ORIGINAL ARTICLE

Anthelmintic activity of aerial parts of *Costus speciosus*

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The purpose of this study is to evaluate and compare the anthelmintic activity of the methanolic and aqueous extracts of the aerial parts of *Costus speciosus* in Indian adult earthworms (*Pheretima posthuma*). The anthelmintic activity of methanolic (25 mg/ml, 50 mg/ml and 100 mg/ml) and aqueous extracts (25 mg/ml, 50 mg/ml and 100 mg/ml) of the aerial parts of *Costus speciosus* was evaluated using Indian adult earthworms (*Pheretima posthuma*) as experimental worms. Albendazole (20 mg/ml) was used as standard drug. The anthelmintic potency of the extracts was inversely proportional to the time taken for paralysis or death of the worms. All the results were expressed as a mean±SEM. The aqueous extract showed more significant effect on paralyzing the worms, in terms of paralysis time, at every concentration compared to that of methanolic extract when compared with standard. In case of the methanolic extract at 25 mg/ml, 50 mg/ml and 100 mg/ml concentrations paralysis was observed at 8.10±0.37, 3.97±0.40 and 2.72±0.26 min respectively and death at 8.88±0.40, 4.78±0.32 and 3.70±0.45 min respectively. The aqueous extract at dose of 25 mg/ml, 50 mg/ml and 100 mg/ml produced paralysis within 6.70±0.33, 3.62±0.30 and 2.55±0.27 min respectively while death was observed within 7.48±0.32, 4.48±0.31 and 3.62±0.29 min respectively. The standard drug Albendazole (20 mg/ml) showed paralysis at 11.65±0.51 min and death occurred after 13.67±0.36 min. As *Costus speciosus* showed significant anthelmintic activity in the experimental study, it can be used as a promising anthelmintic agent.

Key words: Albendazole, anthelmintic activity, *Costus speciosus*, *Pheretima posthuma*

INTRODUCTION

Helminthiasis, or worm infestation, is one of the most prevalent disease and one of the most serious public health problems in the world. Hundreds of millions if not billions of human infections by helminthes exist worldwide and with increased world travel and immigration from the developing countries.[1] Among the most widespread of all chronic infections are those caused by various species of parasitic *helminthes* (worms). For example, it is estimated that over half the world's population may be infected with gastrointestinal helminthes. Inhabitants of tropical or subtropical low-income countries are most at risk; children often become infected with one or more species.

Almost 350 species of helminthes have been found in humans, and most colonise the gastrointestinal tract. In some cases (e.g. *threadworms*), these infections result mainly in discomfort and do not cause substantial ill health, but others, such as *schistosomiasis* (*bilharzia*) and *hookworm* disease, can produce very serious morbidity. Because of its prevalence, the problem of the treatment of *helminthiasis* is therefore one of very great practical therapeutic importance.[2]

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Costus speciosus Koen. (Keu, Crape ginger), an Indian ornamental plant, has long been medicinally used in traditional systems of medicine. This plant of Costaceae (Zingiberaceae) family is commonly known as keukand (Hindi), Variegated Crepe Ginger (English). It is an erect, succulent, perennial herb, up to 2.7 m in height, arising from a horizontal rhizome, found in tropical region of India and also cultivated for ornament.[3]

The rhizomes and roots are ascribed to be bitter,[4-6] astringent,[4-8] acrid, cooling, aphrodisiac,[3,5,8] purgative,[4-7] anthelmintic,[3-7] depurative[3,6-8] febrifuge, expectorant, tonic,[3,4] improves digestion,[5] and stimulant[4,5,8] herb that clears toxins. Juice of the rhizome is applied to head for cooling and relief from headache.[4] An alkaloid extract from *Costus speciosus* rhizomes had papaverine-like smooth muscle relaxant, antispasmodic activities.[9] Rhizomes are given in pneumonia, rheumatism, dropsy, urinary diseases, jaundice, and leaves are given in mental disorders. Bruised leaves are applied in fever; decoction of stem is used in fever and dysentery.[3] Leaf infusion or decoction is utilized as a sudorific or in a bath for

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patients with high fever. Rhizome juice is given with sugar internally to treat leprosy, used as antivermin[7] and for abortion.[3,10] The plant possesses purgative, anti-inflammatory and anti-arthritic effect, antifungal activities and is used in gout rheumatism and bronchial asthma.[7] The plant is used internally for eye and ear infections, diarrhoea (sap from leaves, young stems), cold, catarrhal fever, cough, dyspepsia, skin diseases (rhizome) and snake bites.[3,5,6,8] Rhizomes exhibit cardiotonic, hydrocholeretic, diuretic, CNS depressant and anticholinesterase activities,[7,9] formally used in Malaysia for small pox.[5]

According to the available literature on the pharmacological and phytochemical prospective of *Costus speciosus*, no scientific reports are available on the anthelmintic activity of the extracts of the aerial parts of the plant. Based on this, an attempt has been made to evaluate the anthelmintic activity of the methanolic and aqueous extracts of the aerial parts of the plant.

