



INTERNATIONAL JOURNAL OF PHARMACY AND ANALYTICAL RESEARCH

ISSN:2320-2831

IJPAP |Vol.5 | Issue 3 | July - Sep -2016

Journal Home page: www.ijpar.com

Research article

Open Access

Ethnopharmacological approaches to treat lymphatic filariasis

Saurabh Shrivastava, Bina Gidwani, Anshita Gupta, Chanchal Deep Kaur*

Shri Rawatpura Sarkar Institute of Pharmacy, Kumhari, Durg, Chhattisgarh

*Corresponding Author: Dr. Chanchal Deep Kaur

Email id: dr.chanchaldeep@gmail.com

ABSTRACT

Lymphatic filariasis is one of the oldest and debilitating health problems for the human beings. It is a parasitic disease which is prevalent principally in tropical and subtropical countries. It is a condition with initial clinical manifestations like, presence of high fever with or without rigors. It may be accompanied by itchy irregular erythematous swelling of the skin usually present in legs. This condition emphasizes a typical elephant like leg due to swelling therefore it is also known as elephantiasis. *Wuchereria bancrofti*, *Brugia malayi* and *Brugia timori* are three major causative parasites which are responsible for lymphatic filariasis. The modern synthetic medicines found to be very effective for controlling lymphatic filariasis, but causes lots of side effects. Hence, there is a need to search for effective, non toxic novel herbal drugs with anti filarial activity. The herbal treatment destroys the filarial parasites present within the blood and lymph nodes. Depletion of stoppage and swelling reduction is predominant in the prosperous treatment of lymphatic filariasis. This review provides the information for the researchers to investigate further and to attain lead molecules in the search of novel herbal drugs to treat lymphatic filariasis.

Keywords: Lymphatic filariasis, Bioactive, Herbals, Parasitic disease.

ETHNOPHARMACOLOGICAL APPROACHES TO TREAT LYMPHATIC FILARIASIS

INTRODUCTION: LYMPHATIC FILARIASIS

Lymphatic filariasis is a disease caused by parasite or roundworms (nematode) [1]. The nematode worms are transmitted by mosquitoes.

The mosquitoes responsible for filariasis are belonging to the genera *Aedes*, *Anopheles*, *Culex*, and *Mansonia* [2]. The adult worms survive only in lymphatic system of human. The Lymphatic system is important because it is a first line of defence against disease & infection and it is responsible for maintaining of body's fluid [1], [3].



FIGURE 1: MOSQUITO CAUSING FILARIASIS



FIGURE 2: PATIENT OF FILARIASIS

Lymphatic filariasis is a disease associated with inflammation of the arms and legs, which can provoke elephantiasis and hydrocele which ultimately causes damage and dysfunction of the lymphatic system [4-5]. There are hundreds of filarial parasites, in which only eight species cause infections in humans. The species *Wuchereria bancrofti* is the most prevalent worldwide, *Brugia malayi* is found mostly in Eastern Asia, and *Brugia timori* is confined to East Timor and adjacent islands [6].

Lymphatic filariasis is common in tropical and subtropical countries [7]. Though the disease is not mortal itself but provokes acute and chronic morbidities and has dreadful social influence [8].

HISTORICAL BACKGROUND

Lymphatic filariasis is recognized as a dominant public health dilemma in the worldwide. The Susruta, eminent Indian physician, recorded this disease in his book '*Susruta Samhita*' in 6th century B.C. Madhavakara discussed symptoms and clinical manifestations of the filarial disease in his treatise '*Madhava Nidhana*' in 7th century A.D. Clarke called elephantoid legs as 'Malabar legs' in Cochin in 1904. In 1872, the discovery of microfilariae in the blood was made by Lewis in Kolkata (Calcutta) [9].

PREVALENT STATISTICS

According to World Health Organization, Lymphatic filariasis is a neglected tropical disease with more than 1.3 billion people in 72 countries worldwide affected and a current infection of 120 million with disfigurement in 40 million people. Lymphatic filariasis is treated endemic in Asia, Africa, Pacific Island nations and South America [10-11]. Lymphatic filariasis is common in male

and female both. 10% of women can be suffered with swollen limbs, and 50% of men can afflicted from mutilating genital symptoms. In Asia, Lymphatic filariasis is present in Bangladesh, Cambodia, India, Indonesia, Malaysia, Maldives, Philippines, Sri Lanka and Thailand [12].

TYPES OF LYMPHATIC FILARIASIS

Eight varieties of filarial nematodes are acknowledged to use humans as their host and according to body area covered; these are divided into three groups, as follows:

Lymphatic filariasis

In lymphatic filariasis, the lymphatic system is affected by three types of worms namely *Wuchereria bancrofti*, *Brugia malayi* and *Brugia timori*. It mostly occurs in the lower limbs and genital area. In chronic condition, the host may develop elephantiasis.

Subcutaneous filariasis

This infection is induced by the worms *Loa loa*, *Onchocerca volvulus*, *Mansonella streptocerca*, and *Dracunculus medinensis*. It occurs in the subcutaneous tissue.

Serous/ Peritoneal cavity filariasis

This infection is induced by *Mansonella perstans* and *Mansonella ozzardi*. It occurs in the serous cavity of the abdomen [13]. Lymphatic filariasis is caused by the infection with different species of filariae. *Wuchereria bancrofti*, *Brugia malayi*, *Brugia timori*, *Loa loa*, *Onchocerca volvulus*, *Mansonella ozzardi*, *Dipetalonema perstans* and *Dipetalonema streptocerca* are eight species of filariae in humans [14-15].

Table 1: Description of Filarial Parasites [18-21]

Filarial parasite / species	Vector	Main location of Adults	Main location of microfilariae	Common disease symptoms	Filarial disease
<i>Wuchereria bancrofti</i>	Mosquito	Lymphatics	Blood	Lymphangitis, Elephantiasis, Hydrocele	Lymphatic filariasis
<i>Brugia malayi</i>	Mosquito	Lymphatics	Blood	Lymphangitis, Elephantiasis	Lymphatic filariasis
<i>Brugia timori</i>	Mosquito	Lymphatics	Blood	Lymphangitis, Elephantiasis	Lymphatic filariasis
<i>Loa loa</i>	Deerfly	Connective tissue	Blood	Calabar swellings	Loiasis
<i>Onchocerca volvulus</i>	Black fly	Skin	Skin	Dermatitis, Nodules, Eye	Onchocerciasis
<i>Mansonella</i> species	Culicoides	Serous membranes	Blood and skin	Usually symptomless	Mansonelliasis
<i>Dracunculus</i> species	Copepods	Connective tissue	–	Ulceration	Dirofilariasis

Table 2: The Morphological Differentiation of *Wuchereria Bancrofti* and *Brugia Malayi* Microfilariae [14-22]

Parameters	<i>Wuchereria bancrofti</i>	<i>Brugia malayi</i>
Size	Larger, 244~296 by 5.3~7 µm	Smaller, 177-230 by 5~6 µm
Shape	Smooth curves of body	Rigid curves of body
Cephalic space	Shorter	Longer
Body nuclei	Equal sized, countable	Unequal sized, uncountable
Worms	Male: <ul style="list-style-type: none"> Finger-like tail No nuclei in end of tail Female: <ul style="list-style-type: none"> Vuvla is close to the position of the middle of their esophagus Ovoviviparous, producing thousands of microfilariae 	Male: <ul style="list-style-type: none"> Curved ventrally tail Left papillae more complex Nuclei in end of tail Female: <ul style="list-style-type: none"> Vuvla is close to the position of the middle of their esophagus

SYMPTOMS OF LYMPHATIC FILARIASIS

In most cases, affected patients will not develop any clinical manifestations and they are said to be asymptomatic. In few percentages of patents will show lymphedema. Swelling and edema are due to

abnormal function of lymphatic system. It mostly seen in legs, but also present in arms breast and gentiles. In many cases, patients will develop clinical symptoms after many years. Infected men may develop hydrocele or swelling of the scrotum [1].

