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## Screening of some Nigerian plants for molluscicidal activity

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L'action molluscicide de 25 extraits de plantes nigérianes préparés soit au méthanol, soit avec de l'eau ordinaire, avec ou sans évaporation et utilisés pour différents emplois médicaux et domestiques a été contrôlée sur des Limnées élevées au laboratoire (*Lymnaea natalensis* Krauss). Sept plantes se sont révélées inactives ; en revanche, les extraits des 18 plantes restantes (72 p. 100), dont quelques unes sont connues pour leur effet nocif sur les poissons, ont montré une activité molluscicide. Il s'agit de *Acacia nilotica*, *Aristolochia albidia*, *Balanites aegyptiaca*, *Blighia sapida*, *Boswellia dalzielii*, *Detarium microcarpum*, *Gnidia kraussiana*, *Kigelia africana*, *Nauclea latifolia*, *Opilia celtidefolia*, *Parkia clappertoniana*, *Polygonum limbatum*, *Pseudoce-drela kotschyi*, *Sclerocarya birrea*, *Securidaca longipedunculata*, *Ximenia americana*, *Vetiveria nigriflora* et *Ziziphus abyssinica*. Les DL<sub>50</sub> de ces extraits ont été déterminés. Il est fortement recommandé que leurs effets toxiques sur les poissons, les cercaires, les oeufs de mollusques et les mammifères fassent l'objet de recherches complémentaires afin de déterminer la concentration adéquate d'utilisation, spécialement dans les étangs à poissons. *Mots clés* : Plante - Dicotylédone - Molluscicide - *Lymnaea natalensis* - Toxicité - Nigeria.

### INTRODUCTION

Compared with many parasitic diseases, little overall progress has been made in the control of snail-borne diseases both in man and livestock. It is only in a few areas that substantial progress has been made. The objectives of control of any disease may be simple containment of the spread of infection, a reduction in morbidity, or a significant reduction in transmission resulting in decreased morbidity, severity and prevalence. Available evidence indicates that snail control is the most effective single measure of control of snail-borne diseases. This is because the snail represents the weakest link in the life-cycle of the parasite. Complete eradication of the snail host may be extremely difficult because of the high intrinsic rate of

proliferation, dispersion capabilities and genetic variation. However, there is a possibility that transmission could be prevented by reducing the snail population density below a certain threshold. GOFFMAN and WARREN (6) observed that if the density of susceptible snails falls to the critical level, then the disease will decline. Some degree of control may be achieved by a wide range of measures (20). Control by molluscicides, either alone or in combination with other methods, has been shown to be a rapid and effective means of reducing or eliminating transmission. However, presently there are few molluscicides of acceptable efficacy and these tend to be generally biocidal, affecting many of the plants and animals in the snail habitats. Efforts are therefore being directed towards finding cheaper, more readily available and less polluting molluscicides which can be obtained from local plant materials.

The main objective of this study was to screen some Nigerian plants for molluscicidal activity on *Lymnaea natalensis*, the snail intermediate host of *Fasciola gigantica* (15, 17).

### MATERIALS AND METHODS

Egg-laying adult *L. natalensis* were obtained from Ahmadu Bello University reservoir, Zaria. The maintenance and rearing of the snails was done according to the method described by SHONEKAN (16). In 12 weeks, snails have reached 12 mm and these were used for the screening tests.

#### Plant materials

Information on the plant materials was obtained by interviewing traditional herbalists and Fulani herds-men in some parts of Bauchi and Kaduna States. Information was sought on plants used as soap, in fishing and for traditional medicine. Vernacular names and parts of the plants specified by the consultants were documented. Samples of the various plants indicated were collected with the aid of the local consultants and preserved in a plant press. These were sent to taxonomists at the Department of Biological Sciences, ATBU, Bauchi and ABU, Zaria for proper identification.