MATERIALS AND METHODS

Plant Material

Fresh aerial parts of *Costus speciosus* Koen. (Costaceae), for the proposed work were collected from the Bahadurpur forests of Kolkata in the month of September 2010 and were authenticated by *Dr. D.C. Saini*, Senior Scientist, Palaeobotany, Birbal Sahni Institute of Palaeobotany, Lucknow India. A voucher specimen no. 11723 was deposited and crude drug sample is preserved in the department of Pharmacognosy, Teerthanker Mahaveer College of pharmacy, Moradabad. The whole plant material was dried under shade and was mechanically reduced to moderate coarse powder and stored in air tight containers and used for further successive extraction.

Preparation of Extracts

The dried and coarsely powdered aerial parts of the plant were used for the extraction procedure.

The coarse powder of the plant was successively extracted using a soxhlet apparatus with the solvents in increasing polarity starting with petroleum ether, chloroform, ethyl acetate, methanol and water. The extracts of the aerial parts of *Costus speciosus* were concentrated by rotary evaporator at 40°C under reduced pressure and then dried and stored in desiccators for future use. The dried extracts were suspended in 0.5% CMC in distilled water (vehicle) and used for anthelmintic activity.

Experimental Worms

Indian adult earthworms (*Pheretima posthuma*) were collected from moist soil of the field and washed with tap water to remove all fecal matter for further investigation. The earthworms of 3–5 cm in length and 0.1–0.2 cm in width were selected for the experimental parameter. The anthelmintic activity was evaluated on adult Indian earthworm (*Pheretima posthuma*) due to its anatomical and physiological resemblance with the intestinal round worm of human beings. Because of easy availability, earthworms have been used widely for initial evaluation of anthelmintic compounds.[11-13]

Drugs and Chemicals

Albendazole (Glaxo Smithkline), Petroleum ether, Chloroform, Ethyl acetate, Methanol (Rankem), Carboxy methyl cellulose (Loba Chemie) were used during the experimental protocol.

Anthelmintic Activity

The anthelmintic assay was carried out as per the method of Ajaiyeoba *et al*.[14] with minor modifications. Different extracts and the standard drug solution were poured in different petri dishes. All the earthworms of approximately equal size after washing were released into 10 ml of respective solutions of different concentrations. All the earthworms were divided into 8 groups with 2–3 earthworms in each group. The first group serves as control receives only 0.5% CMC in distilled water, the second group serves as standard receives albendazole (20 mg/ml) suspended in 0.5% CMC and the remaining six groups receive 25 mg/ml, 50 mg/ml and 100 mg/ml concentrations of methanolic extract and aqueous extract of *Costus speciosus* also suspended in 0.5% CMC. Both the extracts were dissolved in minimum amount of 0.5% CMC and then volume was adjusted to 10 ml with distilled water. The corresponding concentration was expressed in term of mg of extract per ml of solvent (mg/ml). The drug and extract solutions were freshly prepared before starting the experiment.

The anthelmintic potency of the extracts was inversely proportional to the time taken for paralysis or death of the worms. The standard drug solution and the extracts caused paralysis followed by death of all selected worms at the selected concentrations. The time taken to paralyze and kill individual worms was observed. The time of paralysis was noted when no movement of any sort could be observed except when the worms were shaken vigorously. The times of death of the worms were recorded after ascertaining that worms neither moved when shaken vigorously or when dipped in warm water (50°C). Death was concluded when the worms lose their motility followed with fading away of their body color. All the results were shown in Table 1 and expressed as a mean±SEM of three worms in each group (n=3).

RESULTS AND DISCUSSION

The predominant effect of albendazole on the worm is to cause a flaccid paralysis that result in expulsion of the

Table 1: Effect of *Costus speciosus* methanolic and aqueous extracts on Indian earthworms (*Pheritima posthuma*)

Test substance	Concentration (mg/ml)	Time taken for P and D in minutes±SEM	
		Pheritima posthuma	
		P	D
Costus speciosus	25	6.70±0.33	7.48±0.32
Aqueous extract	50	3.62±0.30	4.48±0.31
	100	2.55±0.27	3.62±0.29
Costus speciosus	25	8.10±0.37	8.88±0.40
Methanolic extract	50	3.97±0.40	4.78±0.32
	100	2.72±0.26	3.70±0.45
0.5% CMC	–	–	–
Albendazole	20	11.65±0.51	13.67±0.36

