



## Review Article

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### A REVIEW ON ANTHELMINTHIC ACTIVITY OF AYURVEDIC DRUGS

Saliha Siddiqui<sup>1\*</sup>, Kalpana Patni<sup>2</sup>

<sup>1</sup>PG Scholar, Department of Kaumarabhritya, State Ayurvedic College & Hospital, Lucknow, Uttar Pradesh, India

<sup>2</sup>Assistant Professor, Department of Kaumarabhritya, State Ayurvedic College & Hospital, Lucknow, Uttar Pradesh, India

Received on: 03/01/18 Accepted on: 15/02/18

**\*Corresponding author**

E-mail: siddiquisaliha@gmail.com

DOI: 10.7897/2277-4343.09376

#### ABSTRACT

Intestinal parasites have been considered as a major public health problem throughout the world. Tropical countries have relatively much acute problem of worm infestation among adults & children due to various reasons. Modern anthelmintic medicines are very effective in curing worm infestation but also cause a number of side effects and sometimes may cause resistance. Herbal drugs are less effective in compare to synthetic drugs but are relatively free from side effects. As per Ayurveda, herbal drugs are used in treatment of different type of koshtgata krimis. The review presents various clinical and experimental evidences which support the efficacy of ayurvedic drugs like- *Embelia ribes*, *Butea monospermum*, *Trachyspermum ammi*, *Dalbergia sisso* etc against gastrointestinal worm infestation. These drugs have exhibited potent anthelmintic properties against *Ascaris lumbricoides*, *Necator americanus*, *Trichuris trichiura* which are the most common gastrointestinal worm infestation.

**Keywords:** Koshtgata krimis, *Ascaris lumbricoides*, *Butea monospermum*

#### INTRODUCTION

Worm infestation is one of most common disease found in paediatric practice. Intestinal parasites have been considered as a major public health problem throughout the world. Tropical countries like India have relatively much acute problem of worm infestation among adults & children due to various reasons. It affects the children more frequently than the adults. So, in present era, Medical parasitology has become an important part of medicine and as such it forms a recognized branch of applied pathology. The Soil Transmitted Helminths (STH) i.e. *Ascaris lumbricoides*, hook worms (*Ancylostoma duodenale* & *Necator americanus*) & *Trichuris trichiura* are among the most common gastrointestinal worm infestations in human in both tropical and subtropical countries. The world health organization (WHO) estimates that more than 2 billion of the world's population is infected with STH<sup>1</sup>. In India, the reported prevalence of STH ranges from 12.5-66%, with varying prevalence rates for individual parasites<sup>2,3,4</sup>. The school aged children including adolescents & preschool children are more infected by intestinal worms & schistosomes as compared with any other age group and as a result experience growth stunting & diminished physical fitness as well as impaired memory & cognition<sup>5</sup>. are found as manifestation of helminthiasis.

In Ayurveda, parasitic & helminthic infections are described under krimi roga. Different types of krimi are explained in Ayurvedic literature. Acharyas described classification & morphology of krimis in various samhitas in details & accept that krimi act as an etiological factor in different disease i.e. causes krimija shiroroga, krimija hridaroga etc. Acharya Charaka<sup>6</sup> classified krimi's into two main groups i.e; sahaja krimis (which are not harmful to human beings & always lives in their body) & vaikarika krimis (pathogenic in nature which cause disease and harmful for human body). Acharya Charaka, further classified vaikarika krimi into two subgroups as bahya krimi (external) & abhyantara krimi (internal). Acharya Sushruta explained the

twenty types of abhyantara krimi in detail with their causative factors, pathogenesis, clinical features & treatment, Acharya also described that some krimis are visible to naked eyes & some are non-visible to naked eyes<sup>7</sup>. The present study describes many ayurvedic drugs which are commonly used in the management of koshtgata krimis (intestinal worms). This article is a brief review of the Ayurvedic classics, clinical and experimental evidences which supports the efficacy of Ayurvedic drugs against worm infestation.

This review aims to scan the scattered literature and scientific evidences on the properties of anthelmintic effect of Ayurvedic drugs in the management of udara krimi. Classical texts of Ayurveda as well as PubMed, Medline database have been used for the search of relevant literature and research paper. In vitro, in vivo analysis, experimental trials as well as clinical studies are included in this review to search out the therapeutic potential of Ayurvedic drugs.

