ANTHELMINTIC POTENTIALS OF LEAF EXTRACTS OF MEDICINAL PLANTS; A BRIEF REVIEW

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ABSTRACT

Helminthiasis, also known as helminth infection or worm infection is one of the most prevalent disease seen in developed and developing countries. The synthetic drugs are used to cure the disease but due to their toxicity and adverse effects use of herbal remedies predominates. The present study is mainly focused on the various leaf extracts which were used as herbal anthelmintics their method of collection, extraction of phytochemicals, screening-evaluation of in-vitro, in-vivo anthelmintic activity. In majority of cases the in-vitro anthelmintic activity was performed on Indian adult earthworm Pheritima postuma and methanolic, ethanolic, aqueous extracts have showed activity in a dose depended manner, more potent than the reference standards. From the above studies it can be concluded that leaves could be categorized under anthelmintic herbal drugs and become a potent key ingredient of such herbal formulation.


INTRODUCTION

Disease has been an integral part of man and the search for remedies to combat it is been ongoing. Medicines are extensively and safely used to alleviate various symptoms of diseases.[1] In recent times focus on plant research has increased all over the world and there is widespread of belief that the green medicines are healthier and harmless than the synthetic ones.[2] Plants are good sources for new, safe, biodegradable and renewable drugs however the use of plants as therapeutic agents in addition to being used as food is age long.[3] The medicinal plants are recognized for their ability to produce a wealth of secondary metabolites
and mankind has used many species for centuries to treat a variety of diseases.\[4\] Herbal medicines are prepared from a variety of plant materials-leaves, stems, roots, barks, fruits, seeds, flowers and so on. They usually contain most of the biologically active ingredients and are used primarily for treating mild to chronic ailments.

**Traditional system of medicine**

The traditional system of medicine is the sum of all the knowledge and practices, whether applicable or not, used in the diagnosis, prevention and elimination of physical, mental, or social disequilibrium and relying exclusively on practical experience and observation handed down verbally or written form from generation to generation.\[5\] India has an ancient heritage of traditional medicines. Materia medica of India provides lots of information on the folklore practices and traditional aspects of therapeutically important natural products. Indian traditional medicine is based on various systems including Ayurveda, Siddha, Unani and Homeopathy. The evaluation of these drugs is mostly based on phytochemical, pharmacological and allied approaches including various instrumental techniques like chromatography, microscopy and others. The world health organization (WHO) estimates that about 80% of the population living in the developing countries rely almost exclusively on traditional medicines for their primary health care needs.\[6\] Herbal drugs constitute a major part in all the traditional system of medicines. The history of herbal medicines is as old as human civilization. Plants were used medicinally in India, China, Egypt and Greece long before the beginning of the Christian era. It was found that traditional system of medicine utilizes various parts of plants/herbs, animals and also mineral substances.

**Helminthiasis**

Helminthiasis or infection with parasitic worms are the most common infectious agents of humans in developing countries and produce a global burden of disease that exceeds better-known conditions i.e., tuberculosis and malaria.\[7\] The disease is highly prevalent particularly in third world countries due to poor management practices.\[8\] In tropical regions, where prevalence is greatest, simultaneous infection with more than one type of helminths is common. Moreover, human beings can spread these pathogens to previously uninvolved populations through travel, migration and military operations. There are two major phyla of helminthes of which the nematodes includes the major intestinal worms and filarial worms that cause lymphatic filariasis and onchocerciasis, where as the Platyhelminthes include the flukes, such as the schistosomes and the tapeworms, such as the pork tapeworm that causes.
The world health organization reveals that over two billion people are suffering from parasitic worm infections. It is estimated that by the year 2025, about 57% of the population in the developing countries will be influenced by helminths infections.

**Anthelmintics**

Anthelmintics act either locally to expel worms from the gastrointestinal tract or systemically to eradicate adult helminthes or developmental forms that invade organs or tissues. Currently used synthetic anthelmintics such as benzimidazoles, piperazine, Diethylcarbamazine citrate, Ivermectin, Levamisole, etc., are suffering from a variety of adverse effects including anorexia, nausea, vomiting, dizziness, diarrhea, occasional fever, rashes etc.