P – Paralysis; D – Death;

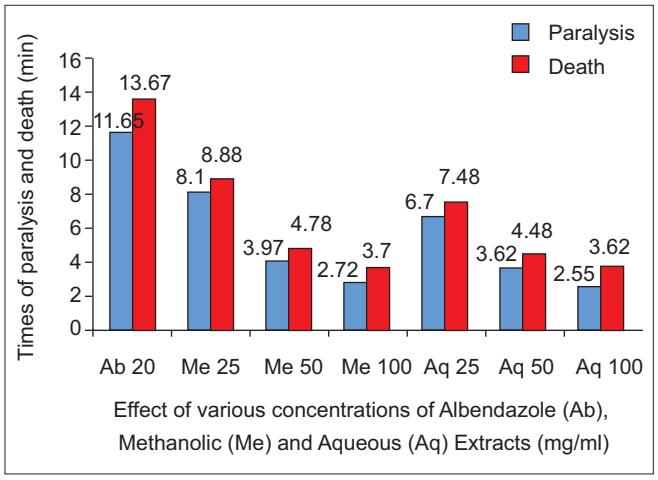

Figure 1: Anthelmintic activity of different extracts of *Costus speciosus*

worm by peristalsis. Albendazole by increasing chloride ion conductance of worm muscle membrane produces hyperpolarisation and reduced excitability that leads to muscle relaxation and flaccid paralysis.[15]

From the results [Figure 1], it is observed that aqueous and methanolic extracts of *C. speciosus* showed excellent anthelmintic activity at all the concentrations. The aqueous extract showed more significant effect on paralyzing the worms, in terms of paralysis time, at every concentration compared to that of methanolic extract when compared with standard. The earthworms selected for the anthelmintic activity were most sensitive to the aqueous extract of *C. speciosus*. The graph revealed dose-dependent paralysis ranging from loss of motility to loss of response to external stimuli, which eventually progressed to death. In case of the methanolic extract at 25 mg/ml, 50 mg/ml and 100 mg/ml concentrations paralysis was observed respectively at 8.10±0.37, 3.97±0.40 and 2.72±0.26 min and death at 8.88±0.40, 4.78±0.32 and 3.70±0.45 min post-exposure. The aqueous extract at dose of 25 mg/ml, 50 mg/ml and 100 mg/ml produced paralysis within 6.70±0.33, 3.62±0.30 and 2.55±0.27 min, respectively, while death was observed within 7.48±0.32, 4.48±0.31 and 3.62±0.29 min respectively. The standard drug Albendazole (20 mg/ml) showed paralysis at 11.65±0.51 min and death occurred after 13.67±0.36 min. The earthworms were more sensitive to the extracts of *C. speciosus* at 25, 50 and 100 mg/ml concentrations as compared to the reference drug albendazole (20 mg/ml). The results were compared with the standard drug, Albendazole and it was found that both extracts were more effective than the selected standard drug.

Helminthic infections of the gastrointestinal tract of human beings and animals have been recognized to have adverse effects on health standards with a consequent lowering of resistance. In search of compounds with anthelmintic activity, a number of substances were screened using different species of worms, for example, earthworms, Ascaris, Nippostrongylus, and Heterakis. Of all these species, earthworms have been used widely for the initial evaluation of anthelmintic compounds *in vitro* because they resemble intestinal "worms" in their reaction to anthelmintics and are easily available. It has been demonstrated that all anthelmintics are toxic to earthworms and a substance toxic to earthworms is worthy for investigation as an Anthelmintic.[16]

The curative properties of medicinal plants are perhaps due to the presence of various secondary metabolites such as alkaloids, flavanoids, glycosides, phenols, saponins, sterols, *etc*. The successive extracts of plant have revealed the presence of alkaloids, flavanoids, cardiac glycosides, saponins, sterols and tannins.[17] From the above results, it is concluded that the extracts of the plant have potent anthelmintic activity when compared with the conventionally used drugs and is equipotent to standard anthelmintic drug. Further results, using *in vivo* models are required to carry out and establish the effectiveness and pharmacological rationale for the use of the plant as an anthelmintic drug.

CONCLUSION

The present study justifies the folkloric claims of the potential anthelmintic activity of *Costus speciosus* aerial parts. The plant may have different mode of actions against the selected helminthes. The possible mechanism of the anthelmintic activity of *Costus speciosus* cannot be explained on the basis of our present results. The plant may be further explored for its phytochemical profile to recognize the active constituent and standardization of dose and toxicity studies for drug development accountable for anthelmintic activity. Further study is required with the selected plant for the development of novel standardized anthelmintic herbal formulations.

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