Anthelmintic Activity of Some Medicinal Plants

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Helminthic infections are now being recognized as cause of much chronic ill health and sluggishness among the tropical people. More than half of the population in the world suffers from worm infection of one type or the other. Helminths also affect domestic animals and livestock causing considerable economic losses. Traditional system of medicine reports the efficacy of several plant products for eliminating helminths. The present paper reviews the research and screening done on plant extracts, their isolates and essential oils against important helminths almost confirming the correct usage of the plants by the ethnic people and the credibility of ethnobotanical explorations.

Keywords: Anthelmintic activity, Essential oils, Plant extractives.

Helminthiasis, or worm infestation, is one of the major public health problems in the world. The 1996 World Health Report states intestinal worms amongst top 10 killers and at least 1,35,000 human lives were lost due to worm infections in 1995 (Nullis, 1996). The helminths which infect the intestine are nematodes viz. hookworm (*Ancylostoma duodenale*), roundworm (*Ascaris lumbricoides*) and pinworm (*Enterobius vermicularis*) etc., cestodes e.g. tapeworm (*Taenia solium*) and trematodes or flukes e.g. *Schistosoma mansoni* and *S. hematobium*. Helminths also affect millions of livestock resulting in considerable economic losses in domestic and farm yard animals. An ideal anthelmintic should have a broad spectrum of action. It should achieve a high percentage of cure with a single therapeutic dose. It should first paralyse the worms and then expel them. It should be free from toxicity to the host and should be cheap.

A study of well known anthelmintic remedies indicates that these drugs are not perfect. Side effects like nausea and giddiness have been reported even in the most common drugs like piperarine salts. Resistance of some parasites to existing drugs and their high cost for large scale deworming of livestock warrant newer anthelmintics. Therefore, research for new ideal anthelmintics is going on.

Indian system of medicine reports the efficacy of medicinal plants like *Chenopodium ambrosioides, Embelia ribes, Trachyspermum ammi, Punica granatum, Artemisia maritima* etc. for eliminating helminths (Krantz and Carr, 1967) Several essential oils and their isolates have been found to possess anthelmintic activity. The activity of these isolates increases with the increased oxygen content. The active principle of anthelmintic drugs is, therefore, relatively rich in oxygen content (Ramstad, 1959). Mention may be made of ascaradiol, aspidinol, santonin, thymol and thujone etc. (David *et al.,* 1968) and the essential oils of cajaput, cinnamon, clove, eucalyptus, turpentine and wormseed etc. (Anonymous, 1968). The present paper reviews the several screenings and attempts made during past 30 years to find the efficacy of essential oils, various plant extractives and their active constituents as possible anthelmintics.

All clinical anthelmintics are markedly toxic to earthworms (*Pheritima posthuma*). This simple test may therefore be used for determining whether a given substance has any anthelmintic properties, and so to determine the relative activity of different samples of a given drug. Most substance which are toxic to earthworms produce a primary irritation or agitation that results in the withdrawal of the worm from the neighbourhood of the poison. By virtue of this effect, anthelmintics doubtless often expel the parasite when

the concentration does not rise sufficiently high to kill the worm (Sollmann, 1918), A number of research workers have used earthworms for the preliminary *in vitro* evaluation of anthelmintic activity.

The essential oil of fresh rhizomes of *Hedychium coronarium* has been found to possess anthelmintic properties (Milagros *et al.,* 1953). The oils of the rhizomes of *H. coronarium* and *H. spicatum* possess better anthelmintic activity than piperazine phosphate against earthworms and tapeworms but the activity against hookworms and nodular worms does not however, compare favourably with that of hexyl resorcinol (Dixit and Varma, 1975). A steam volatile oil isolated from the petroleum ether of *Withania coagulans* Dunal has been found to possess lethal effect on earthworms (Gaind and Budhiraja, 1967). The essential oil of *Piper betle* has revealed anthelmintic effect on earthworms *in vitro* (Ali and Mehta, 1970). The anthelmintic activity of the essential oil of *P. betle* cultivar Sagar Bangla against tapeworms has been found better than that of piperazine phosphate, and the activity against hookworms has been reported greater than that of hexyl resorcinol (Garg and Jain, 1992). Anthelmintic activity studies of the essential oils of *Cymbopogon nardus, C. citratus* and *Zanthoxylum alatum* have revealed that the oil of *C. nardus* has very good effect against earthworms while the oils of *C. citratus* and *Z. alatum* have moderate activity (Kokate and Varma, 1971). The anthelmintic efficacy of the essential oils of *Acorus calamus, Adhatoda vasica,* and *Piper longum* has been evaluated against neuromuscular preparations of *Ascaris lumbricoides* (D'cruz *et al.,* 1980.

