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THE MOLLUSCICIDAL PROPERTIES OF EUPHORBIA HELIOSCOPIA (EUPHORBIACEAE) – AZ EUPHORBIA HELIOSCOPIA (EUPHORBIACEAE) MOLLUSZKICID TULAJDONSÁGAI

ABSTRACT: The crude extracts obtained from Euphorbia helioscopia were assayed against the schistosome bearing snails *Biomphalaria alexandrina* and *Bulinus truncatus*. The acetone extract was the most active with LC_{90} of 26 and 23ppm against both snails, respectively. The effect of some environmental conditions on the activity of the test extracts was investigated.

INTRODUCTION

Nowadays, many developing countries are reluctant to embark on chemical snail control programmes, employing costly synthetic compounds, usually purchased with scarce hard currency. The presently applicable chemical pesticides are generally biocidal affecting other non-target organisms in the snail habitat (WHO, 1965a). Hence, there has been a interest in the study of plant molluscicides with the hope for their ready availability and easy application through simple techniques. Research in this field started in 1930 and has become multidisciplinary. More than 1000 plant species belonging to about 30 families have been screaned for molluscicidal activity (WHO, 1981).

Family Euphorbiaceae is of special interest due to the spread of molluscicidal activity among a number of its members such as Croton macrostachys (DAFFALLA and AMIN, 1976), Croton tiglium (YASURAKA *et al.*, 1980a), Bridella adroviridis (ADEWONMI and SOFOWORA, 1980) and Euphorbia cotinifolia (PEREIRA *et al.*, 1978).

In extension to our efforts concerning the molluscicidal properties of some species pertaining to the family Euphorbiaceae, e. g., Euphorbia lactea (EL-EMAM *et. al.*, 1982), Euphorbia peplus and Euphorbia pseudocactus (SHOEB *et al.*, 1983), we deal in the present investigation with the molluscicidal properties of E. helioscopia. Evaluation was made of the toxicity of its extracts against both schistosome bearing snails *B. alexandrina* and *B. truncatus*, as well as the effect of some environmental conditions on the stability of the active ingredients in these extracts.

E. helioscopia was selected for comprehensive laboratory evaluation of the molluscicidal properties of its extracts for several reasons:

It is a wild herb common in Egypt.

It is annual, quick growing (3-4 months) and reaches fruiting in late spring at the onset of snail transmission. Furthermore, it can easily be propagated via its abundant seed crop.

This plant owes its importance as a valuable medicinal plant for the following reasons:

The seeds contain an oil possessing drying properties and may be substituted for linseed oil. Its physiological action is that an energetic purgative (GILLOT, 1926). It is the source plant of the Chinese drug Ze-Qi used for chronic bronchitis (CHEN-YAN *et. al.*, 1979).

Out of its constituents, two important antitumor substances, Euphoscopin A and B have been recently isolated and characterized (YAMAMURA, 1981).

MATERIALS AND METHODS

Snails:

The snail intermediate hosts of schistosomiasis in Egypt, *Biomphalaria alexandrina* (EHRENBERG) (shell diameter 6-8 mm) and *Bulinus truncatus* (AUDOUIN) (shell height about 5 mm) were used. They were collected from irrigation canals in Giza Governorate that were not previously treated with molluscicides. The snails were left to adapt to laboratory conditions three weeks before being used in bioassays.

