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Determination of plant families having greater Anthelmintic activity

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ABSTRACT

Helminthic infections are among the most widespread infections in humans, distressing a huge population of the world. Normally, the worm lives in GI tract and liver. Most of the synthetic medicine is curing helminthiasis, Synthetic anthelmintic drugs Albendazole, Mebendazole, Niclosamide, Piperazine, Praziquantel, Diethyl carbamazine, Levamisole, Ivermectin, Oxamniquineare are generally using for helminthiasis, but they also have too much adverse effect and toxicity i.e. vomiting, nausea, diarrhea, edema, peptic ulceration etc.So it has been observed alternate / herbal medicine system having beneficial effect on human being to minimize the drawback over synthetic drugs. Hence this review focuses on helminthes, different type of worm, synthetic anthelmintic drug & herbal medicinal drug to treat helminthiasis.

In developing countries they cause a major threat to public health andcontribute to the prevalence of malnutrition, anemia, eosinophilia, andpneumonia. Anthelmintics are drugs that either kill or expel infestinghelminthes and the gastrointestinal tract is the abode of many helminthes,although some also live in tissues, or their larvae migrate into tissues.They harm the host by depriving him of food, causing blood loss, injuryto organs, intestinal or lymphatic obstruction and by secreting toxins.Helminthiasis is rarely fatal, but is a major cause of morbidity.

Key Word: Helminthic, Albendazole, Mebendazole, Niclosamide, piperazine.

INTRODUCTION

Medicinal plants were the potent source of many pharmacological activities.Among that the plants of anthelmintic action has attained a great interest due the capability of the plant and its compound to treat a disease that causes major economic loss and reduced livestock production to the livestock holders. The pathogenic infection causes the severe effect of mortality and other problems that were uncontrolled due to the anthelmintic resistance that is developed in the host organism. Even though, many synthetic drugs were manufactured; they produce more side effect than that of the treatment efficacy. Hence, the need for the exploration of the plants for the treatment has attained a great interest.Our traditional system of medicine has made use of the different parts of plants in different types of diseases, including anthelmintic, anti-inflammatory and antimicrobial activities. Kavirajes and Hakims are still using several medicinal plants to treat helminthiasis. During the recent years, medicinal chemistry has made great strides, especially in synthetic chemistry but, for the sake of therapeutic effect up to the level and nontoxic treatment for helminthiasis, the research of plant-derived drug therapy is mostly needed.

In developing countries they pose a large threat to public health and contribute to the prevalence of anaemia, malnutrition, eosinophilia and pneumonia. Although the majority of infections due to worms are generally limited to tropical countries, they can occur to travelers, who have visited those areas and some of them can be developed in temperate climates . The helminthes which infect the intestine are cestodes e.g. Tapeworms (Taenia solium), nematodes e.g. hookworm (Ancylostoma duodenale), roundworm (Ascaris lumbricoids) and trematodes or flukes (Schistosoma mansoni and Schistosoma hematobolium). The diseases originated from parasitic infections causing severe morbidity
include lymphatic filariasis, onchocerciasis and schistosomiasis. These infections can affect most populations in endemic areas with major economic and social consequences.

Helminthes also affect millions of livestock resulting in considerable economic losses in domestic and farm yard animals. Because of limited availability and affordability of modern medicines most of the world's population depends to a greater extent on traditional medical remedies. The traditional medicines hold a great promise as source of easily available effective anthelmintic agents to the people, particularly in tropical developing countries, including India. It is in this context that the people consume several plants or plant-derived preparations to cure helminthic infections . Ideally an anthelmintic agent should have broad spectrum of action, high percentage of cure with a single therapeutic dose, free from toxicity to the host and should be cost effective. None of the synthetic drug available meets this requirement. Even most common drugs like Piperazine salts have been shown to have side effects like nausea, intestinal disturbances and giddiness. Resistance of the parasites to existing drugs and their high cost warrants the search for newer anthelmintic molecules. The origin of many effective drugs is found in the traditional medicine practices and in view of this several researchers have undertaken studies to evaluate folklore medicinal plants for their proclaimed anthelmintic efficacy . Most of the screenings reported are in vitro studies using some worm samples like Indian earthworm Pheretima posthuma, Ascardia galli, Ascaris lumbricoids, etc. Adult Indian earthworm, Pheretima posthuma has been used as test worm in most of the anthelmintic screenings, as it shows anatomical and physiological resemblance with the intestinal roundworm parasite of human beings. Because of easy availability, earthworms and Ascardia galli worms are used as suitable models for screening of anthelmintic drug . These in vitro screenings are important as they give basis for further in vivo studies.

Helminthiases are parasitic worm infections that cause morbidity to their host. They infect man and animals, causing stunted growth and a substantial threat to health. Helminths infection is a huge challenge, both in developing and developed countries due to their continuous contamination of the environment with their eggs and larvae. Helminths diseases are one of the most neglected among the healthcare systems. Its neglect could be as a result of it chronic and asymptomatic nature of infection, particularly at an early stage. The most common helminths are the soil-transmitted helminths (STH) or intestinal nematodes, filarial worms, schistosomes and onchocerciasis worm. The life cycle of a parasite worm could be very complex, with multiple hosts for different stages; moreover, a major adaptive uttermost parasitism of a worm is a complex life cycle involving trophic transmission. The developmental life-cycle of some helminths (soil-borne nematodes) such as Strongyloides and Hookworms have a free-living stage (rhabditiform larvae) and a parasitic stage (filariform larva) which may require a different host or environment.