**Anthelmintic plants**

Anthelmintic plants that are used traditionally in expelling the worms that are parasitic in nature from the body either by stunning or killing them. They are also known as Vermifuges or Vermicides. Anthelmintic medicinal plants are used as good alternatives for the traditional allopathic medicinal agents. On through literature survey it was found that extracts of leaves of variety of medicinal plants shows anthelmintic properties when compared to other parts of the medicinal plant.

**Herbal drugs as anthelmintics**

The synthetic anthelmintic drugs possess variety of adverse effects and hence are the building blocks to go towards the herbal remedies to cure helminthiasis. The herbal medicines are in great demand in developed and developing countries for primary health care because of their wide biological and medicinal activities, higher safety margins and lesser costs. Hence are traditionally used in various parts of the world to cure different diseases. From ancient time different plants are known to possess significant anthelmintic activity against these invasive types of worms and can be effectively used in the treatment of worm infections. The present review study explains and give insight about different leaf extracts used as anthelmintics, their method of collection, extraction, phytochemical screening and evaluation of *in-vitro, in-vivo* anthelmintic activities.

**Herbal leaves**

Leaves are considered as an outgrowth of the stem and branches from a node with an auxiliary bud. The food material which is necessary for plant growth and maintenance is prepared via this morphological part by the process of Photosynthesis. However leaves can
be dorsoventral possessing distinct upper and lower surfaces or isobilateral type with the palisade parenchyma on both sides of the blade.\textsuperscript{[17]} A number of important characteristics like leaf base, petiole, lamina, shape, venation, margin and apex play an important role in their categorization and differentiation of leaves of various medicinal plants. The leaves are important parts of plants which are of two types, simple and compound leaf. Plants possesses variety of biological activities includes Antibacterial.\textsuperscript{[18]} Anti-fungal.\textsuperscript{[19]} Anti-diabetic.\textsuperscript{[20]} Anti-oxidant.\textsuperscript{[21]} Anti-tumor.\textsuperscript{[22]} Anxiolytic.\textsuperscript{[23]} Anti-viral.\textsuperscript{[24]} Anti-inflammatory activity.\textsuperscript{[25]} etc., Various Leaf Extracts of Herbal plants are utilized as anthelmintics and are discussed in our study.

1. Popi Patilaya and Dadang Irfan Husori have reported the anthelmintic activity of Indonesian \textit{Curangafel-terrae} of family Scrophulariaceae. The leaves of plant are traditionally used to cure helminthiasis. The plant materials were collected from Dairi District, North Sumatra Province, Indonesia. The crude ethanolic extract of the plant material was prepared by macerating the powdereds leaves in 96% of ethanol. The extract was evaporated under reduced pressure. The Phytochemical screening of the dried material and the ethanolic extract of \textit{C. fel-terrae} leaves showed the presence of flavonoids, glycosides, saponins, tannins and terpenoids. They reported that the ethanolic extract of \textit{C. fel-terrae} leaves revealed anthelmintic activity against \textit{P. phostoma}. All the doses exhibited the effect to the worms with the paralysis time ranging from 3.43-41.28 mins and the death time ranging from 7.92-47.26 mins.\textsuperscript{[26]}