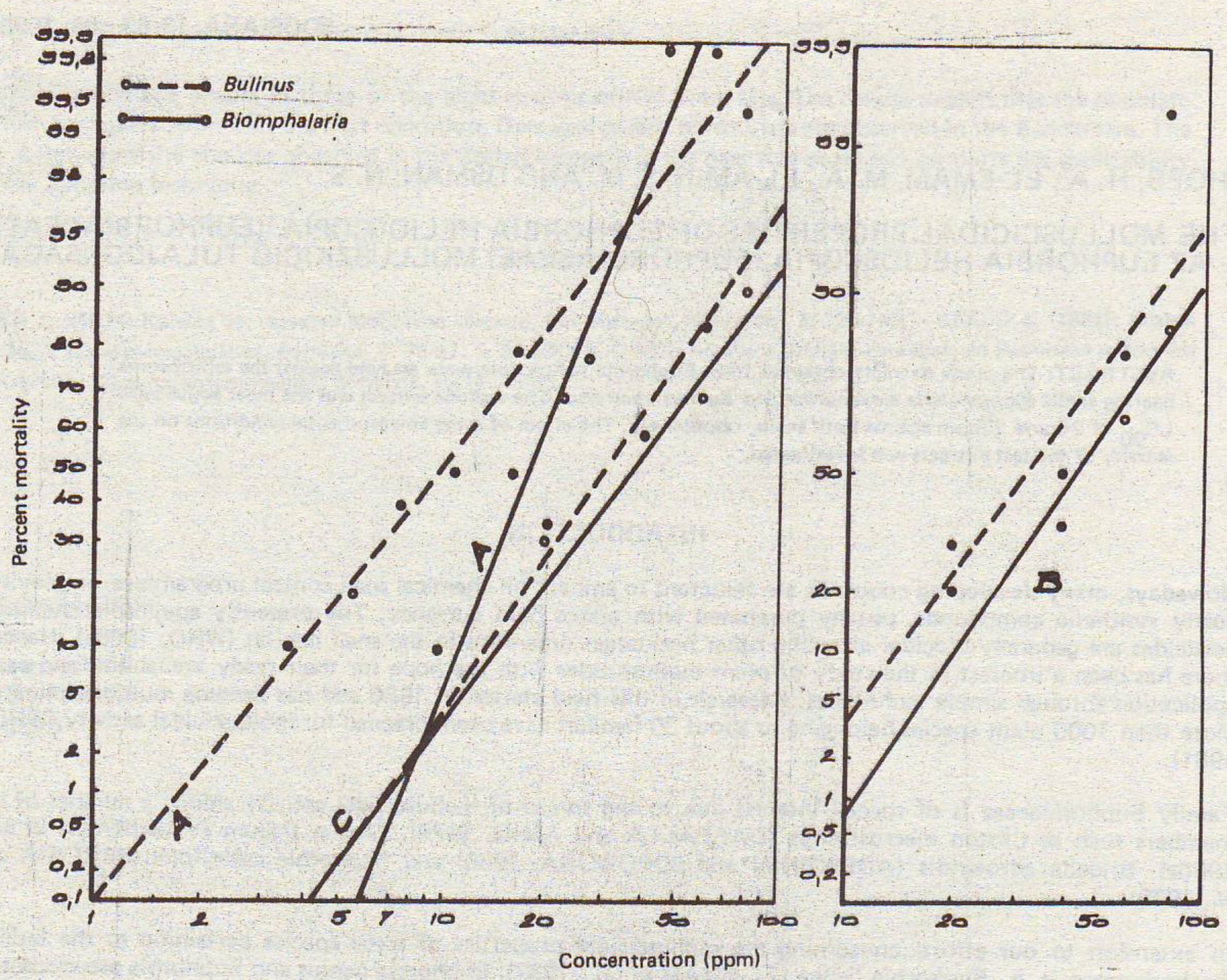

FIG. 1. Dosage mortality of adult snails exposed to A) acetone, B) chloroform and C) methanol extracts.

Table 1. Comparative susceptibility of adult *Biomphalaria* and *Bulinus* to the action of some extracts from E. helioscopia

Extracts	*Biomphalaria*			*Bulinus*		
	LC_{50} (ppm)	LC_{90}	S	LC_{50} (ppm)	LC_{90}	S
Acetone	16 (13.2-19.4)	26	1.46	9.6 (6.4-14.5)	23	2.1
Methanol	36.0 (24.83-52.20)	90.0	2.04	30.5 (20.47-45.45)	68.0	1.88
Chloroform	44.0 (32.35-59.84)	94.0	1.81	32.5 (23.21-45.50)	74.0	1.91
Bayluscide	0.088 (0.068-0.108)	0.32	2.53	0.080 (0.066-0.106)	0.26	2.3

+ Data in parentheses = LC_{50} confidence limits
○ Slope function

Preparation of plant extracts:

Euphorbia helioscopia plants, in the fruiting state, were collected in April from the fields of Giza Governorate and were shade dried. Samples (100g) of finely powdered whole plant material were exhaustively extracted with chloroform, acetone or methanol by soaking at room temperature (25 ± 3° C). The solvents were distilled off under vacuum and the crude extract residues were assayed as aqueous solutions.