#### List of Ayurvedic drugs useful in management of koshtgata krimi

##### *Acorus calamus* (Vacha)

Combination of rhizomes of *Acorus calamus* & root of *Vitex negundo* were exhibited for potent Anthelmintic activity using *Pheretima posthuma* (Indian earthworm)<sup>8</sup>. Study indicate that rhizomes of *A. calamus* bear significant dose dependent effects against intestinal helminths and this active principle b-asarone showed slightly better anthelmintic effects than crude extract<sup>9</sup>. Methanolic and aqueous extracts of *Acorus calamus* plant had been taken for paralysis time and death time of *Pheretima posthuma* (Indian earthworm) . Albendazole was used as a standard drug. This study revealed that methanolic extract showed more significant activity at 100 mg/ml concentration had paralysis time of 5.77 ± 0.34(in min.) and death time of 14.71 ± 1.66(in min.)<sup>10</sup>.

### ***Adhatoda vasica* (Vasa)**

The crude aqueous extract of *Adhatoda vasica* roots showed only mild anthelmintic activity against mixed species of gastrointestinal nematodes in sheep.<sup>11</sup> Reduction in EPG (eggs per gram of faeces) counts and/or recovery of worms at necropsy have previously been used as criterion to assess the anthelmintic efficacy of plant<sup>11,12</sup>. Alkaloids, glycosides, saponins and tannins are the active compounds which conferring the antiparasitic effects of plant<sup>13</sup>.

### ***Aristolochia* species**

The anthelmintic potential of aqueous extract of *Aristolochia indica* linn. and *A. tagala* Cham. against adult Indian earthworm *Pheretima posthuma* and round worms *Ascaridia galli*. Extract of *A. tagala* was found to be more potent and effective at the dose of 2mg/ml compared to the extract of *A. indica* showed dose dependent activity. Plants *A.indica* and *A. tagala* roots possess potent anthelmintic properties<sup>14</sup>. Hexane extract of rhizomes of *A. elegans* has antiprotozoal and antimycobacterial activities<sup>15</sup>. Crude extract and ethyl acetate extract of *A. bractreata* showed the broad spectrum antibacterial activity<sup>16</sup>. Antibacterial, anti-inflammatory and analgesics properties of *A. bracteolata* has been also evaluated<sup>17</sup>.

### ***Artemisia* species**

Anthelmintic effects of crude aqueous extract and methanol extracts of *Artemisia brevifolia* (whole plant) on live *Haemonchus contortus* (gastrointestinal nematode in sheep) as evident from their paralysis and/or mortality exhibited in vitro. This study revealed that, *Artemisia brevifolia* whole plant possesses anthelmintic activity against nematodes<sup>18</sup>. The essential oil of *A. pallens* shown the strong anthelmintic activity against *Pheretima posthuma* (earthworm), *Taenia solium* (tape worm) & *Ascaris lumbricoides* (round worm)<sup>19</sup> & chloroform extracts of stem & root of *A. siversiana* were shown activity against *Syphacia obvelata* (pinworm) *Nippostrongylus brasiliensis* (roundworm) & *Hymenolepis nana* (tape worm) in vivo & result showed that extract was able to eliminate *Hymenolepis nana* from mice<sup>20</sup>.

### ***Azadirachta indica* (Neem)**

Aqueous extract of Neem exhibited anthelmintic activity in dose-dependent manner showing maximum efficacy at 40 mg/ ml concentration for all three types of worms Earthworm (*Pheretima posthuma*), Roundworm (*Ascaridia galli*) and Tapeworm (*Railletina spiralis*). Plant extract exhibited more potent activity at lowest concentration (10 mg/ml) against roundworm (*Ascaridia galli*). Anthelmintic activity of the extract was compared with the standard drug Piperazine citrate (10 mg/ml). Neem which is used traditionally to treat intestinal worm infections, possess significant anthelmintic activity<sup>21</sup>.