2. R Jothi Karumari, S Sumathi, K Vijayalakshmi and S Ezhilarasi have reported the anthelmintic activity of extract of leaves of \textit{Sesbania grandiflora} belongs to family Fabaceae. The aqueous extract of the leaves was prepared by soaking \textit{S. grandiflora} leaf in distilled water for a day and to this benzene was layered to prevent fungal growth. The preparation was filtered through Whatman filter paper and the filtrate was concentrated in water bath at 100\textdegree C. The phytochemical analysis of the aqueous extract reported the presence of flavonoid, phenol, tannin, alkaloid, saponin, steroids and terpenoids. The anthelmintic activity of the leaf extracts was tested against \textit{A. galli}, the largest intestinal parasitic nematode causing diseases in poultry. The aqueous extract of the leaves recorded a definite anthelmintic efficacy against \textit{A. galli}.\textsuperscript{[27]}
3. Lai SM, Sudhahar D, Anandarajagopal K have reported the \textit{in-vitro} anthelminitic activity of leaves of \textit{persicaria chinensis} belongs to family polygonaceae. The plant material was collected from Kepong, Malasia. The coarse powdered leaves of plant material was extracted by order of increasing polarity of solvents, petroleum ether, chloroform, methanol and distilled water by cold maceration technique for seven days. The extracts were filtered with Whatman filter papers separately, followed by evaporation of the excessive solvent using rotary evaporator under reduced pressure to concentrate the extracts. The preliminary phytochemical investigation of the leaf extracts showed the presence of alkaloids, Carbohydrates, Glycosides, protiens, Sterols, Fixed Oils, Fats, Phenolic compounds, Tannins, Triterpenoids, Saponins, Gums, Mucilage, Flavones and Flavonoids. The bioactive constituents that were present in the extracts may cause anthelmintic effect, saponins that were present only in the aqueous and methanol extracts could be given more contribution for the anthelminitic activity of the plant, \textit{P. chinensis}. From the above findings they concluded that the aqueous and methanol extracts may possess powerful anthelmintic activity to expel intestinal parasitic worms.\cite{28}

4. Alby Alphons Baby and Regi Raphael K have showed the anthelmintic activity of leaf extracts of \textit{white abrus}. The leaf of the plants were collected and shade dried for several days. The dried leaves were ground to coarse powder and then macerated for 72 hours in 95\% methanol and extract was concentrated by rotary evaporator. The phytochemical screening of the leaves of \textit{White Abrus} revealed the presence of various valuable secondary metabolites, among them phenolic compounds may contribute to the maximum percentage of anthelmintic activity. The extract was used to study the anthelmintic activity against Indian adult earthworm \textit{Pheretima phostuma}, the extract showed better anthelmintic activity than the standard drug.\cite{29}

5. Vijay Tambe, Rajendra Bhambar have worked on anthelmintic activity of leaf extract of \textit{Hibiscus Tiliceus} Linn. The leaves were collected from the ratnagiri district Maharastra. The extract of the leaves were obtained by continuous hot extraction method by soxhlet apparatus. They used petroleum ether, chloroform, ethyl acetate and ethanol as solvents. The qualitative analysis reveals the presence of carbohydrates, protiens, steroids, alkaloids, saponins, tannins, glycosides, aminoacids. Finally they concluded that the leaves of \textit{hibiscus tiliceus} showed potential anthelmintic activity however they could not isolate any of the phytoconstituents responsible for anthelmintic activity.\cite{30}
6. Kranti Satpute, Wajid Chaus, Jyothi Kadam, Koumudee bodas, Varsha sende, Anand Bafana have reported the anthelmintic activity of leaf extract of *Eugenia Jambolana* Linn of family Myrtaceaceae. The extract was prepared by soaking powdered leaves in ethanol for 48 hrs, filtered through muslin cloth and the filtrate was evaporated to get dry extract. The phytochemical screening gave positive result for the presence of steroids, phenolic compounds, saponins, tannins, glycosides and aminoacids. Indian adult earthworms (*Pheretima posthuma*) were used to study anthelmintic activity against albendazole as standard. The extract showed comparable results as that of standard.[31]

7. Gangadhara angajala, Divya P, Ramya R, Subhashini R have studied on *in-vitro* anthelmintic activity of crude leaf extracts of *Aegle Mermelos correa*. The green leaves were washed thoroughly with water and were kept for drying in shade for 3-4 days. The weighed quantity of powdered drug was defatted by extracting with petroleum ether. The residue was then extracted for 72 hrs with methanol in soxhlet extractor. Anthelmintic activity was performed on adult Indian earthworm, *phoretima posthuma* by using ether and aqueous extracts. It was concluded that the aqueous extract showed better activity than pet ether extract.[32]

