

HOSTED BY



Contents lists available at ScienceDirect

Journal of Traditional and Complementary Medicine

journal homepage: <http://www.elsevier.com/locate/jtcme>

Short communication

Ethnoveterinary medicine of the Shervaroy Hills of Eastern Ghats, India as alternative medicine for animals

Swaminathan Usha^a, Chandrasekaran Rajasekaran^b, Ramamoorthy Siva^{b,*}^a School of Social Sciences and Languages, VIT University, Vellore 632014, Tamil Nadu, India^b School of Biosciences and Technology, VIT University, Vellore 632014, Tamil Nadu, India

ARTICLE INFO

Article history:

Received 24 April 2014

Received in revised form

22 June 2014

Accepted 28 July 2014

Available online 30 January 2015

Keywords:

Eastern Ghats
ethnomedicine
ethnoveterinary practice
Shervaroy Hills
traditional knowledge

ABSTRACT

The Eastern Ghats of India is well known for its wealth of natural vegetation and Shervaroy is a major hill range of the Eastern Ghats of Tamil Nadu. Ethnomedicinal studies in the Eastern Ghats of Tamil Nadu or the Shervaroy Hills have been carried out by various researchers. However, there is not much information available on ethnoveterinary medicine in the Eastern Ghats of India. The aim of this study was to examine the potential use of folk plants as alternative medicine for cattle to cure various diseases in the Shervaroy Hills of the Eastern Ghats. Based on interactions with traditional medicine practitioners, it has been observed that a total of 21 medicinal plants belonging to 16 families are used to cure various diseases such as mastitis, enteritis, arthritis, stomatitis, salivation from the mouth, wounding, and conjunctivitis in animals. It has been observed that the traditional knowledge of ethnoveterinary medicine is now confined only among the surviving older people and a few practitioners in the tribal communities of the Shervaroy Hills. Unfortunately, no serious attempts have been made to document and preserve this immense treasure of traditional knowledge.

Copyright © 2014, Center for Food and Biomolecules, National Taiwan University. Production and hosting by Elsevier Taiwan LLC. All rights reserved.

1. Introduction

Ethnomedicine is a traditional medical practice that concerns the cultural interpretation of health, disease, and illness. The practice of ethnomedicine is a complex multidisciplinary system constituting the use of plants in a spiritual way in the natural environment and has been the source of healing for people for millennia.¹ Many people use plants as alternative remedies in addition to visiting western health care practitioners. The extent of plant use differs with location—that is, it is area specific.

India is rich in plant diversity and possesses almost 7% of the world's flowering plants. The Eastern Ghats of India are endowed with an extensively rich variety of biological species, geological formations, and different ethnic tribes. Ethnomedicinal studies in the Eastern Ghats of Tamil Nadu have been carried out previously by a number of researchers.^{2,3} However, there is not much information available on ethnoveterinary medicine in the Eastern Ghats of India. Ethnoveterinary medicine is a scientific term for

traditional animal health care that encompasses the knowledge, skills, methods, practices, and beliefs about animal health care found among community members.⁴ It comprises community-based local or indigenous knowledge on methods of preparation and administration of medicinal plants for the caring, healing, and managing of livestock. It also includes social practices and the ways in which livestock are incorporated into farming systems.⁵

Since time immemorial, plants have been used for curing various diseases in man and animals. Even today, in rural regions of India, where modern medicine is inaccessible, medicine based on folk plants is often used to treat humans and livestock. This knowledge has been developed through trial and error and also deliberate experimentation.

Keeping the aforesaid facts in view, the present study was undertaken to record the potential use of folk plants as prominent alternative medicine for cattle to cure various diseases in the Shervaroy Hills of the Eastern Ghats.

2. Materials and methods

2.1. Study area

The Shervaroy Hill range is situated 26 km north-east of Salem and forms a major point of the Eastern Ghats. The hill range lies

* Corresponding author. School of Bio Sciences and Technology, VIT University, Vellore 632014, Tamil Nadu, India.

E-mail address: rsiva77in@rediffmail.com (R. Siva).

Peer review under responsibility of The Center for Food and Biomolecules, National Taiwan University.

between 11°48 and 78°11 E longitude^{6–8} with an altitude of 1515 m above mean sea level. The Shervaroy Hills are blessed by nature with its diversified and rich flora. The native tribal people are called “Malayali” meaning “mountain man”. The Malayali tribe is one of the 36 scheduled tribes of Tamil Nadu and they basically depend on agriculture and forest resources for their survival. The tribes belonging to the minor communities are among the least advanced socially and economically. However, they harbor a lot of knowledge on medicinal plants.