Examination of 100 essential oils for their anthelmintic activity against *Schistosoma mansoni* Cercaria revealed that 20 oils inhibited penetration of *S. mansoni* Cercaria throughout the skin, 22 oils were toxic to *S. mansoni* Cercaria and 16 oils inhibited development of larvae of *Strongyloides sterocaradis* and *Ancylastoma canium* during the external stage of host (Gilbert *et al.,* 1972). The essential oil of *Curcuma angustifolia* has shown good anthelmintic activity against earthworms and tapeworms (Banerjee and Nigam, 1978). Anthelmintic activity of the essential oils from the leaves and flowers of *Glossocardia bosvallia,* twigs of *Ageratum conyzoides* and *Piper cubeba* was evaluated (Sharma *et al.,* 1979) when the oil of *A. conyzoides* was found most potent against tapeworms amongst the 3 oils tested. Essential oils of *Boswellia serrata, Nardostachys jatamansi, Cinnamomum tamala, Leucas cilliata* were studied against earthworms and tapeworms when it was found that the essential oils of *C. tamala* and *B. serrata* had better *in vitro* activity than piperazine citrate (Girgune *et al.,* 1978). The anthelmintic studies on the essential oil of *Nigella sativa* against earthworms, tapeworms, hookworms and nodular worms have exhibited fairly good activity against earthworms and tapeworms, the activity against hookworms and nodular worms being comparable with that of hexyl resorcinol (Agrawal *et al.,* 1979). The effect of the essential oil of *Gardenia lucida* was studied on *Pheritima posthuma* and *Taenia solium* when it was observed that the oil showed better efficacy against *T. solium* at higher concentration (Girgune *et al.,* 1979). The essential oil of *Cyperus rotendus* has exhibited strong anthelmintic activity against tapeworms (Girgune *et al.,* 1980).

Varying degrees of anthelmintic efficacy of the essential oils of *Inula racemosa, Pistacia integerrima* galls, *Litsea chinensis* and *Randia dumetorum* seeds against earthworms and tapeworms has been reported (Mishra *et al.,* 1979). The essential oil of *Cyathocline lyrata* Cass. has revealed better activity than that of piperazine phosphate and hexyl resorcinol, against tapeworms and hookworms respectively (Shrivastava, 1979). The essential oil of *Lantana camara* var. *aculeata* has exhibited good anthelmintic activity (Avadhoot *et al.,* 1980). The anthelmintic activity of the essential oil of the fruits of *Zanthoxylum alatum* has been found better than piperazine phosphate against earthworms and could be compared well against roundworms (Mehta *et al.,* 1981). The essential oil from the fruits of *Zanthoxylum limonella* against earth, tape and hookworms has been found better than that of piperazine phosphate (Kalyani *et al.,* 1989). The activity of this essential oil seems to be of particular interest in view of the use of the fruits as condiment in curries.

The anthelmintic activity of the essential oils of *Callistemon viminalis* and *Anacardium occidentale* against earthworms and tapeworms, has revealed these to exhibit *in vitro* efficacy better than piperazine phosphate. The activity of these oils against hookworms was comparable to that of hexyl resorcinol (Garg and Kasera, 1982 a, b). Anthelmintic activity of the essential oils of *Buddlea asiatica* Lour. and *Chloroxylon swietenia* Roxb. Corom, against earthworms, tapeworms and hookworms has been reported (Dengre, 1982).

The essential oil obtained from oleo-gum resin of *Commiphora mukul* has good anthelmintic activity

against tapeworm and hookworms comparable to that of piperazine phosphate and hexyl resorcinol (Kakrani and Kalyani, 1984).

The anthelmintic activity of the essential oils of *Cyathocline lyrata* Cass. and *Tridex procumbens* Linn. has been reported (Pathak, 1986) against earthworms, tapeworms and hookworms. The essential oil of *Aglaia odoratissima* has been found effective against earthworms (Nanda *et al.*, 1987). The essential oil of *Limnophila conferta* has exhibited good anthelmintic activity (Reddy *et al.*, 1991).