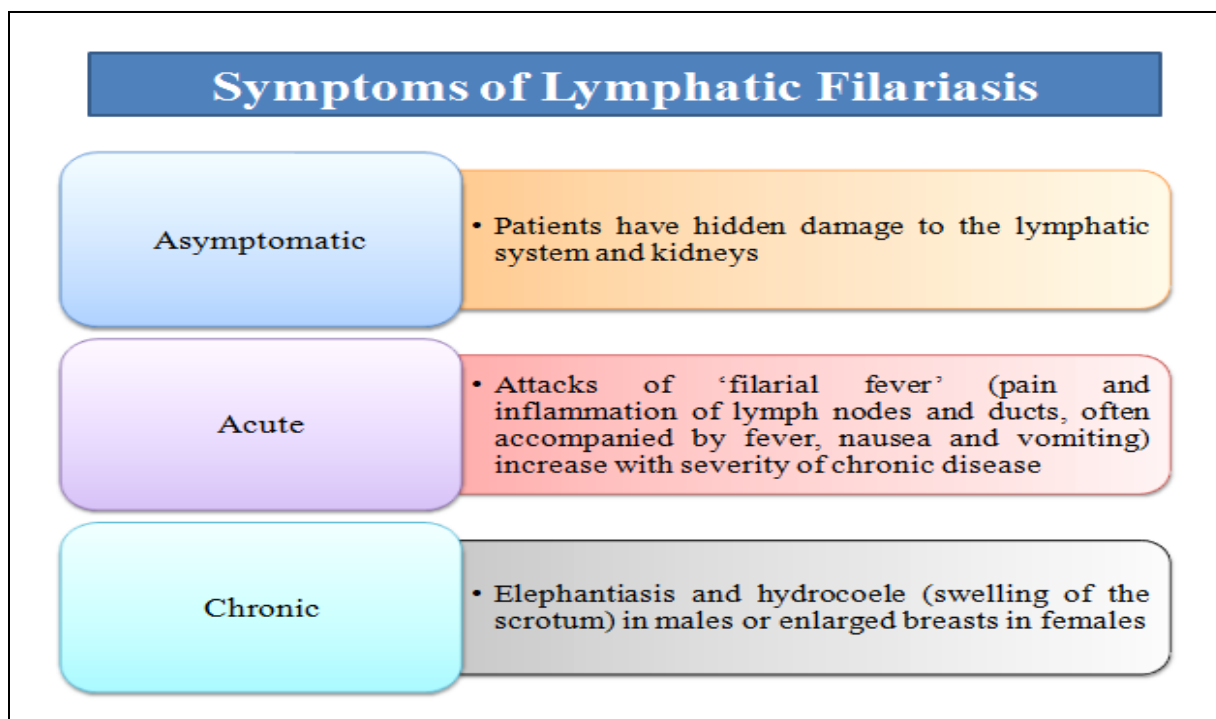


Figure 3: Symptoms of Lymphatic Filariasis [23-25]

In lymphatic diseases, the lymphatic systems are unable to protect against the infections due to decline activities of lymphatic components. Affected persons will have more bacterial infections in the skin and lymphatic system. This will lead to hard the skin, which is known as elephantitis. Many of these bacterial infections can be prevented with appropriate skin hygiene [16] [23-25].

PATHOLOGY OF LYMPHATIC FILARIASIS

The pathology of the lymphatic filariasis is due to a complex reciprocation of bacterial infection,

potential of the parasite and the tissue response of the host. The injury to the lymphatic vessels is intercede both by an immune response to the adult worms and by a direct action of the parasite. In the absence of inflammation, marked lymphatic dilation with lymphedema has been seen in experimental animals with immune deficiency. When immuno competent cells are generated, it produces inflammatory granuloma reaction which causes damaging of the lymphatic vessel, leading to lymphedema [26].

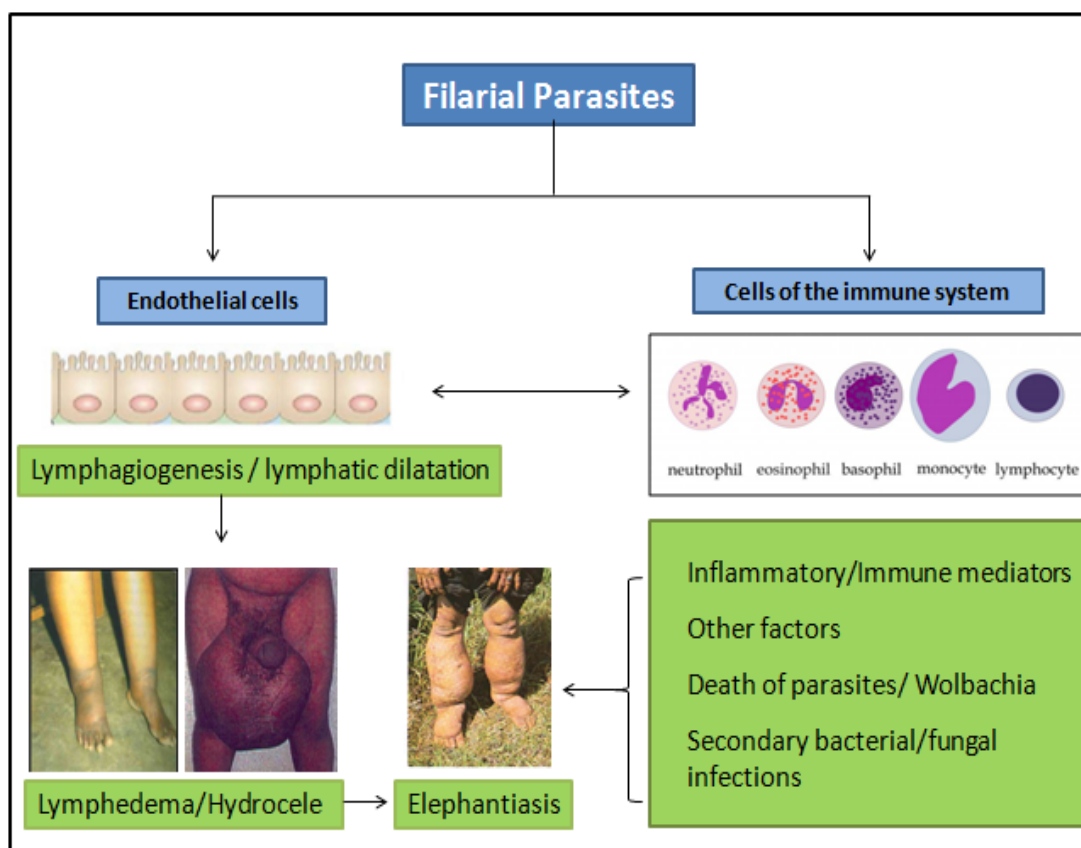


Figure 4: Pathogenesis of Lymphatic Filariasis

Live filarial parasites exert a direct effect on lymphatic cells as well as on the cells of immune system. The interplay between inflammatory or immune mediators, slow abrasion of the parasites and Wolbachia & other factors are involved in the pathogenesis and development of filarial disease. Secondary microbial infections further aggravate the pathology. The other effects of filarial disease encompass lymphedema, hydrocele and elephantiasis [27].

