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## Susceptibility of two-week old *Lymnaea natalensis* to some plant extracts

KELA (S. L.), OGUNSUSI (R. A.), OGBOGU (V. C.), NWUDE (N.). Sensibilité de *Lymnaea natalensis* à quelques extraits de plantes, à l'âge de deux semaines. *Revue Élev. Méd. vét. Pays trop.*, 1989, 42 (2) : 189-192.

Le pouvoir molluscicide de 17 extraits de plantes nigérianes a été évalué sur des *Lymnaea natalensis* Krauss de 2 semaines (méthode par extraction aqueuse sans évaporation). Cinq extraits ont été inactifs ; en revanche les extraits de *Balanites aegytiaca*, *Blighia sapida*, *Boswellia dalzielii*, *Cissampelos mucronata*, *Detarium microcarpum*, *Kigelia africana*, *Opilia celtidifolia*, *Parkia clappertoniana*, *Polygonum limbatum*, *Pseudocedrela kotschyi*, *Nauclea latifolia* et *Securidaca longipedunculata* avaient un effet molluscicide. Cette capacité permettra de les utiliser à l'avenir dans la lutte intégrée contre *Lymnaea natalensis*, ainsi que contre d'autres mollusques. Les données de mortalité pour les valeurs de la concentration létale ( $DL_{50}$ ) pour tous les extraits ont été analysées par la transformation « probit ». Les limites supérieures et inférieures de confiance pour la  $DL_{50}$  ( $P = 0,05$ ) ont aussi été déterminées. *Mots clés* : *Lymnaea natalensis* - Mollusque nuisible - Molluscicide - Plante - Dicotylédone - Toxicité - Nigeria.

molluscicides (3, 8, 14). Techniques used for the control of the one snail host may not be effective for another, even for snails of the same genus (16).

The present work reports the susceptibility of 2-week old *L. natalensis* to different plant extracts whose molluscicidal potency have been reported on 12-week old *L. natalensis* (6). The main objective was to discover indigenous plant extracts that have a wide range of activity on both young and adult *L. natalensis* whose ideal habitats are on the increase in the arid and semi-arid zones of Nigeria. These habitats are being created by water conservation practices as a result of the current period of reduced rainfall.

### INTRODUCTION

There has been increasing interest in the search for cheaper and less polluting molluscicides of plant origin, for use in the integrated control of snail-borne helminths. Most of the work however, has been done on *Schistosoma* (transmitting snails as reviewed by KLOOS and McCOLLOUGH (7), with only a little work being done on *Fasciola*) transmitting snails (14, 15). This may be partly due to firstly lack of awareness of the increasing economic loss caused by fascioliasis (1, 2, 5, 11) or secondly the assumption that such plant screened on *Schistosoma* (transmitting snails may also have activity on *Fasciola*) transmitting snails. This may not be so, as *Lymnaea truncatula* and some strains of *L. natalensis* are semi-aquatic and may exhibit different protective behaviour in test solutions from the aquatic *Biomphalaria* and *Bulinus* which are intermediate hosts of schistosomiasis. Moreover, different species of snails vary in susceptibility to different

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### MATERIALS AND METHODS

#### Procedure involving snails

Egg-laying adult specimens of *L. natalensis* (shell length 15 to 20 mm) were obtained from Ahmadu Bello University Dam, Zaria. The maintenance and rearing of the snails were done according to the method described by SHONEKAN (12). Young snails which hatched out of the egg masses were bred for 2 weeks and used for the susceptibility tests.

#### Procedure involving plants

Bark, fruit, pods and roots of 17 species of flowering plants (Table I) were collected in Northern Nigeria (Kaduna and Bauchi States).

