Review of literature

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"Ethno-veterinary" is the scientific term used for traditional animal health care, encompasses the knowledge, skills, methods, practical and beliefs animal health care found among the members of a community. They have the capacity to identify and diagnose the disease (McCorkle, 1986).

The southern districts of Tamil Nadu, has a predominantly livestock based economy and social welfare. Economic dependence on livestock, lack of effective veterinary infrastructure, etc have forced the farmers even today to apply their indigenous knowledge to look after and maintain their livestock (Ganesan *et al.*, 2008). Traditional healers will offer less for the treatment and control of their animal diseases.

Ethnoveterinary medicine offers great potential because they are cheaper than allopathic drugs and the products are locally available and more easily accessible (Zschocke *et al*., 2000; Masika *et al*., 2000; Tabuti *et al*., 2003; Yineger *et al*., 2007; Masika and Afolayan, 2003; Kone and Atindehou, 2008). However ethnoveterinary knowledge had no place in mainstream of veterinary medicine. In recent years, it has emerged as a challenging field and increasing attention has been paid to ethnoveterinary knowledge and local veterinary practices (Tafara and Taona, 2004).

International status on Ethnoveterinary medicine

In North West Province of South Africa, 45 plant species representing 24 families were used to treat various animal ailments like placenta retention, diarrhoea, gallsickness, fractures, eye inflammation, general ailments, fertility enhancement, general gastrointestinal problems, heartwater, internal parasites,

coughing, red water and tick burden reduction.The plants for treatment are used either as single plant (64%) or in combination (36%). Plant materials were prepared as infusion, decoction, ground fresh material, sap expressed from fresh material, charred and dried. The most common dosage form was a liquid for oral dosing. Other dosage forms included drops, licks, ointments, lotions and powders. Liquid remedies for oral dosing were always administered using a bottle. Medicinal plant material was preferably stored in a dried form in a cool place out of direct sunlight and wind (Van der Merwe *et al.,* 2001). A field documentation studies carried out in Zimbabwe by Tafara and Taona, (2004) documented traditional remedies for septic wounds, helminthes, eye problems, delayed parturition and fractures.

Documentation of ethnoveterinary medicine in Bale Mountains National Park, Ethiopia, revealed that a total of 74 medicinal plant species were distributed among 64 genera and 37 families were recorded to cure blackleg, darissa and hepatitis. The plants used were herbs shrubs, roots and leaves. It was suggested that usually, fresh materials were preferred for medicine preparations. The most frequently used route of drug administration was oral followed by dermal (Yineger *et al.,* 2007).

Study was conducted on ethnoveterinary survey among the Kavirajes of randomly selected villages of Bagerhat district, Bangladesh to gather information on the medicinal plants used for treatment of cattle ailments. A total of 51 plants were recorded to be used for the treatment of animal diseases (Mohammed Rahmatullah *et al.,* 2010). An ethnoveterinary documentary study was conducted in selected hilly regions of Pakistan revealed that 35 plant species representing 25 families were used in the area to treat the ailing animals. Most frequently used plants were from the families Apiaceae, Brassicaceae, Compositae, Pinaceae, Poaceae and Verbenaceae families. Other commonly used ingredients of

ethnoveterinary prescriptions were used engine oil, butter, mineral salt, lasi, kafor, yogurt, milk and buffalo's urine. The most frequent ethnoveterinary practices were recorded for the treatment of gastrointestinal helminthiasis, ticks and lice infestation, myiasis and pneumonia (Zia-Ud-Din Sindhu *et al.*, 2010). Ethnoveterinary practices in 15 villages of Botswana were identified and documented. Nineteen plant species representing 15 families were used to treat and control poultry diseases and parasites (Moreki, 2013).

National status on Ethnoveterinary medicine

It is reported that, in India around 936 medicinal plants are used in veterinary practices and animal health care (Jain, 1999 and Srivastava *et al.*, 2000). Around 23 household plants and plant products are used for the treatment of animal diseases by local people and tribes of Uttarkhand (Lalit Tiwari and Pande, 2010). 46 ethnoveterinary plants were used to treat animal diseases in Jhansi district, Uttar Pradesh (Gaurav Nigam and Narendra Kumar Sharma, 2010). People of Marihan subdivision of Mirzapur district which is dominated by several tribal groups have own ethnoveterinary treatment systems for their livestock diseases like foot and mouth disease, anthrax, pneumonia, ectoparasites, helminthiasis, constipation, diarrhea, mastitis, etc., (Prasant Kumar Singh *et al.*, 2011)

Ramachandra Naik *et al*, (2012) documented 39 ethnoveterinary plants used by Lambani community in Chitradurga district, Karnataka, India. Ethnoveterinary explorations conducted in forest areas of Ahmednagar provide the information about the uses of 37 plants species distributed in 24 families were traditionally used of which the major families are Amaranthaceae, Liliaceae, and Solanaceae. Majority of drug preparation are from leaves, underground parts, stem, fruit, seed, whole plant and latex (Mulay *et al.*, 2012). 14 plants belonging to 11 families are reported to be used for curing various animal ailments in Bankura district of West Bengal (Tamal Mondal and Sayani 2012). Earlier folk veterinary medicine study in

sitapur district of Uttarpradesh, India, reported that, a total of 57 medicinal formulas were recorded for the treatment of different livestock diseases (Rajesh Kumar and Bharathi, 2012). Study in Birbhum district of West Bengal and Dumka district of Jharkhand by Swarnendu mondal and Chowdhury (2012) enumerated a total of 28 ethnoveterinary medicinal plants which were used in preparation of 10 different formulations for curing 10 different diseases. These ethnomedicines are new as they have not been reported in any standard literature.

Some studies on ethnoveterinary practices from different regions of India have been reported but there are no such studies available from Tamil Nadu except few studies in the last decade (Geetha *et al.*, 2006 and Kiruba *et al.*, 2006). Ganesan *et al.*, (2008) enumerated that, in Southern districts of Tamil Nadu ethnoveterinary medicine is used for the treatment of 44 veterinary health hazards. A total of 113 plant species belonging to100 genera and 46 families are used in the treatment of anthrax, bone fracture, bloat, bronchitis, blackquarter, corneal opacity, dog bite, enteritis, foot and mouth diseases etc. Works were carried out to identify, collect and document the ethnoveterinary medicinal plants used by Malayali tribals of salem district and their utilization for primary health care of animals in treating different ailments (Selvaraj *et al.*, 2011). In Perambalur district of Tamil Nadu, 21 plants were reported as veterinary medicine (Devendrakumar and Anbazhagan, 2012).