2.2. Investigating methods

Many extensive and intensive field trips were undertaken between 2011 and 2012 in different seasons for the collection of plants and associated ethnomedicinal information from the Shervaroy Hills.

The information gathered in this paper is based on a plant exploration study conducted at the Shervaroy Hills. A total of 1980 individuals of the Malayali tribe community were approached, and we found that 1519 of them possessed traditional medicinal knowledge. However, seven respondents were practicing as Vaidyars and a questionnaire was administered to them. In addition, we collected data through direct observation of passersby in villages.

Mr Perumal (Fig. 1) of the Malayali tribe, who was one of the folk practitioners, showed and explained the medicinal uses of plants during the treatment of cattle. Each plant was taxonomically



Fig. 1. A local vaithiyar practicing Traditional Medicine in Shervaroy hills. We can see the medicinal Plant *Corallocarpus epigaeus*, locally known as “Garudan Kalangu” in both of his hands.

identified and representative samples were collected as voucher specimens at the School of Biosciences and Technology, VIT University, Vellore, India.

3. Results

Based on the interaction with the traditional medicine practitioners (Fig. 2), it has been observed that plants in the Shervaroy Hills are used to cure various diseases such as mastitis, enteritis, arthritis, stomatitis, salivation from the mouth, wounding, and conjunctivitis in animals. Table 1 shows the details of the folk medicine, their uses, and modes of preparation. One of the cases that we came across during the field visit was the treatment of a cow's wound of a secretary organ, which generally occurs during sexual intercourse.

In addition, during our field trips we observed the following unique features of the Malayali tribe. (1) Local medicine practitioners and other tribes have knowledge on medicinal plants, their uses, and also practice the same worship of nature before they start the treatment (Fig. 3). (2) They know how to cure various diseases of cattle using traditional practices. An example is shown in Fig. 4. (3) After giving medicine, they chant hymns (locally known as “Paadam padithal”) and use a towel on the animal with circular movement to improve the effectiveness of the remedy (Fig. 5). (4) Members of the tribe are staunch vegetarians and also avoid food that is considered gastric (locally known as “vayu”). (5) We observed that in the indigenous system of folk medicine practitioners do not use normal salt—instead they use rock salt. We believe that rock salt contains more potassium and less sodium, which could be useful for treatment.

4. Discussion

The plant species recorded in the present study are arranged in alphabetical order (Tables 1 and 2). The botanical name of each plant is followed by the family, voucher specimen number, local name, parts used, and mode of preparation. A total of 21 medicinal plants belonging to 16 families were recorded to be used by the Malayalis as ethnoveterinary medicine. Literature on phytoconstituents and pharmacological studies of plants recorded in the present survey was extensively searched and reviewed in Table 2. These ethnomedicinal plants have been reported by various researchers to treat various ailments (Table 2). We believe that



Fig. 2. Before using the traditional medicine they worship.

Table 1
The details of medicinal plants used by the Malayali tribe in the Shervaroy Hills.