For example;

The seeds of Caesalpinia crista L. a member of the Fabaceae family are used to treat asthma, chronic fever, cough, headache, stomach or bowel upset and helmintiasis.

Albizia schimperiana of the Fabaceae family is known for its anthelmintic properties .

Albizia gummifera belonging to the Fabaceae family is used in the treatment of guinea- worm and as a vermifuge in children.

Acacia nilotica belongs to the Fabaceae family and has used widely as an astringent, insect repellent.

Ocimum sanctum a member of the Lamiaceae is widely used as an anthelmintic, expectorant, antipyretic, insecticidal and in a variety of skin diseases .

Gastrointestinal parasite becomes a serious threat to the livestock production in the developing nations. Inspite of the development of anthelmintic resistance in the parasites of higher economical significance, chemotherapy is still used widely for the purpose of controlling the helminthes .Helminthiasis which is caused by the helminthes infection is proved to be a major constraint in the livestock production all around the globe. As mentioned above, chemotherapeutics remain the corner stone for treating the helminthiasis by overcoming certain factors such as chemical residues and toxicity, increased cost, non-adaptability of drugs and non-availability in the remote areas .

Synthetic anthelmintics were the only soul source for the control of the gastrointestinal nematode by means of continuous and intensive use in the recent decades. However, certain constraints like the high cost of these drugs and the usual development of the nematode-resistant populations, along with the risk of contamination of the animal products and environment have lead to the search for control alternatives. The usage of medicinal plants for the above problem is more acceptable from the ancient period since they have the advantage of sustainable supply and are ecologically acceptable.

The symptoms of helminths depend on some factors which should be considered during diagnosis. The factors include; the type of worm infection, the duration of infection, the area of infection and the worm burden in the host. The common symptoms of helminthiases are; abdominal pain, diarrhoea, malnutrition, fatigue, enlarged

liver and spleen, gastrointestinal inflammation, pneumonitis, blindness, eosinophilia, bowel obstruction, anaemia, vomiting,
constipation, lymphedema, weight loss, itchy skin and or anus . Long-term exposure to helminths and the worm burden in the infected person is directly related to morbidity and severity of the disease, in almost all kinds of worm infections. There are ranges of diagnostic tools for helminthic infection, which include;

(1) FECAL EGG EXAMINATION: the parasite (s) is identified by microscopically examining the eggs in the faeces of the host, for instance in the case of HAEMONCHUS CONTORTUS, ANCYLOSTOMA DUODENALE, HYMENOLEPIS DIMINUTA and schistosomes infection.

(2) ANTIGEN TEST: parasites produce enzymes, hormones and waste that activate the immune response of the host. This response is a biomarker that could be quantified and qualify but this area of diagnosis is still underdeveloped.

(3) SEROLOGICAL ASSAY: the serum of the host is examined for the parasite-specific antibodies, Echinococcosis can be diagnosed using this technique.

(4) NUCLEIC ACID-BASED DIAGNOSIS: every organism carries unique DNA sequences. This diagnostic probe is sensitive and specific. It is developed to identify and isolate DNA sequences of different species of parasite.

(5) Urine examination: uses point-of-care circulating-cathodic-antigen (POC-CCA) urine test or microscopically examining parasite eggs in host urine, commonly used as a diagnostic tool for Schistosomiasis.

(6) OTHER TOOLS: could involve physical examination of infected areas, confirmation of parasite hydatid cysts in the tissue of the host in the case of Echinococcosis .

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The World Health Organization (WHO) estimates that one billion peopleare infected with Ascaris lumbricoides and 500 million with Trichuristrichiura. Tissue-living nematodes are also an important health problem,with 100 million people being infected with filarial worms such asWucheraria bancrofti and Onchocerca volvulus. The prevalence of helminthiasis is particularly intense in children in countries with poor sanitation, a low standard of education, and little health education .The extent of debility and ill health caused by worms is related to the worm load, type and duration of the infection, with treatment being directed primarily at reduction of worm load. Although the mortality rate associated with parasite infestations is negligible, morbidity such as impaired physical and mental development is significant. The major impact of parasitic infection is the impairment of nutritional status in the patient. A commonly reported consequence of parasitic infection is lethargy, connected not only with a lack of energy for physical activity,but also for mental effort. In addition to the direct impact of nematodes on human health, helminthiasis is a major factor adversely influencing animal breeding. The

nematode life cycle includes an egg, four larval stages, and the adult stage. In the parasitic nematodes most studied, the adults are usually parasitic, and the larval stages free-living or
Parasitic in an intermediate host. One stage has usually been developed which completes the transition from free-living to parasitic - the infective stage. Parasitic nematodes are often a long-lived ensheathed, resistant,non-feeding stage, bridging the gap between the free-living and the parasitic habits. Roundworms are soil-transmitted, each species spending an obligatory period of development on the soil, free from its host.