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### Preparation of plant extracts

The plant parts collected were pounded either wet or dry in a wooden mortar. Methanolic (MEOH) and evaporated crude water (ECW) extracts were obtained by mixing the processed samples in a ratio of 1:5 weight per volume (w/v) with either methanol or distilled water. After soaking at room temperature for 48 hours, they were filtered and evaporated to dryness in a rotary evaporator at 50 °C and 80 °C respectively, according to the method described by IBRAHIM *et al.* (8). The solid extracts obtained were removed and weighed.

### Preparation of the stock solutions

A gram from each extract (MEOH and ECW) was dissolved in a litre of distilled water to give 1,000 ppm stock solutions. Other concentrations used for the tests were serially diluted from the stock solutions. For the UECW extracts, concentrations were estimated from the ECW data and dilutions to concentrations of 10 to 1,000 ppm were made as appropriate.

### Testing for molluscicidal activity

WHO (19, 21) standards for preliminary screening of plants for molluscicidal activity were followed. For each test concentration, four replicates were used, and the number of snails per test was five. Copper sulphate (CuSO<sub>4</sub>) was used as a reference molluscicide and, distilled water and untreated dam-water as controls. Any peculiar protective behaviour of snails in test solutions was noted. In all tests, 24-hour exposure, and 48-hour recovery periods were used.

### Determination of Median Lethal Concentration (LC<sub>50</sub>)

Extracts from plants that had 100 per cent mortality at 100 ppm were diluted serially and further tests were done as described by BAALAWY (2). Mortality data for these tests were analysed by means of computerized probit transformation as described by LITCHFIELD and WILCOXON (11). The fiducial limits of the upper and lower LC<sub>50</sub> (P = 0.05) were obtained as outlined by TALLARIDA and MURRAY (18).

## RESULTS

### Toxicity tests

Details of the results are given in table I. Molluscicidal activity does not appear to be limited to any morpho-

gical part of the plants tested nor restricted to any family. Extracts of 18 (72 per cent) of the plants were found to have molluscicidal activity on adult snails. For the 25 plants, 35 per cent extracted by ECW method were active, 52 per cent of the MEOH extracts, and 64 per cent of the UECW extracts were active.

Five of the 25 plants were molluscicidal with extracts produced by all the three extraction methods. These include the bark of *Balanites aegyptiaca*, *Boswellia dalzielii*, *Detarium microcarpum*, *Ximenia americana* and the pods of *Parkia clappertoniana*. Ten of the plants were molluscicidal with extracts produced by two methods. These were bark of *Kigelia africana*, *Pseudocedrela kotschyi*, *Sclerocarya birrea* the fruit of *Blighia sapida*, the leaves of *Polygonum limbatum*, the pods of *Acacia nilotica* and the roots of *Aristolochia albida*, *Gnidia kraussiana*, *Securidaca longipedunculata* and *Vetiveria nigriflora*. Three of the plants were molluscicidal with extracts produced by one extraction method only. These include the bark of *Nauclea latifolia*, *Opilia celidifolia* and *Ziziphus abyssinica*. The remaining seven plants including the bark of *Anogeissus leiocarpus*, the flowers of *Gmelina arborea*, the fruit of *Luffa cylindrica*, the leaves of *Vernonia amygdalina*, the pods of *Prosopis africana*, the roots of *Cissampelos mucronata* and the stem of *Cissus quadrangularis* were not molluscicidal with either extraction method. However, all the seven plant extracts excluding *Vernonia amygdalina* appeared molluscicidal at higher concentrations with at least one of the extraction methods.

Extracts from *Nauclea latifolia*, *Vernonia amygdalina* and *Vetiveria nigriflora* precipitated after about an hour of introduction of snails. This phenomenon was not observed with extracts from the remaining 22 plants.

It was observed that most snails dropped to the bottom of test solutions or crawled out of extracts and became attached to the side of the beakers.