Therapeutic efficacy of many indigenous plants for several disorders has been described by several researchers and their findings are reviewed and tabulated here.

Ailment	**Name of the plant**	**Reference**
Fever and cough	*Andrographis paniculata*, *Ocimum sanctum* and *Azadirachta indica*	Mohammed Rahmatullah *et al.*, 2010

	Adhatoda vasica, Andrographis paniculata, Cardiospermum halicacabum, Cassia fistula, Cissus quadrangularis, Citrullus colocynthis, Givotia rotteleriformis, Gymnema sylvestre, Lannea coromandelica, Mimosa pudica, Pedalium murex, Pergularia daemia, Pongamia pinnata and *Terminalia chebula*	Selvaraju *et al.*, 2011
	Vigna radiate	Muzafar Sheikh *et al.*, 2013
Foot and Mouth disease	*Acacia nilotica, Mangifera indica,Coriandrum sativum, Alium sativum* and *Annona squamosa*	Prasant kumar Singh *et al.*, 2011
	Curcuma longa	Mohammed Rahmatullah *et al.*, 2010
Helminthiasis	*Scindapsus aureus*	Mohammed Rahmatullah *et al.*, 2010
	Azardirachta indica and *Nicotiana tobacum*	Prasant kumar Singh *et al.*, 2011
Respiratory tract disorder	*Andrographis paniculata*, *Ocimum sanctum* and *Vitex negundo*	Mohammed Rahmatullah *et al.*, 2010
Pain	*Justicia gendarussa, Vitex negundo* and *Sesbania sesban*	Mohammed Rahmatullah *et al.*, 2010

Parasitic infections	*Curcuma longa*	Prasant kumar Singh *et al.*, 2011
Skin infections	*Syzgium aromaticum*	Lalit Tiwari and Pande, 2010
	Nicotiana tabacum	Mohammed Rahmatullah *et al.*, 2010
	Curcuma longa and *Brassica campestris*	Prasant kumar Singh *et al.*, 2011
	Aristolochia bracteolate and *Cassia tora*	Selvaraju *et al.*, 2011
	Alianthes excels	Devendra kumar and Anbazhagan, 2012
Mastitis	*Curcuma longa* and *Musa sapientum*	Prasant kumar Singh *et al.*, 2011
Rheumatism	*Thevetia peruvian*, *Ricinus communis* and *Euphorbia ingens*	Mohammed Rahmatullah *et al.*, 2010
Gastrointestinal disorder	*Aegle marmelos*	Tamal Mondal and Sayani Biswas, 2012
	Aloe vera	Mohammed Rahmatullah *et al.*, 2010
Edema	*Jatropha gossypifolia*	Mohammed Rahmatullah *et al.*, 2010
Lactation	*Vigna mungo*, *Centella asiatica*, *Lagenaria vulgaris* and *Asparagus racemosus*	Mohammed Rahmatullah *et al.*, 2010

	Cassia tora	Mulay *et al.*, 2012
Rabies	*Leucas aspera*	Mohammed Rahmatullah *et al.*, 2010
Eye problems	*Solanum surattense* and *Coffea benghalensis*	Mohammed Rahmatullah *et al.*, 2010
	Leucas cephalotus and *Ficus benghalensis*	Prasant kumar Singh *et al.*, 2011
Fracture and sprains	*Cissus quadrangularis*	Saravanan *et al.*, 2002
	Euphorbia hirta	Mohammed Rahmatullah *et al.*, 2010
	Madhuca longifolia, Curcuma longa, Trachyspermum ammi, Brassica campestris, Moringa oleifera and *Calotropis gigantia*	Prasant kumar Singh *et al.*, 2011
	Strychnos nux-vomica	Selvaraju *et al.*, 2011
Snake bite	*Andrographis paniculata, Mimosa pudica* and *Boerhavia diffusa*	Thirumalai *et al.*, 2010
	Mimosa pudica and *Piper nigrum*	Mohammed Rahmatullah *et al.*, 2010
Insect bite	*Allium cepa*	Sharma and Chinmay Joshi, 2004
	Corchorus capsularis	Mohammed Rahmatullah

		et al., 2010
	Aristolochia indica	Selvaraju *et al.*, 2011
	Cassia fistula	Tamal Mondal and Sayani Biswas, 2012
Wound healing	*Betula alnoides*	Gaur *et al.*, 1992
	Helianthus annus	Tugnaiyat *et al.*, 2000
	Hypericum hookerianum	Mukherjee *et al.*, 2001
	Curcuma amada	Jaiswal *et al.*, 2004
	Euphobia hirta, Leucas aspera, Acalypha indica, Azadirachta indica and *Tridax procumbens*	Selvaraju *et al.*, 2011
	Terminalia alata, Aegle marmelos, Nyctanthes arbor-tristis, Opuntia elatior and *Eclipta prostrata*	Prasant kumar Singh *et al.*, 2011
Anthrax	*Launea procumbens, Cuscuta reflexa, Curcuma longa, Piper nigrum, Bambusa arundinaceae, Citrullus colocynthis, Piper nigrum* and *Zingiber officinale*	Prasant kumar Singh *et al.*, 2011
Burns	*Sesamum indicum*	Mohammed Rahmatullah *et al.*, 2010
	Musa sapientum	Mulay *et al.*, 2012
	Aloe barbadensis	Muzafar Sheikh *et al.*, 2013

Bronchitis	*Corallocarpus epigaeus* and *Musa paradisiacal*	Ganesan *et al.*, 2008
Maggots	*Allium sativum*	Sharma and Chinmay Joshi, 2004
	Carissa carandas and *Datura metel*	Gaurav and Narendra kumar, 2010

Andrographis paniculata

Taxonomic position

Division : Magnoliophyta

Class : Magnoliopsida

Order : Lamiales

Family : Acanthaceae

Genus : *Andrographis*

Species : *paniculata*

Tamil name : Nilavembu, Siriyanangai

English name : Chirata, King of bitters

Description

It is an erect, branched annual herb, 0.3m to 0.9m in height with quadrangular branches; leaves simple, lanceolate, acute at both ends, glabrous, main nerves 4-6 pairs; flowers small with axillary and terminal racemes or panicles, calyx- lobes glandular, pubescent, anthers bearded at the base; fruits linear capsules, acute at both ends; seeds numerous, yellowish brown and sub quadrant.

Distribution

Native of South India and Sri Lanka. The plants growing in northern regions of India, Java, Malaysia, Indonesia, West Indies and America are probably introduced (Azhar Ali Farooqi and Sree Ramu, 2001).

Parts used

Whole plant.

