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Review Article

Anthelminthic/larvicidal activity of some common medicinal plants

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ABSTRACT

The helminthic infection are most common disease in different animals and in human beings, which affecting a large proportion of the world population. Helminthic infection can also affect millions of livestock resulting in considerable economic loss in domestic animals. For control of helminthic disease in different part of world are uses synthetic medicines which are very effective in curing helminthiasis, but it's also causes a number of side effects. The continued uses of synthetic anthelmintic/larvicidal drugs are also causing a major drug resistance problem in several parasitic diseases. The plant derived crude products are less efficient with respect to cure of parasitic diseases but one relatively free from side effect. A large number of medicinal plants are traditionally uses to cure helminthiasis in developing countries. Thus, plant derived drugs are gaining a lot of attention for curing parasitic infection. There are several medicinal plants and their different crude products, organic extracts and active components have been scrutinized for using in various methods in helminthic/larvicidal infection control. The present reviews summarized the use of traditional medicinal plants and their different products further leads to evaluation of new researches.

Keywords: Medicinal plants; Anthelminthic activity; Larvicidal activity; Active components.

1. INTRODUCTION

Ancient man derived more than 90% of medicinal agents from higher plants. Even today, traditional system of medicine is practiced in many countries possessing ancient cultures, and major portion of their therapeutic needs are obtained from plants drugs. India with its wide eco-geographical and climatic diversity possesses a rich medicinal plant's wealth and has a very rich heritage of knowledge in the use of herbal drugs. A large part of world population depends even at the present time on the indigenous systems of medicine *Ayirveda, Unani and Sidha*, including India. Plants with anthelmintic activity have been reviewed by Akhtar et al. [1].

In many parts of the world, natural products are still in use as herbal remedies [2]. In recent

years, there has been a rapid increase in new reports of the anti-parasitic activity of natural products, both from scientific and traditional practices [1]. Thus, plant based medicines have become indispensable and are forming an integral part of the primary healthcare system over the world. The crude extracts of herbal plants have been tested for their putative anthelmintic properties. Active ingredients of these herbal products are now identified and characterized to establish their mode of action. Akhtar et al. [1] have extensively reviewed the anthelminthic activity of several herbal products. Anthelmintic activity of some plants *Alangium larmarckii* [3], *Piper betle* [4], *Piper longum* [5], *Allium sativum* [6], *Zingiber officinale* [6], *Cucurbita mexicana* and *Ficus religosa* [7], *Calotropis procera* [8], *Nicotiana tabacum* [9] and *Ferula asafetida* [10], *Dioscorea zingiberensis* [11], *Matricaria chamomillia* [12] has been reported by several workers.

In a study by Hordegen et al. [13] bromelain, the enzyme complex of the stem of *Ananas comosus* (Bromeliaceae), the ethanolic extracts of seeds of *Azadirachta indica* (Meliaceae), *Caesalpinia crista* (Caesalpiniaceae) and *Vernonia anthelmintica* (Asteraceae), and the ethanolic extracts of the whole plant of *Fumaria parviflora* (Papaveraceae) and of the fruit of *Embelia ribes* (Myrsinaceae) showed anthelmintic efficacy (up to 93%), relative to pyrantel tartrate against infective larvae of *H. contortus*. The methanol extracts of *Mentha piperita* and *Lantana camara* (leaves, stems and roots) exhibited considerable anthelmintic activity against *P. posthuma*.

Helminthic infections are among the most common infections in human beings, affecting a large proportion of the world's population. 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 [14]. 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 *S. hematobolium*). The diseases originated from parasitic infection causing severe morbidity include lymphatic filariasis, onchocerciasis and social consequences. Helminthes infection can also affect millions of livestock resulting in considerable economic losses in domestic and farm yard animals.

