World Journal of Zoology 5 (4): 252-256, 2010
ISSN 1817-3098

Preliminary Study on Culturing of *Lanistes libycus* Using the Leaves of Some Dicotyledonous Plants

[1]Olufemi M. Agbolade, [1]Durojaiye A. Soewu, [2]O.O. Bolanle, [1]Lateef A. Momodu, [1]Olusegun O. Adegboyegun-King, [2]Adedayo O. Odubanjo, [2]Jesse O. Owode and [2]Adedoyin B. Asimi-Aina

[1]Department of Plant Science and Applied Zoology, Parasitology and Medical Entomology Laboratory, Olabisi Onabanjo University, P.M.B. 2002, Ago-Iwoye, Ogun State, Nigeria
[2]Department of Science Laboratory Technology, School of Science, Abraham Adesanya Polytechnic, P.M.B. 1020, Ijebu-Igbo, Ogun State, Nigeria

Abstract: *Lanistes libycus* is a common freshwater apple snail species in southwestern Nigeria, which is of high nutritional and trado-medicinal importance in some parts of the region. In this study we investigated the possibility of keeping the snails out of their natural environment using the leaves of some commonly available dicotyledonous plants. In 2006/2007, specimens of the snails were cultured and fed with one of the following: undried *Tridax procumbens*, dried *T. procumbens*, undried *Hibiscus rosa-sinensis*, dried *H. rosa-sinensis*, undried *Talinum triangulare*, undried *T. procumbens* + *T. triangulare* and undried *T. procumbens* + *H. rosa-sinensis* + *T. triangulare*. In 2008, some other specimens of the snail species were cultured and fed with either undried or dried *T. procumbens*. At the end of the 12 months of culturing (April 2007), the percentage survival of the snails was statistically highest with dried *T. procumbens* (50%) (χ^2 = 63.25, df = 2, P < 0.001), but the shell lengths were not statistically different when fed with dried *T. procumbens*, undried *T. procumbens* + *T. triangulare*, or undried *T. procumbens* + *H. rosa-sinensis* + *T. triangulare* (χ^2 = 0.73, df = 2, P > 0.05). For 2008 study, a comparison of the initial mean live-weight on 1st day with that of 25th day showed no statistical difference for undried *T. procumbens* (t = -0.67, df = 36, P < 0.05) and dried *T. procumbens* (t = 0.01, df = 36, P < 0.05). The results of this study showed that domestication of *L. libycus* using the leaves of some dicotyledonous plants, particularly *T. procumbens*, could be a profitable venture in Ijebu North, southwestern Nigeria.

Key words: *Lanistes libycus* · Apple snails · Edible freshwater snails · Culturing · Dicotyledonous plants · Southwestern Nigeria

INTRODUCTION

Lanistes libycus is a gastropod mollusc belonging to the family Ampullariidae (apple snails). It is widespread in West Africa occurring in marshes, streams sources and shaded woodland streams [1, 2]. This snail species is common in southwestern Nigeria, rich in many essential nutrients and highly sought for by humans for consumption and trado-medicinal purposes in some parts of the region [3-6].

Studies have shown that many of the natural habitats of the snail species are endemic for snail vectors of human and animal schistosomes [7-10]. In addition, many of such habitats are often heavily contaminated with faeces, urine and heavy metals and thereby rendered unsafe through several direct and indirect anthropogenic activities [11, 12]. It has even been established that the snail species accumulates heavy metals which are often available in their natural habitats [13]. The implication of this entire scenario is that collectors of *L. libycus* are readily exposed to numerous hazards in their innocent endeavour to make the best profitable use of this naturally available resource.

While information exist on the farming of some edible land snails [14] and some other apple snail species [15] there seems to be dearth of information, to the best of our

Corresponding Author: O.M. Agbolade, Department of Plant Science and Applied Zoology, Parasitology and Medical Entomology Laboratory, Olabisi Onabanjo University, P.M.B. 2002, Ago-Iwoye, Ogun State, Nigeria. Tel: +234-8055475864, E-mail: agbolmos@yahoo.com.

knowledge, on domestication of *L. libycus*. In view of the established usefulness of the snail species, particularly in some parts of southwestern Nigeria, this study aimed at elucidating the possibility of keeping the snails out of their natural environment using the leaves of some commonly available dicotyledonous plants.