Pharmacognostical studies

The physicochemical analysis of *A.paniculata* plant powder revealed characteristic odour and taste. Macroscopically it showed dark green coloured leaves, quadrangular, short and fibrous stem. Anatomy of the stem showed

collenchyma strands at angles and small crystals of calcium oxalate present in pith and cortex, trichomes 1-3 celled with glandular hairs. The powder treated with different solvents showed characteristic difference (Manoj Kumar Pandey, 2011).

Phytochemical studies on *A.paniculata*

Phytochemical analysis of leaf and stem of *A.paniculata* revealed the presence of flavonoids, alkaloids, glycosides, steroids, phenols, tannins and saponins (Radha *et al.*, 2011).

The phytochemical constituents identified in different parts of the plant are listed below.

Plant part	**Phytochemicals**	**Reference**
Leaves	Andrographolide, b- esosteroles acids and myricelin	Gorter, 1911; Handa and Sharma, 1990; Siripong *et al.*, 1992; Renu Parasher *et al.*, 2011; Anil kumar *et al.*, 2012 and Ali *et al.*, 2013
Root	Apigenin-7, 4-di-O-methyl ether, andrographolide, flavones and 5-hydroxy -8,2,3-tetramethoxy flavones,	Sharma *et al.*, 1992; Tang and Eisenbrand, 1992
	Monohydroxy trimethyl flavones, andrographin, dihydroxy-di-methoxy flavones, panicelin and d-sisterol	Ali *et al.*, 2013
Aerial part	Andrographolide, 14-Deoxy-11,12-didehydroandrographolide, 14-Deoxyandrographolide, 3,14-Dideoxyandrographolide, 14-Deoxy-11-oxoandrographolide, 14-Deoxy-12-	Poonam Kulyal *et al.*, 2010

	hydroxyandrographolide, Neoandrographolide, Andrographiside and 14-Deoxyandrographiside	
Whole plant	Deoxy-11-oxandrographolide, Didehydroandrographolide, neoandrographolide, α-β-unsaturated lactone, homo andrographolide, andrographosterol, andrographane, andrographone, 5,7, tetramethoxy flavanone and 5-hydroxy-7-trimethoxy flavones	Sudhanshu saxena *et al.*, 2000; Rekha and John de Britto, 2010 and Ali *et al.*, 2013

Pharmacological studies of *A. paniculata*

The plant is reported to possess many pharmacological activities and the results are as follows,

Pharmacological activity	Reference
Hepatoprotective	Handa *et al.*, 1990; Kapil *et al.*, 1993; Matsuda *et al.*, 1994; Sudhanshu Saxena *et al.*, 2000; Sabu *et al.*, 2000; Trivedi and Rawal, 2001; Trivedi *et al.*, 2007; Mishra *et al.*, 2009 and Archana *et al.*, 2010
Antipyretic	Deng *et al.*, 1982, Madav *et al.*, 1995; Zhang and Tan, 2000; Katta vijayakumar *et al.*, 2007 and Mishra *et al.*, 2009
Antimalarial	Mishra *et al.*, 1992; Rahman *et al.*, 1999

	and Mishra *et al*., 2009
Antihypertensive	Mishra *et al*., 2009
Antithrombotic	Mishra *et al*., 2009
Antidote	Samy *et al.*, 2008 and Mishra *et al*., 2009
Antiinflammatory	Madav *et al.*, 1995; Agarwal, 1997; Wang *et al*., 1997; Amroyan *et al*., 1999; Zhang and Tan, 2000; Nadkarni, 2000; Trivedi *et al*., 2001; Batkhu *et al*., 2002; Mukherjee, 2002; Kokate *et al*.,2002; Shen *et al*., 2002, Sheeja and Kuttan, 2006 and Katta vijayakumar *et al*., 2007
Antidiarrhoea	Gupta *et al*., 1990; Agarwal, 1997; Nadkarni, 2000; Mukherjee, 2002 and Kokate *et al*.,2002
Antimicrobial	Chopra *et al.*, 1982, Okeke *et al.*, 2001; Soma roy *et al*., 2010; Divya *et al*., 2011; Hosamani *et al.*, 2011 and Radha *et al*., 2011
Antibacterial	Matsuda *et al*., 1994; Singhal *et al*., 2003; Poonam Kulyal *et al*., 2010; Wiart *et al*., 2005; Zaiden *et al*., 2005; Mishra *et al*., 2009; Anjana Sharma *et al*., 2009 and Sule *et al*., 2010
Antifungal	Divya *et al*., 2011

Antiviral	Caceres *et al*., 1991; Thamlikitkul, 1991; Zhang and Tan, 2000; Melchior, 2000; Singhal *et al*., 2003; Coon *et al*., 2004; Wiart *et al*., 2005 and Katta vijayakumar *et al*., 2007
Antioxidant	Wang *et al*., 1997; Zhang and Tan, 2000; Trivedi and Rawal, 2001; Batkhu *et al*., 2002; Sheeja and Kuttan, 2006; Katta vijayakumar *et al*., 2007 and Shirisha and Mastan., 2013
Antidiabetic	Zhang and Tan, 2000; Reyes, 2006 and Syahrin *et al*., 2006
Anticancer	Borhanuddin *et al*., 1994; Singh *et al*., 2001; Rajagopal *et al*., 2003; Kumar *et al*., 2004; Zhou *et al*., 2006; Sheeja and Kuttan, 2007
Antihyperglycemic	Zhang and Tan, 2000 and Katta vijayakumar *et al*., 2007
Analgesic	Matsuda *et al*., 1994; Saraswat *et al*., 1995; Choudhary and Podder, 1984 and Handa and Sharma, 1990
Antifertility	Akbarsha *et al*., 1990 and Matsuda *et al*., 1994
AntiHIV	Otake *et al*., 1995 and Calabrese *et al*., 2000
Immunostimulator	Puri *et al*., 1993; Agarwal, 1997;

	Nadkarni, 2000; Mukherjee, 2002; Kokate *et al.*, 2002; Kumar *et al*., 2004; Iruretagoyena *et al.*, 2005 and Katta vijayakumar *et al*., 2007
Cardioprotective	Zhao and Fang, 1991; Zhang and Tan, 1996 and Yoopan *et al.*, 2007
Filaricidal	Trivedi and Rawal, 2001

Medicinal uses on human

A. paniculata is recommended in charaka samhita (175 BC) for the treatment of Jaundice. The plant is mixed with other plants in poly herbal preparation to treat jaundice (Sharma, 1983).