### ***Butea monosperma* (Palasha)**

Palasonin a compound obtained from seeds of *Butea monosperma* has antihelmintic activity<sup>22</sup>. Anthelmintic effect of *Butea monosperma* var. *lutea* aqueous extract as well as ethanolic extract, is related to the possible presence of alkaloid and tannins in the extract<sup>23</sup>. The anthelmintic activity of different species of *Butea* has been reported against *Ascaridia galli*, *Ascaris lumbricoides*, Earthworms, *Toxocara canis*, *Oxyurids*, *Dipylidium caninum*<sup>24</sup>. The ethanolic extract of the stem bark has been found to inhibit the castor oil induced diarrhea by decreasing the gastrointestinal motility<sup>25</sup>. Acetone fraction from barks and

twigs of *Butea monosperma* possesses significant antimicrobial activity at very low concentration (20ug/disc) on oral pathogenic bacteria<sup>26</sup>.

### ***Caesalpinia crista* (Latakaranja)**

Whole plant and crude aqueous and methanolic extract of plant have been used on Trichostrongylid nematodes of sheep and tested for adult motility assay and egg hatch test, plant exhibited dose and time-dependent anthelmintic effects by causing mortality of worms and inhibition of egg hatching<sup>27</sup>.

### ***Calotropis procera* (Madaar)**

Crude aqueous & methanolic extract of this plant flowers were tested with live *Haemonchus contortus* (nematodes of ruminants) to measure for egg count percent reduction & rule out to possess good anthelmintic activity against nematodes<sup>28</sup>. Different extracts of *Calotropis procera* leaves caused paralysis followed by death of the worms at all tested dose levels, the effect increased with concentration. It was observed that 70% hydroethanolic extract shown better activity as compared to *n*-butanol and chloroform extract of *Calotropis procera* leaves and reference control piperazine citrate<sup>29</sup>.

### ***Carica papaya* (Erandakarkati/ Papita)**

Papaya latex was used to check the *Heligmosomoides polygyrus* (intestinal roundworm of rodents) infections in mice. This study shown an antiparasitic efficacy<sup>30</sup>. Concentrated latex of *Carica papaya* exhibited anthelmintic activity in dose dependent manner taking shortest time for paralysis and death with 100 % concentration hence latex of *Carica papaya* in its different conc. exhibited anthelmintic activity when compared with the standard anthelmintic drug<sup>31</sup>.

### ***Chenopodium album* (Bathua)**

Seed kernel and crude aqueous and methanolic extract of the plant part have been used and tested against Trichostrongylid nematodes of sheep and tested for adult motility assay and egg hatch test. They found that plant exhibited dose and time-dependent anthelmintic effects by causing mortality of worms and inhibition of egg hatching<sup>27</sup>.

### ***Cinnamomum camphor* (Karpura)**

Aqueous extract of *Cinnamomum camphora* possesses anthelmintic activity in dose-dependent manner showing maximum efficacy at 50 mg/ ml concentration for three types of worms. Our plant extract exhibited more potent activity at lowest concentration (10 mg/ml) against roundworm (*Ascaridia galli*). Anthelmintic activity of the extract was compared with the standard drug Piperazine citrate<sup>32</sup>.

### ***Cocos nucifera* (Narikela)**

Ethyl acetate extract of *Cocos nucifera* fruit has tested on sheep nematodes by egg hatching & larval development. These extracts have shown to contain 100% efficacy on egg hatching & 99.77% on larval development<sup>33</sup>. A dose of 1000 mg/kg of butanol extract of bark of the green coconut had 90.70% efficacy in reducing the mouse intestinal nematodes burden<sup>34</sup>.

### ***Coriandrum sativum* (Dhanyaka)**

The ethanolic extract and carbon tetrachloride extract were tested in-vitro for anthelmintic potency by determination of time of

paralysis and time of death of worm. Piperazine citrate (15mg/ml) used as standard. The shortest time of paralysis was observed at higher dose (150 mg/ml) of both ethanolic extract and carbon tetrachloride were found to 28 min and 45 min respectively. Ethanolic extracts of *Coriandrum sativum* possess potent anthelmintic activity compared to carbon tetrachloride extract<sup>35</sup>.