MATERIALS AND METHODS

Sources of Snails and Collection Method: *L. libycus* specimens used for 2006/2007 study were collected from Odogbe stream in Oru (about 4km from Ago-Iwoye) and a seasonal brook that flows through the front of the Mini Campus of the Olabisi Onabanjo University, Ago-Iwoye. Those used for 2008 study were collected from Ipase stream which flows through the access road of the Abraham Adesanya Polytechnic, Ijebu-Igbo. Oru, Ago-Iwoye and Ijebu-Igbo are in Ijebu North Local Government area of Ogun State, southwestern Nigeria and have been described in previous papers [5, 6, 16]. The snails were collected with a pair of stainless steel tongs and, sometimes, a long-handled scoop.

Culturing Methods

(A) 2006/2007 Study: *L. libycus* specimens collected were measured with a pair of venier calipers and those of the same size classes were put into seven sets of three labeled wide-mouthed plastic bowls. The number of snails in each bowl ranged from two to nine. Unchlorinated tap water was poured into each bowl. The composition of the dicotyledonous leaves used to feed the snails of each set was one of undried *Tridax procumbens* (A1), dried *T. procumbens* (A2), undried *Hibiscus rosa-sinensis* (B1), dried *H. rosa-sinensis* (B2), undried *Talinum triangulare* (C), undried *T. procumbens* + *T. triangulare* (D) and undried *T. procumbens* + *H. rosa-sinensis* + *T. triangulare* (E). All drying was done in the sun. The quantity of each feed used in the study ranged from 0.4 to 1.6g, depending partly on the number of snails and partly on the observed feeding rate of the snails in each bowl. This was to avoid under-feeding and over-feeding. Each bowl was covered with polythene mosquito net held in place with rubber band to prevent the snails from escaping. Changing of water and feeding were done every other day. Any mortality was recorded and the specimen was removed immediately on detection. The culturing was done from May 2006 to April 2007 during which the shell length of each surviving snail was measured monthly using venier calipers.

(B) 2008 Study: Based on sizes, *L. libycus* specimens (ranging from three to six) were put into two sets of four labeled wide-mouthed plastic bowls. Unchlorinated tap water was poured into each bowl. The snails in one set of four bowls were fed with 1g of undried *T. procumbens* while those in the other set were fed with 0.6g of dried *T. procumbens*. Changing of water and feeding were done daily except, due to logistics, on weekends. The culturing occurred in July and August 2008. The weight of each snail was measured using a digital weighing balance (MTech. BL310S) on the 1st, 25th and 34th day of culturing.

Statistical Analysis: For comparison of shell length increase over a period of time, the shell length increase index (Li) was calculated using the following formula:

$$Li = \frac{(L^1 - L^2)^2 \times N}{P}$$

Whereas

L^1 = Initial shell length
L^2 = Final shell length
N = Number of weeks of culturing from day 1 of L^1
P = Percentage of surviving snails compared to initial number of snails in May 2006

The chi-square (χ^2) was used to compare snail survival percentages and mean shell lengths while the student's t-test was used to compare mean live-weights where necessary.

RESULTS

Table 1 summarizes the monthly survival of *L. libycus* fed with leaves of some dicotyledonous plants. At the 6th month of culturing (October 2006), the percentage survival of *L. libycus* fed with dried *T. procumbens* (60%) was statistically highest (χ^2 = 63.69, df = 3, P < 0.001). Similarly at the 12th month of culturing (April 2007), the percentage survival recorded with dried *T. procumbens* (50%) was statistically highest (χ^2 = 63.25, df = 2, P < 0.001).