TRANSMISSION CYCLE OF LYMPHATIC FILARIASIS

Lymphatic filariasis is transmitted through mosquito bites. The adult filarial worms generate so many microfilariae. Microfilariae circulate in the peripheral blood. The persons having circulating microfilariae are outwardly healthy but transmit the infection to others through mosquitoes. The persons with chronic filarial swellings suffer severely from the disease but no longer transmit the infection. [28].

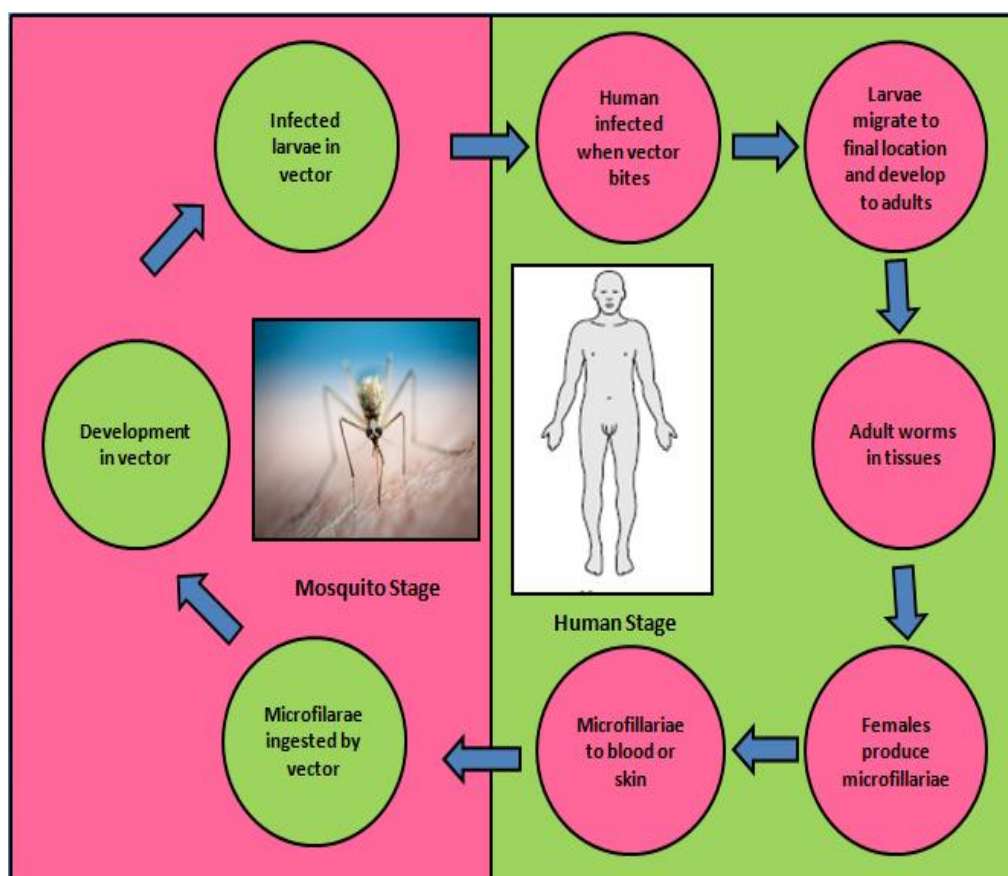


Figure 5: Transmission Cycle of Lymphatic Filariasis

DIAGNOSIS OF LYMPHATIC FILARIASIS

The recognition of microfilariae by microscopic examination is the best way for diagnosing infection. But, this is not always appropriate

method for the reason that in most region of world, microfilariae are circulate in the human blood only at night time. Therefore, the collection of blood should be preferred at night to identify with the appearance of the microfilariae. [28].

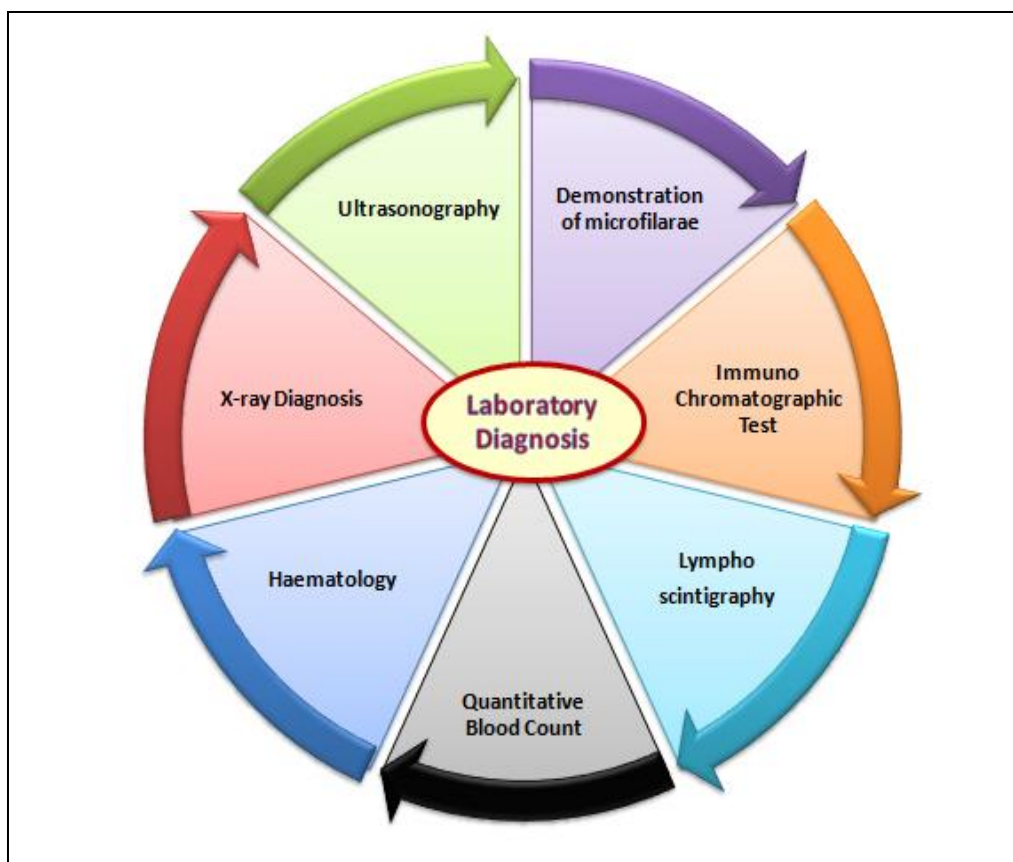


Figure 6: Diagnosis of Lymphatic Filariasis [24-26]

Diagnosis of lymphatic filariasis can be either by clinically or through laboratory assay. Clinically, diagnosis can be made on basis of tests like Detection of microfilaria, Haematology, Immuno Chromatographic Test, Lymphoscintigraphy, Quantitative Blood Count, Ultrasonography and X-ray diagnosis [28].

TREATMENT FOR LYMPHATIC FILARIASIS

Existing therapy for Lymphatic filariasis

Both synthetic drugs and herbal drugs are used for treatment of lymphatic filariasis. Synthetic chemotherapeutic drugs are used in oral dosage form. These drugs are associated with several drawbacks and side effects. The details of synthetic formulations used in lymphatic filariasis are discussed as under -

Synthetic drugs used in Lymphatic filariasis

Diethylcarbamazine, Ivermectin, and Albendazole are the most extensively used drugs in the lymphatic filariasis treatment. Hygiene maintains or surgery is the other ways of treatments. The Diethylcarbamazine can eradicate the microfilariae from the blood and wipe out the adult worms. A polytherapy treatment that includes Ivermectin with Diethylcarbamazine or Albendazole is more effective than each drug alone. Tetracycline antibiotics are also used to kill Wolbachia bacteria. Physical barriers such as mosquito net, Chemical like insect repellent, or mass chemotherapy are some techniques which are applied to prevent the transmission of the disease [29]. This will definitely reduce the average microfilarial titer in blood, thus reducing the spreading through mosquitoes during their subsequent bites [30].