Disease	Plant name	Family	Local name	Voucher specimen	Parts used	Mode of preparation/application
Mastitis	<i>Aloe vera</i> (蘆薈 lú huì)	Liliaceae	Choothu kthalai	VIT-SH121	Leaves and roots	Make into a powder and administer for 10 days
Enteritis	<i>Aristolochia indica</i> L. (馬兜鈴 mǎ dòu líng)	Aristolochiaceae	Eswara mooleekai	VIT-SH142		
	<i>Alpinia officinarum</i> Hance (高良薑 gāo liáng jiāng)	Zingiberaceae	Seetharathai	VIT-SH156	Leaves	Make into a powder, mix with a small amount of "Induppu", dissolve
	<i>Curcuma zedoaria</i> (Christmas.) Roscoe (莪朮 é zhú)	Zingiberaceae	Poolang kizhangu	VIT-SH133	Leaves	in warm/boiled water (half a liter), and administer for 3 days
	<i>Corallocarpus epigaeus</i> Benth Ex. Hook F.	Cucurbitaceae	Kolla koova kizhangu	VIT-SH188	Leaves	
	<i>Glycyrrhiza glabra</i> L. (甘草 gān cǎo)	Fabaceae	Athe mathuram	VIT-SH130	Leaves	
	<i>Kedrostis rostrate</i> (Rottler) Cogn.	Cucurbitaceae	Appak koova kizhangu	VIT-SH126	Roots	
Salivation from the mouth	<i>Piper longum</i> L. (萹苳 bì bó)	Piperaceae	Thepitele	VIT-SH138	Seeds	
	<i>Withania somnifera</i> (L.) Dunal	Solanaceae	Aamukeeran kizhangu	VIT-SH145	Leaves	
	<i>Abrus precatorius</i> L. (雞母珠 jī mǔ zhū)	Fabaceae	Koondumani	VIT-SH114	Leaves	Make into a ball and administer for 3 days
	<i>Allium sativum</i> L. (大蒜 dà suàn)	Alliaceae	Poondu			
	<i>Piper nigrum</i> (黑胡椒 hēi hú jiāo)	Piperaceae	Thepitele	VIT-SH119	Seeds	
Arthritis	<i>Adathoda vasica</i> L. (白珊瑚 bái shān hú)	Acanthaceae	Adathodai eelai	VIT-SH163	Leaves	Make into a powder, dissolve in boiled water, and administer
	<i>Alpinia officinarum</i> Hance (高良薑 gāo liáng jiāng)	Zingiberaceae	seetharathai	VIT-SH156	Leaves	for 3 days
	<i>Glycyrrhiza glabra</i> L. (甘草 gān cǎo)	Fabaceae	Athe mathuram	VIT-SH130	Leaves	
	<i>Withania somnifera</i> (L.) Dunal	Solanaceae	Aamukeeran kizhangu	VIT-SH145	Leaves and roots	
Abdominal colic	<i>Azadirachta indica</i> L. Adelb (印度苦楝 yìn dù kǔ liàn)	Meliaceae	Veam poo	VIT-SH178	Leaves	Administer with cow's milk for 3 days
	<i>Cuminum cyminum</i> L. (孜然 zī rán)	Apiaceae	Nalla seerakam	VIT-SH173	Leaves	
Stomatitis	<i>Cassia auriculata</i> L. (耳葉番瀉 ěr yè fān xiè)	Caesalpinaceae	Aavaram poo	VIT-SH103	Flowers	Make into a powder and administer
	<i>Commiphora caudate</i> (Wight and Arn.) Engl.	Burseraceae	Pachai keeluvai pattai	VIT-SH188	Leaves	twice a day for 7 days
	<i>Embelia ribes</i> Burn. f. (酸藤果 suān téng guǒ)	Myrisnaceae	Vaiveelangam	VIT-SH203	Leaves	
Conjunctivitis	<i>Cordia monoica</i> (Roxb.)	Ehretiaceae	Nare vaeli maram	VIT-SH193	Bark	Make into a powder, dissolve in boiled water, and administer
						three times per day for 2–3 days
Wounding	<i>Corallocarpus epigaeus</i> Benth Ex. Hook F.	Karudan kizhangu	Karudan kizhangu	VIT-SH188	Leaves	Make into a powder, mix with coconut
	<i>Piper betle</i> L. (萹藤 biāo téng)	Piperaceae	Naaga mali	VIT-SH195	Seeds	oil, and apply to
	<i>Polygala chinensis</i> L. (華南遠志 huà nán yuǎn zhì)	Polygalaceae	Seeriya nangai	VIT-SH111	Leaves	wounded area



Fig. 3. A local vaithiyar healing the cow.

these phyto-constituents could be responsible for curing various diseases in cattle. However, additional experimental studies and detailed investigation are required in order to confirm these observations. The traditional uses of medicinal plants in health care practices provide clues to new areas of research for novel biological compounds and discovery of new drugs.⁵⁵ We believe this study could form a basis for further studies to test and validate the pharmacological bioactivity of these plants, and to characterize and isolate the active constituents.

Conclusion

Besides indigenous medicine, ethnic communities use forest products not only for household consumption but also for commercial purposes to generate community income; the conservation of biological resources is integrated with regional and national economies.^{56–58} Numerous plant species are found to have an important role in the everyday life of ethnic and local people.^{59,60} However, it is a matter of concern that the indigenous knowledge of extraction, processing, and practice of using medicinal plants has



Fig. 4. After giving the medicine he is chanting some hymns for curing to be effective.



Fig. 5. Researcher interviewing the Malayali tribes at Shervaroy hills.

Table 2
Phyto-constituents and pharmacological studies of plants recorded in the present survey.