The essential oils of *Cymbopogon martini* Roxb., *Capillipedium foetidum* Lisboa., and *Artabotrys odoratissimus* R. Br. (Siddiqui and Garg, 1990) and juice of crushed leaves of *Varnonia teres* and *Clerodendrum phlomidis* (Garg and Siddiqui, 1992) in varying concentrations (0.1, 0.2 and 0.4%) have exhibited good anthelmintic activity against earthworms, tapeworms and roundworms. The essential oil of *C. martini* has stronger anthelmintic power than the other four test products. The essential oil of the herb *Artemisia pallens* Wall. has shown strong anthelmintic activity against *Pheritima posthuma* (earthworm), *Taenia solium* (tapeworm) and *Ascaris lumbricoides* (roundworm). The helminths have been found to be more susceptible to the oil than to piperazine phosphate of similar concentrations (Nakhare and Garg, 1991). *Artemisia pallens* has been ascribed to possess anthelmintic and stomachic properties in Indian system of medicine (Anonymous, 1956). The results not only confirm the correct usage of the plant by the rurals but also enhance the credibility of ethnobotanical explorations. The essential oil from the flowers of *Eupatorium triplinerve* has been shown to possess good efficacy against *Ascaris lumbricoides* and *Taenia solium* (Garg and Nakhare, 1993).

The *in vitro* anthelmintic activity of the aqueous and alcoholic extracts of *Ananas sativus, Embelia ribes, Mucuna prurita* and *Melia azedarach* has significant activity against *Taenia canina* and *Paramphistomum cervi* (Neogi *et al.*, 1964). *Mucuna prurita* was specially quite active against trematodes. The root bark of *Alangium larmarckii* Thwaites has exhibited good efficacy against the hookworms of dogs and poultry ascarides (Dube and Gupta, 1968).

The aqueous ethereal and alcoholic extracts of *Cucurbita mexicana* (Kaddu) seeds have exhibited good anthelmintic activity against *Moniezia expansa, Fasciolopsis buski, A. lumbricoides, Hymenotepis* and *H. diminuta*. The order of decreasing potency of the extracts in the *in vitro* studies was aqueous, alcoholic and ethereal in decreasing order. The kymographic studies have suggested that the seed extracts act by bringing about a decrease in the movements leading to temporary paralysis (Shrivastava and Singh, 1967). The history of use of *Cucurbita maxima, C. moschata* and *C. pepo* seeds as traditional medicine to expel worms and parasites has been described along with chemistry, pharmacology and toxicity of seeds (Lawrence, 1990).

The anthelmintic activity of alcoholic extracts of stem of *Helleborus niger,* rhizomes of *Zingiber officinale,* seeds of *Carum copticum, Agati gratifolia* and *Mangifera indica* against human *Ascaris lumbricoides* is appreciable (Kaleysaraj, 1974). Rhizomes of *Zingiber zerumbet* showed good *in vitro* anthelmintic activity against human *Ascaris lumbricoides,* while the alcoholic extract of the bark of *Albizzia lebbek,* the bulb of *Allium sativum,* rhizomes of *Alpinia calcarata,* rind of *Citrus acida,* rind of *Citrus aromatica,* rind of *Citrus medica,* rhizomes of *Curcuma aromatica,* rind of *Punica granatum* showed moderate *in vitro* activity (Kaleysaraj, 1975). The alcoholic extract of *P. granatum* showed anthelmintic activity as revealed by a dose dependent inhibition of transformation of eggs to filariform larvae of *Haemonchus contortus* (Prakash Vishwa *et al.,* 1980). Therapeutic efficacy of *P. granatum* and *C. maxima* against clinical cases of nematodiasis in calves has been documented (Pradhan *et al.,* 1992). The *in vitro* anthelmintic activity of *Caraca papaya, Sapindus trifoliatum, Butea frondosa* and *Momordica charantia* has been reported (Lal *et al.,* 1976) against *Ascardia galli* worms of the birds. Various extract of *Vernonia anthelmintica* have been tested for their anthelmintic activity. Alcoholic extract has been found to possess maximum anthelmintic activity, followed by ethereal extract, whereas aqueous extract has no anthelmintic activity (Singh *et al.,* 1985).