A range of control measures for soil-transmitted helminthiasis is available based on chemotherapy, sanitation and health education. The proposed that the most practical way to control helminth infection is by chemotherapy using broad spectrum anthelmintics. There are several anthelmintic available for treating helminthiasis, but a major setback to their continued usage is the development of resistance.In addition, some currently used synthetic anthelmintics are expensive or not readily available. There is thus an urgent need for new,inexpensive drugs which will be able to act for longer periods before resistance sets in much effort is being made at the discovery of new anthelmintics of plant origin. An anthelmintic drug must have a wide margin of safety between its toxicity to the worm and its toxic side effect on the host. To be effective they should be orally active, produce result in a single dose and be cheap.

Resistance to each of the categories of anthelmintic drugs has been reported
and there is a need for new drugs with different mechanisms of action . Plants produce a broad spectrum of secondary metabolites or phytochemicals which aid in several biological activities including the defence of the plant against pests and diseases. The major classes of phytochemicals include phenolic, alkaloids and terpenoids compound. These phyto chemicals make some plants a good source of remedy for ailments. Plant secondary metabolites have been successfully used in ethnomedicine and are generally used for; insecticide, piscicidal, molluscicidal, antimicrobial, antiparasite and other ailments. The global demand for herbal medicines is rapidly on the increases, A relative number of medicinal plants have been reported to possess anthelmintic activity in modern medicine and also utilized by folk ethnic groups worldwide. Several medicinal plants, have been identified following the folk medicine claims and the isolated phytochemicals have been scrutinized for their anthelmintic activities in the search for novel anthelmintic drugs.There are several promising results obtained from in vitro and in vivo studies of antihelmintic medicinal plants but few or none of these results was translated into clinical practice .

Helminths are categorized into three major groups: nematodes (roundworms), trematodes (flukeworms), and cestodes (tapeworms). Almost all these parasites could be treated and the level of infection could be reduced below clinical significance with one or a combination of the following categories of anthelmintic drugs; benzimidazoles, macrocyclic lactones, levamisole, piperazine and amino-acetonitrile derivatives. However, the resistance of helminths to these drugs has been recorded in some literature which is common in the field of veterinary medicine .The resistance of helminths to drugs poses health complications to both man and animals worldwide. The knowledge of the genetics and mechanisms of helminths resistance to drugs is essential to prevent resistance; to newly developed anthelmintic drugs, to reduce the spread of resistant parasites and to better manage parasite control at all stages of their lifecycle. The resistance of gastrointestinal nematodes and also in others parasites worms such as liver fluke was documented to be high in ruminant . It is, therefore, necessary for parasitological exploration of the mechanisms of anthelmintic resistance in other to develop alternative treatment approaches and drugs for the control of helminths. The main strategies leading to the discovery of new anthelmintic drugs were mainly based on the screening of new drugs via an in vitro and in vivo test systems .

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AIM

The need for medicinal plants possessing anthelmintic activity is gaining interest due to the capacity of the constituents present in such plants to treat a disease that cause a major economic loss to the livestock holders and human beings. As pathogenic infections cause severe mortality, it can’t be controlled even with the use of synthetic drugs. The use of synthetic drugs causes more side effects than their therapeutic efficacy. So, there arises a need for exploring the medicinal plants that can cause a reduction in the helminthics infection. This study aims to identify and discuss about the different medicinal plant families having higher anthelmintic properties.

IMPORTANCE OF ANTHELMINTIC ACTIVITY

An anthelmintic is an agent used to remove parasitic worms from the body of the host. These worms, belonging to the animal phyla Nemathelminthes (roundworms) and Platyhelminthes (tapeworms and flukes), are endoparasites of man, of other animals and at times of certain plants. The anthelmintic agents used in human infections consist primarily of drugs and dyes, which act to narcotize, kill and at times digest the worms. In the case of helminthes inhabiting the gastrointestinal tract and biliary passages the dislodged worms are usually evacuated in the faeces.

Anthelmintics are used to treat people who are infected by helminthes or parasitic worms. These drugs are also commonly used to treat infected animals.

In humans, the **classes** of parasitic worms include:

Cestodes: flatworms and tapeworms

Trematodes: flukes

Nematodes: roundworms, also called whipworms, pinworms, hookworms, and threadworms.

Common names for helminth infections include:

Enterobiasis: caused by Enterobius vermicularis, a pinworm

Acariasis: caused by ascaris worms, a type of roundworm

Beef tapeworm: caused by Taenia saginata

Pork tapeworm: caused by Taenia solium

Schistosomiasis (also called bilharziasis): caused by Schistosoma, a type of fluke

Filariasis: (also called elephantiasis) caused by filarial roundworms

Trichuriasis: caused by Trichuris trichiura, a whipworm

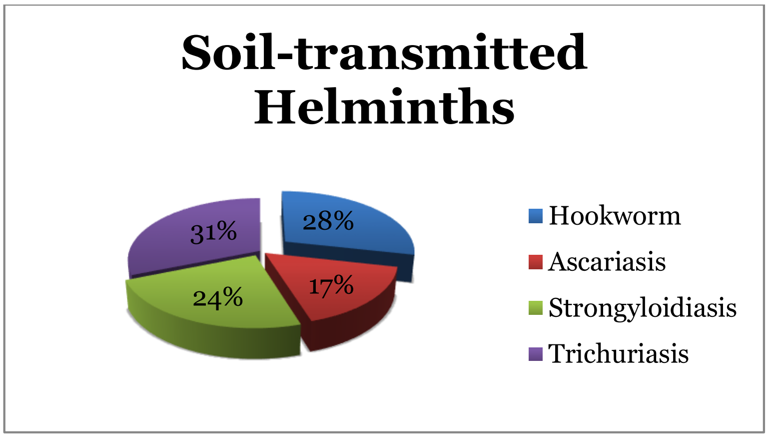
Soil-transmitted helmenthiasis:

