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MOLLUSCICIDAL ACTIVITIES OF SOME ALKALOIDS

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ABSTRACT. Ninety-eight alkaloids were screened for molluscicidal activity on *Biomphalaria glabrata*; 31 of these were found to be active at 5 ppm. The results suggest that plants containing non-toxic alkaloids could be exploited for use as molluscicides.

INTRODUCTION

The need to study and develop alternative drugs from medicinal plants, and the desire to encourage and improve upon the traditional usage of herbal preparations, have led to the extraction of alkaoids from these plants for both chemical and biological studies.

Molluscs are not infective, but some fresh water snails are intermediate hosts for the cercariae of *Schistosoma* spp. Schistosomiasis control has two objectives which are controlling the transmission of the parasite and controlling the disease in the human population (1). The intermediate hosts belong to the genera *Biomphalaria, Bulinus* and *Oncomelania*. These snails can be controlled by molluscicides. Adewnmi and Aladesanmi (2) and Aladesanmi et. al. (3) have reported the molluscicidal activity of alkaloids in *Dysoxylum lenticellare*, thus prompting our present investigation which involves the molluscicidal activities of some naturally occuring and commercially available alkaloids.

EXPERIMENTAL

Source of snails. Biomphalaria glabrata (Puerto Rican strain) were cultured in the laboratory as previously described (4). Snails of 9.0 to 12.0 mm in diameter were used.

Molluscicidal tests. Unless otherwise stated, the WHO provisional plan as described for testing of molluscicide was followed (5). The alkaloids were dissolved in 12.5% dimethylsulphoxide (DMSO) and made into desired concentrations with snail water. Final concentration of DMSO per test and control solutions was 0.2%. The number of replicates for each test and also control was two. The number of snails per test was 10. Exposure and recovery periods of 48 hr each were allowed for each test and control. Mortality was recorded at the end of the recovery period.

Chemicals. The tested alkaloids were from the collection of one of us (FDM), and of natural (6-13) or commercial origin. Many of the alkaloids (Table 1-3) have been isolated from the following families: Loganiaceae, Rutaceae, Rubiaceae, Papaveraceae, Leguminasae, Apocynaceae and Solanaceae. Bayluscide (the ethanolamine salt of niclosamide supplied by Bayer of West Germany) was used as the reference molluscicide.

Table 1. Alkaloids with potential molluscicidal activity. Number of dead snails out of a total of 20 are presented.

Alkaloid	Results at different concentrations in ppm				
	30	15	10	5	0
Strychine	20	20	20	20	0
Sempervirine	20	20	20	20	0
Kokusaginine	20	20	20	20	0
Dictamine	20	20	20	20	0
Canthin-6-one	20	20	20	20	0
4-Methoxy-2(3'Pentyl) -Quinoline	20	20	20	20	0
Sanguinarine	20	20	20	20	0
Isopteropodine	20	20	20	20	0
Speciophylline	20	20	20	20	0
Emetine.HCl	20	20	20	20	0
Harman	20	20	20	20	0
Nor-Harman	20	20	20	20	0
Papaverine.HCl	20	20	20	20	0
Morphine	20	20	20	20	0
*Dicentrine	20	20	20	20	0
+Glaucine	20	20	20	20	0
Sparteine.CH_3I	20	20	20	20	0
Spartein.H_2SO_4	20	20	20	20	0
Tryptamine.HCl	20	20	20	20	0
Dregamine	20	20	20	20	0
19-Oxo-ibogaine	20	20	20	20	0
Reserpine	20	20	20	20	0
*Nicotine tartrate	20	20	20	20	0
*Solanine	20	20	20	20	0
*Solanidine	20	20	20	20	0
Veratrine	20	20	20	20	0
Cycloboxine	20	20	20	20	0
Agmatine.H_2SO_4	20	20	20	20	0
Ergotamine.HCl	20	20	20	20	0
Cocaine	20	20	20	20	0
Tropococaine	20	20	20	20	0

* Compounds producing 20/20 and 10/20 at concentrations of 2.5 and 1.0 ppm respectively.
\+ Compounds producing 10/20 at a concentration of 2.5 ppm.

Table 2. Alkaloids with moderate molluscicidal activity. Number of dead snails out of a total of 20 are presented.