8. Raman R Chandak, Nishikant K Bharat, Subhash J Devdhe, Hiral F Majmudar have reviewed the *in-vitro* anthelmintic activity of leaves of *Cleome Viscosa* Linn belongs to family Capparidaceae. The extract was prepared by defatting the powdered leaves with pet-ether, then extracted with methanol which was further evaporated to dryness to obtain alcoholic extract. Aqueous extract was obtained by macerating for 24 hrs. Preliminary phytochemical investigation of alcoholic extract revealed the presence of anthraquinone glycosides, phenolic compounds and steroids while aqueous extract showed the presence of glycosides and phenolic compounds. The above extracts (i.e. alcohol and aqueous) were investigated for their anthelmintic activity against *Pheretima Postuma* and *Ascardia galli*. From the studies they concluded that both the alcoholic and aqueous extracts showed significant anthelmintic activity than the standard, Albendazole.[33]

9. Nayak Sarojini, Chakraborti Chandra kanti, Mohanta Dibya Singh das, Jaiswal Priyanka, Sah Usha Kumari have reported the anthelmintic activity of *Clitoria ternatea* leaf extracts. The powdered leaves were passed through a sieve (No.40) and were macerated in methanol for 3 days at room temperature. The resulting extract was filtered through a filter paper. The filtrates obtained were then evaporated to dryness under reduced pressure. The
anthelmintic activity was performed on adult Indian earthworm *Pheritima posthuma*, collected from moist soil and washed with normal saline to remove all feacal matter. From the studies they concluded that the ethanolic extract did not showed any anthelmintic activity while methanolic extract showed anthelmintic activity in a dose depended manner and was more potent than the standard piperazine citrate.\(^\text{[34]}\)

10. Garai Ranju, Sutar Niranjan, Patro Saroj Kumar, Pal Vishesh Kumar, Pandey Shailendra Kumar have evaluated the anthelmintic activity of leaves of *Acalypha Indica*. They performed the extraction procedure by using coarse powdered leaves. The plant material were first defatted with pet-ether and extracted with ethanol. Aqueous extract was obtained by macerating the leaves for 24 hrs. The phytochemical evaluation showed the presence of Carbohydrates, Alkaloids, Glycosides, Flavonoids, Tannins and Saponins. They concluded that the anthelminitic activity of both aqueous and ethanolic extracts are comparable with that of the standard drug.\(^\text{[35]}\)

11. Omale James and Ubimago Ojonugwa Thank God have studied the anthelmintic activity of leaves of *Saba Florida* of family Apocyanaceae. The powdered leaves were subjected to aqueous and chloroform extraction. The above extracts were used for evaluation of anthelmintic activity utilizing Nigerian adult earthworm, *Terrestris lumbricoides*. The chloroform and aqueous extracts showed anthelmintic activity comparable to that of reference standard Albendazole.\(^\text{[36]}\)

12. Lokman Taib Al-Barwary have evaluated the anthelmintic activity of leaves of *Urtica dioica* and *Tanacetum vulgare* L. The leaves were powdered mechanically by commercial blender. The powdered leaves were then extracted by ethanol. The aqueous extract was prepared by boiling 100 gm of the plant powder in 200 ml of distilled water, mixed up well and shaked for 15 min. The mixture was filtered through a Whatman No.1 filter paper. Hydatid cysts of *Echinococcus granulosus*, were collected from the liver and lungs of infected sheep slaughtered at Duhok slaughtered house and used at the Research Laboratory of the faculty of Veterinary Medicine, University of Duhok. The protoscolices were obtained from the hydatid fluid and washed three times in normal saline and Ring solution. At the end of the study they revealed that the aqueous extract of *Urtica dioica* and *Tanacetum vulgare* have a significant anthelmintic activity. While, the ethanol extract of both plant has less effect.\(^\text{[37]}\)
13. Prashanta Kr. Deb, Ranjib Ghosh, Sankari Das, Tejendra Bhakta have evaluated the \textit{in-vitro} anthelmintic activity of \textit{acorus calamus} leaves. The fresh leaves were dried under shade. Then coarse powder was extracted with extra pure methanol and 50\% ethanol successively in a Soxhlet extractor repeatedly for 48 hours. The extract was dried by solvent evaporation in a thermostat water bath at 50-60\(^\circ\)C temperature. Aqueous extract was prepared by macerating the coarse powder for 48hrs. Preliminary phytochemical screening of crude extract revealed the presence of tannins, steroids, flavonoids, Saponins and terpinoids. The presence of these phyto-constituents showed a significant anthelmintic activity on \textit{Pheretima posthuma} at all the tested doses when compared to control.\cite{38}