Plant name	Phyto-constituents	Extract	Therapeutic efficacy	References
<i>Abrus precatorius</i> L. (雞母珠 jī mǔ zhū)	Alkaloids; phenolics; flavonoids	Ethanol, chloroform, petroleum ether	Antidiarrheal; antifertility	9
<i>Adathoda vasica</i> L. (白珊瑚 bái shān hú)	Alkaloids, mimosine, mucilage and root contains tannins, vasicine, vasicinone, 7-hydroxyvasicine, vasicinolone, 3-deoxyvasicine, vasicol, vasicoline, adhatodine, anisotone, betaine, steroids, carbohydrates, alkanes, triterpines (aamirine), flavonoids (apigenin, astragalin, kaempferol, quercetin, vitexin benzoate, and hydroxycinnamate derivatives), flavons, flavonols, flavanones, flavanonols, flavan-3-ols (catechins), and anthocyanidins, saponins	Methanol, chloroform, diethyl ether, ethanol, acetone	Antimicrobial; anthelmintic; antioxidant; larvicidal; antiinflammatory; antiproliferative; antidiarrheal	10–12
<i>Allium sativum</i> L. (大蒜 dà suàn)	Alkaloids; flavonoids; anthraquinones	Bulb of <i>A. cepa</i> and seeds of <i>A. sativum</i> are squashed and filtered Bulb Methanol	Filtrate is dropped into the nostrils to cure bronchitis; reduced appetite; stomach ache; arthritis; internal parasites; rheumatism	13,14
<i>Aloe vera</i> (蘆薈 lú huì)	Polysaccharides; glycoproteins (lectins); anthraquinones	Leaf pulp with common salt; leaf pulp with curd; leaf pulp Succulent leaf paste and 5 g of <i>Areca catechu</i> nut in water; mucilage is mixed with salt and water Pulp mixed with sour milk and water	Prevents miscarriage; burn injuries; applied on swollen portion of the udder of cows or buffaloes against mastitis Orally to cattle to cure corneal opacity; orally to cattle to cure debility and general weakness Applied to cure burns of the animal; immunomodulatory effect; antioxidant effects; wound healing; anticancer effects	15–17
<i>Alpinia officinarum</i> Hance (高良薑 gāo liáng jiāng)		Hydroalcoholic extract Diethyl ether	Suppresses inflammatory cytokines; antioxidant; antibacterial; treats stomach ache; analgesic; antiemetic	18
<i>Aristolochia indica</i> L. (馬兜鈴 mǎ dòu líng)	Phenanthrene derivative, aristolochic acid, quinine, aristolindiquinone, lactones (e.g., aristololide), alkaloids (e.g., aristolochine), terpenes (e.g., mono and sesquiterpenes including linalool, ishwarone, aristolochene, and terpinolene)	Paste from roots; leaves boiled with neem oil Roots and stems Whole plant—ethanol extract	Given orally to cattle to cure bloating; treatment of injured horns in cattle; ethnoveterinary aches and pains; rheumatism; antiarthritic effect; antibacterial effect; antineoplastic; madness; snakebite; antiestrogenic activity; abortifacient activity; antitumor; antifertility; immunomodulatory; antiinflammatory activity; antihyperuricemia	19,20
<i>Azadirachta indica</i> L. Adalb (印度苦楝 yìn dù kǔ liàn)	Flowerin, flowerone, <i>O</i> -methylazadirone, diepoxyazadirol, nimbaflavone, 3'-prenylaringenin, salannolide, 1 α -methoxy-1,2-dihydroepoxyazadiradione, 1 β ,2 β -diepoxyazadiradione, 7-acetylneotrichilenone, desacetyl-7-benzoylazadiradione, 7-desacetyl-7-benzoylepoxyazadiradione, 7-desacetyl-7-benzoyl-gedunin, 11-hydroxyazadirachtin-B, 1-tigloyl-3-acetylazadirachtinin, 1,2-diacetyl-7-tigloyl-12-hydroxyvilasinin, 23-desmethyllimocin-B, 1 α ,7 α -diacetoxyapotirucall-14-ene-3 α ,21,22,24,25-pentanol, odoratone, 2 β ,3 β ,4 β -trihydroxypregnan-16-one	Fruit paste; leaf paste with equal quantity of turmeric powder; infusion of leaves is used for body wash Decoction from fresh leaves and salt Ethanol extract Methanol extract	Given to cattle for internal heat; orally for constipation; to repel external parasites like flies, fleas, bugs, and lice; drops into eyes to remove insects from the eyes; antihelminthic; antidiabetic; chemopreventive; inhibits murine Ehrlich carcinoma and B16 melanoma; inhibits breast cancer cell lines; hepatoprotective activity	21–26
<i>Corallocarpus epigaeus</i> Benth Ex. Hook F	Sesquiterpene lactone, corallocarpenoyl ester, aliphatic C32 keto diol	Tuber decoction	Chronic mucous enteritis; anthelmintic; hepatoprotection; oral administration for snake bite as antivenom	27
<i>Cuminum cyminum</i> L. (孜然 zī rán)	Cuminal, cuminic, alcohol, γ -terpinene, safranal, <i>p</i> -cymene, β -pinene, terpenes, terpenols, terpenals, terpenones, terpene esters, aromatic compounds, embelin, embelinol, embeliaribyl ester, embeliol, embelic acid, volatile acid, fixed oil, resin, tannins, christembine, caffeic acid, vanillic acid, chlorogenic acid, cinnamic acid, <i>o</i> -cumarinic acid, potassium embelate, 2,5-dihydroxy, 3-undecyl-1,4-benzoquinone, embelin, quercitol, fatty ingredients, vilangin	Methanol extract Acetone extract Ethanol:water extract (20:10) Ethanol:water extract (20:10)	Antispasmodic; carminative; appetite stimulant agent; dyspepsia; diarrhea; jaundice; hypolipidemic effect; inhibits arachidonate-induced platelet aggregation; chemopreventive against induced fore-stomach and uterine/cervical tumors; treats stomach ache; diuretic; astringent; bactericidal; fungicidal; antiulcer activity; anticonvulsant effects; anthelmintic; antifertility; analgesic; antiinflammatory; antirheumatic; anti-fever; ascites; bronchitis; jaundice; mental disorders; antidiabetic; antidyslipidemic; antioxidant; cardioprotective; treats middle cerebral artery occlusion; wound healing property	28–44