Alkaloid	Results at different concentrations in ppm				
	30	15	10	5	0
ß-Colubrine	20	5	0	0	0
α-Colubrine	20	4	0	0	0
Pseudostrychnine	20	10	0	0	0
Pseudobrucine	20	4	0	0	0
Vomicine	20	5	0	0	0
Acetyldiaboline	20	4	0	0	0
Skimmianine	20	20	-	-	0
Hordenine	20	20	-	-	0
Pteropodine	20	4	0	0	0
Caffeine	20	20	0	0	0
Chelidonine	20	15	4	0	0
Apomorphine.HCl	20	5	0	0	0
Sparteine	20	20	-	-	0
Physostigmine	20	5	0	0	0
Galegine.H_2SO_4	20	5	0	0	0
Yohimbine	20	15	0	0	0
1-Acetyl-3-carboxymethyl- ß-carboline	20	4	0	0	0
Delphinine	20	10	4	0	0
Piperine	20	20	10	0	0
Colchicine	20	20	-	-	0
Berberine.HCl	20	20	-	-	0
Arecoline	20	20	-	-	0
Harmaline	20	20	-	-	0

Table 3. Alkaloids with little or no molluscicidal activity. Number of dead snails out of a total of 20 are presented.

Alkaloid	Results at different concentrations in ppm				
	30	15	10	5	0
Brucine	0	0	0	0	0
Dihydrobrucine	0	0	0	0	0
N-oxystrychnine	0	0	0	0	0
Icajine	16	2	0	0	0
Novacine	10	0	0	0	0
Holstiine	0	0	0	0	0
Diaboline	15	0	0	0	0
Wieland-Glumlick - aldehyde	10	5	0	0	0
11-Ome Diaboline	10	0	0	0	0
Retuline	5	0	0	0	0
18-Deoxy Wieland-Glumlick aldehyde	0	0	0	0	0
Akagerine	0	0	0	0	0
Bis-Nor-dihydrotoxiferine	0	0	0	0	0
C-curarine	10	2	0	0	0
Nigritanine	5	0	0	0	0
Maculine	10	0	0	0	0
Berberine	10	0	0	0	0
7,8-dihydro-berberine	0	0	0	0	0
Narcotine	0	0	0	0	0
Mitraphylline	0	0	0	0	0
Theophylline	15	10	0	0	0
Cinchonine	0	0	0	0	0
Bulbocapnine.HCl	0	0	0	0	0
Apocodeine	2	2	0	0	0
Armepavine	5	0	0	0	0
Narceine	5	0	0	0	0
Boldine	0	0	0	0	0
Lupanine	0	0	0	0	0
Aspidospermine	5	0	0	0	0
19-oxo-coronaridine	0	0	0	0	0
Atropine.H_2SO_4	4	2	0	0	0
Scopolamine	0	0	0	0	0
Belladonnine.H_2SO_4	10	6	4	0	0
Aconitine	10	5	0	0	0
Jervine	0	0	0	0	0
Mescaline.H_2SO_4	0	0	0	0	0
Serotonine.H_2SO_4	0	0	0	0	0
Carbazole	0	0	0	0	0
4-OH-Quinazoline	0	0	0	0	0
2,4-dihydroxy-Quinazoline	0	0	0	0	0
Hydrastine	4	4	0	0	0
Canadine	0	0	0	0	0
Cotarnine	0	0	0	0	0
Heroine	0	0	0	0	0

RESULTS AND DISCUSSION

Of the 98 alkaloids tested, 74 were molluscicidal at various concentrations. The relative potencies of the alkaloids as potential molluscicides are presented in Tables 1 to 3. 31 were found to be most potent based on their lethal effect on the snails. The most active members of this group are dicentrine, glaucine, and solanidine. The molluscicidal activity shown by this group is less than that of Bayluscide which kills all the snails at lower concentrations of 1.0 and 0.8 ppm. However, the molluscicidal action of this group of alkaloids are comparable to some natural saponin containing plant molluscicides such as *Tetrapleura tetraptera*, *Phytolacca dodecandra* and *Swartzia madagascariensis* (18). However, they are several times more potent than virgiline (17). Table 2 shows the activity of the alkaloids with moderate molluscicidal activity while Table 3 depicts the alkaloids with little or no activity.

Despite the fact that the molluscicidal activities of the alkaloids isolated from *D. lenticellare* (2,3), virgiline (17) and solanidine (14) have been reported, this is the first report describing the molluscicidal properties of the other alkaloids.

Structure activity relationships among the alkaloids is difficult to ascertain at this stage. The vast majority of plants tested for molluscicidal activity were collected from Brazil, Egypt, Nigeria, Puerto Rico, the Sudan (15) and China. The active components in over 90% of the species of Leguminosae, Papaveraceae, Rubiaceae, solanaceae listed by Farnsworth et. al., (16) are not known. Alkaloids could be responsible for the molluscicidal activities of the plants (in these families) listed by Farnsworth et. al. (16).

Toxicological data for some of these alkaloids abound in the literature. The direct use as molluscicides of plants containing less toxic alkaloids needs further evaluation. Plants are being selected from these families (Leguminosae, Papaveraceae, Rubiacea, Rutaceae and Solanaceae) for further investigation as candidate molluscicides.

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