In Traditional Asian medicine, it is used as an immune system booster and has significant activity in curing common cold, flu and upper respiratory infections (Melchior, 2000). Andrographolide forms the major constituent of the ayurvedic drug switradilepa, which is effective in treating vitiligo, a dermatological disease (Pullaiah, 2002). Leaf paste of *A. paniculata* is used to treat poison bites, snake bite and diabetes (Coon and Ernst, 2004; Ramar perumal samy *et al.*, 2008). It is also used as an ingredient of several poly herbal preparations used as hepatoprotectants in India, one of which has been reported as efficacious in chronic hepatitis B virus infection (Anil Kumar *et al.*, 2012). Leaves of *A.paniculta* and *M.longifolia* fruits are made into paste and administered in an empty stomach to kill intestinal worms (Swarnendu Mondal and Rahaman, 2012). The whole plant is used as a blood purifier (Daryush Talei *et al*., 2014).

Medicinal uses on animals

Andrographis paniculata has been used in the treatment of some skin infections in India. It is considered beneficial to the skin and is used both internally

and externally (Jain, 1991 and Tapsell *et al*., 2006). The juice of fresh leaves of *A.paniculata* is a domestic remedy in the treatment of colic pain, loss of appetite, constipation and diarrhoea (Saxena *et al*., 1998).

Paste of *Corallocarpus epigaeus* root, leaves of *Andrographis paniculta* and *Aristolochia bracteolate* mixed with neem oil is given orally and applied externally to cattle for three days to cure scabies (Ganesan *et al*., 2008).

Leaf juice mixed with cow milk is administered orally to cure *Tinea curis* (Kingston *et al*., 2009). Leaf paste is used as an antidote for snake bite in cattle (Thirumalai *et al*., 2010). Young plants are made into paste and administered in empty stomach to kill abdominal worms in cattle (Swarnendu Mondal and Rahaman, 2012). Root mixed with pepper is pounded and given for insect bite (Devendrakumar and Anbazhagan, 2012).

Lawsonia inermis

Taxonomic position

Division : Magnoliophyta

Class : Magnoliopsida

Order : Myrtales

Family : Lythraceae

Genus : *Lawsonia*

Species : *inermis*

Tamil name : Maruthondri

English name : Henna

Description

Glabrous much branched deciduous shrub reaching a height of up to 6 meters with 4 lateral branches often ending in spines; leaves simple, opposite, entire, lanceolate, petiole very short or absent; flowers white or rose coloured, fragrant, in large terminal pyramidal panicled cymes, stamens 8, in 4 pairs inserted on the calyx , seeds numerous, smooth and pyramidal.

Distribution

It is native of India, North Africa, Asia and Australia (Wyk and Wink, 2004). In India, it is mostly grown in the states of Rajasthan, Gujarat, Madhya Pradesh and Punjab (Khandelwal *et al.*, 2002).

Parts used

Leaves, Roots, flowers and seeds.

Pharmacognostical studies

The physico-chemical characters of leaves revealed, loss on drying (4.5%), total ash (14.60 %), acid insoluble ash (4.5%), water soluble ash (3.0%), extractive value of alcohol 3.8% and aqueous extractive value was 5.0% (Agarwal *et al.*, 2014).

Phytochemical studies on *L.inermis*

Phytochemical studies on leaves of *L.inermis* showed the presence of carbohydrates, cardio glycosides, saponins, oils, fats, tannins, flavonoids and amino acids (Thenmozhi and Rajeshwari Sivaraj, 2010). The other phytochemicals reported in the plant is listed below,

Plant part	Phytochemicals	Reference
Leaves	Lawsone, mannitol, tannic acid, mucilage, gallic acid, napthaquinone, tannin, flavonoid, terpenoid, steroid, cardiac glycoside, 2, hydroxyl 1-4, napthaquinone, β-sitosterol, stigmasterol, lawsoniasides, lawliosodes, trihydroxynaphthalene, 1,4-di-β-D-glucopyranoside and 2,3,4,6 tetrahydroxyacetoxy-2- β-D-glucopyranoside, henna tannic acid, Apigenin-7-glucoside, apigenin-4-glycoside, lutelin-7-glycoside, luteolin, luteolin-7-O-glucoside and acacetin-7-O-glucoside, glucose, aminoacids, carotenoids, tocopherols, ascorbate and phenols	Simon *et al.*, 2010; Upadhyay *et al.*, 2010 Jiny Varghese *et al.*, 2010 and Agarwal *et al.*, 2014
Bark	Isoplumpagin n-tricontyl n-tridecanoate, lupeol, 30-	Gupta *et al.*, 1993; Jiny Varghese *et al.*, 2010

	norlupan-3 β- ol-20-one, betulin, betulinic acid and pentacyclic triterpenes, napthoquinone, isoplumbagin, triterpenoids-hennadiol and aliphatics (3-methylnonacosan-1-ol)	and Agarwal *et al.*, 2014
Aerial part	Coumarins, lacoumarins, 5-allyoxy-7-hydroxycoumarin, three new laxanthones, laxathones I, II and III, 1,3-dihydroxy-6, 7-dimethoxy xanthone, 1-hydroxy-3, 6-diacetoxy-7-methoxyxanthone and 1-hydroxy-6-acetoxy xanthone	Jiny Varghese *et al.*, 2010
Root	24β-ethylcholest-4-en-3β –ol	Agarwal *et al.*, 2014
Flowers	α- and β- ionones, -methoxy-3-methyl-1,4-naphthoquinone, apiin and cosmosiin	Jiny Varghese *et al.*, 2010
Seed	Behenic acid, proteins, carbohydrates, fibres, fatty oils, arachidic acid, stearic acid, palmitic acid, oleic acid and linoleic acid	Jiny Varghese *et al.*, 2010 and Agarwal *et al.*, 2014
Whole plant	Cu, Ni, Mo, V, Mn, Sr, Ba, Fe, Al, Na_2O, CaO and K_2O Laxanthone I, Laxanthone II, Laxanthone III and n-Tricontanol	Jiny Varghese *et al.*, 2010 Agarwal *et al.*, 2014

Pharmacological studies

Various pharmacological studies reported on *L.inermis* are given in the table.

