

Molluscicidal Activity of the Essential Oils of *Cymbopogon nervatus* Leaves and *Boswellia papyrifera* Resins

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Abstract: The main objectives of this research is to evaluate the molluscicidal activity of the volatile oils of *Cymbopogon nervatus* and *Boswellia papyrifera* against the snails *Biomphalaria pfeifferi* and *Bulinus truncatus* under laboratory conditions. It is evident from the present results that *C. nervatus* (LD₅₀ against *B. pfeifferi* = 213.099 ppm; LD₅₀ against *B. truncatus* = 237.33 ppm) and *B. papyrifera* (LD₅₀ against *B. pfeifferi* = 213.31 ppm; LD₅₀ against *B. truncatus* = 311.05 ppm) essential oils are potential molluscicidal agents. Their toxicity exhibited a dose dependent pattern. The demonstrated bioactivity may be attributed to terpenoid compounds present in these oils. The present study can be considered as the first attempt to evaluate these plants against hosts of Bilharzia. These oils may offer an alternative tool for the control of schistosomiasis in Sudan.

Key words: *Boswellia papyrifera*, *Cymbopogon nervatus*, essential oils, molluscicidal activity, snails control

INTRODUCTION

The negative impacts of synthetic molluscicides on the environment have created an increasing usage of plant extracts as molluscicides. Schistosomiasis, caused by the parasite *Schistosoma*, is an important disease in Sudan and in many other tropical countries (Davis,1996). The life cycle of this parasite involves an intermediate host, represented in Sudan by snails of the genus *Biomphalaria* and *Bulinus* thus besides chemotherapy of infected people, one of the strategies to combat this disease is to interrupt the parasites life cycle in endemic areas via control of the snails population.

The Molluscicidal activity of many Sudanese medicinal plants against a variety of snail vectors of tropical diseases have been well investigated by Amin *et al.* (1972), El-Tohami (1979), El-Kheir and El-Tohami (1979, 1980), Ahmed (1983) Mohamed (1983), Ayoub (1982, 1984, 1985), Ahmed *et al.* (1984, 1985), Bashir *et al.* (1987), Abdel *et al.* (1990), Abdalla (1990), Hamid (1993), Abdalla (1994), Babiker (1995) and Hashim (1996). Most of the extracts from these medicinal plants show remarkable molluscicidal activity against snails *Biomphalaria Pfeifferi* and *Bulinus truncatus*.

The objective of this study is to use an environment-oriented tool in control of schistosomiasis but the specific objectives are to evaluate the efficacy of candidate

Sudanese aromatic plants for their molluscicidal activity and to explore newer molluscicidal agents from higher plants effective against some snails of the genus *Biomphalaria* and *Bulinus*.

MATERIALS AND METHODS

Tested material: Plant species, *Cymbopogon nervatus* leaves were collected from Gedaref region, East Central Sudan and *Boswellia papyrifera* resins was purchased from Omdurman market. These plant materials were carefully examined for identification by the Herbarium at the Botany Department, Omdurman Islamic University, Omdurman, Sudan.

Isolation of essential oils: The essential oils of *Cymbopogon nervatus* leaves and *Boswellia papyrifera* resin were obtained by hydrodistillation method described in British Pharmacopoeia (1988).

Snails collection: Five malacological field surveys were conducted for snails collection from water bodies around EL Faki Hashim village, North Khartoum. A series of laboratory experiment were designed and conducted in indoor aquaria at Zoology Department, Faculty of Science and Technology, Omdurman Islamic University, in May 2006.

Maintenance of the snails: The collected snails were sorted out into different snail species in the laboratory, exploiting the Danish Bilharzias Laboratory (DBL) keys constructed by Christensen and Frandson (1985). The snails *Biomphalaria pfeifferi* and *Bulinus truncatus* were kept in the laboratory in balanced water. Tap water was left in containers for two days to ensure the evaporation of any chlorine in the water (if any) and the sedimentation of any foreign particles at the bottom. Snails were screened for natural infection with any trematodes. Snails free from infection were kept in plastic bowls, each containing 2 liters of treated water. The maintained snails were fed daily on green lettuce.

Studied activity: The bioassay of molluscicidal activity against the snails *Biomphalaria pfeifferi* and *Bulinus truncatus* was evaluated according to the established procedures (WHO, 1965). Mortality was determined according to Abbot Formula.

Five adult snails (8-14mm in diameter) were placed in a plastic dish, containing 200 ml of essential oil water solution of *Cymbopogon nervatus* leaves and *Boswellia papyrifera* resin at final concentration ranging from 75-1000 ppm. Each test concentration was set in triplicate. Snails were exposed to aromatic water extract for 24 h at room temperature, and were kept under normal diurnal lighting. After 24 h, the extract was decanted; the snails rinsed twice with aerated tap water and offered lettuce leaves as food. The tested snails were then left in water for another 24 h, and at the end of this period were examined to assess mortality. Snails were considered dead if they remained motionless, did not respond to the presence of food or if the shell looked discolored. In control experiment, snails were not exposed to the potential extract and these remained in water during the experiment.