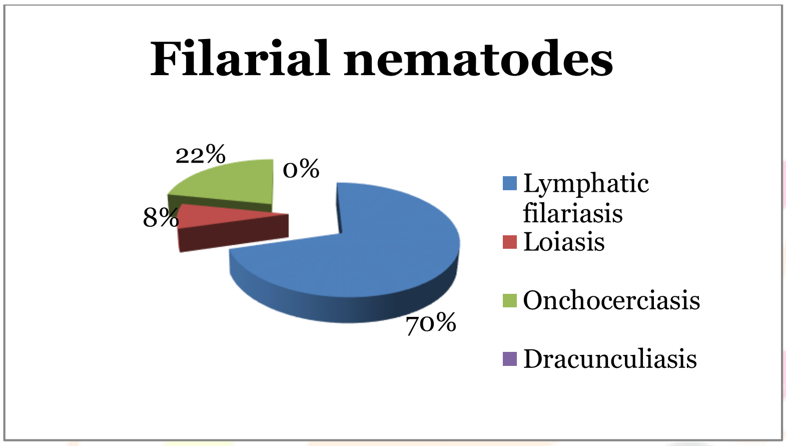
Soil-transmitted helmenthiasis (STH) is a group of parasitic infections of the intestine caused by nematode worms usually transmitted by soil. STH is the most prevalent of neglected tropical diseases and is responsible for significant morbidity and, indirectly, mortality in poor developing countries. STH contributes to general weakness, malnutrition, iron-deficiency anemia, and impaired physical and intellectual development in school-age children.(7) The three main causative worms of soil-transmitted helmenthiasis of public health importance are:

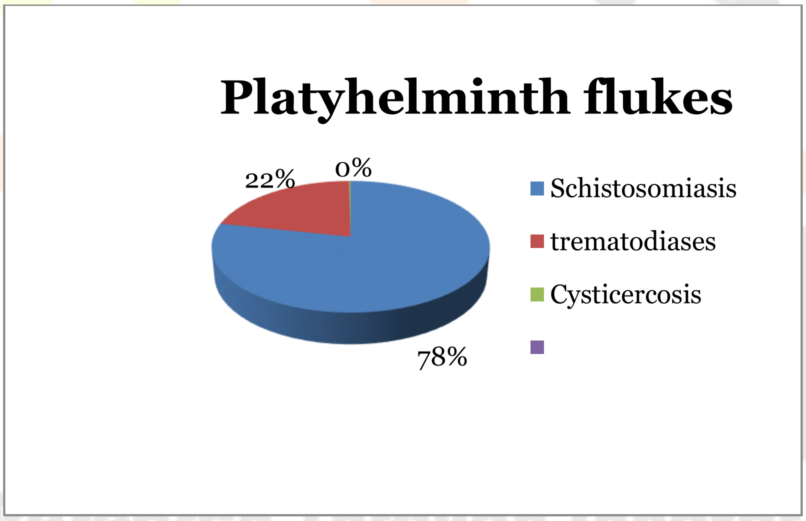
TABLE 1

Disease	Major parasite	Global prevalence (Million)	Regions of prevalence
Soil-transmitted Helminths			
Hookworm	NECATOR AMERICANUS; ANCYLOSTOMA DUODENALE	740–1300	Latin America, Sub-Saharan Africa, South Asia, and the Caribbean
Ascariasis	ASCARIS LUMBRICOIDES	1221–1472	Southeast Asia, Sub-Saharan Africa, and Latin America
Strongyloidiasis	STRONGYLOIDES STERCORALIS	30–100	Tropical and subtropical countries in Asia, Africa, and Latin America
Trichuriasis	TRICHURIS TRICHIURA	750–1050	Tropical Asia, Africa and South America
Filarial nematodes			
Lymphatic filariasis	BRUGIA MALAYI; WUCHERERIA BANCROFTI	120	Tropical and subtropical regions of Africa, Asia, South and Central America and Nations of Pacific Island
Loiasis	LOA LOA	13	West and Central Africa
Onchocerciasis (river blindness)	ONCHOCERCA VOLVULUS	37	Sub-Saharan Africa, Yemen and isolated areas of South America
Dracunculiasis	DRACUNCULUS MEDINENSIS	0.01	Chad, Ethiopia and Mali
Platyhelminth flukes			
Schistosomiasis	SCHISTOSOMA MANSONI; SCHISTOSOMA HAEMATOBIUM; SCHISTOSOMA JAPONICUM	200–209	Africa, Middle East, Brazil, Venezuela, the Caribbean, Suriname, China, Indonesia, the Philippines and France
Food-borne trematodiases	CLONORCHIS SINENSIS; FASCIOLOPSIS BUSKI; OPISTHORCHIS VIVERINNI; PARAGONIMUS SPP; FASCIOLA HEPATICA	56	East Asia and South America
Cysticercosis	TAENIA SOLIUM; ECHINOCOCCUS SPECIES; TAENIA SAGINATA	0.4	Latin America, West Africa, India, Russia, North-East China, Pakistan and Southeast Asia

Global prevalence of major human helminthes and regions.