Pharmacological activity	Reference
Antimicrobial	Malekzadeh, 1968; Ghaleb Mohammad adwan *et al.*, 2008; Dinesh Babu and Subhasree, 2009; Iram Gull *et al*., 2013 and Agarwal *et al.*, 2014
Antibacterial	Malekzadeh, 1968; Sharma *et al.*, 1995; Baba-Moussa *et al*., 1997; Dama *et al*., 1999; Papageorgiou *et al.*, 1999; Ali *et al*., 2001; Riffel *et al.*, 2002; Bhuvaneswari *et al.*, 2002; Kirkland and Marzin, 2003; Habbal *et al*., 2005; Saadabi, 2007; Kawo and Kwa, 2011; Wasim *et al*., 2013 and Agarwal *et al.*, 2014
Antifungal	Tripathi *et al.*, 1978; Dixit *et al*., 1980; Natarajan and Lalithakumar, 1987; Singh and Pandey, 1989; Prasirst *et al.*, 2004; Aghel *et al*., 2005; Raveesha *et al*., 2007; Anwar *et al*., 2007 and Agarwal *et al.*, 2014
Antiviral	Khan *et al*., 1991; Mouhajir *et al.*, 2001 and Agarwal *et al.*, 2014
Antioxidant	Prathiba and Korwar, 1999; Omar, 2005; Prakash *et al*., 2007; Arul priya

	and Lalitha, 2012 and Agarwal *et al.*, 2014
Antiparasitic	Wendal, 1946, Badri and Burkinshaw, 1993; Kayser *et al.*, 2000; Kayser *et al.*, 2003; Okpekon *et al.*, 2004 and Agarwal *et al.*, 2014
Antidiabetic	Arayne *et al.*, 2007; Syamsudin and Winarno, 2008 and Agarwal *et al.*, 2014
Hepatoprotective	Anand *et al.*, 1992; Ahmed *et al.*, 2000; Bhandarkar and Khan, 2003; Hemalatha *et al.*, 2004; Latha *et al.*, 2005 and Agarwal *et al.*, 2014
Nematicidal	Korayem and Osman, 1992
Anticoagulant	Kumar *et al.*, 1985
Wound healing	Hamdi *et al.*, 1997; Muhammad and Muhammad, 2005; Nayak *et al.*, 2007 and Agarwal *et al.*, 2014
Protein glycation inhibitory	Sultana *et al.*, 2009 and Agarwal *et al.*, 2014
Memory and behaviour effectiveness	Iyer *et al.*, 1998
Enzyme inhibitory activity	Yogisha *et al.*, 2002
Abortifacient	Aguwa, 2002 and Agarwal *et al.*, 2014
Antisickling	Chang and Suzuka, 1982 and Agarwal *et al.*, 2014
Anti inflammatory	Singh *et al.*, 1982; Gupta *et al.*, 1993;

	Alia *et al*., 1995 and Agarwal *et al.*, 2014
Anticorrosive	Agarwal *et al*, 2014
Cytotoxic	Ali and Grever, 1998; Wang *et al*., 2007; Endrini *et al*., 2007 and Agarwal *et al*., 2014
Anti trypanosomal	Wurochekke *et al*., 2004
Molluscicidal	Singh and Singh, 2001
Antidermatophytic	Natarajan *et al*., 2000
Analgesic	Bagi *et al*., 1988 and Mohsin *et al*., 1989
Antifertility	Munshi *et al*., 1977
Tuberculostatic	Sharma, 1990
Immunostimulator	Dikshit *et al.*, 2000 and Mikhaeil *et al.*, 2004

Medicinal uses on human beings

L. inermis has been used cosmetically and medicinally for over 9000 years. Traditionally in India, it applied to hands and feet for decoration. Its use became popular in India because of its cooling effect in the hot Indian summers. The leaves, flowers, seeds, stem bark and roots are used in traditional medicine to treat a various diseases like rheumatoid arthritis, headache, ulcers, diarrhoea, leprosy, fever, leucorrhoea, diabetes, cardiac disease, hepatoprotective and colouring agent (Chetty, 2008). It reduces inflammations, enhances wound contraction and skin breaking strength (Shivanandan Nayak, 2007).

The powder of the dried leaves used as a tonic astringent (Egharevba and Ikhatua, 2008). Infusion of flowers used to treat headache and insomnia.

Bark is given to cure jaundice, spleen enlargement and skin diseases (Pawan porwal *et al.*, 2011).

Seed powder with ghee was effective against dysentery (Agarwal *et al.*, 2014).

Root, leaf, flower and seed cures premature graying of hair, anaemia, cancer and Alzheimer's disease (Soma Roy *et al.*, 2010).

Medicinal uses on animals

Leaf paste is used to cure impetigo (Kingston *et al.*, 2009). Dried leaf powder mixed water with to prepare paste and is applied topically on affected area of tick infestation and pediculosis (Sindhu *et al.*, 2010) for joint pain and throat swelling (Mulay *et al.*, 2012). Leaves are also used in the treatment of skin diseases of animals (Agarwal *et al.*, 2014).

Flowers are very fragrant and used to extract perfume. Infusion of the flowers is used to bruises and emmenagogue.

Seed powder is good for liver disorders.

Bark is powdered and applied to burns and scalds.

Root is a potent medicine for gonorrhea and herpes infection. It is an astringent pulped and used for sore eyes. Decoction of root along with indigo is an abortifacient and is useful in treatment of hysteria and nervous disorders (Gagandeep Chaudhary *et al.*, 2010). Dried leaf powder is mixed with water and given to animal to cure haematuria (Muzafar sheikh *et al.*, 2013).

Madhuca longifolia

Taxonomic position

Division : Magnoliophyta

Class : Magnoliopsida

Order : Ericales

Family : Sapotaceae

Genus : *Madhuca*

Species : *longifolia*

Tamil name : Illupai

English name : South Indian Maduca or Butter tree

Description

It is a large deciduous tree with 17m height. The bark is grey or blackish with shallow wrinkles and vertical cracks, 1 cm thick, rough, brownish- grey with many vertical furrows, pealing off into 5mm thick flakes, exuding white sticky thick latex. Young branches, leaves and petioles are pubescent or tomentose. The leaves alternate clusters at the ends of branches, 7.5-10 cm, elliotic or oblong-elliptic and shortly acuminate with cuneate base, 10-18 x 2-4 cm, slightly leathery, base and apex acute, margin entire, hairless, distinctly stalked, lateral nerves 14-16 pairs. Flowers bisexual, axillary and solitary, 1.5-2 cm long, with prominent stalk, many, at ends of the branches and are borne on drooping pedicles. The calyx coriaceous and densely rusty-tomentose. Corolla yellowish-white and early caduceous. Stamens are 20-30 and anthers hispid at the back with stiff hairs. Fruits are ovoid, fleshy and green berries and 2.5-5.0 cm long. Seeds are 1-4. Flowering during April-May and fruiting in June-July.

Distribution

It is native of India and adapted to arid regions. It occurs in the plains and lowers, hills of India upto 1200m. Commonly found in West Bengal, Bihar, Madhya Pradesh, Odissa, Punjab, Uttar Pradesh and Tamil Nadu

Parts used

Leaves, bark, seeds, flowers and fruits.