Table 3: Comparison Of Diethylcarbamazine, Ivermectin And Albendazole [25], [31-42]

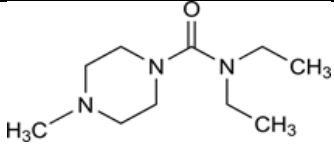
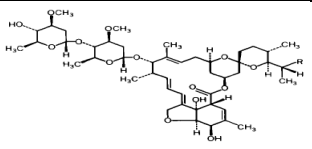
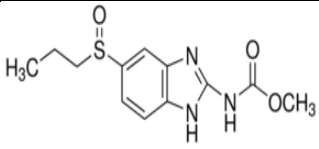
Parameters	Diethylcarbamazine	Ivermectin	Albendazole
Structure			
Molecular formula	C ₁₀ H ₂₁ N ₃ O	C ₄₈ H ₇₄ O ₁₄	C ₁₂ H ₁₅ N ₃ O ₂ S
Molecular weight	199.293 g/mol	875.10 g/mol	265.333 g/mol
Marketed preparation	Carbilazine, Hetrazan, Notezine, Spantonin	Agimect, Stromectol, Evertin-6	Aben, Abenzer, Albendol
Dosage	50 mg	12mg, 6mg	200 mg, 400 mg
Mechanism	Don't have direct action of parasite but mediate through host immune system	Directly acts on microfilariae and no action on adults	Kills adult worms and no action on microfilariae
Side effect	Loss of vision, Itching and swelling of face, especially in eye	Swelling of lymph node, Skin rash	Enlargement of lymph nodes, Fall in blood pressure.

Table 4: List of Marketed Preparation Of Drugs Used In Lymphatic Filariasis [33-42]

S.No	Chemical Name	Category	Brand Name	Dosage Form	Dose	References
1.	Diethylcarbamazine citrate	Anthelmintic	Hetrazan, Notezine	Tablet	50 mg	33, 34
2.	Ivermectin	Anthelmintic	Stromectol	Tablet	6 mg	35, 36
3.	Albendazole	Anthelmintic	Vermox	Tablet	500 mg	37, 38
4.	Mebendazole	Anthelmintic	Vermox	Tablet	500 mg	37, 38
5.	Tetracycline	Antibiotics	Tetrax	Capsule	500 mg	39, 40
6.	Doxycycline	Antibiotics	Elidox	Capsule	100 mg	41
7.	Levamisole	Anthelmintic	Ergamisol	Tablet	50 mg	42

Herbal drugs used in Lymphatic filariasis

Many synthetic drugs are used for the treatments of lymphatic filariasis. But they have side effects like swelling and enlargements of lymph node. Nowadays, herbal drugs preparations are also used, as the herbal drugs are easily available and not so costly, to cure lymphatic filariasis [3], [23], [43-44].

India has rich sources of the herbal drugs. Herbals drugs are ethically confirmed for traditional used in the treatment of lymphatic filariasis by many researchers. The natural drugs were proven to have less side effects in spite their relatively low activity. Many herbal drugs were claimed to have anti filarial activity [45-47].

Table 5: Herbal Plants Have Anti Filarial Activity [48-119]

S.No.	Name of Plants	Family	Part used	References
1.	<i>Acacia auriculiformis</i> A. Cunn.	Fabaceae	Funicles	48, 49, 50
2.	<i>Adenia gummifera</i>	Passifloraceae	Root	51, 52
3.	<i>Aegle marmelos</i> Corr.	Rutaceae	Leaves	53, 54, 55
4.	<i>Afstonia boonei</i>	Apocynaceae	Bark, fresh latex, fresh stem-bark	56, 57, 58
5.	<i>Alnus nepalensis</i> D. Don	Betulaceae	Leaves	59, 60
6.	<i>Alstonia congensis</i>	Apocynaceae	Latex	61
7.	<i>Alstonia scholaris</i>	Apocynaceae	Apocynaceae	62
8.	<i>Andrographis paniculata</i> Burm. f.	Acanthaceae	Leaves	63, 64, 65
9.	<i>Argyrea speciosa</i>	Convolvulaceae	Whole plant	66, 67
10.	<i>Asparagus adscendens</i> Roxb.	Liliaceae	Plant extracts	68
11.	<i>Azadirachta indica</i> A. Juss.	Meliaceae	Flowers	69, 70
12.	<i>Bauhinia racemosa</i> Lam.	Caesalpinaeae	Leaves	71
13.	<i>Boerhavia repens</i>	Nyctaginaceae	Immature shoots	71
14.	<i>Butea monosperma</i> L.	Fabaceae	Leaves and Roots	72, 73
15.	<i>Caesalpinia bonducella</i> L.	Caesalpiniaceae	Seed kernel	74, 75
16.	<i>Calotropis gigantea</i>	Asclepiadaceae	Leaf, latex	61, 76, 77
17.	<i>Calotropis procera</i>	Asclepiadaceae	Whole plant, root, milky juice, bark	78, 79, 80
18.	<i>Carapa procera</i>	Meliaceae	Dried fruit, seed	81
19.	<i>Cardiospermum halicacabum</i> Linn.	Sapindaceae	Plant extracts	82
20.	<i>Cassia alata</i> Linn	Caesalpiniaceae	Plant extracts	83
21.	<i>Cedrus deodara</i> Roxb.	Pinaceae	Plant extracts	84
22.	<i>Centratherum anthelminticum</i> (Willd.) Kuntz	Asteraceae	Seed	85, 86
23.	<i>Cleistopholis glauca</i>	Annonaceae	Dried bark	61
24.	<i>Clerodendrum capitum</i>	Verbenaceae	Root	61
25.	<i>Cyrtomium fortune</i>	Polypodiaceae	Dried rhizome	87
26.	<i>Delonix elata</i>	Leguminosae	Whole plant	61
27.	<i>Dichrostachys cinerea</i> , <i>D. glomerata</i>	Leguminosae	Dried stem bark, inner bark	78, 79
28.	<i>Dombeya amanuensis</i>	Steruliaceae	Root	80
29.	<i>Eclipta alba</i>	Compositae	Dried whole plant	61
30.	<i>Elaeophorbia Drupifera</i>	Euphorbiaceae	Leaf	81
31.	<i>Elephantopus scaber</i>	Compositae	Dried root	77
32.	<i>Emicostema littorale</i>	Gentianaceae	Whole plant	82
33.	<i>Erythrophleum guineense</i>	Leguminosae	Crushed bark	83
34.	<i>Eucalyptus robusta</i>	Myrtaceae	Leaves	61
35.	<i>Excoecaria agallocha</i> L.	Euphorbiaceae	Leaves	84
36.	<i>Ficus racemosa</i> Linn.	Moraceae	Fruits	85
37.	<i>Glycyrrhiza glabra</i> Linn.	Fabaceae	Roots	86, 87
38.	<i>Hibiscus mutabilis</i> Linn.	Malvaceae	Leaves	88, 89, 90
39.	<i>Hibiscus sabdariffa</i> Linn.	Malvaceae	Leaves	89
40.	<i>Lantana camara</i> Linn.	Verbenaceae	Stem	90
41.	<i>Leucas aspera</i> (Willd.) Linn.	Lamiaceae	Plant extract	91
42.	<i>Leucas cephalotes</i> Spreng.	Labiatae	Flower	92
43.	<i>Limeum ptercarpum</i>	Molluginaceae	Aerial parts	77