Poisoning with extracts caused the adult snails either to retract into the shell or to become swollen and remain extended from the shell opening. The former response was seen with extracts of *Acacia nilotica*, *Anogeissus leiocarpus*, *Aristolochia albida*, *Cissus quadrangularis*, *Gmelina arborea*, *Luffa cylindrica*, *Nauclea latifolia*, *Sclerocarya birrea*, *Vernonia amygdalina*, *Vetiveria nigriflora*, *Ximenia americana* and *Ziziphus abyssinica*. The latter response was seen particularly with extracts of *Balanites aegyptiaca*, *Blighia sapida*, *Gnidia kraussiana*, *Opilia celidifolia*, and *Securidaca longipedunculata*, together with CuSO<sub>4</sub> control; in addition to being swollen and extended out of their shell, snails expelled haemolymph.

Results of the statistical analysis of the lethal concentration values for extracts molluscicidal with one or

TABLE I Results of the molluscicidal screening of plant extracts on 12-week old *Lymnaea natalensis*.

Plant family and species	Plant part tested (month collected)	Conc. in ppm	MEOH extract	ECW extract	UECW extract
			Percentage mortality at 100 ppm	Percentage mortality at 100 ppm	Percentage mortality at 100 ppm
1. AMPELIDIACEAE <i>Cissus quadrangularis</i> Rich.	Fresh stem (August, 1986)	1,000	0	Could not be concentrated because of its mucoid nature.	100
		500	0		100
		100	0		45
		50	0		25
		10	0		20
2. ANACARDIACEAE (* <i>Sclerocarya birrea</i> (A. Rich.) Hochst	Bark (Oct., 1986)	1,000	100	100	20
		500	100	100	0
		100	100	100	0
		50	100	100	0
		10	0	0	0
3. ARISTOLOCHIACEAE (* <i>Aristolochia albida</i> Duch.	Dried roots (Sept., 1986)	1,000	100	100	100
		500	100	100	100
		100	5	100	100
		50	0	100	20
		10	0	0	0
4. BIGNONIACEAE (* <i>Kigelia africana</i> (Lam.) Benth.	Bark (Sept., 1986)	1,000	100	100	100
		500	100	100	100
		100	45	100	100
		50	0	55	0
		10	0	0	0
5. CAESALPINIACEAE (* <i>Detarium microcarpum</i> Guill. & Perr.	Bark (Aug., 1986)	1,000	100	100	100
		500	100	100	100
		100	100	100	100
		50	100	100	100
		10	10	30	0
6. COMBRETACEAE <i>Anogeissus leiocarpus</i> Guill. & Perr.	Bark (Aug., 1986)	1,000	100	100	85
		500	100	100	80
		100	0	20	45
		50	0	0	0
		10	0	0	0
7. COMPOSITAE <i>Vernonia amygdalina</i> Del.	Fresh leaves (Oct., 1986)	1,000	0	0	75
		500	0	0	65
		100	0	0	40
		50	0	0	0
		10	0	0	0
8. CUCURBITACEAE <i>Luffa cylindrica</i> Roem.	Green fruits (Jan., 1987)	1,000	0	0	100
		500	0	0	100
		100	0	0	0
		50	0	0	0
		10	0	0	0
9. BURSERACEAE (* <i>Boswellia dalzielii</i> Hutch.	Bark (Sept., 1986)	1,000	100	100	100
		500	100	100	100
		100	100	100	100
		50	100	100	100
		10	35	20	0
10. GRAMINEAE <i>Vetiveria nigriflora</i> Stapf	Dried roots (Sept., 1986)	1,000	0	100	100
		500	0	100	100
		100	0	100	100
		50	0	100	55
		10	0	0	0
11. MALIACEAE (* <i>Pseudocedrela kotschyi</i> Harms-Holl.	Bark (Oct., 1986)	1,000	100	100	100
		500	100	100	100
		100	100	50	100
		50	10	0	0
		10	0	0	0