Pharmacognostical studies

The leaf powder of *M.longifolia* dark green in colour, fine, odourless with slight bitter taste. Powder showed paracytic type of stomata, unisariate and covering trichomes. Vein islet number ranged from 5-7, vein termination number ranged from 3.2-5.4. Stomatal number and stomatal index ranged from 17.9-18.8.

Phytochemical studies on *M. logifolia*

Preliminary phytochemical investigation was already carried over in the flower of *M. longifolia*. The alcoholic extract of *M. longifolia* seeds showed the presence of tannins, flavonoids, steroids, terpenes, cardioglycosides and saponins (Neha Shekhawat and Rekha vijayvergia, 2010)

The plant contains various phytochemicals and are listed below,

Plant part	**Phytochemicals**	**Reference**
Leaves	b- esosteroles acids, myricelin, ß-carotene, xanthophyll, erthodiol, n-hexacosanol, n-octacosanol, palmitic acid, myricetin, quertin, 3beta-caproxy- and palmitoxy-olean -12-en-28-ol, oleanolic acid, beta-sistosterol and its 3-O-beta-D-glusoised and stigmasterol.	Anonymous, 2007; Priyanka Yadav, 2012 and Patel *et al.*, 2012
Bark	Cupeol acetate, b-amyrn acetate, a-	Anonymous, 2007;

	spinasterol, erthrodidla-monocaprytase, betulinic and oleunollic acids, caprylaises, xylase, rhamnase, glucose and galactose	Priyanka Yadav, 2012 and Patel *et al.*, 2012
Flowers	L-arabinose, D-galactose, glucose, D-glucuronic acid, fructose, maltose, L-rhamnose, D-xylose, biotin, folic acid, inositol, niacin, pantothenic acid riboflavin thiamine, amylase, catalase, emulsion, invertase, maltase, oxidase, malic acid succinic acids (salts), anthocyanin, betaine and protein.	Chatterjee and Pakrashi,2000; Priyanka Yadav, 2012 and Patel *et al.*, 2012
Fruits	Protein, oil, oleic acid, linoleic acid, palmitic acid and stearic acid	Chatterjee and Pakrashi,2000; Priyanka Yadav, 2012 and Patel *et al.*, 2012
Seed	Saponins, Mi-saponin A, Mi saponins B, Fixed oil, oleic acid, Myristic acid, a-alanine, aspartic acid, cystine, glycine, isoleucine, leucine, lysine, methionine, proline, serine, Illipene, prosapogenol, beta-sitosterol, sucrose, arginine, glutamic acid, histidine, tryptophan, tyrosine, bassianin, cellulose, oligosaccharides and starch	Chatterjee and Pakrashi,2000; Priyanka Yadav, 2012 and Patel *et al.*, 2012
Seed oil	Arachidic, linoleic, oleic, myristic, palmitic and stearic acids	Chatterjee and Pakrashi, 2000; Irfan ali khan and

		Atiya, 2005; Priyanka Yadav, 2012 and Patel *et al.*, 2012
Seed kernal	Hexacosanol, quercetin, dihydroquercetin, ß- sistosterol and its 3ß-D-glucoside, Protobasic acid, prosopogenol and Mi saponin C	Chatterjee and Pakrashi,2000; Irfan ali khan and Atiya, 2005; Priyanka Yadav, 2012 and Patel *et al.*, 2012

Pharmacological studies

The pharmacological activities of *A. paniculata* is listed below,

Pharmacological activity	Reference
Antimicrobial	Westendarp, 2006; Ghaleb Mohammad Adwan *et al.*, 2008; Priyanka Yadav, 2012 and Patel *et al.*, 2012
Antibacterial	Aniel Kumar *et al.*, 2010
Antifungal	Mangesh khond *et al*., 2009
Anticancer	Kumar, 2004; Priyanka Yadav, 2012 and Patel *et al.*, 2012
Antioxidant	Palani *et al.*, 2009; Shalu Agrawal *et al.*, 2011; Kishore kumar *et al.*, 2007; Priyanka Yadav, 2012 and Patel *et al.*, 2012
Antiparasitic	Westendarp, 2006
Antidiabetic	Lal, 1986; Nath vijendra and Khatri Pavan Kumar, 2010; Pavan kumar *et al.*, 2011 and Anu

	Chaudhary *et al.*, 2011
Anti-irritant	Westendarp, 2006
Antisecretolytic	Westendarp, 2006
Antiphlogistic	Westendarp, 2006
Antiepileptic	Priyanka Yadav, 2012 and Patel *et al.*, 2012
Antihyperglycemic	Priyanka Yadav, 2012 and Patel *et al.*, 2012
Hepatoprotective	Saraswat, 1995; Palani *et al.*, 2009; Priyanka Yadav, 2012 and Patel *et al.*, 2012
Antimalarial	Rahman, 1999
Wound healing	Smita Sharma *et al.*, 2010
Anti fertility	Priyanka Yadav, 2012 and Patel *et al.*, 2012
Antiulcer	Priyanka Yadav, 2012 and Patel *et al.*, 2012
Antipyretic	Neha Shekhawat and Rekha vijayvergia, 2010; Priyanka Yadav, 2012 and Patel *et al.*, 2012
Antidermatophilic	Dwivedi *et al.*, 2008
Anti inflammatory	Priyanka Yadav, 2012 and Patel *et al.*, 2012
Antihelmintic	Dwivedi *et al.*, 2008
Anticonvulsant	Sandip patel *et al.*, 2011
Antipneumonia	Dwivedi *et al.*, 2008
Analgesic	Agung *et al.*, 2012; Priyanka Yadav, 2012 and Patel *et al.*, 2012
Antidote	Yosiokal *et al*, 1974 and Yoshikawa *et al*, 2000

Medicinal uses on human

Bark is an astringent, emollient, hypoglycaemic and tonic and their powder is used to cure rheumatism, bleeding gums, stomach ache, tonsillitis and diabetes (Agarwal, 1997).

Distilled juice of flower and fruits are used in the treatment of helminthes, acute and chronic tonsillitis, cough and bronchitis. Fresh juice arrest bleeding and helps in curing urinary ailments like burning and dehydration (Varier, 2004; Ayyanar and Ignacimuthu, 2005).

Roots of the plant are applied on ulcers.