Pounded plant material was mixed with distilled water in a ratio of 1:5 weight per volume (w/v) and allowed to stand for 48 hours at ambient temperature. The suspension was filtered first through two layers of cheese cloth (inserted in 2.0 mm mesh gauze). For each plant extract, a known volume of the filtrate was concentrated to dryness in vacuo at 50 °C using a rotary evaporator as described by IBRAHIM *et al.* (4). Yield of solid extract per volume of solution evaporated was calculated. This was used to estimate the amount of extract in a known volume of unevaporated crude water (UECW) extract to be used for susceptibility tests.

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**TABLE I** Summary of effect of 100 ppm unevaporated crude water (UECW) extracts on 2-week old *Lymnaea natalensis* (ten snails exposed per replicate of each treatment).

Plant species	Part tested	Percent mortality at 100 ppm	Molluscicidal
<i>Acacia nilotica</i>	Pod (dry)	0	No
<i>Aristolochia albida</i>	Root (dry)	10	No
* <i>Balanites aegyptiaca</i>	Bark (dry)	100	Yes
* <i>Blighia sapida</i>	Fruit (wet)	100	Yes
* <i>Boswellia dalzielii</i>	Bark (dry)	100	Yes
* <i>Cissampelos mucronata</i>	Root (dry)	100	Yes
* <i>Detarium microcarpum</i>	Bark (dry)	100	Yes
<i>Gnidia kraussiana</i>	Root (dry)	0	No
* <i>Kigelia africana</i>	Root (dry)	100	Yes
* <i>Opilia celtidifolia</i>	Bark (dry)	100	Yes
* <i>Parkia clappertoniana</i>	Pod (dry)	100	Yes
* <i>Polygonum limbatum</i>	Leaves (dry)	100	Yes
* <i>Pseudocedrela kotschyi</i>	Bark (dry)	100	Yes
* <i>Nauclea latifolia</i>	Bark (dry)	100	Yes
* <i>Securidaca longipedunculata</i>	Root (wet)	100	Yes
<i>Ximenia americana</i>	Bark (dry)	0	No
<i>Vetiveria nigriflora</i>	Root (dry)	10	No
CuSO <sub>4</sub> (1 ppm)		100	Yes
Distilled water		0	No
Untreated Dam water		0	No

\* Extracts were molluscicidal when 100 percent mortality were recorded at 100 ppm based on WHO (16, 17) standards.

## Susceptibility tests

Hundred ppm solutions of the UECW extracts were prepared by dilution based on information obtained through evaporating known volumes of crude aqueous extracts. Susceptibility tests were evaluated by diluting each extract with distilled water to provide a series 10 to 90 ppm and exposing 10 snails each to the two replicates for all treatments. When mortality data were not consistent for calculating lethal concentration (LC) values, the solutions were diluted further to have spaced mortality. Mortality data for LC values for all extracts were converted to probit as described by LITCHFIELD and WILCOXON (10). The X<sup>2</sup> test for goodness of fit, between observed results and those expected, was conducted for each plant extract found to have molluscicidal activity.

## RESULTS

As summarised in table I, it can be seen that five plants i.e. *Acacia nilotica*, *Aristolochia albida*, *Gnidia kraussiana*, *Ximenia americana* and *Vetiveria nigriflora* were not active on young snails at 100 ppm. The results also revealed that the other extracts though molluscicidal

at 100 ppm on young snails differ in their toxicity. *Cissampelos mucronata* though not molluscicidal on adult snails at 100 ppm was toxic to young snails at this concentration.

The LC<sub>50</sub> values of these extracts on 2-week old *L. natalensis* presented in table II range from 0.46 ppm in *Parkia clappertoniana* pods to 61.50 ppm in *Boswellia dalzielii* bark and the LC<sub>90</sub> values from 1.33 ppm also in *Parkia clappertoniana* to 166.68 ppm in *Pseudocedrela kotschyi* bark.