44.	<i>Lycopodium rubrum</i>	Lycopodiaceae	Whole plant	93
45.	<i>Mallotus philippensis</i> (Lam.) Muell. Arg	Euphorbiaceae	Leaves	94
46.	<i>Melia azadirachta</i>	Meliaceae	Bark	95
47.	<i>Microglossa afzelii</i>	Compositae	Dried leaves	96
48.	<i>Moringa oleifera</i> Lam.	Moringaceae	Gum extract	97
49.	<i>Mussaenda elegans</i>	Rubiaceae	Leaves	61
50.	<i>Myrianthus arboreus</i>	Moraceae	Dried stem-bark	61
51.	<i>Neurolaena lobata</i> Linn.	Asteraceae	Plant extract	98
52.	<i>Ocimum sanctum</i>	Lamiaceae	Leaves	99
53.	<i>Odyndea gabunensis</i>	Simaroubaceae	Dried stem-bark	100
54.	<i>Pachyelasma tessmanii</i>	Leguminosae	Dried fruit	101
55.	<i>Pachypodanthium staud</i>	Annonaceae	Dried stem-bark	101
56.	<i>Piper betle</i> Linn.	Piperaceae	Plant extract	102, 103
57.	<i>Plumbago indica</i> Linn.	Plumbaginaceae	Root	104
58.	<i>Pongamia pinnata</i> Linn.	Fabaceae	Leaves	105
59.	<i>Psoralea corylifolia</i> Linn.	Fabaceae	Leaves and Seeds	92
60.	<i>Raphia farinifera</i>	Palmae	Dried fruit	106
61.	<i>Ricinus communis</i> Linn.	Euphorbiaceae	Seed	107
62.	<i>Richiea caparoides</i>	Capparidaceae	Leaf, root	77
63.	<i>Rynchosia hirta</i>	Leguminosae	Whole plant	108
64.	<i>Sargentodoxa cuneata</i>	Sargentodoxaceae	Dried stem	79
65.	<i>Saxifraga stracheyion</i> Hook. f. & Thorns.	Saxifragaceae	Roots	109
66.	<i>Solanum khasanum</i> Clarke.	Solanaceae	Berries	110
67.	<i>Sphaeranthus indicus</i> Linn.	Asteraceae	Leaf	111
68.	<i>Streblus asper</i> Lour.	Moraceae	Stem bark	112, 113
69.	<i>Tinospora crispa</i> (L.) Hook. f. & Thomson	Menispermaceae	Stem	114
70.	<i>Trachyspermum ammi</i> Linn.	Apiaceae	Plant extract	115
71.	<i>Vitex negundo</i> Linn.	Verbenaceae	Leaves	116, 117
72.	<i>Withania somnifera</i> Dunal.	Solanaceae		118
73.	<i>Xylocarpus granatum</i> Koenig	Meliaceae	Fruit	114
74.	<i>Zingiber officinale</i> Rosc.	Zingiberaceae	Rhizomes	119

Table 6: List of Marketed Preparation of Herbals Used In Lymphatic Filariasis [120-134]

S.No.	Brand Name	Active Constituents	Dosage Form	Dose	References
1.	Harithaki Kalkyam	Terminalia Chebula	Paste	50 mg	120, 121
2.	Vrudda Daru Chornam	Lettsomia Nervosa	Powder	70 mg	120, 121
3.	Pippalyadi Chornam	Piper Longum, Terminalia Chebula	Powder	60 mg	120, 121
4.	Sowreshwara Grutham	Vitex Negunda, Pinus Deodar Devdar	Paste	500 mg	120, 121
5.	Vidangadhi Tylam	Embella Ribes Zingiber Officianale	Syrup	100 ml	120, 121
6.	Nityanandarasa	Suddha Hingula, Gandhakabhasma	Tablet	100 mg	122, 123
7.	Sleepadagajakesari	Trikatuka, Suddha Nabhi, Ajovan	Pill	1 gm	122, 124
8.	Vidangadi Taila	Vidangadi	Syrup	100 ml	122, 125

9.	Nityanand-Ras	Ginger, Black pepper, Heavy Metals	Tablet	250-500 mg	126, 127
10.	Kanchnaar-Guggulu	Kanchnaar, Guggulu	Tablet	500 mg	126, 128
11.	Triphala-Guggulu	Chebolic Myrobalan, Indian Gooseberry, Belleric Myrobalan	Tablet	500 mg	126, 129
12.	Arogya-Vardhini	Heavy Metals, Guggulu	Tablet	500 mg	130
13.	Sookshma-Triphala	Triphala, Kajjali	Tablet	250 mg	131
14.	Gandhak-Rasayan	Gandhak	Tablet	250 mg	132
15.	Mahamanjishthadi-Qadha	Manistha, Musta, Neem	Syrup	450 ml	133, 134

CONCLUSION

Available literature and Ethno medical surveys described the use of the plants in traditional system of medicine as anti-filarial agents ensuring their clinical efficacy and safety. The present review is a survey of literature demonstrates the importance of natural herbal products in treatment of lymphatic filariasis.

Now-a-days, Due to fewer side effects of herbal drugs medicines, the significance of herbal drugs in medicine has increased broadly. Therefore, the demand for the herbal formulation is increasing day by day. In future, the molecular mechanism of the plants drugs should be understood and lead molecules are to be isolated to meet the demand and requirement of the high potency and to develop

best herbal formulations to replace or compensate the currently available synthetic formulations. The invention of the novel lead molecules might hopefully convey upgrade in the safe and effective treatment of lymphatic filariasis.

Acknowledgment

The authors are thankful to the Director, Shri Rawatpura Sarkar Institute of Pharmacy, Kumhari, Durg (C.G.) for providing the necessary infrastructure. The authors are thankful to CGCOST /MRP/1120/MRP for financial assistance.

Conflict of interest

The authors have no conflict of interest.

REFERENCES

- [1]. http://www.cdc.gov/parasites/lymphaticfilariasis/gen_info/faqs.html
- [2]. https://en.wikipedia.org/wiki/Wuchereria_bancrofti
- [3]. <http://www.digherbs.com/lymphatic-diseases.html>
- [4]. <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2918796/>
- [5]. <http://patient.info/doctor/lymphatic-filariasis>
- [6]. http://apps.who.int/iris/bitstream/10665/85347/1/9789241505291_eng.pdf
- [7]. <http://www.who.int/mediacentre/factsheets/fs102/en/>
- [8]. <http://www.cdriindia.org/shailja.htm>
- [9]. http://karhfw.gov.in/PDF/Copy%20of%20ELFG%2015.04_Revised2_18.8.pdf
- [10]. Pandey A. Current Status of Lymphatic Filariasis in Sarangarh Tehsil, District Raigarh, Chhattisgarh. IOSR Journal of Pharmacy and Biological Sciences 10, 2015, 1-3.
- [11]. Sabesan S, Vanamail P, Raju KH, Jambulingam P. Lymphatic filariasis in India: epidemiology and control measures. Journal of postgraduate medicine. 1, 56(3), 2010, 232.
- [12]. <http://monsterologist.blogspot.in/2014/12/lymphatic-filariasis.html>
- [13]. <http://www.news-medical.net/health/What-is-Filariasis.aspx>
- [14]. <http://netclass.csu.edu.cn/JPKC2007/CSU/29jishengchong/jiaoxuekejian/English/4.Nematodes3.ppt>
- [15]. Rao RU. Endosymbiotic Wolbachia of parasitic filarial nematodes as drug targets. Indian Journal of Medical Research. 1,122(3), 2005, 199.