2. *IN VITRO* AND *IN VIVO* ANTHELMINTIC/ LARVICIDAL ACTIVITY

In the beginning, most of the *in vitro* researches regarding anthelmintic of plants, their different extracts or oil have been based on their toxic effects on earthworm, *Pheritima posthuma* [15-22]. The essential oils of *Gardenia lucida* (Rubiaceae), *Cyperus rotendus* (Cyperaceae), *Inula racemosa* (Compositae), *Psitacia integrrima* (Anacardiaceae), *Litsea chinensis* (Lauraceae) and *Randia dumetorum* (Rubiaceae) seeds have been reported to possess good anthelmintic activity against tapeworms and earthworms [18, 19]. Most of these substances which are toxic to earthworms produce a primary irritation or agitation that results in the withdrawal of the worm from the neighborhood of the poison.

In vivo trials have also been conducted for the evaluation of anthelmintic activity of various plant materials. Githiori et al. [23] evaluated the anthelmintic properties of *Albizia anthelmintica* extracts against *H. polygrus* infections in mice. *In vivo* trials have also been carried out in domestic animals such as sheep, goats and cattle etc. for the evaluation of anthelmintic activity of various medicinal plants and its active compound. The efficacy of test substances in such studies has generally been adjudged on the basis of expulsion of worms from hosts [24-28] or reduction in the number of eggs per gram of feces (EPG) passed by the infected hosts following treatment with substances of plant origin.

By asset of this effect, anthelmintics doubtless often drive out the parasite when the concentration does not get sufficiently higher to kill the worm [29]. Some worker have also used hookworms, *Haemonchus contortus*, and tapeworms and/or *Ascaris lumbricoides* for the evaluation of *in vitro* anthelmintic activity of different plant materials [3, 4, 19-22, 30-35]. A modified egg hatch assay [36] is often used to evaluate the effect of plant products against eggs of *Haemonchus contortus*. Some other

research conducting *in vitro* studies have used an alteration of the larval development assay (LDA) or larval motility tests which are commonly used for testing of resistance of parasites to anthelmintic [37, 38].

Bany et al. [39] reported the effect of alchinal, a complex preparation of three substances *Echinacea purpurea* extract, *Allium sativum* extract and cocoa, on the development of *T. spiralis* in mice. Quinolines that exhibited good activity *in vitro* have been studied *in vivo* on *T. spiralis* in mice model [40]. The anticestodal properties of few other plants namely, *Gladiolus gandavensis, Trifolium repens*, *Strobilanthes discolor* and *Butea minor* have been well ascertained using experimentally induced *H. diminuta* in albino rats [41-43].

Extracts of *Cucurbita pepo* (Cucurbitaceaea), *Calotropis gigantean* (Asclepiadaceae), *Juglans regia* (Juglandaceae), *Momordica charantia* (Cucurbitaceae), *Musa paradisaca* (Musaceae) and *Scindapsus offcinalis* (Araceae) have been found to show profound anthelmintic activity on *Haemonchus contortus* of goat origin [30].

The cestocidal efficacy of *Acacia auriculiformis* in *H. diminuta* rat model are reported by Ghosh et al. [44]. Bogh et al. [45] reported the anthelmintic efficacy of extracts of *Embelia schimperi* against *Echinostoma caproni*, *H. polygyrus* and *H. microstoma* in mice and also against *H. diminuta* in rats. The stem bark extract of *Berlinia grandiflora* has been reported to possess anthelmintic efficacy based on its testing against *N. brasiliensis* infections in albino rats [46]. Kaushik et al. [47] evaluated extracts of 11 plants which proved lethal to *Ascaridia galli in vitro*, including those from *Amomum aromaticum* (Zingiberaceae) root and rhizome, *Ammora wallichii* stem, *Anthocephalus indicus* (Rubiaceae) stem and bark, *Calamintha umberosa* (Labiatae) plant, *Dalbergia latifolia* (Leguminosae) stem and bark, *Datura quercifolia* (Solanaceae) fruit, *Datura metal* (Solanaceae) plant, *Ficus religiosa* (Urticaceae) stem and bark, *Sentia myrtina* plant, and *Sumplocos crataegoides* (Sumplocos) leaves.