The slope function values for most extracts as presented in table II are all similar, ranging from 1.18 in *Opilia celtidifolia* bark to 1.75 in *Nauclea latifolia* bark, implying that similar mortalities may be produced with similar proportionate increase in concentration of extracts, except *Parkia clappertoniana*, *Pseudocedrela kotschyi* and CuSO<sub>4</sub> which had values of 2.28, 3.32 and 6.27 respectively. Table II further shows that, all the X<sup>2</sup> values are not significant, suggesting that mortality data observed are homogeneous.

## DISCUSSION

One major problem in the control of snail-borne diseases is that different species of snails vary in susceptibility to different molluscicides (3, 8, 9, 14). Most of the reported work on trials of plant molluscicides has been on the genera *Biomphalaria* and *Bulinus* which are intermediate hosts of schistosomiasis (7). *Balanites aegyptiaca*, *Parkia clappertoniana* and *Securidaca longipedunculata* have been reported to be molluscicidal on these species of snails (7). The present work has confirmed that these plants also have molluscicidal effect on young *Lymnaea natalensis*. This is encouraging since these three plants and *Ambrosia maritima* (14) can be used in the integrated control of fascioliasis and schistosomiasis in endemic foci. The molluscicidal potency of *Blighia sapida*, *Boswellia dalzielii*, *Cissampelos mucronata*, *Detarium microcarpum*, *Kigelia africana*, *Nauclea latifolia*, *Opilia celtidifolia*, *Polygonum limbatum* and *Pseudocedrela kotschyi* have been elucidated for the first time using *Lymnaea natalensis*, the snail intermediate host of *Fasciola gigantica*.

UECW extracts of *Acacia nilotica*, *Aristolochia albida*, *Gnidia kraussiana*, *Vetiveria nigriflora* and *Ximenia americana* were non-toxic to young *L. natalensis* at the concentration at which they were toxic to adult snails (6). This suggest that young *L. natalensis* are less susceptible than adult to these extracts. For effective control of *L. natalensis* with these extracts, two applications spaced 2 months apart should be

TABLE II Lethal concentration (LC) values of unevaporated crude water (UECW) extracts for 2-week old *Lymnaea natalensis*.

Plant species	LC <sub>10</sub> (PPM)	LC <sub>16</sub> (PPM)	LC <sub>50</sub> (PPM)	LC <sub>84</sub> (PPM)	LC <sub>90</sub> (PPM)	LC <sub>95</sub> (PPM)	Slope function (S)	χ <sup>2</sup> NS	Lower & Upper values of LC <sub>50</sub> (PPM)
<i>Parkia clappertoniana</i>	0.16	0.20	0.46	1.05	1.33	1.80	2.28	2.33	0.32- 0.66
<i>Detarium microcarpum</i>	1.54	1.73	2.60	3.91	4.40	5.10	1.50	1.45	2.02- 3.35
<i>Opilia celtidifolia</i>	5.77	6.06	7.17	8.49	8.92	9.42	1.18	1.44	6.46- 7.96
<i>Balanites aegyptiaca</i>	5.73	6.09	7.51	9.25	9.82	10.60	1.23	1.40	6.75- 8.34
<i>Kigelia africana</i>	3.17	6.03	10.33	17.70	20.67	25.16	1.71	1.96	6.45-16.56
<i>Nauclea latifolia</i>	5.64	6.62	11.60	21.17	23.69	29.04	1.75	1.69	8.19-16.32
<i>Pseudocedrela kotschyi</i>	7.58	10.72	35.54	117.91	166.68	258.29	3.32	4.85	25.50-49.55
<i>Securidaca longipedunculata</i>	23.92	26.42	37.26	52.55	58.04	65.80	1.41	3.03	31.31-44.34
<i>Cissampelos mucronata</i>	17.73	21.01	37.82	68.09	80.68	100.01	1.60	3.52	28.10-50.92
<i>Polygonum limbatum</i>	26.97	30.86	47.19	78.41	89.71	106.37	1.59	2.37	38.86-62.27
<i>Blighia sapida</i>	42.61	45.17	55.30	67.69	71.77	77.27	1.22	3.97	48.78-62.68
<i>Boswellia dalzielii</i>	48.26	50.95	61.50	74.22	78.36	83.93	1.21	2.67	52.16-72.51
CuSO <sub>4</sub>	0.00	0.00	0.03	0.17	0.29	0.57	6.27	4.05	0.01- 0.14

NS = X<sup>2</sup> not significant (P = 0.05).