Table 2 shows monthly shell length of surviving *L. libycus*. In October 2006, there was no significant difference in the shell lengths of snails fed with dried *T. procumbens*, undried *H. rosa-sinensis*, undried *T. procumbens* + *T. triangulare*, or undried *T. procumbens* + *H. rosa-sinensis* + *T. triangulare* ((χ^2 = 0.90, df = 3, P > 0.05). Similarly, the shell length increase indices (Li) in October 2006 for snails fed with dried *T. procumbens* (2.74), undried *H. rosa-sinensis* (0.02),

Table 1: Monthly survival of *Lanistes libycus* fed with leaves of some dicotyledonous plants

	No. (%) of snails surviving*						
Month/Year	A1	A2	B1	B2	C	D	E
May 2006	17 (100)	10 (100)	19 (100)	7 (100)	12 (100)	ns	ns
June 2006	15 (88.2)	10 (100)	18 (94.7)	7 (100)	9 (75.0)	ns	15 (100)
July 2006	10 (58.8)	9 (90.0)	13 (68.4)	4 (57.1)	7 (58.3)	ns	13 (86.7)
Aug 2006	5 (29.4)	8 (80.0)	10 (52.6)	1 (14.3)	5 (41.7)	20 (100)	8 (53.3)
Sept 2006	3 (17.6)	7 (70.0)	3 (15.8)	0 (0)	1 (8.3)	12 (60.0)	5 (33.3)
Oct 2006	0 (0)	6 (60.0)	1 (5.3)	0 (0)	0 (0)	8 (40.0)	2 (13.3)
Nov 2006	0 (0)	6 (60.0)	0 (0)	0 (0)	0 (0)	1 (5.0)	1 (6.7)
Dec 2006	0 (0)	5 (50.0)	0 (0)	0 (0)	0 (0)	1 (5.0)	1 (6.7)
Jan 2007	0 (0)	5 (50.0)	0 (0)	0 (0)	0 (0)	1 (5.0)	1 (6.7)
Feb 2007	0 (0)	5 (50.0)	0 (0)	0 (0)	0 (0)	1 (5.0)	1 (6.7)
Mar 2007	0 (0)	5 (50.0)	0 (0)	0 (0)	0 (0)	1 (5.0)	1 (6.7)
Apr 2007	0 (0)	5 (50.0)	0 (0)	0 (0)	0 (0)	1 (5.0)	1 (6.7)

* ns = no specimen

Table 2: Monthly shell length of *Lanistes libycus* fed with leaves of some dicotyledonous plants

	Mean ± S.D (mm)*						
Month/Year	A1	A2	B1	B2	C	D	E
May 2006	33.4±7.1	32.4±7.5	31.5±6.7	31.5±6.6	33.8±6.8	ns	ns
June 2006	34.9±6.2	32.4±7.5	32.3±6.1	31.5±6.6	35.5±5.3	ns	37.9±4.2
July 2006	38.8±3.4	32.4±8.0	35.1±4.2	36.8±5.0	35.8±6.2	ns	39.0±3.4
Aug 2006	41.5±2.1	33.5±6.2	39.9±4.6	40.4±0.0	35.2±7.3	26.5±2.9	39.6±3.3
Sept 2006	43.5±0.3	35.6±2.8	38.1±4.4	ns	38.8±0.0	27.2±3.4	40.4±4.2
Oct 2006	ns	36.1±2.8	35.2±0.0	ns	ns	27.9±2.9	40.3±1.0
Nov 2006	ns	36.1±2.8	ns	ns	ns	28.3±0.0	40.4±0.0
Dec 2006	ns	35.9±3.1	ns	ns	ns	28.3±0.0	40.4±0.0
Jan 2007	ns	35.9±3.1	ns	ns	ns	28.4±0.0	40.4±0.0
Feb 2007	ns	36.0±3.1	ns	ns	ns	28.5±0.0	40.5±0.0
Mar 2007	ns	37.3±3.2	ns	ns	ns	28.5±0.0	40.5±0.0
Apr 2007	ns	37.3±3.2	ns	ns	ns	28.6±0.0	40.6±0.0

* ns = no specimen

Table 3: Survival and live-weight of cultured *Lanistes libycus* fed with *Tridax procumbens* leaves