- [16]. <http://www.med.cmu.ac.th/dept/parasite/nematode/wbmf.htm>
- [17]. http://nematode.net/NN3_frontpage.cgi?nav_bar_selection=speciestable&subnav_selection=Brugia_malayi
- [18]. deVries CR. Basic science of lymphatic filariasis. Indian Journal of Urology 2005, 21 5-8.
- [19]. <http://www.dermnetnz.org/arthropods/filariasis.html>
- [20]. <https://www.us.elsevierhealth.com/media/us/samplechapters/9781416044703/Chapter%2084.pdf>
- [21]. http://medicinosul.uomosul.edu.iq/files/pages/page_8874975.pdf
- [22]. http://www.pathobio.sdu.edu.cn/sdjsc/theory_eng_ppt/Filariae%20spiralis.ppt
- [23]. <http://www.drrajkumarsharma.com/drgaurav/LYMPHATIC%20FILARIASIS.htm>
- [24]. <http://hpathy.com/cause-symptoms-treatment/filariasis/>
- [25]. Tripathi RP, Katiyar D, Dwivedi N, Singh BK, Pandey J. Recent developments in search of antifilarial agents. Current medicinal chemistry. 1, 13(27), 2006, 3319-34.
- [26]. <http://www.pitt.edu/~super7/31011-32001/31201-31211.ppt>
- [27]. Shahab Mohd, Bhattacharya SM. Combating Mosquito-Borne Lymphatic Filariasis with Genomics Technologies: Enabling Novel Drug Discovery for Neglected Tropical Diseases. Current Pharmacogenomics and Personalized Medicine 10, 2012, 148-158
- [28]. Anitha K, Shenoy RK. Treatment of lymphatic filariasis: Current trends. Indian Journal of Dermatology, Venereology, and Leprology. 1, 67(2), 2001, 60.
- [29]. https://en.wikipedia.org/wiki/Wuchereria_bancrofti
- [30]. <http://www.truckeemeadowherbs.com/ns/DisplayMonograph.asp?StoreID=C9F86B352F584C1195F89F22478F18AD&DocID=condition-lymphaticfilariasis>
- [31]. <http://www.ncbi.nlm.nih.gov/pubmed/18978537>
- [32]. Mahajan RS, Goswami K, Hande S, Bhoj P. Evolution of anti-filarial therapeutics: An overview. Journal of Microbiology and Antimicrobial Agents. 1(1), 2015.
- [33]. <http://www.drugs.com/cons/diethylcarbamazine.html>
- [34]. <http://www.drugbank.ca/drugs/DB00711>
- [35]. <http://www.medicinenet.com/ivermectin-oral/article.htm>
- [36]. <http://reference.medscape.com/drug/stromectol-ivermectin-342657>
- [37]. http://www.medicinenet.com/mebendazole_chewable-oral/article.htm
- [38]. <http://www.drugs.com/mtm/mebendazole.html>
- [39]. <http://emedicine.medscape.com/article/1109642-overview#a3>
- [40]. <http://www.bddrugs.com/product5.php?page=2&idn=299&prev1=&prev=>
- [41]. <http://emedicine.medscape.com/article/1109642-overview#a4>
- [42]. <http://www.cyto.purdue.edu/cdroms/cyto2/17/chmrx/antifilr.htm>
- [43]. file:///E:/LF/27_10_15/Elephantiasis%20Symptoms,%20Causes%20&%20Treatment.html
- [44]. Sahare KN, Singh V. Antifilarial potential of Vitex negundo L. leaves and diethylcarbamazine citrate against Setaria cervi in vitro. WJPPS. 3(6), 2014, 1605-12.
- [45]. Mendam K, Kavitha B, Naik SJ. NATURAL SOURCES USED FOR TREATMENT AND PREVENTION OF FILARIASIS.
- [46]. Sahare KN, Anandharaman V, Meshram VG, Meshram SU, Gajalakshmi D, Goswami K, Reddy MV. In vitro effect of four herbal plants on the motility of Brugia malayi microfilariae. Indian Journal of Medical Research. 127(5), 2008, 467.
- [47]. Ranjini G, Selvakumari E, Gopal V. Perception of natural antifilarial drugs. International Research Journal of Pharmacy 4, 2013, 27-30.
- [48]. Maurya SK, Singh AK, Seth A. POTENTIAL MEDICINAL PLANTS FOR LYMPHATIC FILARIASIS: A REVIEW. Journal of Critical Reviews. 2(1), 2014, 1-6.
- [49]. Ghosh MA, Babu SP, Sukul NC, Mahato SB. Antifilarial effect of two triterpenoid saponins isolated from Acacia auriculiformis. Indian journal of experimental biology. 31(7), 1993, 604-6.
- [50]. Ghosh NK, Babu SS, Sukul NC, Ito A. Cestocidal activity of Acacia auricu filiformis. Journal of helminthology. 70, 1996, 172.
- [51]. Murthy PK, Joseph SK. Plant products in the treatment and control of filariasis and other helminth infections and assay systems for antifilarial/anthelmintic activity. Planta medica. 77(06), 2011, 647-61.

- [52]. Haerdi F. Die Eingeborenen-Heilpflanzen des Ulanga-Distriktes Tanganjikas (Ostafrika). In: Haerdi F, Kerharo J, Adam JG eds, Afrikanische Heilpflanzen / Plantes médicinales africaines Acta Tropica Supplementum 1964, 1-278.
- [53]. Sahare KN, Anandhraman V, Meshram VG, et al. Anti-microfilarial activity of methanolic extract of *Vitex negundo* and *Aegle marmelos* and their phytochemical analysis. Indian J Exp Biol 46, 2008, 128–131.
- [54]. Sahare KN, Anandharaman V, Meshram VG, Meshram SU, Gajalakshmi D, Goswami K, Reddy MV. In vitro effect of four herbal plants on the motility of *Brugia malayi* microfilariae. Indian Journal of Medical Research. 127(5), 2008, 467.
- [55]. Sharma RD, Veerpathran AR, Dakshinamoorthy G, Sahare KN, Goswami K, Reddy MV. Possible implication of oxidative stress in anti filarial effect of certain traditionally used medicinal plants in vitro against *Brugia malayi* microfilariae. Pharmacognosy research. 2(6), 2010, 350.
- [56]. Sharma RD, Veerpathran AR, Dakshinamoorthy G, Sahare KN, Goswami K, Reddy MV. Possible implication of oxidative stress in anti filarial effect of certain traditionally used medicinal plants in vitro against *Brugia malayi* microfilariae. Pharmacognosy research. 2(6), 2010, 350.
- [57]. Oliver BEP. Anti-infective activity of higher plants. In, Medicinal plants in Tropical West Africa. Cambridge: Cambridge University Press. 1986, 123-190.
- [58]. Ojewole JAO. Studies on the pharmacology of echitamine, an alkaloid from the stem bark of *Alstonia booneri* L. (Apocynaceae) Int J Crude Drugs Res 22, 1984, 121-143.
- [59]. Yadav D, Kushwaha V, Saxena K et al. Diarylheptanoid compounds from *Alnus nepalensis* express *in vitro* and *in vivo* antifilarial activity. Acta Trop 128, 2013, 509–517.
- [60]. Yadav D, Singh SC, Verma RK, Saxena K, Verma R, Murthy PK, Gupta MM. Antifilarial diarylheptanoids from *Alnus nepalensis* leaves growing in high altitude areas of Uttarakhand, India. Phytomedicine. 20(2), 2013, 124-32.
- [61]. Dalziel JM. The Useful Plants of West Tropical Africa. London: The Crown Agents for the Colonies. 1937, 612.
- [62]. Guha Bakshi DN, Sensarma P, Pal DC. A lexicon of medicinal plants in India. Calcutta: Naya Prokash; 1999, 290.
- [63]. Dutta A, Sukul NC. Filaricidal properties of a wild herb, *Andrographis paniculata*. J Helminthol 56, 1982, 81–84.
- [64]. Zaridah MZ, Idid SZ, Omar AW, Khozirah S. In vitro antifilarial effects of three plant species against adult worms of subperiodic *Brugia malayi*. Journal of ethnopharmacology. 78(1), 2001, 79-84.
- [65]. Misra S, Verma M, Mishra SK, Srivastava S, Lakshmi V, Misra-Bhattacharya S. Gedunin and photogedunin of *Xylocarpus granatum* possess antifilarial activity against human lymphatic filarial parasite *Brugia malayi* in experimental rodent host. Parasitology research. 109(5), 2011, 1351-60.
- [66]. Watt JMM, Breyer-Brandwijk G. The medicinal and poisonous plants of Southern and Eastern Africa. London: E. & S. Livingstone Ltd. 1962.
- [67]. Githens TS. Drug Plants of Africa, African Handbooks No.8. Philadelphia: University of Pennsylvania Press. 1948, 125.
- [68]. Singh R, Khan NU, Singhal KC. Potential antifilarial activity of roots of *Asparagus adscendens* Roxb, against *Setaria cervi* in vitro. Indian journal of experimental biology. 35(2), 1997, 168-72.
- [69]. Mathai A, Devi KS. Anti-parasitic activity of certain indigenous plants. Anc Sci Life 12, 1992, 271–273.
- [70]. Mishra V, Parveen N, Singhal KC et al. Antifilarial activity of *Azadirachta indica* on cattle filarial parasite *Setaria cervi*. Fitoterapia 76, 2005, 54–61.
- [71]. Sashidhara KV, Singh SP, Misra S, Gupta J, Misra-Bhattacharya S. Galactolipids from *Bauhinia racemosa* as a new class of antifilarial agents against human lymphatic filarial parasite, *Brugia malayi*. European journal of medicinal chemistry. 50, 2012, 230-5.
- [72]. Sahare KN, Anandharaman V, Meshram VG, Meshram SU, Gajalakshmi D, Goswami K, Reddy MV. In vitro effect of four herbal plants on the motility of *Brugia malayi* microfilariae. Indian Journal of Medical Research. 127(5), 2008, 467.