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12. MENISPERMACEAE <i>Cissampelos mucronata</i> Rich.	Dried roots (Aug., 1986)	1,000	40	40	100
		500	15	15	100
		100	0	0	40
		50	0	0	0
		10	0	0	0
13. MIMOSACEAE (i) (*) <i>Acacia nilotica</i> Del.	Dry pods (Jan., 1987)	1,000	100	100	100
		500	100	100	100
		100	100	25	100
		50	0	0	100
		10	0	0	15
(ii) (*) <i>Parkia clappertoniana</i> Keay	Dry pods (May, 1986)	1,000	100	100	100
		500	100	100	100
		100	100	100	100
		50	100	100	100
		10	90	95	100
(iii) <i>Prosopis africana</i> Taub.	Dry pods (Oct., 1986)	1,000	100	0	100
		500	100	0	55
		100	5	0	0
		50	0	0	0
		10	0	0	0
14. OLACEAE (*) <i>Ximenia americana</i> Linn.	Bark (Aug., 1986)	1,000	100	100	100
		500	100	100	100
		100	100	100	100
		50	100	100	100
		10	0	0	0
15. OPILIACEAE (*) <i>Opilia celtidifolia</i> (Huill. & Perr.) Endl. Ex Walp.	Bark (Aug., 1986)	1,000	100	Could not be concentrated because of its foamy nature.	100
		500	100		100
		100	25		100
		50	5		100
		10	0		25
16. POLYGALACEAE (*) <i>Securidaca longipedun- culata</i> Fres.	Fresh roots (Sept., 1986)	1,000	100	15	100
		500	100	0	100
		100	100	0	100
		50	100	0	80
		10	5	0	25
17. POLYGONACEAE (*) <i>Polygonum limbatum</i> Meisn.	Dried leaves (Jan., 1987)	1,000	100	100	100
		500	100	100	100
		100	100	0	100
		50	100	0	100
		10	0	0	0
18. RHAMNACEAE (*) <i>Ziziphus abyssinica</i> Lam.	Dried roots (Aug., 1986)	1,000	100	100	100
		500	100	100	100
		100	100	20	80
		50	0	25	0
		10	0	0	0
19. RUBIACEAE (*) <i>Nauclea latifolia</i> Smith.	Bark (Sept., 1986)	1,000	100	100	100
		500	100	35	100
		100	0	5	100
		50	0	0	55
		10	0	0	0
20. SAPINDACEAE (*) <i>Blighia sapida</i> Koenig.	Fresh fruit (Jan., 1987)	1,000	100	Could not be concentrated because of its foamy nature.	100
		500	100		100
		100	100		100
		50	100		100
		10	0		40
21. THYMELACACEAE (*) <i>Gnidia kraussiana</i> (= <i>Lasiosiphon kraussia- nus</i> ) Meisn.	Dried roots (Sept., 1986)	1,000	100	100	100
		500	100	100	100
		100	100	0	100
		50	100	0	60
		10	30	0	0
22. VERBENACEAE <i>Gmelina arborea</i> Roxb.	Dry flowers (Jan., 1987)	1,000	15	100	100
		500	0	100	100
		100	0	0	0
		50	0	0	0
		10	0	0	0
23. ZYGOPHYLLACEAE (*) <i>Balanites aegyptiaca</i> (Linn.) Del.	Bark (Sept., 1986)	1,000	100	100	100
		500	100	100	100
		100	100	100	100
		50	100	100	100
		10	100	100	100

CuSO<sub>4</sub> : Molluscicidal at 2 ppm.

Untreated dam-water : non-molluscicidal

Distilled water : non-molluscicidal.

(\*) Plants that have passed WHO (19,21) standards i.e. 100 per cent mortality at 100 ppm (4 replicates of 5 snails tested).

TABLE II Statistical analysis of median lethal concentrations (in ppm) of the three extracts on 12-week old *Lymnaea natalensis*.