The essential oils of several plants namely, *Callistemon viminalis* (Myrtaceae), *Anacardium occidentale* (Anacardiaceae), *Buddlea asiatica* (Loganiaceae), *Chloroxylon swientenia* (Rutaceae) and oleo-gum resin of *Commiphora mukul* (Burseraceae) have been reported to possess profound anthelmintic activity against tape and hookworms and their efficacy was also noted to be comparable to that of piperazine phosphate and hexylresorcinol [48]. In other studies the essential oils of *Artemisia pallens* (Compositae), *Eupatorium triplinerve* (Compositae), *Artabotrys odoratissimus* (Annonanceae), *Capillipedium foetidum* (Poaceae) and the grass of *Cymbopogon martini* (Poaceae) have been reported to possess strong anthelmintic activity against *T. solium* and *A. lumbricoides* [22, 35, 49].

2.1. *Carica papaya*

The anthelmintic property of the aqueous extract of the seeds of *Carica papaya* (Carbicaeceae) against *Ascaris lumbricoides* and *Ascaridia galli* has been also well been established [43]. A high efficacy of *C. papaya latex* against experimental *Heligmosomoides polygyrus* infections has been reported by Satrija et al. [50]. The benzyl isothiocyanate isolated from *C. papaya* seed and use as anthelmintic activity against *Caenorhabditis elegans* [51]. Hounzangbe-Adote et al. [52] reported the anthelmintic activity of *Zanthoxylum zanthoxyloides*, *Morinda lucida* and *Newbouldia* leaf extracts and *C. papaya* seed extracts collected in Western Africa against different stages of *H. contortus*. Another study, *Z. zanthoxyloides*, *M. lucida*, *N. laevis* and *C. papaya* extracts induced a dose-dependent inhibition of egg hatching of *T. colubriformis*. These plant extracts also showed their effects against the infective larvae of *T. colubriformis*. In contrast, for adult worms, the effects were statistically significant only for *N. laevis* and *C. papaya* [53]. Okeniyi et al. [54] has been reported the seed of *C. papaya* are cheap, natural, harmless, readily available monotherapy and prevention against intestinal parasitosis.

The anthelmintic efficacy of plant cysteine proteinases of *C. papaya* have been reported in mice infected with adult *Trichuris muris*, a rodent gastrointestinal nematode [55]. In another study, Stepek et al. [56] reported the anthelmintic effects of cysteine proteinases of *C. papaya* against *Protospirura muricola* in rodent model.

2.2. *Cucurbita mexicana*

The aqueous, etheral and alcoholic extracts of *Cucurbita mexicana* (Cucurbitaceae) seeds have exhibited significant anthelmintic activity against *Moniezia expansa*, *Fasciolopsis buski*, *Ascaris lumbricoides* and *Hymenolepis diminuta*. Aqueous extract was found to possess the most significant toxicity as compared to alcoholic and etheral extracts [57]. The water and ethanol extract of *C. Mexicana* seed are effective and displayed high anthelmintic efficacy against *Aspiculuris tetraptera* in mice [58].

2.3. *Hedychium coronarium*

The rhizomes and oil of *Hedychium coronarium* (Zingiberaceae) and *H. spicatum* (Zingiberaceae) possess better anthelmintic activity than piperazine phosphate against earthworms and tapeworms [16].

2.4. *Butea monosperma*

All parts of *Butea monosperma* have been used as crude drug for the treatment of skin disease, tumors, wounds, ulcers and piles [59]. The crude seed powder of *B. monosperma* showed anthelmintic activity in sheep. The different species of *Butea* has been reported anthelmintic activity against *Ascaris lumbricoide*, *Ascaridia galli*, earthworm, *Toxocara canis*, *Dipylidium caninum* and *Taenia* [60]. Palasonin, an active principle of *Butea monosperma* (Leguminosae), has also been established to possess good anthelmintic activity against *A. lumbricoides*, using an *in vitro* assay [61].

