namakkal, Rasipuram, Tiruchengodu, Paramathi Velur, KolliHills, Sendamangalam and Komarapalayam.

Ethnoveterinary practitioners in Namakkal district were interviewed and got the details regarding the ingredients used, method of preparation, administration, dosage and side effects of the herbal recipe they are using for the treatment of the animals. Existing scientific information about the ingredients used in the ethnoveterinary practices was also recorded.

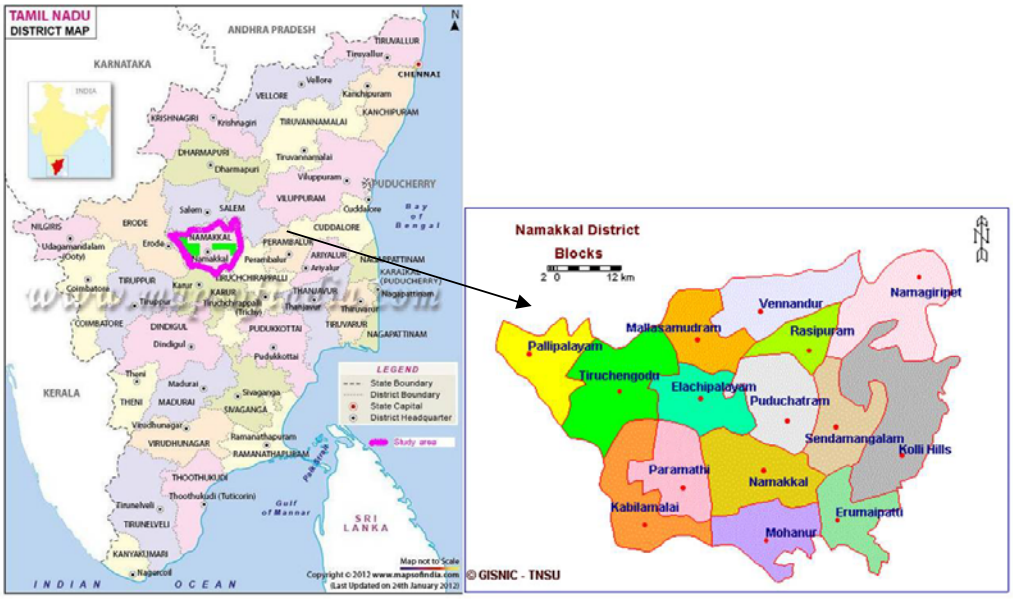

Fig.1 Location of the study area

3. Results and Discussion

A total of 40 plant species were enumerated with detailed information on parts used, method of preparation, mode of administration and ailments treated. The people in and around the area has confidence in ethnoveterinary treatment. They were not reporting any side effects on using these recipes. The plants are freshly plucked and used for the treatment purpose. The ethnoveterinary recipes recorded from the ethnoveterinary practitioners for various disease conditions are given in the Table 1.

Pharmacological properties of herbs used for various disease conditions

The pharmacological properties of the plants and plant products used in ethnoveterinary practices were reviewed and the scientific background of using the herbs for the treatment of animals for various conditions was evaluated from the existing literatures.

Poisonous bite

The anti-cobra venom activity of ethanolic extract of *A. paniculata* is comparable with anti-snake venom (Premendran *et al.*, 2011) [29]. *Andrographis paniculata* extract and anti-scorpion venom have scorpion venom neutralizing ability *in vivo* and *in vitro*, but their combination is most effective in venom neutralizing ability (Kale *et al.*, 2013) [14]. Thus the venom neutralizing property of this plant may be a reason for its clinical effect in poisonous bites.

Decreased milk secretion

Euphorbia hirta has been tested for its antibacterial, antifungal, anthelmentic, antioxidant, antidiarrhoeal, antidiabetic, antiallergic, diuretic, anti-tumor and immunomodulating activity and it was also reported that *E. hirta* is used by nursing mothers with deficient milk supply (Huang *et al*., 2012) [13]. But it was not yet tested for its galactagouge properties. Moreover pearl millet is rich in calcium which may enhance the milk secretion.

Downer cow

Recipe 1: *Clerodendrum phlomidis* was proved to have anti-inflammatory, analgesic, anti-arthritic, antimicrobial and antioxidant properties (Rambhau *et al.*, 2014) [30]. Due to above mentioned properties; the plant may slightly improve the condition of the downer cow, which has been a downer for long time due to muscle damage. But the plant was not proved to be a nerve tonic or supplement the minerals like calcium or phosphorous, whose deficiency is one of the main causes of a downer cow.