Soil-transmitted Helminths
28%
17%
24%
31%
Hookworm
Ascariasis
Strongyloidiasis
Trichuriasis


Filarial nematodes
22%
0%
8%
70%
Lymphatic filariasis
Loiasis
Onchocerciasis
Dracunculiasis


Platyhelminth flukes
22%
0%
78%
Schistosomiasis
trematodiases
Cysticercosis

SL No:	Plants	Family	Part Used	Effective against	Chemical constituent
1	Acacia albida	Fabaceae	Roots and leaves, Seeds	Nematodes, Tape worm	Stearic acid, oleic acid, linoleic acid, methyl ester and linolenic acid, methyl ester, Alkaloids, Saponins, Tannins, Flavanoids.
2	Acacia farnesiana	Fabaceae	Pods	Haemonchus contortus	Alkaloids, amides ,amines , carbohydrates, carboxylic acid , flavonoids , glycosides , phenol , proteins , reducing sugar , steroids , tannin , terpenoids , and amino acids.
3	Acacia oxyphylla	Fabaceae	Stem bark	Ascardia galli	Alkaloids , Flavanoids
4	Adhatoda vesica	Acanthaceae	Roots	GI nematodes	Vasicine, Quinazoline Alkaloids, Vasicol.
5	Agave sisalana perr	Aspargus	Leaves	gastrointestinal nematodes	Homo isoflavonoid and saponin
6	Ageratum conyzoides	Asteraceae	Leaves, flowers	Tape-worms	Prococene I, Prococene II, Beta caryophyllene , Bisabolene
7	Alangium lamarckii	Alangiaceae	Roots, bark	Hook-worms, ascarids	Alangium alkaloids , Alangine , Isotubulosine.
8	Albizia gummifera	Fabaceae	Root, stem bark and pods	Nematodes	Apocarotenoids, chalcone, dipeptide, elliptosides, essential oils, fatty acids
9	Albizia anthelmintica	Fabaceae	Bark	Haemonchus contortus, Heligmosomoides polygyrus	Gallic acid , Quercetin
10	Albizia schimperiana	Fabaceae	Stem bark	Haemonchus contortus	Spermine alkaloids and several triterpenes (lupeol, lupenone, oleanoic acid and hederagenin)

11	Allium sativum	Lillaceae	Bulb	Round-worms	Allicin
12	Aloe ferox	Asphodelaceae	Leaves	Heterakis gallinarum	Saccharides, polyphenols, flavonoids, glycoproteins, minerals, vitamins, anthraquinones, lipids, amino acids, and enzymes
13	Annona senegalensis	Annonaceae	Leaf, bark, root	Nippostrongyllus Braziliensis	p-cymene, monoterpenes,
14	Arachis pintoi	Fabaceae	Whole plant	Haemonchus contortus	flavonoids, phenolic acids, phytosterols, alkaloids, and stilbenes.
15	Artemisia annua	Asteraceae	Leaves	gastrointestinal nematodes	terpenes, antioxidant phenolics and flavonoids,
16	Azadirachta indica	Meliaceae	Leaves	bovine strongylosis	Azadirachtin , Nimbin , Nimbolinin.
17	Berlinia grandiflora	Fabaceae	Stem bark	Caenorhabditis elegans	Tannins, alkaloids, flavonoids, glycosides, saponins, phenols
18	Bixa orellana	Bixaceae	Seeds	Ascaridia galli, Ascaris suum	Carotenoids , Apocarotenoids , Terpenes , Terpenoids.
19	Butea frondosa	Fabaceae	Seeds	Haemonchus contortus	Alkaloids, flavonoids, phenolic compounds, amino acids, glycosides, steroids
20	Butea frondosa	Fabaceae	Seeds	Ascaridia galli Palasonin	Steroids , Flavanoids , Alkaloids , Triterpenes.
21	Butea monosperma	Fabaceae	Leaves	Haemonchus contortus	alkaloids, flavonoids, phenolic compounds, amino acids,

					glycosides, steroids
22	Caesalpina crista	Fabaceae	Root, stem, leaves and seed	Trichostrongylid nematodes	Alkaloids, cassane-diterpenes, flavonoids, nor-cassane diterpenes, proteins, saponins, triterpenoids,
23	Caeselpinia bonducella	Fabaceae	Leaves	Nematode S. obvelata and cestode H. diminuta parasites	Alkaloids, flavonoids, phenolic compounds, amino acids, glycosides, steroids
24	Calliandra calothyrsus	Fabaceae	Legume	Haemonchuscontortus, Trichostrongylus, Strongyloides papillosus	Tannins , Flavanoids , Terpentines.
25	Capillipedium foetidum	Poaceae	Oil, grass	Pheretima posthuma	4- Nonanol , Alpha – murolal ,4-tridecanone , 4-undecanone.
26	Carica papaya	Caricaceae	Seed	Nematodes	Alkaloids (carpaine and pseudocarpaine), proteolytic enzymes (papain and quimiopapain), and benzyl isothiocyanate**,**
27	Carum copticum	Umbelliferae	Seeds	Ascaris lumbricoides	Myrcene , Alpha-terpinene , Terpinolene , Thymol.
28	Cassia alata	Fabaceae	Leaves	Pheretima posthuma and Ascardia galli.	Flavones, flavonols, flavonoids glycosides, alatinon, alanonal and β-sitosterol
29	Ceratonia siliqua	Fabaceae	Pod	Gastrointestinal nematodes	2-methlybutanoic acid, methyl hexanoate and limonene
30	Chenopodium album	Chenopodiaceae	Leaves	Nematodes	Ascaridole , P- cymene ,Pinane.