Plant species	LC <sub>50</sub> values and fiducial limits (in ppm)		
	UECW extract	MEOH extract	ECW extract
1 <i>Parkia clappertoniana</i>	3.40 ( 2.35- 4.91)	6.40 ( 5.64- 7.26)	7.21 ( 5.47- 8.03)
2 <i>Balanites aegyptiaca</i>	3.53 ( 2.70- 4.63)	7.26 ( 6.46- 8.17)	6.13 ( 5.48- 6.86)
3 <i>Detarium microcarpum</i>	4.50 ( 3.60- 5.53)	11.42 (10.87-11.99)	15.11 (12.47-18.33)
4 <i>Blighia sapida</i>	11.60 ( 9.73-13.83)	17.21 (14.72-20.12)	—
5 <i>Polygonum limbatum</i>	13.09 (10.93-15.68)	23.93 (21.48-26.63)	—
6 <i>Opilia celidifolia</i>	15.74 (13.37-18.53)	—	—
7 <i>Acacia nilotica</i>	16.14 (13.80-18.89)	80.28 (78.74-81.85)	—
8 <i>Ximenia americana</i>	17.06 (15.98-18.21)	25.50 (23.27-27.95)	21.49 (18.95-24.37)
9 <i>Securidaca longipedunculata</i>	21.11 (16.95-26.27)	22.23 (19.56-25.28)	—
10 <i>Boswellia dalzielii</i>	32.21 (29.77-34.84)	11.23 ( 9.81-12.84)	22.64 (19.79-25.91)
11 <i>Nauclea latifolia</i>	41.60 (37.87-45.69)	—	—
12 <i>Vetiveria nigritana</i>	47.69 (44.52-51.07)	—	14.98 (14.20-15.81)
13 <i>Gnidia kraussiana</i>	49.66 (46.52-53.00)	12.14 (10.48-14.07)	—
14 <i>Aristolochia albida</i>	57.61 (54.29-61.13)	—	36.29 (35.01-37.62)
15 <i>Kigelia africana</i>	68.30 (64.02-72.86)	—	45.37 (41.92-49.11)
16 <i>Pseudocedrela kotschyi</i>	77.82 (76.14-79.55)	51.56 (48.50-54.80)	—
17 <i>Sclerocarya birrea</i>	—	22.88 (21.03-24.89)	15.49 (14.30-16.78)
18 <i>Ziziphus abyssinica</i>	—	78.21 (72.25-78.28)	—
CuSO <sub>4</sub> (Control)	0.75 ( 0.66- 0.84)	—	—

— : No significant molluscicidal effect.

more of the extraction methods, are charted in table II. From the limited data, there appear to be some differences in LC<sub>50</sub> values for the different plant extracts. These differences also exist for the same plant with different extraction methods compared with CuSO<sub>4</sub> controls.

Based on the computed LC<sub>50</sub> for the different extracts as shown in table II, the UECW extracts have values ranging from 3.40 ppm in *Parkia clappertoniana* to 77.82 ppm in *Pseudocedrela kotschyi*, while the MEOH extracts have values varying from 6.40 ppm in *Parkia clappertoniana* to 80.28 ppm in *Acacia nilotica*. The ECW extracts have values of 6.13 ppm to 45.37 ppm in *Balanites aegyptiaca* and *Kigelia africana* respectively ; with an LC<sub>50</sub> value of 0.75 ppm for the CuSO<sub>4</sub> controls. It is apparent that various levels of non-significant differences exist within and between extracts and controls as revealed by fiducial limits.