<i>Curcuma zedoaria</i> (Christmas.) Roscoe (莪朮 è zhú)	Curzerenone, curcumenol, beta-elemene, isocurcumenol	Rhizome and root	In Ayurveda and Unani as antihelmintic, antipyretic, alexiteric, expectorant, and carminative; treats stomach ache; applied to bruises and sprains; strengthening; taken by women after child birth	45
<i>Glycyrrhiza glabra</i> L. (甘草 gān cǎo)	Alizarin, mollugin, lucidin, primveroside, rofecoxib, celecoxib	Methanol	Antineoplastic Cancer chemoprevention	46
<i>Kedrostis rostrata</i> (Rottler) Cogn	—	Root paste	Orally administered to increase fodder consumption	47
<i>Piper longum</i> L. (華荜 bì bó)	—	Root pieces in water	Infusion for stomach ache and cough	
		Fruits (12–15) in 300 mL of water	Oral administration for indigestion	48
		Fruit powder with onion juice	Applied to the affected hoof during foot and mouth disease	
<i>Piper nigrum</i> (黑胡椒 hēi hú jiāo)	Piperlactum A & D oxoarporphine (cepharadione A), piperine, sylvamide, 2,4 tetradecadienoic acid isobutyl amide, tetracosanoic acid, p-hydrocinnamate ester, 2-butenedioic acid, cinnamic acid, tetracosanoic acid, benzoic acid, phenolic amides, pellito-[3',4'(methylenedioxy) cinnamoyl, piperidine, piperine, piperolactam D, cepharadione A, and 2,4-tetradecadienoic acid isobutyl amide, monoterpene, limonene	Mixture of seeds with equal quantity of <i>hengu</i> (<i>Ferula asafoetida</i>), ginger, turmeric and common salt	Fed with rice gruel for indigestion	19
		Teaspoonful of <i>P. nigrum</i> ; teaspoonful of <i>P. nigrum</i> folded with five leaves of <i>Piper betel</i>	To cattle orally to cure anthrax and constipation; to cattle orally to cure bloating	49–52
		Petroleum ether extract	Antioxidant efficiency	
		Ethanol, methanol, chloroform	Larvicidal activity	
		Hexene	Antiinflammatory	
		Chloroform	Antiproliferative activity	
		Acetone	Antidiarrheal effect	
		Root is mixed with grass; leaf paste with equal quantity of <i>Medicago sativa</i>	Antimicrobial activity	
<i>Withania somnifera</i> (L.) Dunal	Hydrocortisone, withanolides	Decoction of root powder along with <i>Hyoscamus niger</i> seed powder, <i>Bambusa arundinacea</i> leaf powder, <i>Gur</i> and <i>Zingiber officinale</i> powder, boiled in milk	Given to cattle to cure bronchitis; orally to cure debility and general weakness in horses	19
			To cure retard placenta	53
			Antioxidant activity, anticancer activity, antiinflammatory activity	54
			Cardioprotective activity	
			Immunoregulator and chemoprotective	
			Antifungal activity	
			Antiinflammatory, antitumor, cytotoxic, immunomodulating activities	