Average number of snails, N, exposed per replicate of each treatment is 10.

made so that young snails which survive the first application are killed.

The LC values presented reveal that most of these extracts have good potential for future use in integrated control of *L. natalensis* in endemic foci. Differences in slope function indicate the extent to which increase in concentration of extracts should be made, to secure an increase in mortality. Toxicological investigations on the cercaricidal, ovicidal and piscicidal effects of these extracts at molluscicidal concentrations are currently under investigation. These, together with the nature and mode of action of the molluscicidal principles, may finally lead to selection of less polluting extracts, which may be readily available, within the reach of most rural communities. Such extracts would be used in the control of *Lymnaea*

*natalensis*, other snails and the trematode diseases they transmit.

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KELA (S. L.), OGUNSUSI (R. A.), OGBOGU (V. C.), NWUDE (N.). Susceptibility of two-week old *Lymnaea natalensis* to some plant extracts. *Revue Elev. Méd. vét. Pays trop.*, 1989, 42 (2) : 189-192.

The molluscicidal potency of 17 Nigerian plants extracted by the unevaporated crude water (UECW) method was evaluated on two-week old *Lymnaea natalensis* Krauss. Five extracts were not active but extracts of *Balanites aegyptiaca*, *Blighia sapida*, *Boswellia dalzielii*, *Cissampelos mucronata*, *Detarium microcarpum*, *Kigelia africana*, *Opilia celtidifolia*, *Parkia clappertoniana*, *Polygonum limbatum*, *Pseudocedrela kotschyi*, *Nauclea latifolia* and *Securidaca longipedunculata* were molluscicidal. There is potential for their future use in the integrated control of *Lymnaea natalensis*, as well as other snails. Mortality data for lethal concentration values for all extracts were analysed by use of probit transformation. The upper and lower fiducial limits of the LC<sub>50</sub> (P = 0.05) were also determined. *Key words* : *Lymnaea natalensis* - Noxious snail - Molluscicide - Plant - Dicotyledon - Toxicity - Nigeria.

KELA (S. L.), OGUNSUSI (R. A.), OGBOGU (V. C.), NWUDE (N.). Sensibilidad de *Lymnaea natalensis*, de dos semanas de edad a algunos extractos de plantas. *Revue Elev. Méd. vét. Pays trop.*, 1989, 42 (2) : 189-192.

Se evaluó la acción moluscicida de 17 extractos de plantas de Nigeria sobre *Lymnaea natalensis* Krauss de 2 semanas de edad por medio del método de extracción acuosa sin evaporación. Cinco extractos fueron inactivos; en cambio tenían un efecto moluscicida los extractos de *Balanites aegyptiaca*, *Blighia sapida*, *Boswellia dalzielii*, *Cissampelos mucronata*, *Detarium microcarpum*, *Kigelia africana*, *Opilia celtidifolia*, *Parkia clappertoniana*, *Polygonum limbatum*, *Pseudocedrela kotschyi*, *Nauclea latifolia* y *Securidaca longipedunculata*. Así se podrá utilizarlas para la lucha integrada contra *Lymnaea natalensis*, así como contra otros moluscos. Se analizaron por la transformación « probit » los datos de mortalidad para los valores de la concentración letal (DL<sub>50</sub>) en todos los extractos. Se determinaron también los límites superiores e inferiores de confianza para la DL<sub>50</sub> (P = 0,05). *Palabras claves* : *Lymnaea natalensis* - Molusco dañino - Moluscicida - Planta - Dicotiledón - Toxicidad - Nigeria.

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