2.5. *Azadirachta indica*

Azadirachta indica is a tree of Meliaceae family. Medicinal property of this plant is mentioned in traditional Indian Ayruvedic system of therapy [62]. All parts of the *Azadirachta indica* including the leaves, bark, fruits, seed and oil have medicinal properties and contain over ten different active components with azadirachtin as the most potent component and widely studied [63]. *Azadirachta indica* are toxic against *Salmonella* [64] *Plasmodium* and *Trypanosma* species [65, 66]. It has larvicidal activity against *L. acuminata* and larvae of *Fasciola gigantica* [6, 67]. In context of India, which is endowed with vast resources of medicinal plants, there is a strong tradition of using plant-based medicines in alternate system of medicine among native societies [1].

Phytochemical of plants and their controlled experiments associated strategies, can offer new alternatives for effective and economical control of parasite borne disease [1]. *Azadirachta indica* seeds inhibit 68.3% of larval hatching of *Haemonchus contortus* with the use of azadirachtin at 1% obtained from seeds [68]. In cattle, the consumption of dried leaves caused a reduction in the number of eggs of per gram of feces [69]. Rahman et al. [70] have evaluated the *in vitro* anthelmintic activity of Neem plant (*Azadirachta indica*) extract against third-stage *Haemonchus contortus* larvae from goats. It was recorded that 4 mg/ml methanolic extract gave 40% mortality. Aqueous leaves extract of *Azadirachta indica* leaves have significant anthelmintic activity against earthworms (*Pheretima posthuma*), tapeworms (*Raillietina spiralis*) and roundworms (*Ascaridia galli*) species [71].

2.6. *Nigella sativa*

Nigella sativa exhibits considerable anthelmintic activity against tapeworms, hookworms and nodular worms with the activity being comparable with that of hexylresorcinol against hookworms and nodular worms [72]. Mahmoud et al. [73] has been reported that the oil of *N. sativa* decreased the number of *Schistosoma mansoni* in liver and intestine of infected mice. The seed of *N. sativa* demonstrated an inhibitory effect on egg lying adult female worm and also effective against miracidium, cercaria and adult worm of *S. mansoni* [74].

2.7. *Zanthoxylum*

The anthelmintic activity of *Zanthoxylum alatum* (Rutacae) has been found to be comparable to that drug against roundworms [20], while the essential oil from the fruits of *Z. limonella* has been reported to bear better anthelmintic efficacy than that of piperazine phosphate [75].

2.8. *Punica granatum*

Inhibition of transformation of eggs to filariform larvae of *H. contortus*, Prakash et al. [76] established the dose-dependent anthelmintic activity of the alcoholic extract of *Punica granatum*. Swarnakar et al. [77] has been reported the methanolic extract of *P. granatum* shows anthelmintic activity against *Pheretima pasthuma*.

2.9. *Ocimum sanctum*

Various essential oils and eugenol isolated from *Ocimum sanctum* Linn. (Lamiaceae) have shown potent anthelmintic activity against *C. elegans*. Martinez-Ortiz-de-Montellano et al. [78] studied the effect of a tropical tannin-rich plant, *Lysiloma latisiliquum* on adult populations of *H. contortus* in sheep and suggested that a short-term consumption of *L. latisiliquum* can modulate directly the biology of adult *H. contortus* affecting the worm size and female fecundity. The essential oil of *Ocimum sanctum* and eugenol, tested *in vitro*, showed potent anthelmintic activity in the *Caenorhabditis elegans* model [79]. Singh and Nagaichi, [80] evaluated the antiparasitic effects of ethyl alcohol phytochemicals as cure of worm infections in traditional medicine systems extract of *Ocimum sanctum* against *A. galli in vitro*.