diminished to a great extent among the new generation of ethnic people. It has been observed that the traditional knowledge of ethnoveterinary medicine is now confined only among the surviving older people and a few practitioners in the tribal communities of the Sheraroy Hills. Unfortunately, no serious attempts have been made to document and preserve this immense treasure of traditional knowledge. Lack of a focused conservation strategy could also cause a depletion of this valuable resource.⁶¹ The vanishing forest has had a cascading effect on the tribal population, which dwindles rapidly, and along with this the knowledge they hold. These tribal people are now mostly working as casual laborers in coffee estates and construction sites. It is time that steps are taken towards documenting the treasures of these indigenous knowledge systems. Otherwise, we are bound to lose vital information on the utilization of the natural resources that surround us.

Conflicts of interest

There is no conflict of interest in this article.

Acknowledgment

The authors sincerely thank VIT Management for their moral support and encouragement.

References

- Williams LA. Ethnomedicine. *West Indian Med J*. 2006;55:215–216.
- Udayan PS, George S, Tushar KV, Balachandran I. Medicinal plants used by the Malayali Tribes of Servarayan Hills, Yercaud, Salem District, Tamil Nadu, India. *Zoo's Print J*. 2006;21:2223–2224.
- Parthipan M, Aravindhavan V, Rajendran A. Medico-botanical study of Yercaud hills in the eastern Ghats of Tamil Nadu, India. *Anc Sci Life*. 2011;30:104–109.
- McCorkle CM. An introduction to ethnoveterinary research and development. *J Ethnobiol*. 1986;6:129–149.
- Misra KK, Anil Kumar K. Ethno-veterinary practices among the Konda Reddi of East Godavari district of Andhra Pradesh. *Stud Tribes Tribals*. 2004;2:37–44.
- Dorairaj K. *Working Plan for Salem Forest Division*. Salem: Government of Tamil Nadu; 1963.
- Matthew KM. *Materials for the Flora of Tamil Nadu Carnatic*. Tiruchirapalli: Rapinat Herbarium; 1981.
- Sivaraj N, Krishnamurthy KV. Flowering phenology in the vegetation of shevaroyis, South India. *Vegetatio*. 1989;79:85–88.
- Janakiraman N, Jasmin Jansi J, Johnson M, Jeeva Babu A. Phytochemical investigation of *Abrus precatorius* L. using TLC, GCMS and FTIR. *Asian Pac J Trop Biomed*. 2012;1–9.
- Savittree M, Isara P, Nittaya SL, Worapan S. Radical scavenging activity and total phenolic content of medicinal plants used in primary health care. *J Pharm Sci*. 2004;9:32–35.
- Al-Shaibani IRM, Phulan MS, Arijjoand A, Qureshi TA. Ovicidal and larvicidal properties of *Adhatoda vasica* (L.) extracts against gastrointestinal nematodes of sheep *in vitro*. *Pak Vet J*. 2008;28:79–83.
- Josephin Sheeba B, Selva Mohan T. Antimicrobial activity of *Adhatoda vasica* against clinical pathogens. *Asian J Plant Sci Res*. 2012;2:83–88.
- Mikail HG. Phytochemical screening, elemental analysis and acute toxicity of aqueous extract of *Allium sativum* L. bulbs in experimental rabbits. *J Med Plants Res*. 2010;4:322–326.
- Lalit T, Pande PC. Ethnoveterinary medicines in Indian perspective: reference to Uttarakhand, Himalaya. *IJTK*. 2010;9:611–617.
- Chow JTN, Williamson DA, Yatesb KM, Goux WJ. Chemical characterization of the immunomodulating polysaccharide of *Aloe vera* L. *Carbohydr Res*. 2005;340:1131–1142.
- Reynolds T, Dweck AC. *Aloe vera* leaf gel: a review update. *J Ethnopharmacol*. 1999;68:3–37.
- Chandan BK, Saxena AK, Shukla S, et al. Hepatoprotective potential of *Aloe barbadensis* Mill. against carbon tetrachloride induced hepatotoxicity. *J Ethnopharmacol*. 2007;111:560–566.
- Tao L, Wang ZT, Zhu EY, Lu YH, Wei DZ. HPLC analysis of bioactive flavonoids from the rhizome of *Alpinia officinarum*. *S Afr J Bot*. 2006;72:163–166.
- Ganesan S, Venkateshan G, Banumathy N. Medicinal plants used by ethnic group Thottianaickans of Semmalai hills (reserved forest), Tiruchirappalli district, Tamil Nadu. *IJTK*. 2006;5:245–252.
- Ramachandran S, Nandha Kumar S, Dasaratha Dhana Raju M. Effect of *Aristolochia indica* on diuretics induced gout. *Pharmacol Online*. 2008;1:304–308.
- Siddiqui BS, Afshan F, Gulzar T, Sultana R, Naqvi SN, Tariq RM. Tetracyclic triterpenoids from the leaves of *Azadirachta indica* and their insecticidal activities. *Chem Pharma Bull (Tokyo)*. 2003;51:415–417.
- Garg HS, Bhakuni DS. Salannolide, a meliacin from *Azadirachta indica*. *Phytochem*. 1984;23:2383–2385.
- Kraus W, Baumann S, Bokel M, et al. Control of insect feeding and development by constituents of *Melia azadara*. In: *Proceedings of the 3rd International Neem Conference, Nairobi*. 1986:21.
- Kumar CS, Srinivas M, Yakkundi S. Limonoids from the seeds *Azadirachta indica*. *Phytochem*. 1996;43:451–455.