Day	Feed	No. (%) surviving	Live-weight (Mean±S.D)
1st	Undried *T. procumbens*	19 (100)	8.70 ± 3.05
	Dried *T. procumbens*	19 (100)	6.65 ± 3.08
25th	Undried *T. procumbens*	19 (100)	9.42 ± 3.42
	Dried *T. procumbens*	19 (100)	6.54 ± 3.27
34th	Undried *T. procumbens*	17 (89.5)	8.73 ± 3.35
	Dried *T. procumbens*	17 (89.5)	6.15 ± 3.08

undried *T. procumbens* + *T. triangulare* (0.59) and undried *T. procumbens* + *H. rosa-sinensis* + *T. triangulare* (0.44) showed no significant difference (χ^2 = 4.66, df = 3, P > 0.05). In April 2007, the shell lengths of snails fed with dried *T. procumbens*, undried *T. procumbens* + *T. triangulare*, or undried *T. procumbens* + *H. rosa-sinensis* + *T. triangulare* were not statistically different (χ^2 = 0.73, df = 2, P > 0.05). Similarly, their shell length increase indices in April 2007 (0.47, 0.10 and 0.07, respectively) were statistically similar (χ^2 = 0.10, df = 2, P > 0.05).

The survival and mean live-weight of *L. libycus* fed with undried or dried *T. procumbens* are summarized in Table 3. A comparison of the initial mean live-weight on

1st day with that of 25th day showed no statistical difference for undried *T. procumbens* ($t = -0.67$, $df = 36$, $P < 0.05$) and dried *T. procumbens* ($t = 0.01$, $df = 36$, $P < 0.05$). However, neither eggs nor juveniles of *L. libycus* were recorded.

DISCUSSION

The survival of some specimens of *L. libycus* for 12 consecutive months outside their natural habitat, even in the absence of an aerator, is suggestive of the ruddiness of the snail species and its ability to endure domestication. This indicates a ray of hope for the possibility of keeping the snails and a leeway out of the serious hazards posed by the prevalent contamination of the natural habitats of the snails [11, 12]. The ability of the leaves of the used dicotyledonous plants to support the survival of *L. libycus* in this study shows their suitability in the domestication of the snails. This agrees with the earlier record that the leaves of *T. procumbens* and *T. triangulare* are eaten by *Archachatina marginata* [14]. The results obtained in this study show that dried *T. procumbens* supports the highest percentage survival of *L. libycus* for the longest period.

There seems to be gradual shell length increase with the different plants used in this study. It is important to note that all the plants, singly or in combination, generally supported shell growth equally. This observation may constitute cheering news to the poultry industry that may use the shell as calcium source in feed formulation while, in return, egg shells from poultry may be calcium source for the snails.

A quantitative consideration of the cultured snails seems to raise some fear in view of the general depreciation of the live-weight of the snails. Humans who consume *L. libycus* are interested in the fleshy part which corresponds essentially to the foot and head regions. The results of this study seem to suggest that the cultured snails are best harvested about a month after domestication for human consumption. However, apple snails, including *L. libycus*, are known to aestivate under certain conditions during which metabolism decreases substantially [15]. This might have been responsible for the live-weight depression as this has been previously reported in *Archachatina marginata* [17]. The noted relative decrease in the mean live-weight of snails fed with dried *T. procumbens* in this study was least expected since it supported the highest percentage of snails for the longest period in the 2006/2007 study. The drying of *T. procumbens* leaves might have caused denaturation and/or substantial loss of some important essential nutriments (particularly proteins, vitamins and pro-vitamins) needed by the snails which they may possess.

In this study, neither eggs nor juveniles of *L. libycus* were recorded. This is a serious cause for concern because juveniles are needed for the purpose of continuity and sustainability of the domestication. However, a number of factors might have contributed to this observation. First, the gonochoristic nature of the snails necessitates the presence of both male and female snails which might not have been so in many cases in the present study. Unfortunately, the sexes are not easily distinguished using the outward morphological characters. Second, their reproductive cycle is influenced by food availability and water temperature [15, 18]. Lack of calcium supplementation has been noted to cause infertility in terrestrial edible snail species [14]. It is also possible that the water temperature regimen and some other signals normally available in the natural environment needed for mating and egg production were lacking in the improvised environment. Third, the ability of apple snails to consume eggs [15] is another possibility which might have occurred unnoticed in this study.

The results of this study have shown that domestication of *L. libycus* using the leaves of some dicotyledonous plants, particularly *T. procumbens* (a widespread weed), could be a profitable venture in Ijebu North, southwestern Nigeria. However, further studies are required towards achievement of simultaneous shell length and live-weight growth and production of viable eggs.