2.10. *Berlina grandiflora*

Berlina grandiflora and its active compound triterpenoid, betulinic acid shows or showed anthelmintic activity against *C. elegans* [46] in different solvent fractions. The bark and stem of *B. grandiflora* are effective anthelmintic against *N. brasiliensis* in infected albino rats [46].

2.11. *Evolvulus alsinoides*

In vitro anthelmintic activities of *Evolvulus alsinoides* extract against earthworm, *P. posthuma* and reported it to be better than piperazine citrate Dash et al. [81]. The essential oil of *Ocimum gratissimum*, a tropical plant well known for its ethnoveterinary use, showed strong anthelmintic activity *in vitro* against *H. contortus* [68].

2.12. *Melia azedarach*

The anthelmintic activity of ethanolic extract of *Melia azedarach* Linn (Meliaceae) was found to be better against *T. solium* than that of piperazine phosphate [82]. The anthelmintic activity of *M. azedarach*, *in vivo* studies have been performed with aqueous methanolic and ethanolic extracts of the fruits in chicken [83], of the seed in sheep [84] and seed, leaves in *in vitro* against *Haemonchus contortus* [85].

2.13. *Rubus fructicosus*

The woody plants, *Rubus fructicosus*, *Quercus robur* and *Corylus* showed remarkable anthelmintic activity when tested on 3rd-stage larvae (L3) and adult worms of *Teladorsagia circumcincta*, *H. contortus* and *Trichostrongylus colubriformis* [86]. The crude methanol extract of *R. fructicosus* fruits are showed anthelmintic activity against *Ascaridia galli* [87].

2.14. *Mangifera indica*

The anthelmintic properties of Vimang, an aqueous extract of *Mangifera indica* family stem bark and mangiferin, the major polyphenol present in Vimang, were investigated in the experimentally induced *T. spiralis* infections in mice [88]. Patil et al. [89] reported the methanolic extract of *M. indica* leaves were show anthelmintic activity against *Phertima posthma*.

2.15. *Punica granatum*

The fruit rind powder of *Punica granatum* tested for efficacy against gastrointestinal nematodes of sheep showed a remarkable decrease of 85% in the EPG counts in the treated groups. In a separate experiment the same fruit rind powder also showed considerable reduction in EPG in sheep naturally infected with mixed cestode species [83]. The glycosides and alkaloids of *P. granatum* have also shown good anticestodal efficacy in goats [90, 91].

2.16. *Melia azedarach*

Melia azedarach was also reported to be

capable of reducing the EPG in *A. galli* infected chickens [83]. Based on reduction in EPG, the whole plant powder of *Fumaria parviflora*, its water and ethanol extracts were also observed to be possessing significant anthelmintic efficacy against *Trichostrongylus*, *Haemonchus* and *Trichuris* infections in sheep [92].

2.17. *Saussurea lappa*

Saussurea lappa roots powder, its water and methanol extracts have also been found to possess anthelmintic effects in mixed infections of nematodes in sheep [93]. The toxicity of glycosides extracted from the roots of *S. lappa* was noted to be even better than aqueous or methanol extracts in sheep and buffalo-calves infected with mixed species of nematodes [94].

2.18. *Zingiber officinale*

Zingiber officinale is perennial plant and is considered to be the universal medicine in ayurveda. The anthelminthic activity of ethanol extracts of rhizomes of *Z. officinale* against human *Ascaris lumbricoldes* is appreciable [31, 95]. Goto et al. [96] reported the lethal effect of *Z. officinale* on *Anisakis* larvae *in vitro.* The antifilarial effect of *Z. officinale* against *Driofilaria immitis* has been reported by Datta and Sukul, [97]. Adewunmi et al. [98]; Sunita and Singh, [67] have reported the larvicidal activity of *Fasciola gigantic* larvae (sporocyst, redia and cercaria) *Z. officinale. Z. officinale* extract tested against experimentally induced *Setariacervi* infections in rats showed significant ant filarial activity [99]. Its seeds of *Carum copticum* (Umbelliferae), *Agati gratifola* (Leguminosae) and *Mangifera indica* (Anacardiaceae) have shown appreciable anthelmintic activity against human *Ascaris lumbricoides* [95]. Kalesaraj, [31] also reported that rhizomes of *Z. zerumbet* (Zingiberaceae) bear significant anthelmintic activity against human *A. lumbricoides*.