- Balaseshthil S, Arivazhagan S, Ramachandran CR, Ramachandran V, Nagini S. Chemopreventive potential of neem on 7,12-dimethylbenz[a]anthracene-induced hamster buccal pouch carcinogenesis. *J Ethnopharmacol*. 1999;67:189–195.
- Du YH, Jia RY, Yin ZQ, et al. Acaricidal activity of extracts of neem (*Azadirachta indica*) oil against the larvae of the rabbit mite *Sarcoptes scabiei* var. *cuniculi* *in vitro*. *Vet Parasitol*. 2008;157:144–148.
- Nadkarni KM, Nadkarni AK. *Indian Materia Medica*. London: Sangam Books; 1982.
- Yan JH, Tang KW, Zhong M, Deng NH. Determination of chemical components of volatile oil from *Cuminum cyminum* L. by gas chromatography-mass spectrometry [Article in Chinese] *Se Pu*. 2002;20:569–572.
- Morton JF. *Herbs and Spices*. New York, NY: Golden Press; 1976.
- Dhandapani S, Ramasamy SV, Rajagopal S, Namasivayam N. Hypolipidemic effect of *Cuminum cyminum* L. on alloxan-induced diabetic rats. *Pharmacol Res*. 2002;46:251–255.
- Farag RS, Daw ZY, Hewedi FM, Ei-Baroty GSA. Antimicrobial activity of some Egyptian spice essential oils. *J Food Prot*. 1989;52:665–667.
- Singh G, Upadhyay RK. Fungitoxic activity of cuminaldehyde, main constituent of *Cuminum cyminum* oil. *Fitoterapia*. 1991;62:86.
- Afifi NA, Ramadan A, El-Kashoury EA, El-Banna HA. Some pharmacological activities of essential oils of certain umbelliferous fruits. *Vet Med J Giza*. 1994;42:85–92.
- Iacobellis SN, Cantore LP, Capasso F, Sentore F. Antibacterial activity of *Cuminum cyminum* L. and *Carum carvi* L. essential oils. *J Agri Food Chem*. 2005;53:57–61.
- Jirovetz L, Bushbauer G, Stoyanova AS, Georgiev EV, Damianova ST. Composition, quality control and antimicrobial activity of the essential oil of the cumin seeds from Bulgaria that had been stored for up to 36 years. *Int J Food Sci Tech*. 2005;40:305–310.
- Singh G, Marimuthu P, Lampasona MP. *Cuminum cyminum* L. chemical constituents, antioxidant and antifungal studies on its volatile oil and acetone extract. *Indian Perfum*. 2006;50:31–39.
- Gachkar L, Davood Y, Mohammad BR, Masood T, Shakiba AA, Iraj R. Chemical and biological characteristics of *Cuminum cyminum* and *Rosmarinus officinalis* and essential oils. *Food Chem*. 2007;102:898–904.
- Nayak SU, Joshi VK, Maurya S, Singh UP. Analysis of phenolic acids in different market samples of vidanga (False black pepper). *AYU*. 2009;30:181–187.
- Rao TVP, Venkateswarlu VV. Some natural and synthetic methyl-bisbenzoquinones. *Bull Natl Inst Sci India*. 1965;28:14.
- Gupta S, Sanyal SN, Kanwar U. Antispermatic effect of embelin, a plant enzoquinone, on male albino rats *in vivo* and *in vitro*. *Contraception*. 1989;39:307–320.
- Zutshi U, Johri RK, Atal CK. Possible interaction of potassium embelate: a putative analgesic agent, with opiate receptors. *Indian J Exp Biol*. 1989;27:656–657.
- Krishnaswamy M, Purushothaman KK. Antifertility properties of *Embelia ribes*. *Indian J Exp Biol*. 1980;18:1359–1360.
- Kapoor VK, Chawla AS, Kumar M, Kumar P. Anti-inflammatory agent in Indian laboratories. *Indian Drugs*. 1983;30:481–488.
- Kirithkar KR, Basu BD. *Indian Medicinal Plants*. Dehradun: International Book Distributors; 1987:1511.
- Sabu M, Skornickova J, Rehse T. Other economically important *Curcuma* species. In: Nirmal Babu K, Ravindran PN, Sivaraman K, eds. *Turmeric: The Genus Curcuma*. Boca Ratan, Florida, USA: CRC Press; 2007:451–467.
- Kaura P, Kaura S, Kumar S, Singh P. *Rubia cordifolia* L. and *Glycyrrhiza glabra* L. medicinal plants as potential source of COX-2 inhibitors. *Am J Biomed Sci*. 2009;2:108–120.
- Patil PS, Patel MM, Bhavsar CJ. Comparative antidiabetic activity of some herbal plants extracts. *Pharm Sci Monit*. 2010;1:12–19.
- Bharati KA, Sharma BL. Studies on ethnoveterinary uses of plant resources of Sikkim. *Indian For*. 2009;135:691–696.
- Kapoor IP, Singh B, Singh G, De Heluani CS, De Lampasona MP, Catalan CAN. Chemistry and *in vitro* antioxidant activity of volatile oil and oleoresins of black pepper (*Piper nigrum*). *J Agri Food Chem*. 2009;57:5358–5364.
- Vijayakumar RS, Surya D, Nalini N. Antioxidant efficiency of black pepper and piperine in rats with high fat diet induced oxidative stress. *Redox Rep*. 2004;9:105–110.
- Park IK, Lee SG, Shin SC, Park JD, Ahn YJ. Larvicidal activity of isobutyl amides identified in *Piper nigrum* fruits against three mosquito species. *J Agri Food Chem*. 2002;50:1866–1870.
- Ramya BS, Ganesh P. Phytochemical analysis and comparative effect of *Cinnamomum zeylanicum*, *Piper nigrum* and *Pimpinella anisum* with selected antibiotics and its antibacterial activity against the Enterobacteriaceae family. *IJPBA*. 2012;3:914–917.
- Nigam G, Sharma NK. Ethnoveterinary plants of Jhansi district, Uttar Pradesh. *IJTK*. 2010;9:664–667.