## DISCUSSION

It seems generally agreed that control of the snail intermediate host is one effective means of reducing the transmission of trematode diseases. The possibility that vegetable molluscicides may be of value in control of snails was suggested by LEMMA (10) when he made direct observation of the molluscicidal effect of *Phytolacca dodecandra* on schistosom-transmit-

ting snails. The present results have confirmed this possibility ; based on the standardized method proposed by WHO (19, 21) for preliminary screening of potential plant molluscicides : 18 (72 per cent) of the 25 plants screened had a molluscicidal effect on *L. natalensis*. One of the problems envisaged in use of plant extracts, in the control of snails, is the choice of solvent for extracting plant materials. From the results obtained, activity recorded for the different types of extraction method shows that 16 (64 per cent) UECW extracts were active, 9 (36 per cent) ECW extracts were active and so were 13 (52 per cent) of the MEOH extracts. This clearly shows that, water as a solvent was superior to methanol, implying that the potential active ingredients in these plants are water-soluble. This is encouraging since the use of plant molluscicides is more likely to be undertaken in rural areas where use of special solvents and sophisticated technology may not be feasible. MEOH extracts of *Acacia nilotica*, *Blighia sapida*, *Detarium microcarpum*, *Parkia clappertoniana*, *Securidaca longipedunculata* and *Ximenia americana* did not increase their potency over water extracts.

On the other hand, it was observed that MEOH extracts of *Boswellia dalzielii*, *Gmelina arborea*, *Pseudocedrela kotschyi* and *Ziziphus abyssinica* increased their potency. It seems that molluscicidal activity of some plants is either enhanced or diminished depending on the solvent used. This calls for using different solvents during extraction and experimentation so as to determine the one that gives the best results.

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Results obtained in this study show that some of the plants apparently recorded as being non-molluscicidal at 100 ppm were however active at higher concentrations (e.g. *Anogeissus leiocarpus*, *Cissampelos mucronata*, *Cissus quadrangularis*, *Gmelina arborea*, *Luffa cylindrica* and *Prosopis africana*).

The potency of some extracts as molluscicides may have been affected by the high temperature (80 °C) used during evaporation and concentration of the ECW extracts. It should be noted that although the UECW extracts of *Acacia nilotica*, *Blighia sapida*, *Gnidia kraussiana*, *Nauclea latifolia*, *Opilia celitdefolia*, *Polygonum limbatum* and *Pseudocedrela kotschyi* were effective molluscicides, none of these were effective in the form of ECW extracts at 100 ppm. The evaporation of the extracts at 80 °C could have denatured the active compounds of the plants.

It has been reported that molluscicidal activity of plants is not restricted to any morphological part (1). In a preliminary screening test on *Bulinus globosus*, these workers reported 10 per cent mortality with the MEOH extracts of the fruit of *Kigelia africana*. The results obtained from this study showed that MEOH, ECW and UECW extracts of the bark of the same plant had 45 per cent, 100 per cent and 100 per cent mortality respectively on *Lymnaea natalensis*. This may suggest that the active molluscicidal compound is more concentrated in the bark of this plant, or *Bulinus globosus* is not so susceptible as *L. natalensis*. Lack of activity in *Prosopis africana* which FELKER and BANDURSKI (5) reported to exhibit properties toxic to snails may be due to two reasons. Firstly, the pods of this plant used for this study might have contained less molluscicidally active compounds. Another possibility is that *L. natalensis* may be less susceptible than other snails to extracts of *Prosopis africana*.

Different species of snails differ in their susceptibility to different molluscicides (4). Most of the reported work on plant molluscicides has been on the genera *Biomphalaria* and *Bulinus*, snail intermediate hosts of schistosomiasis (9). *Balanites*, *Parkia*, *Polygonum*, *Securidaca* and *Ximenia* have been reported to be molluscicidal on these two genera of snails. The present work has confirmed that these plants are molluscicidal to *L. natalensis*. This is encouraging since these five plants can be used in the integrated control of fascioliasis and schistosomiasis in endemic foci.