- [73]. Sharma RD, Veerpathran AR, Dakshinamoorthy G, Sahare KN, Goswami K, Reddy MV. Possible implication of oxidative stress in anti filarial effect of certain traditionally used medicinal plants in vitro against *Brugia malayi* microfilariae. *Pharmacognosy research*. 2(6), 2010, 350.
- [74]. Datte JY, Traore A, Offoumou AM, Ziegler A. Effects of leaf extract of *Caesalpinia bonduc* (Caesalpiniaceae) on the contractile activity of uterine smooth muscle of pregnant rats. *Journal of ethnopharmacology*. 60(2), 1998, 149-55.
- [75]. Gaur RL, Sahoo MK, Dixit S et al. Antifilarial activity of *Caesalpinia bonducella* against experimental filarial infections. *Indian J Med Res* 128, 2008, 65–70.
- [76]. Banu MJ, Nellaiappan K, Dhandayuthapani S. Mitochondrial malate dehydrogenase and malic enzyme of a filarial worm *Setaria digitata*: some properties and effects of drugs and herbal extracts. *Jpn J Med Sci Biol* 45, 1992, 137-150.
- [77]. Ayensu ES. *Medicinal Plants of West Africa*. Algonac, Michigan: Reference Publications Inc. 1978; 330.
- [78]. Deka L, Majumdar R, Dutta AM. Some ayurvedic important plants form district Karnrup (Assam). *Ancient Sci Life* 3, 1983, 108-115.
- [79]. Iwu MM. *Empirical Investigation of Dietary Plants Used in Igbo Ethnomedicine*. New York: Nina Etkind Redgroove Publishing Company. 1986, 116.
- [80]. Hedberg I, Hedberg O, Madati PJ et al. Inventory of plants used in traditional medicine in Tanzania. Part III. Plants of the families Papilionaceae-Vitaceae. *J Ethnopharmacol* 9, 1983, 237-260.
- [81]. Sahu TR. Less known uses of weeds as medicinal plants. *Ancient Sci Life* 4, 1984, 245-249.
- [82]. Ampofo O. "Plants that heal" *World Health. The Magazine of the World Health Organization* 1977, 26-30.
- [83]. Maheshwari JK, Singh KK, Saba S. Ethno-medicinal uses of plants by the Thurus of Kheri District, U. P. *Bull Med Ethnobot Res* 1, 1980, 318-337.
- [84]. Patra JK, Mohapatra AD, Rath SK, et al. screening of antioxidant and antifilarial activity of leaf extracts of *Excoecaria agallocha* L. *Int J Integr Bio* 7, 2009, 9–15.
- [85]. Mishra V, Khan NU, Singhal KC. Potential antifilarial activity of fruit extracts of *Ficus racemosa* Linn. against *Setaria cervi* in vitro. *Indian J Exp Biol* 43, 2005, 346–350.
- [86]. Kalani K, Kushwaha V, Verma R et al. Glycyrrhetic acid and its analogs: a new class of antifilarial agents. *Bioorg Med Chem Lett* 23, 2013, 2566–2570.
- [87]. Hoerauf A. New strategies to combat filariasis. *Expert Rev Anti Infect Ther* 4, 2006, 211–222.
- [88]. Fullerton M, Khatiwada J, Johnson JU et al. Determination of antimicrobial activity of sorrel (*Hibiscus sabdariffa*) on *Escherichia coli* O157:H7 isolated from food, veterinary, and clinical samples. *J Med Food* 14, 2011, 950–956.
- [89]. Saxena K, Dube V, Kushwaha V. Antifilarial efficacy of *Hibiscus sabdariffa* on lymphatic filarial parasite *Brugia malayi*. *Med Chem Res* 20, 2010, 1594–1602.
- [90]. Saini P, Gayen P, Nayak A et al. Effect of ferulic acid from *Hibiscus mutabilis* on filarial parasite *Setaria cervi*: molecular and biochemical approaches. *Parasitol Int* 61, 2012, 520–531.
- [91]. Misra N, Sharma M, Raj K, et al. Chemical constituents and antifilarial activity of *Lantana camara* against human lymphatic filariid *Brugia malayi* and rodent filariid *Acanthocheilonema viteae* maintained in rodent hosts. *Parasitol Res* 100, 2007, 439–448.
- [92]. Qamaruddin, Parveen N, Khan NU et al. In vitro antifilarial potential of the flower and stem extracts of *Leucas cephalotes* on cattle filarial parasite *Setaria cervi*. *J Nat Rem* 2, 2002, 155–163.
- [93]. Baoua M, Fayn J, Bassiere J. Preliminary phytochemical testing of some medical plants of Niger. *Planta Medica* 10, 1976, 251-266.
- [94]. Singhal KC, Sharma S, Mehta BK. Antifilarial activity of *Centratherum anthelminticum* seed extracts on *Setaria cervi*. *Indian J Exp Biol* 30, 1992, 546–548.
- [95]. Dragendorff G Stuttgart: Ferdinand Enke. Phytochemical and pharmacological studies on *Calotropis procera*. In, 3rd International Conference of Traditional and Folk Medicine Lecatecas, Mexico; 1985.
- [96]. Singh R, Singhal KC, Khan NU. Antifilarial activity of *Mallotus philippensis* Lam. on *Setaria cervi* (Nematoda: Filarioidea) in vitro. *Indian J Phys Pharmacol* 41, 1997, 397–403