Seeds are laxative and used in piles and constipation. The gummy juice of the seeds is applied for rheumatism and skin-affections. Madhuca oil is used for the treatment of skin diseases, rheumatism, headache and as a laxative. The Bhil tribals of Madhya Pradesh use the oil cake to keep away the snakes. The seeds of *M. longifolia* are ground with water and are used as a collyrium in snake-bitten fainting (Ramadan *et al*, 2006). Pounded seeds mixed with leaf extract of *Ocimum tenuiflorum* are applied on the affected parts to cure skin diseases (Kingston *et al.*, 2009). Leaves are used in the treatment of wound healing, burns, skin diseases, head ache and rheumatism (Patel *et al.*, 2012)

Medicinal uses on animals

Plant parts are used for sore, lice, external parasite, bone fracture, wounds, worm, rinder pest, bronchitis and urinary disorder in animals (Rajesh Kumar and Bharati, 2012).

Leaves are astringent. Given as cattle fodder and is used to cure stomach ache and ulcers. It is useful to cure burning sensation in body, debility emaciation, respiratory diseases, snake bite and fish poison. It is mixed with butter and applied on burns.

Flowers are considered demulcent, tonic, cooling and are used in cough, cold and bronchitis (Chopra *et al.,* 1969). It is mixed with common salt and given to animals orally for constipation. Flowers of *M.longifolia*, *Trachyspermum ammi*, *Curcuma longa* and common salt are mixed with mustard oil and were applied externally for sprain or fracture (Prasant kumar Singh *et al*., 2011).

Bark extracted with water and used to dress wounds caused by maggots infestation in hoof. It is good remedy for itch, swelling, fractures and snakebite poisoning (Yosiokal *et al.,* 1974; Yoshikawa *et al.*, 2000).

Skin disease of animals

WHO has recognized the inevitability of the use of alternate system of medicine for certain conditions such as cancer, skin diseases, multiple sclerosis, etc., for which no definite solutions are available in allopathic system (Anonymous,1992).

Mycotic infections are the most common skin infection in tropical developing countries on animals. Humid weather, over population and poor hygiene are the ideal conditions for the growth of dermatophytes (Vaijayantimala, 2001). It is considered to be a major animal health problem in many parts of the world (Guest and Sam, 1998). This causes high economic loss especially in livestock and in leather industries due to downgrading of hides and skin and also it decreases meat and milk production (Calderone, 1989; Gudding and Lund, 1995)

Dermatophytosis is caused by fungi in the genera *Microsporum, Trichophyton* and *Epidermophyton*. These are the pathogenic members of the keratinophilic (keratin digesting) soil fungi. Both *Microsporum* and *Trichophyton* are human and animal pathogens and *Epidermophyton* is a human pathogen.

Dermatophytes are classified into three types. They are,

- **Zoophilic dermatophytes:** These are mainly found in animals but can be transmitted to humans.

- **Anthropophilic dermatophytes:** Mainly found in humans and are very seldom transmitted to animals.
- **Geophilic dermatophytes:** Found mainly in soil, where they are associated with decomposing hair, feathers, hooves and other keratin sources. They infect both humans and animals.

Fungal pathogens

All domestic animals are susceptible to dermatophytes. A wide variety of dermatophytes have been isolated from animals, but a few zoophilic species are responsible for the majority of infections, viz. *Microsporum canis, Trichophyton mentagrophytes, Trichophyton equinum and Trichophyton verrucosum* and also the geophilic species *Microsporum gypseum* (Mahmoudabadi and Zarrin, 2008).

Dermatophytes acquired by animals can spread to human but is rare. Anthropophilic dermatophytes (ie., fugus causing disease in human) readily spread among people but rarely transmitted to animals.

Dogs and cats are easily affected by *Microsporum canis*, particularly cats. *M. gypseum* and *T.mentagrophytes* are found occasionally.

Trichophyton verrucosum is the most common species which will affect the cattle. Species *T.mentagrophytes, T. equinum, M. gypseum, M. nanum* and *M. canis* found occasionally.

Sheep and goats are frequently affected by *T. verrucosum* but *M. canis* outbreaks have also been reported.

T. equinum and *M. equinum* are the most common pathogens found in horses. *M.gypseum, M. canis* and *T. verrucosum* are seen occasionally (Hainer, 2003).

Antifungal drugs for topical treatment

Topical lotions or shampoos or antifungal drugs are used to treat skin disease. The available antifungal agents are listed below (Giguere, 2006),

Sl.no	Antifungal drugs	Spectrum and Clinical applications
1	Polyenes: Natamycin and Nystatin	• Filamentous and dimorphic fungi and yeasts. • Local treatment against ringworm. • Cows with *Candida* mastitis • Filamentous fungal keratitis and *Candida* metritis in horses. • Malassezia infections of the outer ear in dogs
2	Azole antifungals • Imidazoles: Miconazole, Enilconazole, Clotrimazole and Ketoconazole • Triazoles:Fluconazole	• Broad spectrum • Topical treatment dermatophytes infection. • Local application in mycotic keratitis and endometritis in horses. • Local treatment for yeast mastitis and mycotic endometritis in cows. • Canine nasal Aspergillosis
3	Allylamines: Naftifine, and Terbinafine	• Treatment of dermatophytic and Malassezia infections.

Though this disease cured with conventional antifungal agents, the disease had a tendency to reoccur in the same area or other ones (Natarajan *et al.*, 2003).

Practically, the antifungals available in the market are the same as those developed for the human but with modified strengths (Hector, 2005). Few antifungal agents are available and licensed for use in veterinary treatment. The use

of these drugs is limited to treat animal due to their high toxicity, cost effectiveness and problems of residues in products (Araujo *et al.*, 2009). Moreover most of the antifungal drugs are immuno suppressive and cause many side effects like fatigue, blurred vision, hepatotoxicity, hair loss, deposition of drug residue in milk, etc., (Good man and Gil man, 1995)

Vaccines are available in some countries for *T. verrucosum* in cattle and *T.equinum* in horses. It can prevent or decrease clinical signs, but has not been shown to eliminate the fungus (Fort Dodge Animal Health, 2004).

Therapeutic efficacy of many indigenous plants for several disorders has been described by practitioners of traditional medicine (Venugopal Pankajalakshmi and Venugopal Taralakshmi, 1994). Treatment based on Indian medicinal plants is becoming increasing and physicians are also looking for alternative treatments because of the side effects of the present-day drugs (Gupta, 1994).

Fungi are able to improve resistance against conventional drugs rapidly, prompting the constant need to identify novel antifungal agents. Among the natural sources for therapeutic substances, plants have always played a classic role for such purposes since the dawn of human history. The application of medicinal plants has long been an integral part of both human and veterinary medicine and the practice is still rather common in Asian countries, including China, India, Japan, Pakistan, Sri Lanka and Thailand (Hoareau and Da Silva, 2011).