Mortality was determined according to Abbot Formula (El-Kamali, 2001):

$$\frac{\text{Treatment mortality \%} - \text{control mortality}}{100 - \text{mortality\% control}}$$

Each test was replicated two times. The number of dead snails was expressed as % mortality. The Lethal Dose, LD₅₀ and LD₉₅ values were calculated following the method of Finney (1971). The obtained data were subjected to probit regression analysis. Some tabular and pictorial forms were generated post- statistical analysis. The lethal doses LD₅₀ and its LD₉₅ were determined for each extract.

RESULTS AND DISCUSSION

Mollusciciding is still considered the most important means of controlling schistosomiasis transmission. In

Table 1: Molluscicidal activity of *Cymbopogon nervatus* and *Boswellia papyrifera* essential oil extracts

Plant	<i>Biomphalaria pfeifferi</i>		<i>Bulinus truncatus</i>	
	Concentration (ppm)	Mortality (%)	Concentration (ppm)	Mortality (%)
<i>Cymbopogon nervatus</i>	600	100	400	100
	400	100	350	100
	300	90	300	75
	200	50	250	50
	100	25	200	25
	75	0	150	12.5
		100	0	
<i>Boswellia papyrifera</i>	400	100	400	100
	350	90	350	75
	300	90	300	62.5
	250	90	250	50
	200	70	200	25
	150	60	150	12.5
	100	0	100	0

Table 2: The lethality of *Cymbopogon nervatus* and *Boswellia papyrifera* essential oil extracts on *Biomphalaria pfeifferi* and *Bulinus truncatus*

Plant	Lethal concentration (ppm)			
	LD ₅₀		LD ₉₅	
	<i>B.p.</i>	<i>B.t.</i>	<i>B.p.</i>	<i>B.t.</i>
<i>Cymbopogon nervatus</i>	213.099	237.33	506.69	331.05
<i>Boswellia papyrifera</i>	213.31	311.05	311.92	370.76

B.p. = *Biomphalaria pfeifferi*; *B.t.* = *Bulinus truncatus*

rural communities the cost of synthetic molluscicides and/or chemotherapy prohibits their use. Plant molluscicides, applied as crude aqueous suspensions are the source of cheap, effective and environmentally acceptable alternatives. The discovery of the potent molluscicidal properties of some plant-derived agents in Tropical regions like *Phytolacca dodecandra* (Phytolacaceae) from Ethiopia, has prompted a large amount of work on plant-derived compounds which show toxicity to schistosomiasis-transmitting snails (Lemma, 1965; Marston and Hostettmann, 1985).

Two snails have been chosen for this study: *Biomphalaria pfeifferi* and *Bulinus truncatus*. The criteria for studied snails are (a) *B. pfeifferi* a serve intermediary host for *Schistosoma mansoni* and (b) *B. truncatus* is the intermediate host for *S. haematobium*. These snails were found in irrigation canals in Khartoum State, Central Sudan. *C. nervatus* "NaI" and *Boswellia papyrifera* "Track Track" were selected to investigate their extracts effect against tested snails. Mortality was expressed on probit probabilities and plotted against the log. Transformed values of aromatic water extract concentration. The results of the toxicity of the investigated essential water solutions against the tested snails are presented in Table 1. The regression line obtained from this data was used for LD₅₀ and LD₉₅ determination (Table 2).

The essential oil water extracts of the *Cymbopogon nervatus* leaves exhibited high toxic effects on *Biomphalaria pfeifferi* at concentration range between 100-600 ppm (The LD₅₀ was 213.099 ppm) whereas the essential oil water solution extract of the *Boswellia*

papyrifera resin showed high toxic effects at concentration range between 150-400 ppm (The 24-h LD₅₀ of extract was 213.31 ppm). The aqueous essential oil of leaf of *Cymbopogon nervatus* showed high toxic effects on *B. truncatus* snail at concentration range between 250-400 ppm (The 24-h LD₅₀ of oil was 237.33 ppm) whereas the essential oil water solution extract of the *Boswellia papyrifera* resin exhibit high toxic effects at concentration range between 250-400 ppm (The LD₅₀ was 254.77 ppm) (Table 2).

It was evident from the present results that *C. nervatus* and *B. papyrifera* essential oils are potential sources of botanical molluscicides. Their toxic effect is dose dependent. Thus, the toxicity study reverted that the toxic components of two plants are water-soluble. In this study, the findings recapitulated that the concentration/response relationships vary among tested snails. This is expected since different animals varied in routes of exposures to the toxic substances.

This is the first evaluation of these plants against hosts of Bilharzia. The good results observed offer an alternative tool for the control of schistosomiasis. Bioassay-directed fractions of the active crude materials, to isolate and identify the compound responsible of the molluscicidal activity, are essential to understand the mechanisms involved thereof.

CONCLUSION

This study concluded that the essential oil water solution extracts of *Cymbopogon nervatus* leaves and *Boswellia papyrifera* resins are extracts have significant activity against *Biomphalaria pfeifferi* and *Bulinus truncatus* snails and offer an alternative tool for the control of schistosomiasis. This is the first evaluation of these plants against hosts of Bilharzia (*B. pfeifferi* and *Bulinus truncatus*). Bioassay- directed fractions of the active crude materials, to isolate and identify the compound responsible of the molluscicidal activity and to test other stages of snail's life cycle (egg masses and neonates), are essential to understand the mechanisms involved thereof.

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