31	Clitoria ternatea	Fabaceae	Leaves	Pheretima posthuma.	Tannins, phlobatannin, carbohydrates, saponins, flavanoids, flavonol glycosides, proteins, alkaloids, antharaquinone, anthocyanins, cardiac glycosides
32	Commiphora mukul	Burseraceae	Oleo-gum resin	Tape-worms, hookworms	Resins , Steroids , Diterpenoids , Aliphatic ester.
33	Croton joufra	Euphorbiaceae	Leaves	nematodes and cestodes	Alkanoids, flavonoids, amino acid, phenol, phytic acid,
34	Cucurbita maxima	Cucurbitacae	Seeds	Aspiculuris tetraptera	Flavonoids, tannins, phenolics and saponins
35	Cucurbita moschata	Cucurbitaceae	Seeds	Cestodes	Polyphenol , Flavanoids , Tannins .
36	Cucurbita pepo	Cucurbitaceae	Seed	Gastrointestinal nematodes	Berberine, Palmatine, Cucurbitine, Tryptophan, Citrulline.
37	Cyathocline lyrata	Asteraceae	Essential oil	Tape-worms, hookworms	Sesquiterpene , Monoterpene , Beta –elemene ,Alpha –humulene ,Caryophyllene.
38	Cymbopogon martini	Poaceae	Leaves	Haemonchus contortus	bicyclic monoterpene, nerol and α-pinene
39	Dalbergia latifolia	Fabaceae	Leaves	Nematodes	alkaloids, carbohydrates, glycosides, flavonoids, alkaloids, phenolic compounds and tannin.
40	Datura quercifolia	Solanaceae	Fruit	Ascaridia galli	Steroids , Terpenoids ,Lectins , Tannins , Phenols , Glycosides .
41	Diospyros scabra	Ebenaceae	Seeds	Fasciolosis, lungworms	Flavanoids , Coumarinis , Ionone , Triterpenoids ,

					Acetophenone.
42	Dodonea viscose	Sapindaceae	Leaves	Intestinal-worms	Alkaloids, flavonoids, steroids, phenolics, saponins, tannins, carbohydrates, glycosides.
43	Embelia ribes	Myrsinaceae	Seeds	Tape-worms	Embelin 2.5–3.1%; quercitol 1.0%; fatty ingredients 5.3% and alkaloid schristembine, a resinoid, tannins
44	Eupatorium triplinerve	Asteraceae	Flowers	Ascaris lumbricoides ,Taenia solium	2-tertbutyl-1,4-methoxybenzene as major constituent (74.3 %) followed by b- selinene (8.6%)
45	Gardenia lucida	Rubiaceae	Essential oil	Tape-worms, earthworms	Glycoside, Alkaloids, Steroids , Flavanoids , Phenol , Tannins , Triterpenoids.
46	Gliricidia sepium	Fabaceae	Whole plant	Nematodes , avermectin , trematodes , cestodes.	Glycosylated flavonoids and methoxyphenols
47	Hagenia abyssainicia	Rosaceae	Fruit	Round-worms	phloroglucinol derivatives, phenols, saponins, flavonoids, anthraquinones, terpenoids, alkaloids
48	Helleborus niger	Ranunculaceae	Stem	Ascaris lumbricoides	carbohydrate, glycoside, saponins, flavonoid, phytosterols, tannins
49	Hyoscyamus niger	Solanaceae	Seeds	Nematode	alkaloids, saponins, lignans, coumarinolignans, flavonoids
50	Khaya senegalensis	Meliaceae	Bark	Gastrointestinal nematodes	flavonoids and phenols
51	Lagenaria siceraria	Cucurbitaceae	Seeds	Cestodes, moniezia	sterols, terpenoids, flavonoids, and saponins
52	Lantana trifolia	Verbenaceae	Fruit	Fasciolosis,	kaempferol-3,7-dimethyl ether ,