- [97]. Kushwaha V, Saxena K, Verma SK, Lakshmi V, Sharma RK, Murthy PK. Antifilarial activity of gum from *Moringa oleifera* Lam. on human lymphatic filaria *Brugia malayi*. *Chronicles of Young Scientists*. 2(4), 2011, 201.
- [98]. Fujimaki Y, Kamachi T, Yanagi T, Caceres A, Maki J, Aoki Y. Macrofilaricidal and microfilaricidal effects of *Neurolaena lobata*, a Guatemalan medicinal plant, on *Brugia pahangi*. *Journal of helminthology*. 79(01), 2005, 23-8.
- [99]. BANU MJ, NELLAIAPPAN K, DHANDAYUTHAPANI S. Mitochondrial malate dehydrogenase and malic enzyme of a filarial worm *Setaria digitata*: some properties and effects of drugs and herbal extracts. *Japanese Journal of Medical Science and Biology*. 45(3), 1992, 137-50.
- [100]. Vasileva B. *Plants medic Conakrynales de Guinea*. Republic de Guinea: Conakry; 1969.
- [101]. Titanji VPK, Ayafor JF, Mulufi JP et al. In vitro killing of *Onchocerca volvulus* (Filaroidea) adults and microfilariae by selected Cameroonian medicinal plant extracts. *Fitoterapia* 58, 1987, 338-339.
- [102]. Tripathi S, Singh N, Shakya S. Gender based differences in phenol and thiocyanate contents and biological activity in *Piper betle* L. *Curr Sci* 91, 2008, 746-749.
- [103]. Singh M, Shakya S, Soni VK et al. The n-hexane and chloroform fractions of *Piper betle* L. trigger different arms of immune responses in BALB/c mice and exhibit antifilarial activity against human lymphatic filarid *Brugia malayi*. *Int Immunopharmacol* 9, 2009, 716-728.
- [104]. Mathew N, Paily Abidha KP, Vanamail P et al.. Macrofilaricidal activity of plant *Plumbago Indica/rosea in vitro*. *Drug Dev Res* 56, 2002, 33-39.
- [105]. Uddin Q, Parveen N, Khan NU et al. Antifilarial potential of the fruits and leaves extracts of *Pongamia pinnata* on cattle filarial parasite *Setaria cervi*. *Phytother Res* 17, 2003, 1104-1107.
- [106]. Kokward JO. *Medicinal plants of East Africa*. Nairobi, Kenya: East Africa Literature Bureau; 1976.
- [107]. Shanmugapriya R, Ramanathan T. Antifilarial activity of seed extracts of *Ricinus communis* against *Brugia malayi*. *J Pharm Res* 5, 2012, 1448-1450.
- [108]. Kerharo J, Adam JG. *Pharmacopée sénégalaise traditionnelle*. Paris: Vigot; 1974.
- [109]. Singh R, Singhal KC, Khan NU. Exploration of antifilarial potential and possible mechanism of action of the root extracts of *Saxifraga stracheyi* on on cattle filarial parasite *Setaria cervi*. *Phytother Res* 2000; 14 63-66.
- [110]. Ghosh M, Shinhbabu SP, Sukul NC et al. Antifilarial effect of solamargine isolated from *Solanum Khastanum*. *Int J Pharm* 32, 1994, 1-7.
- [111]. Mishra V, Parveen N, Singhal KC, Khan NU. Antifilarial activity of *Azadirachta indica* on cattle filarial parasite *Setaria cervi*. *Fitoterapia*. 76(1), 2005, 54-61.
- [112]. Mathai A, Devi KS. Anti-parasitic activity of certain indigeous plants. *Ancient science of life*. 12(1-2), 1992, 271.
- [113]. Chatterjee RK, Fatma N, Murthy PK et al. Macrofilaricidal activity of the stem bark of *Streblus asper* and its major active constituents. *Drug Dev Res* 26, 1992, 67-78.
- [114]. Zaridah MZ, Idid SZ, Omar AW, Khozirah S. In vitro antifilarial effects of three plant species against adult worms of subperiodic *Brugia malayi*. *Journal of ethnopharmacology*. 78(1), 2001, 79-84.
- [115]. Mathew N, Misra-Bhattacharya S, Perumal V, Muthuswamy K. Antifilarial lead molecules isolated from *Trachyspermum ammi*. *Molecules*. 13(9), 2008, 2156-68.
- [116]. Parveen N. Antifilarial activity of *Vitex negundo* L. against *Setaria cervi*. *Fitoterapia* 62, 1991, 163.
- [117]. Sahare KN, Singh V. Antifilarial activity of ethyl acetate extract of *Vitex negundo* leaves in vitro. *Asian Pacific journal of tropical medicine*. 6(9), 2013, 689-92.
- [118]. Kushwaha S, Soni VK, Singh PK, Bano N, Kumar A, Sangwan RS, MISRA-BHATTACHARYA S. *Withania somnifera* chemotypes NMITLI 101R, NMITLI 118R, NMITLI 128R and withaferin A protect *Mastomys coucha* from *Brugia malayi* infection. *Parasite immunology*. 34(4), 2012, 199-209.
- [119]. Datta A, Sukul NC. Antifilarial effect of *Zingiber officinale* on *Dirofilaria immitis*. *J Helminthol*. 61(3), 1987, 268-70.
- [120]. [Http://Ayurvedamsrinivasa.Com/Treatments/Filariasis.Html](http://Ayurvedamsrinivasa.Com/Treatments/Filariasis.Html)
- [121]. <http://www.blazelead.com/Vidangadi-Taila/Venkateswara-Ayurveda-Nilayam/NP/2650163-5151-0/>
- [122]. [Http://Ayuraarogyam.Com/Filariasis-C-88_59/](http://Ayuraarogyam.Com/Filariasis-C-88_59/)
- [123]. <http://www.amritadrugs.com/Ingredient/h-hingula-shuddha.php>

- [124]. http://ayuraarogyam.com/filariasis-c-88_59/
- [125]. http://ayuraarogyam.com/sastric-or-traditional-products-c-88_25/vidangadi-taila-p-217.html
- [126]. [Http://Ezinearticles.Com/?Filariasis-\(Elephantiasis\)---Ayurvedic-Herbal-Treatment&Id=2053565](http://Ezinearticles.Com/?Filariasis-(Elephantiasis)---Ayurvedic-Herbal-Treatment&Id=2053565)
- [127]. [Http://Ayurvedinfo.Com/2012/07/26/Nityananda-Rasa-Benefits-Dosage-Ingredients-Side-Effects/](http://Ayurvedinfo.Com/2012/07/26/Nityananda-Rasa-Benefits-Dosage-Ingredients-Side-Effects/)
- [128]. [Https://Www.Ayurtimes.Com/Kanchanar-Guggulu-Or-Kanchnar-Guggul/](https://Www.Ayurtimes.Com/Kanchanar-Guggulu-Or-Kanchnar-Guggul/)
- [129]. [Http://Www.Triphalapowderbenefits.Com/Triphala-Guggul/](http://Www.Triphalapowderbenefits.Com/Triphala-Guggul/)
- [130]. <http://ayurvedinfo.com/2012/07/10/aogyavardhini-vati-benefits-dosage-ingredients-side-effects/>
- [131]. <http://www.ayurvedikalp.com/product/Ayurveda-Rasashala-SOOKSHMA-TRIPHALA-60-Tablets-for-Tonsillitis-Stomatitis>
- [132]. <http://ayurvedinfo.com/2012/07/21/gandhaka-rasayana-benefits-dosage-ingredients-side-effects/>
- [133]. <http://www.healthbyayurveda.in/products/Mahamanjisthadi-Kadha-.html>
- [134]. <http://ayurvedinfo.com/2012/02/15/maha-manjishtadi-kashayam-benefits-dose-side-effects-ingredients-reference/>