*Acacia nilotica*, *Cissus quadrangularis*, *Luffa cylindrica* and *Ziziphus abyssinica* have not been tested previously for molluscicidal activities, though activities of *Acacia dudgeoni*, *Cissus populnea*, *Luffa operculata* and *Ziziphus jaozeiro* have been reported. KLOOS and McCULLOUGH (9) citing BARBOSA and MELLO (1969) reported 30 per cent mortality of *Biomphalaria glabrata* with water extract of the bark of *Ziziphus jaozeiro*. The present work reports 100 per cent morta-

lity on *L. natalensis* with the MEOH extract of the root of *Ziziphus abyssinica*. Similarly, 100 per cent activity reported with the MEOH and UECW extracts of the pods of *Acacia nilotica* and 0 per cent mortality with the MEOH extract of the stem of *Cissus quadrangularis* on *L. natalensis* support the findings of ADEWUNI and SOFOWORA (1) on *Bulinus globosus*. Hundred per cent activity at 100 ppm reported with water extract of the fruit of *Luffa cylindrica* contrasts with the 60 per cent activity of water extract of the fruit of *Luffa operculata* on *Bulinus stramina* (9). These variations could be due to the ecotypes of the plants, and the plant and snail species used.

According to the local consultants, *Balanites aegyptiaca*, *Boswellia dalzielii*, *Detarium microcarpum*, *Gmelina arborea*, *Parkia clappertoniana* and *Ximenia americana* are used as fish poisons while *Balanites aegyptiaca*, *Blighia sapida*, *Opilia celitdefolia* and *Securidaca longipedunculata* are used as local laundry soap (3). This suggests that most potent fish poison plants and plants used as traditional laundry soap exhibit molluscicidal activities, supporting the findings of DOSSAJI *et al.* (4) and LUGT (12) who separately reported similar observations on different plant molluscicides.

Sublethal doses apparently irritated the snails, they crawled out of the test solutions in order to avoid contact with extracts. This could be protective behavior of *L. natalensis* to avoid contact with treated water. It is suggested that for field trials, the concentration of such extracts and the duration of application, especially in small pools of water and rice paddies, be increased for desirable results.

It has been confirmed by McCULLOUGH *et al.* (13) that molluscicides cause stress to the water-balance system of snails by lowering the surface tension. This could have accounted for the rapid submergence of snails in some extracts, and to some extent be the cause of snail mortality. Poisoning, which caused snails to expel haemolymph, could be due to destruction of the blood system by extracts. Poisoning which caused snails to remain extended from the shell opening could be due both to action on the central nervous system (CNS), leading to loss of water-balance control, and inhibition of the enzymatic activities of the snails (13). It has also been documented by these workers that death caused by  $\text{CuSO}_4$  is due to inhibition of the enzymatic sulfhydryl group. It may be speculated that extracts of *Boswellia dalzielii*, *Detarium microcarpum*, *Kigelia africana*, *Parkia clappertoniana* and *Pseudocedrela kotschyi* whose mode of action caused snails to remain extended out of the shell opening could be neurotoxic in action.

Toxicity of extracts varied as revealed by the  $\text{LC}_{50}$  values which though not superior to  $\text{CuSO}_4$  controls are potentially good, being natural products.

Some plant molluscicides have been studied and the chemical basis of their action identified. Flavonol glycoside, a cyanogenic compound has been reported as the active material of *Polygonum senegalensis* (4). Similarly, the triterpenoid saponin oleanolic acid glucoside has been identified as the active material for the molluscicidal action of *Polygonum dodecandra* (7). A variety of other plants including *Balanites aegyptiaca* have saponins as their molluscicidal compound (13). Mortalities due to extracts of *Acacia nilotica*, *Balanites aegyptiaca*, *Blighia sapida*, *Luffa cylindrica*, *Polygonum limbatum*, *Opilia celtidefolia*, *Securidaca longipedunculata* and *Vernonia amygdalina* that had characteristic foamy extracts were probably due to saponins. It is probable that diterpenes present in *Gnidia kraussiana* (14) could have been the cause of snail mortality in extracts of these plants. There is however need to work on the chemical basis of these plants.