Recipe 2: *Withania somnifera* was proved to have anti-inflammatory, immunomodulatory, adaptogenic/ antistress, antimicrobial, antioxidant, anticonvulsant, taming and mild depressant effect (Uddin *et al.*, 2012) [42]. *Hibiscus rosa-sinensis* (Sukirti and Prashant, 2011) [38] and a small peptide in soybean are having antifatigue property (Niiho *et al.*, 1993) [23]. *Cucurbita pepo* was proved to have antiinflammatory, antioxidant, antimicrobial, antiulcer and hepatoprotective properties. The plant is also effective in urinary tract infections (Gutierrez, 2016) [12]. *Phyllanthus emblica* possess antiinflammatory, antioxidant, antimicrobial, antipyretic, analgesic and neuroprotective properties (Gaire and Subedi, 2014) [9].

Cissus quandrangularis was proved to have bone fracture healing, anti-osteoporotic, parasympathomimetic, anti-inflammatroy, analgesic, appetite stimulant and anabolic properties (Mishra *et al.*, 2010) [22]. *Amorphophallus paeoniifolius* is having anti-inflammatory, antioxidant, antimicrobial, antihelmintic, analgesic, gastroprotective protective and immunomodulatory, properties (Anuradha and Neeraj, 2014) [2]. The above said properties of the plant especially the neuroprotective and parasympathomimetic properties may be responsible for improvement in the condition of the downer animal.

Foot and Mouth disease

Recipe 1: *Aegle marmelos* has been tested for its

immunomodulatory, antibacterial, anti-inflammatory, analgesic, antipyretic, antifungal and antioxidant properties (Lambole *et al*., 2010) [19]. *Mukia maderaspatana* has been proved for its immunomodulatory, antibacterial, anti-inflammatory and antioxidant properties (Petrus, 2011) [26]. No experimental or clinical trial was conducted to test the pharmacological actions of *Atalantia racemosa.* The above said properties of the plant may control the secondary bacterial infection and helps to heal the lesions produced by the virus. The immunomodulatory property of the plant may help the animal to fight against the virus causing the disease.

Recipe 2: *Aegle marmelos* is having immunomodulatory, antibacterial, anti-inflammatory, analgesic, antipyretic, antifungal and antioxidant properties (Lambole *et al.,* 2010) [19]. *Azadirachta indica* has been tested and proved for its antimicrobial, antiviral, antifungal, anthelmintic, anti-inflammatory, immunomodulatory and spermicidal properties (Atawodi and Atawodi, 2009) [3]. *Curcuma longa* possess antibacterial, anti-inflammatory, antioxidant and immunomodulating potential (Rohini *et al.,* 2011) [32]. The above said properties of the plant may control the secondary bacterial infection, heal the viral lesion, reduces pain and improves the immune system of the animal to fight against the virus. The plants used against FMD were not proved to have any antiviral property.

Foot and Mouth disease

Recipe 1: *Aegle marmelos* has been tested for its immunomodulatory, antibacterial, anti-inflammatory, analgesic, antipyretic, antifungal and antioxidant properties (Lambole *et al*., 2010) [19]. *Mukia maderaspatana* has been proved for its immunomodulatory, antibacterial, anti-inflammatory and antioxidant properties (Petrus, 2011) [26]. No experimental or clinical trial was conducted to test the pharmacological actions of *Atalantia racemosa.* The above said properties of the plant may control the secondary bacterial infection and helps to heal the lesions produced by the virus. The immunomodulatory property of the plant may help the animal to fight against the virus causing the disease.

Table 1: Ethnoveterinary recipe followed by traditional healers of Namakkal district for various animal disease conditions.