2.19. *Matricaria chamomilla*

The anthelmintic effects of *Matricaria chamomilla* L. were established in experimental *Ostertagia ostertagi* experimental infection in lambs [12].

2.20. *Dioscorea zingiberensis*

The anthelmintic activity of trillin and gracillin, the two bioactive compounds of *Dioscorea zingiberensis* C. H. Wright was investigated against *Dactylogyrus intermedius* (Monogenea) in goldfish under *in vivo* conditions. The study revealed that both trillin and gracillin are effective against *D. intermedius*, and the gracillin exhibits more interesting perspectives for the development of a candidate antiparasitic agent [11].

2.21. *Paris polyphylla*

The methanol extract of rhizomes of *Paris polyphylla* and its two steroidal saponins compounds, dioscin and polyphyllin D were established to possess a promising *in vivo* anthelmintic activity against *Dactylogyrus intermedius* [11]. The anthelmintic study of five alkaloids (sanguinarine, cryptopine, a-allocryptopine, protopine and 6-methoxyl-dihydrochelerythrine) from *Macleaya microcarpa* (Maxim) Fedde against *Dactylogyrus intermedius* in *Carassius auratus* provided evidence that the plant extract, as well as the isolated compounds, especially sanguinarine, might be the potential plant-based medicines for the treatment of *D. intermedius* infection.

2.22. *Ferula asafoetida*

Ferula asafoetida is known to possess antimicrobial, antioxidant, anti carcinogenic, antispasmodic, molluscicidal and antithelminthic activity [10, 100-104]. The alcoholic extract of *F. asafoetida* and it active component ferulic acid and umbelliferone has shown moderate anthelmintic activity against *Fasciola gigantica* larvae [6, 67]. Ferulic acid has been reported to have many physiological functions, including protection against coronary disease, lowers cholesterol and increases sperm viability [105]. Ferulic acid has been shown to potentially exert several beneficial effect on health [106], it significantly protect against UV-induced erythematic in human [107], act as a

peroxyl radical scavenger and increased the resistance of LDL to oxidation.

It also has a strong insecticidal activity and caused high percentage of mortality on eggs and larvae of insects and regarded as an ovicidal agent [108].

2.23. *Allium sativum*

Dried, powdered of *Allium sativum* contains approximately 1% allicin which is the most significant compound (S-allyl cystein sulfoxide) [109]. The most biologically active compounds, (diallyl thiosulfinat or diallyl disulfide) does not exist in *A. sativum* until it is crushed or cut; injury to the *A. sativum* bulb activates the enzyme allinase, which metabolized alliin to allicin. Allicin was first chemically isolated in the 1940, has antimicrobial effects against viruses, bacteria, fungi and parasite [110-111].

Sunita et al. [6] has been studies the larvicidal activity of allicin against *Fasciola gigantica* larvae sporocyst, redia and cercaria in different month of the year 2011-2012. However, increasing problems of development of resistance in helminthes against anthelmintic drugs [112] have led to the screening of medicinal plants for their anthelmintic activity. The alcoholic extract of bulb of *A. sativum* has also shown moderate *in vitro* anthelmintic activity against human *Ascaris lumbricoldes* [31]. *A. sativum* has been reported to be effective in dysentery and also acts as vermifuge 113, 114]. Oil of *A. sativum* has also been reported to possess anthelminthic activity [115, 116] and discards all injurious parasites in the intestine [113]. *A. sativum* has shown anthelminthic action in *in vitro* and *in vivo* condition against helminthes [31].