## CONCLUSION

Toxicological investigations of these extracts on fish and mammals are strongly recommended with a view

to determining suitable molluscicidal concentration especially for plants that are established fish poisons. This together with further toxicity tests on the cercaricidal, larvicidal and ovicidal effects of these extracts may lead to selection of more potent, less persistent, naturally occurring plant molluscicides of acceptable efficacy for future integrated control of snails and snail-borne diseases especially in fish ponds.

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KELA (S. L.), OGUNSUSI (R. A.), OGBOGU (V. C.), NWUDE (N.). Screening of some Nigerian plants for molluscicidal activity. *Revue Elev. Méd. vét. Pays trop.*, 1989, 42 (2): 195-202.

Methanolic (MEOH), evaporated crude water (ECW) and unevaporated crude water (UECW) extracts of 25 Nigerian plants, used for different medicinal and domestic purposes were screened for molluscicidal activity on laboratory-reared *Lymnaea natalensis* Krauss. Seven of the plants were not active; extracts from 18 (72 per cent) of the plants, some of which are reknowned fish poisons, had molluscicidal activity. These were *Acacia nilotica*, *Aristolochia albidia*, *Balanites aegyptiaca*, *Blighia sapida*, *Boswellia dalzielii*, *Detarium microcarpum*, *Gnidia kraussiana*, *Kigelia africana*, *Nauclea latifolia*, *Opilia celtidefolia*, *Parkia clappertoniana*, *Polygonum limbatum*, *Pseudocedrela kotschyi*, *Sclerocarya birrea*, *Securidaca longipedunculata*, *Ximenia americana*, *Vetiveria nigriflora* and *Ziziphus abyssinica*. The LC<sub>50</sub> of these extracts were determined. It is strongly recommended that the toxic effects of these extracts against fish, cercariae, snail eggs and mammals be further investigated so as to determine the right concentration, especially for use in fish ponds. *Key words*: Plant - Dicotyledon - Molluscicide - *Lymnaea natalensis* - Toxicity - Nigeria.

KELA (S. L.), OGUNSUSI (R. A.), OGBOGU (V. C.), NWUDE (N.). Detección de la actividad moluscicida de algunas plantas de Nigeria. *Revue Elev. Méd. vét. Pays trop.*, 1989, 42 (2): 195-202.

Se comprobó sobre limneas (*Lymnaea natalensis* Krauss) criadas en laboratorio la acción moluscicida de 25 extractos de plantas de Nigeria preparados sea con metanol, sea con agua natural evaporado o no y utilizados para varios empleos medicinales y domésticos. Siete plantas fueron inactivas; en cambio, los extractos de demás 18 plantas (72 p. 100), de las que algunas se conocen a causa de su efecto nocivo sobre los peces, mostraron una actividad moluscicida. Se trata de *Acacia nilotica*, *Aristolochia albidia*, *Balanites aegyptiaca*, *Blighia sapida*, *Boswellia dalzielii*, *Detarium microcarpum*, *Gnidia kraussiana*, *Kigelia africana*, *Nauclea latifolia*, *Opilia celtidefolia*, *Parkia clappertoniana*, *Polygonum limbatum*, *Pseudocedrela kotschyi*, *Sclerocarya birrea*, *Securidaca longipedunculata*, *Ximenia americana*, *Vetiveria nigriflora* y *Ziziphus abyssinica*. Se determinaron las DL<sub>50</sub> de dichos extractos. Se aconseja mucho la realización de investigaciones complementarias sobre los efectos tóxicos en los peces, las cercarias, los huevos de moluscos y los mamíferos para determinar la concentración adecuada de utilización, en particular en las albuferas. *Palabras claves*: Planta - Dicotiledón - Moluscicida - *Lymnaea natalensis* - Toxicidad - Nigeria.

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