S. No	Botanical name	Family	Local name	Parts used	Quantity	Animal treated	Condition treated	Method of preparation
1.	*Andrographis paniculata*	Acanthaceae	Nilavembu	Leaves	One handful	Cattle, sheep and Goat	Poisonous bite	The leaves should be ground and made into a paste and administered orally once a day for 7-15 days. Complete recovery from the effects of poisonous bite will be noticed within 15- 20 days.
2.	*Euphorbia hirta*	Euphobiaceae	Amman pacharici	Leaves	Three to four handfuls	Cattle	Reduced milk secretion	The leaves should be ground with pearl millet and fed to animals once a day for 5-7 days. Milk secretion starts increasing after one week.
3.	*Pennisetum glaucum*	Poaceae	Pearl millet (Thinai)	Seed	One handful			
4.	*Clerodendrum phlomidis*	Verbenaceae	Thaludhalai	Leaves	Three handfuls	Cattle	Downer cow	The leaves should be ground and made into a paste and administered orally twice a day up to recovery. Improvement noticed within 7-10 days.
5.	*Withania somnifera*	Solanaceae	Amukkara	Root	100 gm	Cattle	Downer cow	The ingredients should be ground and administered orally twice a day for one week. Improvement in the condition will be noticed after one week.
6.	Glycine max	Fabaceae	Soya	Seed	20 gm			
7.	*Hibiscus rosa-sinensis*	Malvaceae	Sembaruthi	Leaves	20 gm			
8.	*Cucurbita pepo*	Cucurbitaceae	Venpoosani	Fruit	20 gm			
9.	*Amorphophallus paeoniifolius*	Araceae	Karunaikilangu	Leaves	20 gm			
10.	Zingiber officinale	Zingiberaceae	Inji	Tuber	10 gm			
11.	*Phyllanthus emblica*	Phyllanthaceae	Nellikkai	leaves	20 gm			
12.	*Cissus quandrangularis*	Vitaceae	Pirandai	Leaves and stem	10 gm			
13.	*Aegle marmelos*	Rutaceae	Vilva maram	Leaves	One handful	Cattle	Foot and Mouth disease	The herbal leaves should be fried in the neem oil and administered orally once a day for one day. Animal will recover within 1-2 days.
14.	*Mukia maderaspatana*	Curcurbitaceae	Musumusukkai	Leaves	One handful			
15.	*Atalantia racemosa*	Rutaceae	kaattu kolinji	Leaves	One handful			
16.	*Azadirachta indica*	Meliaceae	Veppamaram	Leaves	100 gm	Cattle	Foot and Mouth	The ingredients should be boiled in a mud pot in 2

							disease	litres of water until it becomes ½ litre. Then it should be strained and administered orally once in 3 hours until the symptoms subside.
17.	*Aegle marmelos*	Rutaceae	Vilva maram	Leaves	50 gm			
18.	*Curcuma longa*	Zingeberaceae	Manjal	Tuber	10 gm			
19.	*Corallocarpus epigaeus*	Cucurbitaceae	Akasha garudan kilangu	Tuber	1/2 Kg	Cattle	Anorexia and decreased weight gain due to intestinal parasitism	The mentioned ingredients should be pounded along with small quantity of salt and made into a lemon size balls. Administer 3 lemon size prepared medicine balls thrice a day for three days orally. After three days of administration the feed intake will increase and the animal starts gaining weight.
20.	*Allium sativum*	Amaryllidaceae	Malaipoondu	Tuber	one number			
21.	*Curcuma longa*	Zingeberaceae	Manjal	Tuber	25 gm			
22.	*Cuscuta reflexia*	Cuscutaceae	Verillakothaan	Whole plant	-	Cattle	Dystocia	The whole plant should be ground and made into a paste and can be administered orally to the cattle that are unable to deliver the calf (normal presentation). The animal will deliver the calf within one hour.
23.	*Ficus religiosa*	Moraceae	Arasa ilai	Leaves	100gms	Cattle	Infertility	The leaves of the plants should be dried in shade and ground into powder. The powder was divided into five equal parts to administer for five days. The powder was mixed with 750 ml of water and administered orally. This should be repeated for three consecutive months. <u>For prevention</u> Calf – 500 to 750 ml once a day Cattle – 1 lit once a day
24.	*Mangifera indica*	Anacardiaceae	Maamaram	Leaves	100gms			
25.	*Azadirachta indica*	Meliaceae	Veeppamarm	Leaves	100gms			
26.	*Syzygium cumini*	Myrtaceae	Naval maram	Leaves	100gms			
27.	*Solanum trilobatum*	Solanaceae	Thuthuvalai	Leaves	One handful	Sheep and Goat	Upper respiratory tract infection	The mentioned ingredients should be boiled in 3 lit of water, until it becomes 1 lit. Administer the 250 ml of this decoction twice a day for one week. Improvement in the condition was noticed within 2-3 days of administration of medicine.
28.	*Solanum xanthocarpam*	Solanaceae	Kandankathiri	Leaves	One handful			
29.	*Adathoda vasica*	Acanthaceae	Adathoda	Leaves	one handful			
30.	*Cuminum cyminum*	Apiaceae	Seeragam	Seeds	10 gm			
31.	*Piper nigrum*	Piperaceae	MIilagu	Seeds	5 gm			
32.	*Pergularia daemia*	Asclepiadoideae	Veliparuthi	Leaves	one handful	Cattle	Ephemeral fever	The mentioned ingredients should be ground and administered orally twice a day for two days. Recovery noticed within 2-3 days.
33.	*Moringa oleifera*	Moringaceae	Murunga maram	Bark	one handful			
34.	*Piper nigrum*	Piperaceae	Milagu	Seeds	1 teaspoon			
35.	Dried ginger	Zingeberaceae	Inji	Seeds	1 teaspoon			
36.	*Solanum virginianum*	Solanaceae	Kandagkathiri	Fruit	5-7 numbers	cattle	Habitual abortion	The first two ingredients should be ground and administered orally followed by drenching of 200 ml of neem oil. It should be given during the first day of estrus and then inseminated after 24 hours
37.	*Curcuma longa*	Zingeberaceae	Manjal	Tuber	one handful			