2.24. *Balanite*

The larvicidal activity of aqueous extracts of seed, endocarp, mesocarp and the whole fruit of *B. aegyptiaca* against adult *Biomphalaria pfeifferi* and *Lymnaea natalensis* as well as the cercariacidal activity of its seed on *Schistosoma mansoni* cercariae were investigated. With regards to the snail species, *B. pfeifferi* no mortality was observed for *B. pfeifferi* exposed to extracts' concentrations of 2, 5 and 8 ppm of all tested plant parts after 24 hours exposure. Hundred percent mortality rates were observed on *B. pfeifferi* exposed to a concentration of 100 ppm for the seeds and mesocarp, no mortality was observed at 24 hours exposure period below the concentrations of 15 ppm. From the cercariacidal investigation, the *in vitro* cercariacidal activity of the plant on *S. mansoni* cercariae showed that the mortality rates of cercariae were elevated by increasing both the concentrations of seeds and the time of exposure. The *in vivo* observation of the infectivity of *S. mansoni* cercariae was evaluated by pre-exposing the cercariae with seed extracts and then exposing to mice, it was found that infectivity of cercariae was completely inhibited at 15 ppm. And a significant reduction in tissue egg deposition occurred even at lower concentrations than 15 ppm ($p<0.05$).

2.25. *Alangium larmarckii*

The anthelmintic toxicity of the root and bark of *Alangium larmarckii* (Alangiaceaea) are use against the hookworms of dogs and poultry ascarids reported by Dubey and Gupta, [3].

2.26. *Piper betle*

The anticestodal activity of essential oil from *Piper betle* has been found to be superior to that of piperazine phosphate, and the activity against hookworms has been reported greater than that of hexylresorcinol [4]. The leaves extract of *P. betle* are potential anthelmintic [117].

2.27. *Piper longum*

The essential oil from the fruits of *Piper longum* was screened for the anthelmintic activity against *Ascaris lumbricoids*. The experiment revealed that its oil has a definite paralytic action on the nerve muscular preparation of *A. lumbricoids* [5].

2.28. *Semecarpus anacardium*

It is found throughout the hotter/warmer parts of India and its nuts are commonly known as Bhilawa. Chattopadhyaya and Khare [118] reported that anacardic acid isolated from the oil of nuts of

Semecarpus anacardium (Anacardiaceae) and its sodium salt both have good anthelmintic toxicity.

2.29. *Mimusops elengi*

The barks of *Mimusops elengi* have cardiotonic, alexipharmic, anthelmintic and astringent repoted by Kirtikar and Basu, [119]. Crude alcoholic extract and its various fractions were evaluated for their anthelmintic potential using *Pheretima posthuma* and *Ascardia galli* as testworms. The crude alcoholic extract and its ethyl acetate and n-butanol fractions significantly demonstrated paralysis and also caused death of worms especially at higher concentration of 100 mg/ml as compared to standard reference piperazine citrate (10 mg/ml).

2.30. *Cardiospermum halicacabum*

Cardiospermum halicacabum extract when tested *in vitro* for its efficacy against L3 of *Strongyloides stercoralis* showed reduction in the viability of larvae [120].

2.31. *Evolvulus alsinoides*

The ethanolic extract of *Evolvulus alsinoides* (Convolvulaceae) was observed to show more anthelmintic action as compared to piperrazine citrate Dash et al. [81].

3. CONCLUSION

The traditional use of a wide variety of common medicinal plants holds a great prominence source of easily available and effective anthelmintic/larvicidal activity in different animals. The present review of literature indicate the screening of crude products, organic extracts and different plant derived active components is need to further studies at molecular level for searching different phytochemicals which can replace the synthetic drugs in control of wide parasitic infections diseases.

AUTHOR'S CONTRIBUTION

All the authors involved in conception and design, drafting the review article. The final manuscript has been approved by all authors.

TRANSPARENCY DECLARATION

The authors declare that there is no conflict of interest regarding the publication of this article.

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