14. R. Das, D. K. Mehta and a. Gupta have studied the \textit{in-vitro} anthelmintic activity of leaves of \textit{juglans regia} L of family Juglandaceae against \textit{pheretima posthuma}. The coarsely powdered leaves were extracted successively with petroleum ether, methanol and water by maceration process at room temperature for three days. On phytochemical screening of crude extracts revealed the presence of alkaloids, flavonoids, tannins and saponins. Tannins and polyphenolic compounds were shown to produce anthelmintic activities. The studies were concluded that the aqueous extract showed potent activity than the standard piperazine citrate.\cite{39}

15. M. Chinna Eswaraiah, A. Elumalai, Anil Boddupalli and Ravi Kiran Gollapalli have evaluated the anthelmintic activity on \textit{Bougainvillea glabra} Leaves. The collected leaves were washed, shade dried and converted into moderately coarse powder by mechanical grinder. The powdered material was extracted successively with petroleum ether, ethyl acetate, methanol and water by using soxhlet apparatus. The anthelmintic activity was performed on adult Indian earthworm \textit{Pheretima posthuma} and the methanolic extract showed better activity.\cite{40}

16. RR. Manjula, U. Spandana, T. Joshi Anand and M. Sudheer have reported the \textit{in-vitro} anthelmintic activity of the leaves of \textit{Tephrosia purpurea}. The leaves were extracted with methanol and distilled water. Methanolic leaf extract of \textit{Tephrosia purpurea} showed the presence of alkaloids, carbohydrates, flavanoids, tannins and phenolic compounds and the presence of these phytoconstituents were responsible for anthelmintic activity.\cite{41}

17. G. P. Choudhary have studied the anthelmintic activity of leaves of \textit{Coleus aromaticus} benth. The dried powdered leaves were extracted with 95\% ethanol by using
soxhlet extractor and extract was concentrated under reduced pressure. Phytochemical screening revealed the presence of alkaloids, flavonoids, saponins, tannins, terpenoids, glycosides, steroids and anthraquinones in the extract. The In-vitro Anthelmintic activity was carried out by microwell plate assay using Levamisole and ivermectin as reference standard. The free living roundworm *Rhabditis pseudoe longa* was used for the anthelmintic screening.[42]

18. Javid Ahmad, Syed Tanveer and Bilal A. Zargar have evaluated the anthelmintic activity of *Mentha longifolia* leaves Against *Ascaridia galli*. Leaves were powdered, extracted with water and methanol. The in-vitro trials for anthelmintic activity were performed on A. galli. In-vitro assessment of anthelmintic activity of *M. longifolia* revealed that the effect of crude aqueous extract and crude hydroalcoholic extract was concentration dependent.[43]

19. Sibaram Paria, Subhasish Maity and Musfiqua Mookerjee have reported the anthelmintic activity of leaves of *Vitex negundo* family Verbenaceae. Leaves were subjected to soxhlet extractor, by increasing solvent polarity. Leaf powder was subsequentially extracted using Petroleum ether, chloroform, ethanol, methanol and aqueous solvent in Soxhlet apparatus. Preliminary phytochemical study was conducted for presence of alkaloid, glycosides, reducing sugar, tannins and phenols, sterols, Saponins and flavonoids. The in-vitro anthelmintic activity was performed on adult indian earthworm *Pheretima posthuma* against piperazine as standard. These studies revealed that methanolic extract showed potent activity than standard.[44]

20. Bairagi GB, Kabra AO and Mandade RJ have studied the anthelmintic activity of *Lawsonia inermis* L. Leaves in Indian Adult Earthworms. The collected leaves of *Lawsonia inermis* L. were dried under shade and powdered in electric blender. The powdered leaves were then subjected to extraction by maceration. The extracts were concentrated by evapouration at room temperature and used for pharmacological studies. Piperazin citrate was used as reference standard. From the results of the it was concluded that, petroleum ether extracts of *Lawsonia inermis* L. demonstrate to possess dose dependant anthelmintic activity when compared to Piperazine citrate.[45]