Table 2. Time-concentration relationship of the molluscicidal potency of some extracts from E. helioscopia

Extract	concentration (ppm)	% mortality of adult snails after the following exposure periods (hrs)							
		Biomphalaria				*Bulinus*			
		3	6	24	48	3	6	24	48
Methanol	40	–	–	50	60	–	–	60	80
	60	–	–	85	70	–	–	85	90
	80	10	20	100	95	20	30	100	100
	100	20	40	100	100	30	50	100	100
	150	40	60	–	–	60	75	–	–
	200	65	80	–	–	85	100	–	–
Chloro-	40	–	–	40	60	–	–	55	75
form	60	–	40	70	70	–	20	95	90
	80	20	–	85	90	10	–	100	100
	100			100	100	–	70	100	100
	150	40	75	–	–	50	100	–	–
	200	75	85	–	–	80	100	–	–
Acetone	10	–	–	40	60	–		60	70
	15	–	–	60	70		–	80	70
	20	–	–	100	100			100	100
	25	20	50	–	–	30	70	–	–
	30	40	80	–	–	50	100	–	–
	35	50	100	–	–	80	100	–	–
control									

Table 3. Effect of temperature on the molluscicidal activity of extracts from E. helioscopia.

Extract concentrations (ppm)		% mortality of adult snails after 24-hr exposure at following temperature degrees (C^{o}) ✱							
		Biomphalaria				*Bulinus*			
		10	15	20	25	10	15	20	25
Acetone	10	0	10	20	20	0	0	40	40
	15	20	40	60	70	30	50	60	80
	20	40	70	100	90	60	90	100	100
	25	80	90	100	100	100	100	100	100
Methanol	40	40	55	30	45	50	60	80	60
	60	70	65	85	70	75	85	100	90
	80	100	90	90	95	95	100	100	100
Chloro-	40	55	40	80	45	60	60	80	70
form	60	85	55	90	80	85	80	90	85
	80	95	80	100	90	80	100	100	100
	100	100	100	100	100	85	100	100	100

✱ Temperature degrees = 2 ^{o}C.

Table 4. Effect of sun-light on the molluscicidal properties of some extracts from E. helioscopia.

Extract concentrations (ppm)		% mortality of adult snails after 24-hr exposure	
		Biomphalaria	*Bulinus*
Acetone	15	10	40
	20	60	70
	25	90	100
	30	100	100
Methanol	50	55	80
	100	80	90
	150	100	100
	200	100	100
Chloro-	50	35	60
form	100	55	65
	150	70	85
	200	100	100
Control ●		100	100

● Freshly prepared solutions of 100 ppm from methanol and chloroform and of 20 ppm of acetone extracts without exposure to sun-light.

Table 5. Effect of storage on the molluscicidal efficiency of some extracts gained from E. helioscopia.

Extract concentrations (ppm)		% mortality of adult *Biomphalaria*		
		Refrigerated (10C°)	Boiled (25° ± 3°C)	Unboiled (25° ± 3°C)
Acetone	10	20	0	40
	15	50	0	40
	20	90	60	70
	25	100	80	100
Methanol	50	40	30	30
	100	60	30	40
	150	90	40	40
	200	100	60	50
Chloro-	50	50	20	30
form	100	60	50	40
	150	60	60	70
	200	100	60	70
Control ●		100	100	100

● 100% mortality was observed at 100 ppm from methanol and chloroform and at 20 ppm from acetone extracts freshly preapared solutions.
+ storage for 7 days

Testing for molluscicidal activity:

Stock solutions of 500 ppm in distilled water (w/v) were freshly prepared from which serial dilutions were then made as indicated in the text. The number of snails used for each dilution and for control was groups of 10. Exposure and recovery periods were 24 hours each. Bioassays were carried out as detailed earlier (EL-EMAM *et al.*, 1982). Statistical analysis of the data was made following the method of LITSCHFIELD and WILCOXON (1949).