Aqueous alcoholic extracts of *Vinca alba* and *Caesalpinia ferrea* have exhibited some activity against Ancylostomatidae larval stage development (Giazzi *et al.,* 1991). The oil (hexane extract) from the flowers of *Artemesia scoparia* has exhibited good anthelmintic activity (Naqvi *et al.,* 1991). The aqueous extracts of 8 Sudanese plants *Balanites aegyptiaca, Sesbania sesban, Albizzia anthelmintica, Cymbopogon narvetus, Abrus precatorius, Rhyncosia minima, Striga hermontheca* and *Anogeissus leiocarpus* have been found effective against the free living rhabditid

nematode, *Caenorhabditis elegans* (Ibrahim, 1992). Ethanolic extract of the bark of *Piliostigma thonningii* has been found to have a broad spectrum anthelmintic activity on highly motile insheathed, nonfeeding third stage larvae of Haemonchus, Oesophagostomum, Bunostomum and Trichostrongylus. The extract induced a concentration dependent lethality in the larvae and caused 100% lethality between 2 and 15 h in the species studied. 100% lethality was achieved by adding 0.80 mg/ml of the extract to the solution containing Bunostomum within 2 h while the same concentration achieved 100% lethality over 15 h in Oesophagostomum (Asuzu and Onu, 1993). The extract also exhibited a potent dose dependent anthelmintic action in *Ascaridia galli* infected cockerels by stimulating the neuromuscular junction principally and the ganglion to a lesser degree (Asuzu and Onu, 1994). Recently, the quantitative studies of 33 taenicidal plant extractives have been made in which their intraperitoneal LD_{50} values in mice and their respective median effective oral dose and worm expulsion time in humans have been evaluated (Desta, 1995).

The anthelmintic property of the aqueous extract of the seeds of *Carica papaya* against *Ascaris lumbricoides* and *A. galli* has been evaluated (Dhar *et al.*, 1965). Benzyl isothiocyanate was isolated from the extract as its active principle mainly responsible for the anthelmintic activity. The metabolic pathways in general and carbohydrate pathways in particular and neuromuscular coordination have become the major target sites of action of anthelmintic compounds (Sharma, 1987). The mechanism of anthelmintic action of benzyl isothiocyanate lies both in inhibiting energy metabolism and in affecting motor activity of the parasite *in vitro* (Kumar *et al.*, 1991). Palasonin, an active principle isolated from *Butea frondosa* seeds and its piperazine salt exhibited good anthelmintic activity, minimal lethal concentrations being 1.0 and 0.75 mg/kg respectively against *Ascaris lumbricoides* of human origin. A single dose of sodium salt (25 mg/kg) or piperarine salt (20 mg/kg) was completely effective against *Toxicara canis* in dogs (Kaleysaraj and Kurup, 1968). Anacardic acid isolated from the oil of nuts of *Semecarpus anacardium* and its sodium salt have been found to be potent anthelmintic agent (Chattopadhyaya and Khare, 1969). Anthelmintic activity of some plants with their active constituents was evaluated against *Clonorchis sinensis* and analogues. The active constituent of *Machilus thumbergii* bark and *Schizandra chinensis* seeds is meso-dihydro-guaiaretic acid. The active constituents of roasted fruits of *Prunus mume* (2-hydroxymethylfurfural), root of *Scutellaria baicalensis* (5, 2'-dihydroxy-6, 7, 8, 6'-tetramethoxy flavone), and root of *Inula helenium* (alantolactone and an unidentified compound) have been isolated, identified and their anthelmintic activity determined (Ahn and Rhee, 1986). Pharmacologically active anthelmintic compound in *Ficus insipida* is the enzyme ficin present in it which has been confirmed by clinical trials (Phillips, 1990). Ellagitannins and complex tannins from *Quercus petraea* bark have been reported to possess strong anthelmintic activity (Konig *et al.*, 1994). The active anthelmintic compounds in *Pluchea symphytifolia* have been isolated and characterized as caffeoyl quinic acids.

Most of the screenings reported are *in vitro* studies but these give lead for *in vivo* investigations. The results lend credibility to the use of plants mentioned in traditional system of medicine by the common people and need for more ethnobotanical explorations.

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