								of administration of medicine.
38.	*Acalypha indica*	Euphorbiaceae	Kuppaimeni	Leaves	1-2 handful	Cattle, sheep and Goat	Hepatitis	Each ingredient should be ground separately and one amla size taken from each and given orally twice a day for 5 days.
39.	*Achyranthes aspera*	Amaranthaceae	Nayuruvi	Leaves	1-2 handful			
40.	*Pergularia daemia*	Asclepiadoideae	Veliparuthi	Leaves	1-2 handful			
41.	*Cabada fruticosa*	Capparaceae	Viluthi ilai	Leaves	1 handful	Cattle	To prevent summer season related diseases	The leaves were boiled in 1 liter coconut oil and strained. The oil is applied over the neck region and four legs once a day daily.
42.	*Andrograhis echioides*	Acanthaceae	Kopuram thangi	Leaves	1 handful			
43.	*Mollugo nudicaulis*	Molluginaceae	Parpadagam	Leaves	1 handful			
44.	*Coleus aromaticus*	Lamiaceae	Karpuravalli	Leaves	10 leaves	Cattle	Mastitis	The leaves were boiled in 150 ml coconut oil, cooled and applied over the affected udder.
45.	*Melia azedarach*	Meliaceae	Malai vembu	Leaves	1 handful	Cattle	Bloody vaginal discharge	Grind the leaves and administer orally once a day for one day.





Interviewing ethnoveterinary practitioners

Recipe 2: Aegle marmelos is having immunomodulatory, antibacterial, anti-inflammatory, analgesic, antipyretic, antifungal and antioxidant properties (Lambole *et al.*, 2010) [19]. *Azadirachta indica* has been tested and proved for its antimicrobial, antiviral, antifungal, anthelmintic, anti-inflammatory, immunomodulatory and spermicidal properties (Atawodi and Atawodi, 2009) [3]. *Curcuma longa* possess antibacterial, anti-inflammatory, antioxidant and immunomodulating potential (Rohini *et al.*, 2011) [32]. The above said properties of the plant may control the secondary bacterial infection, heal the viral lesion, reduces pain and improves the immune system of the animal to fight against the virus. The plants used against FMD were not proved to have any antiviral property.

Anorexia and decreased weight gain due to intestinal parasitism

Ethanolic extract of *Corallocarpus epigaeus* root and rhizome has potent anthelmentic action than the aqueous extract and their activity was comparable with the standard drug piperazine citrate. It causes paralysis followed by death of the worms at all tested dose levels. The plant also studied for its antibacterial and antidiabetic properties (Kiruba *et al.*, 2011) [18]. Hydroalcoholic extracts of Curcuma longa at different concentrations (10, 20 and 50 mg/ml) proved to have anthelmentic action. *Curcuma longa* also proved to have antibacterial, antioxidant and immunomodulating potential (Rohini *et al., 2011*) [32]. Garlic has anthelmintic antifungal, antibacterial, probiotic and antioxidant action (Prajatka *et al.*, 2015) [28]. The anthelmintic property of the recipe may be effective in intestinal parasitism. The antioxidant and immunomodulating property of the plant may boost the immune system of the animal and the probiotic property may enhance the feed intake.

Infertility

Ficus religiosa has been tested and proved for its antimicrobial, anthelmintic, anti-inflammatory and antiulcer property (Amandeep *et al.*, 2011) [1]. *Mangifera indica* has

antimicrobial, antiviral, antifungal, anthelmintic, anti-inflammatory and immunomodulatory properties (Parvez *et al.,* 2016) [25]. *Azadirachta indica* was proved for its antimicrobial, antiviral, antifungal, anthelmintic, anti-inflammatory, immunomodulatory, antiimplantation and spermicidal properties (Atawodi *and Atowadi,* 2009) [3]. *Syzygium cumini* has been tested and proved for its antimicrobial, antifungal, anti-inflammatory and antioxidant properties. The plant also has anti-fertility property in male rats which arrest spermatogenesis (Shalini *et al.,* 2013) [35]. The antimicrobial, antifungal and antiviral properties of the plants may remove the infections of the uterus. The anthelmentic property of the plant removes the helmintic infections and improves the nutrient absorption which may help to increase the conception rate in animals. But the anti-implantation, spermicidal and anti-infertility properties of this recipe remain controversial in this treatment.