#### ***Dalbergia sissoo* (Sheesham)**

The anthelmintic effect of ethanolic extract of *Dalbergia sissoo* Roxb bark was comparable with the standard drugs, although it caused both paralysis and death of the worms similar to piperazine citrate and albendazole. The anthelmintic activity was evaluated on adult Indian earthworm *Pheretima posthuma* as well as on worm parasites of human beings *Ascaridia galli* (nematodes)<sup>36</sup>. The extract of *Dalbergia sissoo* Roxb was reported as anti-inflammatory<sup>37</sup>, antidiarrheal<sup>38</sup>, analgesic and antipyretic activity<sup>39</sup>.

#### ***Embelia ribes* (Vidanga)**

Aqueous and alcoholic extracts of *Embelia ribes* seed revealed potent in vitro ovicidal and mild larvicidal activity against exogenous stages of *Haemonchus contortus* (nematode) in sheep. The corrected faecal egg count reductions were 38.1 and 46.3% with aqueous extract and 74.3 and 65.6% with alcoholic extract on day 7 and 10 post treatment, respectively<sup>40</sup>. The ethanolic extract of the seeds of *Embelia ribes* (10-200 µg/mL) exhibited potent anthelmintic activity<sup>41</sup>. The highest activity (diameter of zone of inhibition 27mm) was demonstrated by the ethanolic extract of *Embelia ribes* fruits against *Pseudomonas aeruginosa* while the lowest activity (diameter of zone of inhibition 2mm) was demonstrated by the water extract against *Escherichia coli*. The aqueous extract generally showed lower activity against the test organisms compared to the ethanolic extract<sup>42</sup>.

#### ***Ficus benghalensis* (Vata/Bargad)**

Aqueous & methanolic extracts of roots of *Ficus benghalensis* has been found to show a potent anthelmintic activity when compared to the standard drug. Aqueous extracts of *Ficus benghalensis* at 20 mg/ml concentration shows paralysis at 3.44 min and death at 4.34 min, whereas methanolic extract shows paralysis at 3.02 min and death at 4.36 min. The standard drug, Albendazole shows paralysis at 2.68 min and death after 5.29 min. Phytoconstituents like flavonoids, amino acids, steroids, saponins and tannins may be responsible to show a potent anthelmintic activity<sup>43</sup>.

#### ***Mallotus philippinensis* (Kampillaka)**

The anthelmintic effect on tape worm had been evaluated in albino rates, from the resin of the plant showed lethal effect of 35.69% and 78.21% in small intestine in concentrations 60 and 120mg/kg respectively.<sup>44,45</sup> Methanolic extract of *M. philippinensis* leaves decreases the CCl<sub>4</sub>-induced elevation in biochemical parameters (SGOT, SGPT, ALP, direct bilirubin and total bilirubin) on pre-treatment at doses 100–200mg/kg and also improved the functional and antioxidant parameters. These suggest that leaves extract was effective in functional improvement of hepatocytes. Histopathological studies also suggest the hepatoprotective activity of plant<sup>46</sup>. Ethanolic and ethyl acetate fraction of plant also possesses significant antimicrobial activity<sup>47</sup>.

#### ***Moringa oleifera* (Shigru)**

Seed oil of *Moringa oleifera* has been shown anthelmintic activity which was investigated on adult Indian earthworm<sup>48</sup>. *M. oleifera* seed aqueous and ethanolic extracts possess bioactive compounds (tannin and saponins) with in-vitro anthelmintic activity against *H. Contortus* eggs and third stage larvae<sup>49</sup>.

#### ***Ocimum sanctum* (Tulsi)**

Tulsi leaves has anthelmintic property and also check vomiting<sup>50</sup>. The essential oil of *Ocimum sanctum* L, showed potent anthelmintic activity in the *Caenorhabditis elegans* (nematode) and eugenol being the predominant component of the essential oil, is suggested as the anthelmintic principle<sup>51</sup>. Aqueous extract of tulsi is found effective in patients suffering from viral encephalitis.<sup>52</sup> Larvicidal efficacy against larvae of *A. stephensi*, *A. aegypti* and *Culex quinquefasciatus* shown by essential oil of *Ocimum sanctum* L<sup>53</sup>. Another study showed that the mosquito larvicidal property of both leaf and flower extract of *Ocimum sanctum* L, against larvae of *Aedes aegypti* and *Culex quinquefasciatus*. Compared to flower extract, leaf extracts were found to be more effective against both types of mosquitoes<sup>54</sup>.