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				lungworms	verbascoside , apigenin , umuhengerin
53	Lawsonia inermis	Lythraceae	Leaves	Fasciolosis	saponins, proteins, alkaloids, terpenoids, quinones, coumarins, xanthones, fat, resin and tannins.
54	Leucaena leucocephala	Fabaceae	Seeds	Caenorhabditis elegans	Mimosine (β-(N-(3-hydroxy-4-oxypyridyl))-α-aminopropionic acid)
55	Leucas martinicensis	Lamiaceae	Aerial parts	Gastrointestinal nematodes	lignans, flavonoids, coumarins, steroids, terpenes, fatty acids
56	Mimosa pudica	Fabaceae	Seeds	Pheretima posthuma.	flavonoids, lignans, alkaloids, terpenoids, steroids and saponins
57	Mitragyna stipulosa	Rubiaceae	Roots	Guinea-worm	alpha-amyrin, 3beta-acetyl ursolic acid and a mixture of oleanolic and ursolic acid and beta-sitosterol
58	Momordica charantia	Cucurbitaceae,	Seeds	Fasciola hepatica	Tetracyclic triterpenoids and their glycosides,
59	Monodora myristica	Annonaceae	Seeds	Nigeria	alkaloids, tannins, saponins, resins, steroids, glycosides, flavonoids, cyanogenic glycosides, oxalates, and phytates

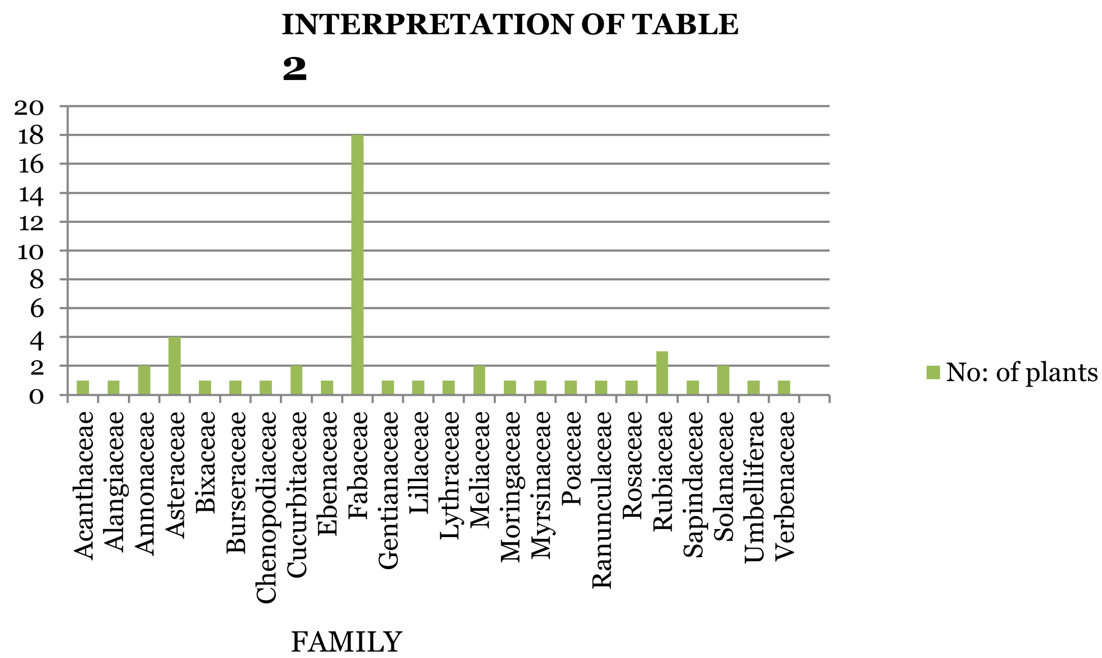
60	Moringa oleifera	Moringaceae	Seeds	Pheretima posthuma	Alkaloids , Flavonoids , Saponins , Terpenoids , and Tannins
61	Nigella sativa	Ranunculaceae	Seeds	Caenorhabditis elegans	p-cymene, carvacrol, thymohydroquinone (THQ), dihydrothymoquinone (DHTQ), α-thujene, thymol, t-anethole, β-pinene, α-pinene, and γ-terpinene
62	Ocimum sanctum	Lamiaceae	Leaves	Pheretima posthuma	Alkaloids, Carbohydrates, Steroids and Tannins
63	Paraserianthes falcataria	Fabaceae	Bark	Haemonchus contortus	Tannins Alkaloids, flavonoids, saponins
64	Piper longum	Piperaceae	Fruits	strongyle ova, larvae and adult amphistomes	β-caryophyllene, pentadecane, and bisabolene.
65	Pterogyne nitens	Fabaceae	Leaves and Fruits	Haemonchus contortus	Quercetin 3-O-sophoroside, taxifolin, astilbin, ourateacatechin, caffeic, ferulic, sinapic, chlorogenic and gallic acids,
66	Randia dumetorum	Rubiaceae	Seeds	Earth-worms, tapeworms	Saponins, valeric acid resin, wax, and some coloring matter
67	Senna alata	Fabaceae	Leaves	Pheretima posthuma and Ascardia galli	Phenolics (rhein, chrysaphanol, and glycosides), anthraquinones fatty acids (oleic, palmitic, and