54. Prakash J, Gupta SK, Dinda AK. *Withania somnifera* root extract prevents DMBA-induced squamous cell carcinoma of skin in Swiss albino mice. *Nutr Cancer*. 2002;42:91–97.
55. Sharma M, Kumar A. Pharmacognostical characterization of some selected medicinal plants of semi-arid regions. *J Pharmacogn Phytochem*. 2012;1: 216–228.
56. Maikhuri RK, Nautiyal S, Rao KS, Saxena KG. Medicinal plants cultivation and biosphere reserve management: a case study from the Nanda Devi Biosphere Reserve, West Himalaya. *Curr Sci*. 1998;74:157–163.
57. Nautiyal S, Maikhuri RK, Rao KS, Saxena KG. Medicinal plant resources in Nanda Devi Biosphere Reserve in the Central Himalaya. *J Herbs Spices Med Plants*. 2001;8:47–64.
58. Raghupathy L. Conservation and sustainable use of medicinal plants: current issues. In: Samant SS, Dhar U, Palni LMS, eds. *Himalayan Medicinal Plants: Potential and Prospects*. Nainital: Gyanodaya Prakashan; 2001: 415–426.
59. Siva R. *Assessment of Genetic Variation in Some Dye Yielding Plants Using Isozyme Data*. 2003. PhD thesis submitted to Bharathidasan University.
60. Siva R. Status of natural dyes and dye yielding plants in India. *Curr Sci*. 2007;92: 916–925.
61. Siva R, Rajasekaran C, Mudgal G. Induction of somatic embryogenesis and organogenesis in *Oldenlandia umbellata* L., a dye yielding medicinal plant. *Plant Cell Tiss Org Cult*. 2009;98:205–211.