21. Moses Samuel Rajan, Cassiano Machado, Prinkesh Fanasia, Sunil Koshy and Gopikrishna have studied the anthelmintic activity of leaves of *Sesbania sesban*. The leaves were shade dried and were grounded to coarse powder. Powder was then extracted with
ethanol, further evaporated to dryness to dry residue. Aqueous extract was also obtained by decoction method with fresh leaves powder by heating upto 1.5 hours. The ethanolic extract of *Sesbania sesban* leaves showed significant anthelmintic activity by causing paralysis followed by the death of *Pheretima posthuma* worms but not as significant when compared to the standard reference Piperazine citrate.\(^{[46]}\)

22. T. Satyanarayana, B. Gangarao, G. Surendra, Rajesh K and M. Raghupathi have reported the anthelmintic activity of *Annona Squamosa linn* leaf extract. The collected leaves were shade dried and made into coarse powder, extracted successfully using various polar solvents like hexane, ethylacetate, ethanol. The obtained extracts were made solvent free using rota evaporator and extracts showed significant anthelmintic activity compared to the standard Albendazole.\(^{[47]}\)

23. K Hemamalini, A Rajini, Uma Vasireddy and E Ratna Sundari have evaluated the anthelmintic activity of leaf extract of *Sophora Interrupta*. The air dried coarse powder of the leaves of *Sophora interrupta* was defatted with petroleum ether, then the marc was extracted with methanol. Phytochemical screening revealed the presence of Alkaloids, tannins, saponins, flavonoids and terpenoids. The methanolic extract was used to evaluate the anthelmintic activity and showed the effect in a dose dependent manner.\(^{[48]}\)

24. Suman kundu, saptarshi roy, suranjana nandi, bidisha ukil, larisha m. Lyndem have reported the anthelmintic activity of leaf extract of *Senna occidentalis*. The fresh leaves were collected, washed thoroughly with distilled water and allowed to dry in an oven at 50\(^{\circ}\)C. The coarse powder was then extracted with 90\% ethanol. The methanolic extract showed the anthelmintic activity in a dose manner on rat tapeworm *hymenolepis diminuta*.\(^{[49]}\)

25. Megha Kasarwala1, Saurabh Parmar, Dipen Patel, Marmik Bhavsar, Parth Thakkar have reported the anthelmintic activity of leaves of *Ailanthus Excelsa* Roxb. The Ethanolic extracts of air dried leaves were prepared by Soxhelt apparatus, concentrated and vacuum dried which gave powder like extracts. The extracts were subjected to qualitative chemical investigation and revealed the presence of various phytoconstituents such as alkaloids, flavonoids, carbohydrates, tannins, proteins, coumarines etc. they concluded that some of these phytoconstituents were responsible to show anthelmintic activity.\(^{[50]}\)
26. Dasrao Patil, Pradeep Halle and Anil Bade have evaluated the anthelmintic activity of leaves of *Terminalia catappa*. The red leaves of the plant were pulverized by mechanical grinder and passed through a sieve no. 20. The powdered leaves were extracted successively with petroleum ether, methanol and water. The aqueous extract was obtained by cold maceration. They found that Methanolic extract of *Terminalia Catappa* leaves were found to possess anthelmintic activity in a concentration depended manner.\textsuperscript{[51]}

27. C Velmurugan, Sujith Thomus, Anurag BhargavaSK Shajahan have studied the anthelmintic activity of leaves of *Gossypium hebachium* linn. The collected leaves were shade dried, coarsly powdered and extracted with n-hexane, ethyl ether and 80% ethanol. The preliminary phytochemical screening revealed the presence of alkaloids, flavonoids, saponins, tannins and glycosides. The anthelmintic activity was evaluated on indian adult earthworm *pheretima phostuma*. At higher concentration the extract exhibited the most potent anthelmintic activity when compared with the positive controle albendazole.\textsuperscript{[52]}