#### ***Terminalia chebula* (Haritaki)**

The alcoholic extract of *Terminalia chebula* Retz. showed marked and potent anthelmintic activity than the aqueous extract and standard drug albendazole. Standard drug albendazole is showing moderate activity while aqueous extract of *Terminalia chebula* Retz. is showing comparatively less anthelmintic activity<sup>55</sup>.

#### ***Trachyspermum ammi* (Yavani)**

Phytochemical tannins are chemically polyphenolic compound and shown to produce anthelmintic activities and tannin can bind to free proteins in gastro intestinal tract of host animal or glycoproteins on the cuticle of parasite and may cause death. The aqueous extract of seeds of *Trachyspermum ammi* at higher concentration (40mg/ml) showed good anthelmintic activity and alcoholic extract of *Trachyspermum ammi* at normal concentration showed good anthelmintic activity and it is compared with effect produced by reference standard drug albendazole. This experimental evidence exhibited the anthelmintic activity<sup>56</sup>.

#### ***Tribulus terrestris* (Gokshura)**

Analysis of the extracts of *Tribulus terrestris* fruit evaluate significant and much better antimicrobial & anthelmintic activities<sup>57</sup>. Methanolic extract of *Rheum palmatum* and petroleum ether extract of *Tribulus terrestris* were screened for their anthelmintic activity. Both extracts showed anthelmintic activity in dose dependent manner<sup>58</sup>.

#### ***Trigonella foenum-graecum* (Methika)**

The seeds of *Trigonella foenum-graecum* have a potent anthelmintic activity when compared with conventionally used drug. It is comparable with standard drug. Aqueous and alcoholic extracts have shown paralysis and death of earthworms and it was compared in the same concentration with albendazole as reference drug. Alcoholic extract in the concentration of 60 mg/ml has taken less time to cause paralysis, and little more time to cause death of earthworms as compared with same concentration of reference drug<sup>59</sup>.

### **Zingiber officinale (Shunthi)**

The anthelmintic activity of alcoholic extracts of rhizomes of *Z. officinale* against human *Ascaris lumbricoides* is appreciable<sup>60,61</sup>. The antifilarial effect of *Z. officinale* against *Dirofilaria immitis* has been reported<sup>62</sup> and also reported lethal effect of *Z. officinale* on *Anisakis* larvae in- vitro<sup>63</sup>. have reported molluscicidal and antischistosomal activities of *Z. officinale*<sup>64</sup>. In-vitro methanol extracts of *Zingiber officinale* killed all the test worms (*Haemonchus contortus*) within two hours post exposure shown the anthelmintic property<sup>65</sup>.

### **Ziziphus nummularia (Jharber), Acacia nilotica (Kikar/Babul)**

Crude methanolic extract of bark of *Ziziphus nummularia* & fruit of *Acacia nilotica* was studied on trichostrongylid nematodes of sheep to exhibited egg hatch test, adult motility assay & the larval development assay. This study revealed the dose & time dependent anthelmintic effects. *Acacia nilotica* was found to be more potent than *Ziziphus nummularia* in egg hatch test & larval development assay<sup>66</sup>.

### **CONCLUSION**

Since the ancient period, herbs have fundamental source of medications. This review is an attempt to scanning the anthelmintic property of certain possible drugs which are described in the Ayurveda. These herbs possess anthelmintic property against the intestinal worms, it is scientifically proved by researches. For the more efficacy and proper use of herbal medications there is needed more extensive studies directed towards the experimental validation of the plants. To establish an effective alternative treatment against various helminths it is essential to studies these herbs at the molecular level and to find out the active constituents, specific mode of action of the plants and their clinical evaluation

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**Cite this article as:**

Saliha Siddiqui & Kalpana Patni. A review on anthelmintic activity of Ayurvedic drugs. *Int. J. Res. Ayurveda Pharm.* 2018;9(3):127-132 <http://dx.doi.org/10.7897/2277-4343.09376>

Source of support: Nil, Conflict of interest: None Declared

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