Reports are available in the usage of herbs to cure skin diseases, there are some 82 plants used in the treatment of skin diseases like *Abrus precatorius, Acacia nilotica, Allium cepa, Allium sativum, Azardirachta indica, Beta vulgaris, Ocimum sanctum, Pongamia pinnata, Annona squamosa* etc., (Sharma and Chinmay Joshi, 2004); *Nerium oleander, Eclipta alba* (Uncini Manganelli *et al.*, 2001), *Pistacia hypogeal, Conium maculatum, Calendula arvensis, Heliotropium europaeum, Raphanus raphanistrum, Olea europaea, Helleborus foetidus,*

Nicotiana tobacum (Bonet and Valles, 2007); *Calpurnia aurea*, *Bersama abyssinica* and *Solanum marginatum* (Yineger *et al.,* 2007). Plants like garlic, lemon grass, datura, acacia, a triplex ginger, neem, basil, eucalyptus, alfalfa and basil are also used as antifungals agents (Aly and Bafiel, 2008). *Cassia alata, Justicia flova, Lawsonia inermis, Rauvolifa vomitoria* and *Vitex doniana* were reported to cure skin disease of domestic animals (Egharevba and Ikhatua, 2008).

It is reported that methanol extract of *Cymbopogon citratus* showed maximum antifungal activity against *Trichophyton mentagrophytes*, followed by *T. verrucosum, Microsporum canis* and *Epidermatophyton floccosum* than leaves of *Ocimum bacilicum, Nerium oleander, Olea europaea* and leaves and flowers of *Lantana camara* (Fardos, 2009).

It is reported that, *Acorus calamus, Aegle marmelous, Anacardium occidentale, Andrographis paniculata, Argemone Mexicana, Asparagus racemosus, Azardirachta indica, Cassia alata, Cassia auriculata, Clerodendron inerme, Clitoria ternatea, Corallocarpus epigaeus, Crinum defixum, Curcuma longa, Cynodon dactylon, Glycrrhiza glabra, Hygrophila auriculata, Lawsonia inermis, Madhuca longifolia, pongamia pinnata, Terminalia bellerica* and *Wrightia tinctoria* are the indigenous plants used for treating skin diseases (Kingston *et al.,* 2009).

In Southeast Asian region, the commonly found plants like *Allium sativum, Piper betle, Rhinacanthus nasutus* and *Senna alata* are used as antifungal agents (Bajpai *et al.,* 2010)

The aqueous and organic solvent extracts of *Pergularia tomentosa* and *Mitracarpus scaber* were active against *T. rubrum, T. mentagrophytes* and *M.gypseum* (Shinkafi and Manga, 2011).

The bark of *Albizia lebbek*, leaf and bark of *Annona reticulata* extracts showed potential inhibitory activity against the fungus *T. rubrum* (Sai devi *et al.*, 2012).

The leaves of *L. inermis* are used to cure head ache, skin infections and teeth diseases (Wasim Raja *et al.*, 2013) and the bark is used to cure leprosy and bleeding disorder (Agarwal *et al*., 2014)

Herbal formulation against fungal pathogens

Plants are the important source of natural drugs. Any part of the plant or animal can be used as a drug either in the form of crude drug or in the form of extraction or decoction.

Herbal formulations are available in the market to alleviate the diseases.

Oil-aqueous cream was prepared with *Psoralea corylifolia* to cure eczema using stearic acid as base (Beena *et al.*, 2010).

A herbal formulation was prepared by mixing *Lawsonia inermis* paste with oleaginous as a base to cure skin infections caused by bacteria and fungi (Deborah *et al.*, 2011).

A cream was prepared by boiling the mixture of dried leaves of *Calotropis gigantea, Curcuma longa* powder and *Pongamia pinnata* oil in a ratio 5:2:2 and applied to treat eczema and other skin infections (Dibakar Mishra, 2011).

Mandeep Singh *et al.*, (2011) reported that, evaluation of a herbal cosmetic cream showed optimum pH range of 6-7, higher viscosity, good homogeneity, spreadability was found to be uniform and primary skin irritation test revealed absence of edema and erythema.

In another studies it is reported that, evaluation of a herbal formulation used for treatment of eczema showed pH of 5.9 and viscosity was proved to be higher which indicates that the cream is easily spreadable (Beena *et al.*, 2010)

It is reported that, primary skin irritantion test done with a herbal hair oil showed no sign of any erythema or edema on skin of rabbits which indicates that the hair oil is non irritant and safer to use (Pooja Banerjee *et al*, 2009)

Application of Nanotechnology in herbal medicine

Nanotechnology is a combination of knowledge from various fields like physics, chemistry, biology, medicine, informatics and engineering. It is an emerging technological field with great potential to lead in great breakthrough that can be applied in real life. The development of specific guidance for safety evaluation of nanotechnology products is strongly recommended (Logothetidis, 2012).

In practice of Ayurveda, herbo-mineral/metallic formulations (Bhasma of metals and minerals) are used since 7^{th} century. It was supported that these medicines have superior level of efficacy in comparison to other Ayurvedic formulations. Several studies claimed that "Bhasmas" are biologically produced nanoparticels (Prasanta Kumar Sarkar and Anand Kumar Chaudhary, 2010).

Silver nanoparticles synthesized from $AgNO_3$ through a simple green route using the leaves of *Andrographis paniculata* showed antiplasmodial activity against *Plasmodium falciparum* (Panneerselvam *et al.*, 2011).

Biosynthesis of anisotropic gold nanoparticles using aqueous extract of *Madhuca longifolia* and their potential as IR blockers indicated that tyrosine residue was identified as the active functional group for gold ion reduction (Mohammed Fayaza *et al.*, 2011).

Antimicrobial potent silver nanoparticles were prepared using whole plant aqueous extract of *A. paniculata*. Its effect against bacterial strains such as *B.subtilis, E. coli, P. aeruginosa, P. fluorescence, S. aureus, S. typhii* and *V. parahaemolyticus* and pathogenic fungi such as *A. flavus* and *A. niger* showed

good inhibitory activity on all bacterial species, whereas it showed anti-fungal activity only on *A. niger* and had no effect on *A. flavus* (Rajasekar *et al.,* 2013)

Leaf extracts of *Lawsonia inermis* was used for preparation of antibacterial Poly Ethylene Oxide (PEO) and Poly Vinyl Alcohol (PVA) nanofibers via electrospinning technique. The result revealed that 2.793 wt % Li in PVA and PEO based solutions showed bactericidal effects against *Staphylococcus aureus* and bacteriostatic action to *Escherichia coli* (Avci *et al.*, 2013).