28. Sravanthi V, Nagabharathi M, Manga P, Sowjanya B, Usha Rani B, Bhairagi P, Sridhar K and P Umadevi have reported the anthelmintic activity of leaves of *Achyranthes aspera* of family Amaranthaceae. The leaves of the plant were dried in shade and made into fine powder, extracted with water and ethanol. The anthelmintic activity was performed on indian adult earthworm *pheretima postuma* using piperazine as reference standard. They observed that the Aqueous and Ethanolic extracts obtained were found to possess good anthelmintic activity, but the ethanolic extract showed better anthelmintic activity when compared to aqueous extract and standard drug Piperazine citrate.\textsuperscript{[53]}

29. Ajay Sharma, Sumit Gupta, Sandeep Sachan, Ashutosh Mishra, Anshu Banarji have studied the anthelmintic activity of leaves of *Saraca indica* Linn. Fresh leaves were collected, washed thoroughly and dried under shade and then made into a coarse powder using dry grinder, extracted with ether (60-80°C), acetone, chloroform, methanol and water in order of increasing polarity. The individual leaf extracts like petroleum ether, chloroform, methanol and water were subjected to qualitative chemical investigation for the identification of different phytoconstituents like sterols, glycosides, saponins, carbohydrates, alkaloids, flavonoids, tannins, proteins and triterpenoids. The anthelmintic activity was evaluated on *Pheretima posthuma*, and concluded that methanol, chloroform and aqueous extracts showed better anthelmintic activity when compared with standard drug at the same concentration.\textsuperscript{[54]}
30. Wahid A Mulla, Varad S Thorat, Rohan V Patil, Kishor B Burade have evaluated the anthelmintic activity of leaf extract of *Alocasia indica* Linn. Of family Araceae. Leaves were cut into small pieces and allowed it to shed dry and then homogenized to get a coarse powder. Powder was extracted with hydroalcohol (ethanol- 95% and water in 1:1 proportion) at room temperature by cold maceration method and Solvent extraction with petroleum ether and ethyl acetate, then the extracts were concentrated. The anthelmintic activity was evaluated using adult Indian earthworm, the hydroalcoholic extract of leaves of *Alocasia indica* Linn. and its different fractions exhibited anthelmintic activity in dose-dependant manner.\[55\]

31. Manas kumar pal have recorded the anthelmintic activity of the leaves of *Paederia foetida* Linn of family Rubiaceae. The plant materials (leaves) were collected, shade dried and made to fine powder using a laboratory mill. The dry powder was extracted with methanol using maceration process for 48 hours. The phytochemical tests of methanolic extract revealed the presence of alkaloids, sterol and fixed oil. The anthelmintic activity was evaluated on Indian earthworm *Pheretima posthuma*, concluded that the extract showed dose dependent activity as compared to standard drug piperazine citrate.\[56\]

32. S S Das, Monalisha dey and K Ghosh have reported the anthelmintic activity of *Tamarindus indica* Linn of family Caesalpiniaaceae. The shade-dried leaves were pulverized into coarse particles and extracted with water by maceration (5% chloroform water) and with absolute ethanol using Soxhlet extractor for 72 hours. The preliminary phytochemical analysis were carried out which revealed the presence of tannins along with other chemical constituents contained within them. They also reported that tannins produce anthelmintic activities, as they bind to free proteins in the GI tract of host animals or glycoprotein on the cuticle of the parasite thereby cause deaths. Both the extracts showed anthelmintic activity in a dose dependent manner but the alcoholic extract appeared to be more effective on both parasites of *Pheretima posthuma* and *Tubifex tubifex*\[57\].

**CONCLUSION**

In the present study, anthelmintic activity of herbal leaves of various families such as Schrophularaceae, Fabaceae, Polygonaceae, Capparidaceae, Apocyanaceae, Myrtaceae, Caesalpinaceae, Juglandaceae, Amaranthaceae, Araceae and Rubiaceae etc., were reviewed. In most of the cases the indian adult earthworm *pheretima posthuma* was used for screening the activity due to its anatomical and physiological resemblance to intestinal roundworm parasite of human beings. On through survey it has also been concluded that methanol,
ethanol and aqueous extracts showed significant anthelmintic activity. Though tannins present in the leaves are the responsible phytoconstituents, the anthelmintic activity predominates due to the presence of other phytoconstituents also. Further it can be concluded that, in future studies the isolation of these phytoconstituents and their optimization leads the herbal preparations alternative to synthetic drugs.

REFERENCES