Upper respiratory tract infection

Solanum trilobatum was proved to have antimicrobial, anti-inflammatory, immunomodulating and antioxidant properties (Balakrishnan *et al.,* 2015) [4]. *Solanum xanthocarpam* possess antimicrobial, bronchodilatory and antiallergic property (in ova albumin induced asthma model in mice) (Singh and Singh, 2010) [37]. *Adathoda vasica* has bronchodilatory, antiallergic, antitussive, antitubercular, antimicrobial activity (Gangwar and Ghosh, 2014). Cumin has caffeine and other essential oils that act as a decongestant. Presence of caffeine (the stimulating agent), the abundantly aromatic essential oils (the disinfectants) make cumin an ideal anti congestive agent for those suffering from respiratory disorders such as asthma and bronchitis (Kaur and Sharma, 2012) [16]. Kim *et al.* (2009) [17] reported that the oral administration of piperine in different proportion to mice suppressed and reduced the infiltration of eosinophil, hyper responsiveness and inflammation due to the suppression of the production of histamine, interleukin- 5, immunoglobulin E and interleukin-4. The above said properties of the plants in the recipe may be responsible for its clinical cure.

Ephemeral fever

Pergularia daemia has been demonstrated to possess multiple pharmacological activities such as anti-inflammatory, hepatoprotective, antioxidant, antibacterial, antifungal and analgesic, (Karthiswaran, 2010) [15]. *Moringa oleifera* bark was proved to have antimicrobial and antiinflammatory property (Goyal *et al.,* 2007). The above mentioned properties may be responsible to control the clinical signs of the disease but it does not have antiviral or immunomodulating property to fight against the virus causing the disease.

Habitual abortion

Solanum virginianum was proved to have antimicrobial activity (Dahake and Kohar, 2015). *Curcuma longa* has antibacterial, anti-inflammatory, antioxidant and immunomodulating potential (Rohini *et al., 2011)* [32]. Neem oil possesses anthelmintic property (Atawodi and Atawodi, 2009) [3]. The antibacterial and immunomodulating properties of the recipe may be responsible to remove the infections of uterus which may be one of the reasons to prevent the habitual abortion.

Hepatitis

Suresh Kumar *et al., (2013)* [40] reported that the methanol extract of *Acalypha indica* at the dose rate of 300mg/Kg exhibited hepatoprotective activity in rats and presence of flavonoids may be are responsible for the same. Investigation by Manjunatha *et al.,* (2012) [20] revealed that the ethanolic extract of *Achyranthus aspera* (100mg/kg p.o) have hepatoprotective effect in CCl_4 induced hepatotoxicity in rats. The data obtained was found comparable with silymarin (100mg/kg p.o).

Ethanol extract and its ethanol fraction from aerial parts of *Pergularia daemia* exhibited significant hepatoprotective effect against CCl4 induced hepatotoxicity in rats (Suresh Kumar *et al.,* 2008) [39].

The hepatoprotective properties of the plants in the recipe may be responsible for its clinical cure.

For cooling effect / To prevent the heat related diseases

Mollugo nudicaulis plant was proved to have anti-inflammatory, analgesic and antipyretic properties (Sahul *et al.,* 2011) [34]. *Andrographis echioides* plant was proved to have antibacterial, anti-inflammatory, analgesic, antipyretic, anthelmintic, antiulcer, hepatoprotective and diuretic properties (Mathivanan and Suseem, 2015) [21]. *Cabada fruticosa* was proved to have antimicrobial, anti-inflammatory, antipyretic and antidiabetic properties (Saha *et al.,* 2015) [33]. The above said properties of the plants in the recipe may be responsible for its clinical effect.

Mastitis

Coleus aromaticus was proved to have antibacterial, antifungal, anti-inflammatory and immunomodulation properties which might be responsible for its clinical cure (Rashmi *et al.,* 2011) [31].

Bloody vaginal diarrhoea

Melia azedarach was proved to have antibacterial, antifungal, insecticidal, anti-inflammatory, analgesic, anthelmintic, immunomodulatory and antioxidant properties (Deepika Sharma and Yash Paul, 2013 [7].

Conclusion

The existing scientific information supports the use of these herbs for treating the above mentioned conditions. For some ethnoveterinary recipe for treating diseases like FMD, the herbal plants have not proven for antiviral property, but have antibacterial and immunomodulating property. For such plants further research has to be made to explore its pharmacological potentials.

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