					linoleic acids), steroids, and terpinoids
68	Sesbania grandiflora	Fabaceae	Leaves	gastrointestinal nematodes	Alkaloids, flavonoids, glycosides, tannin, anthraquinone, steroid, pholobatannins, and terpenoids.
69	Solanum torvum	Solanaceae	Fruits	Pheretima posthuma	Steroids, steroid saponins, steroid alkaloids, and phenols.
70	Swertia chirata	Gentianaceae	Whole plant	Ascaridia galli	Coumarins, flavonoids, phytosterol, phenols, tenins, alkaloids, triterpenes, anthraquinons
71	Trichilia emetic	Meliaceae	Bark	Fasciolosis, lungworms	Resins, tannin, pectin, sesquiterpenoid
72	Uvaria hookeri	Annonaceae	Root ,bark	Haemonchus contortus	Uvaretin , a C-benzyldihydrochalcone and its derivatives, diuvaretin
73	Vernonia amygdalina	Asteraceae	Stem, bark	Haemonchus contortus	Carbohydrates, saponins, alkaloids, tannins, proteins
74	Vigna Unguiculata (L) Walp	Fabaceae	Seeds	Edriluseuginiae earthworms	Carbohydrates, glycosides, alkaloids, flavonoids, tannins, polyphenols, saponins, vignalin
75	Xylopia aethiopica	Annonaceae	Seeds	Gastrointestinal nematodes	Cardiac glycoside, flavonoids, phlobatannins, tannins, phenol, anthraquinones, saponin and steroids

1.3. Prevalence of helminthiasis

The prevalence of helminth is high in tropical and subtropical areas of the world and it is more likely to increase with global climate change especially in the area of poor social infrastructures and lack of sanitation., reported an estimate of 187 million people suffers from Schistosomiasis in Sub-Saharan Africa, India, China, East Asia and the Americas. Taylor et al. (2010), reported 90% of the estimated 120 million cases of lymphatic filariasis was caused by WUCHERERIA BANCROFTI in about 83 countries in Africa, Asia, South and Central America. In 2010, it was estimated globally; 819.0 million (95% Credible Interval (CI), 771.7–891.6 million) were infected with A. LUMBRICOIDES, 464.6 million (95% CI, 429.6–508.0 million) are infected with T. TRICHIURA, and 438.9 million people (95% CI, 406.3–480.2 million) cases of hookworm was reported (Pullan et al., 2014).

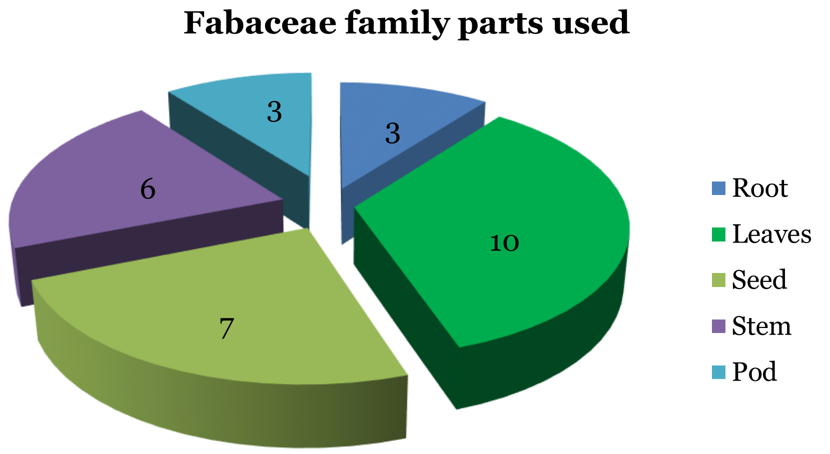
It was also documented that helminths undergo adaptation and evolutionary changes due to climatic change or resistance to anthelmintic drugs (Prichard, 2008; James et al., 2009; Nalule et al., 2013; Bauri et al., 2015; Hotez et al., 2016). The adaptation of helminths to this hash environment, encourage the high prevalence of the parasites in the pandemic regions.



INTERPRETATION OF TABLE:

Plant secondary metabolites are considered as the sources of chemical components responsible for wide therapeutic activities of several medicinal plants . Some studies are available for anthelmintic activity of tannins, alkaloids, and flavonoids. The presence of these phytochemicals may be responsible for the observed anthelmintic activity of plant extracts in the present study. Furthermore, tannins have been shown to interfere with coupled oxidative phosphorylation, thus blocking ATP synthesis in these parasites.

DISCUSSION:



The present research was conducted to document the indigenous knowledge of ethnoveterinary practices against gastro-intestinal nematodes and scientifically validate some widely used ethnobotanicals being currently used in the ethno-veterinary medicinal system for their anthelmintic activity. For this purpose, documentation of 75 plant species was done which were used as traditional recipes of 25 families for the treatment of helminthiasis, in which the families Fabaceae have more anthelmintic activity. Most frequently used part of the plant was leaves (n=9) followed in order by seeds (n=7), whole fruit (n=1) stem bark (n=5)and root(n=3). The problem of anthelmintic resistance, toxicity, and the increasing concern over the presence of drug residues in animal products has led to a renewal of interest in the use of plant based drugs. Plant materials evaluated in the current study had been identified from various sources to serve as anthelmintic agents by traditional healers.

CONCLUSION

The present study enabled us to conclude the potential use of medicinal plants in the Fabaceae family as anthelmintic agents against most of the parasites. Further research study is needed to explore more plants for the treatment and to reduce the cost, toxicity of the synthetic anthelmintic drugs ,when compared to the natural drugs that are obtained from the plant source were cheaper and provide lesser effect on the host organism. Hence, more study must be carried out to explore the plant of higher efficiency and lesser side effect.

Research Through Innovation

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