Table 6. Effect of pH on the molluscicidal activity of different extracts from E. helioscopia

Extracts / concentrations (ppm)		% mortality of adult snails exposed to the following pH							
		Biomphalaria				*Bulinus*			
		4	6	8	10	4	6	8	10
Acetone	10	0	0	30	20	30	0	20	20
	15	50	60	60	70	70	50	40	70
	20	60	90	90	100	90	80	100	100
	25	80	100	90	100	100	100	100	100
Methanol	10	30	35	30	20	40	30	30	35
	20	60	35	30	40	70	55	50	55
	50	80	85	70	55	80	90	85	90
	80	90	100	100	100	100	100	100	100
Chloro-form	10	20	25	30	30	35	40	20	40
	20	30	30	35	40	70	65	50	55
	50	70	70	60	90	90	80	70	90
	80	80	90	80	100	100	100	100	100
Control ●		0	0	0	0	0	0	0	0

● Snails were exposed to pH values without extracts.

Table 7. Effect of river-bed mud on the molluscicidal toxicity of some extracts from E. helioscopia.

Extract concentrations (ppm)		% mortality of adult snails after 6-hr exposure using the following river-bed mud concentrations (ppm)					
		Biomphalaria			*Bulinus*		
		5,000	10,000	control ●	5,000	10,000	control ●
Acetone	20	40	30	–	50	50	–
	25	60	50	–	90	80	–
	30	80	90	100	100	100	100
Methanol	100	30	40	–	40	55	–
	150	50	70	–	60	80	–
	200	60	80	85	75	100	90
Chloro-form	100	40	30	–	80	65	–
	150	50	60	–	95	90	–
	200	80	85	70	100	100	100

● concentrations without river-bed mud.

RESULTS AND DISCUSSION

The results in Table 1 (see also Fig. 1) indicate that the acetone extract is the most effective to possibly containing the most molluscicidally active constituents. Also the L-dp lines (slope functions) of the three extracts were steeper than that of Bayluscide the reference molluscicide which might suggest faster but less possible development of resistance (for L-dp lines of Bayluscide against both snail species see EL-EMAM *et al.*, 1982).

Bulinus truncatus has been found to be more susceptible than *Biomphalaria alexandrina* to the toxic action of the three extracts.

The cumulative effect of a molluscicidal extract would be causably correlated with the stability of the active ingredients under different environmental conditions. Accordingly, pertinent observations were made on the activity of the present extracts as influenced by temperature, pH, sunlight, mud and storage following the design of the World Health Organisation (1953, 1965b). From the results in Table 3, it is evident that raising the temperature is followed by an increase in the mortality percentage. Analogously, the decrease in temperature yielded a decrease in the mortality percentage. The deterioration in the acitivity of tested extracts under the effect of sun radiation may be attributed to photochemical degradation of the active constituents in the extracts (Table 4). Similarly, the activity depression arised by storing the aqueous solutions at room temperature (Table 5) and the non-increase in the mortality percentage by increasing the exposure period from 24 to 48 hours (Table 2) may be attributed to rapid biodegradation. However, the toxicity of the tested extracts showed stability within a wide range of pH (Table 6) and in the presence of mud (Table 7).

From the above, it is posssible to conclude that, the easy availability of Euphorbia helioscopia, the wide variation of its medical importance and uses, the promising molluscicidal activity of its acetone extract and the stability of the toxic action of the three extracts under the effect of some environmental conditions besides the rapid biodegradation of the aqueous solutions of these extracts favour the field application of the acetone extract of this plant as an economic, active and safe molluscicide.

ÖSSZEFOGLALÁS

Az Euphorbia helioscopiából nyert nyers extraktumokat próbálták ki a szerzők a bilharzia két köztesgazdája, a *Biomphalaria alexandrina* és a *Bulinus truncatus* ellen. A 26 és 23 ppm-es LC_{90} acetonos kivonat bizonyult a leghatásosabbnak.

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