ACKNOWLEDGEMENTS

We appreciate the technical assistance of Miss' Wunmi Abimbola of the Olabisi Onabanjo University, Ago-Iwoye and Miss 'Tobi Jokotagba of the Abraham Adesanya Polytechnic, Ijebu-Igbo, Ogun State, Nigeria.

REFERENCES

1. Ndifon, G.T. and F.M.A. Ukoli, 1989. Ecology of freshwater snails in south-western Nigeria. 1. Distribution and habitat preferences. Hydrobiologia, 171: 231-253.
2. Brown, D.S., 1994. Freshwater snails of Africa and their medical importance. 2nd Edn. Taylor and Francis Ltd., London, pp: 609.

3. Agbolade, O.M., 1992. Preliminary survey of *Schistosoma haematobium* infection in Ago-Iwoye, Ogun State. M.Sc. Dissertation of the Department of Zoology, University of Ibadan, Ibadan, Nigeria.
4. Agbolade, O.M., 2000. Urinary schistosomiasis and persistent freshwater contact in Mamu, Ogun State, Nigeria. Nigerian J. Sci., 34: 41-45.
5. Agbolade, O.M., D.O. Akinboye, O.T. Fajebe, O.M. Abolade and A.A. Adebambo, 2004. Human urinary schistosomiasis transmission foci and period in an endemic town of Ijebu North, Southwest Nigeria. Tropical Biomedicine, 21(Suppl): 15-22.
6. Agbolade, O.M., T.O. Olayiwola, E.G. Onomibre, L.A. Momodu and O.O. Adegboyegun-King, 2008. Trado-medicinal and nutritional values and biosafety of *Lanistes libycus* in Ijebu-North, southwest Nigeria. World Appl. Sci. J., 3(6): 921-925.
7. Smyth, J.D., 1996. Animal parasitology. Cambridge University Press, Cambridge, pp: 549.
8. WHO, 2002. Prevention and control of schistosomiasis and soil-transmitted helminthiasis. World Health Organization Technical Report Series, pp: 912.
9. Heyneman, D., 2004. Medical parasitology. In Medical microbiology. Brooks, G.F., J.S. Butel and S.A. Morse, (Eds.). 23rd Edn. McGraw Hill, New York, pp: 661-701.
10. Agbolade, O.M., D.O. Akinboye, O.T. Fajebe, O.M. Abolade and T.M. Olateju, 2005. Population, seasonal abundance and infections of *Lanistes libycus* from a schistosomiasis-endemic town in Ijebu North, south-west Nigeria. Nigerian J. Parasitol., 26: 37-41.
11. Ezeama, C.F., 2004. Characterisation of microbiological and physico-chemical properties of the ecosystems of freshwater snails (*Lanistes libycus*) in Upper Cross River Basin, Nigeria. J. Tropical Microbiol., 3: 78-83.
12. Agbolade, O.M., O.O. Adesanya, T.O. Olayiwola and G.C. Agu, 2010. Faecal and heavy metal contamination of some freshwaters and their vicinities in Ijebu-North, Southwestern Nigeria. J. Toxicology and Environmental Health Sci., 2(2): (in press).
13. Adewunmi, C.O., W. Becker, O. Kuchnast, F. Oluwole and G. Dorfler, 1996. Accumulation of copper, lead and cadmium in freshwater snails in southwestern Nigeria. Science of the Total Environment, 193: 69-73.
14. Odaibo, A.B., 1997. Snail and snail farming: Nigerian edible land snails. Stirling- Horden Publishers Ltd., Ibadan, Nigeria, pp: 10-11.
15. Bronson, C.H., 2002. Apple snails. Florida Department of Agriculture and Consumer Services, Technical Bulletin, 3: 1-4.
16. Agbolade, O.M., T.T. Oni, O.E. Fagunwa, K.M. Lawal and A. Adesemowo, 2009. Faecal contamination of dump sites in some communities in Ijebu-North, south- western Nigeria. Nigerian J. Parasitol., 30(2): 57-60.
17. Abdussamad, A.M., O.A. Osinowo, O.F. Smith and S.A. Onadeko, 2010. Liveweight changes and mortality rate in the giant African land snail *Archachatina marginata* during a six-week aestivation period. World J. Zool., 5(2): 75-81.
18. Anonymous, 2009. Apple snails. Available on: http://www.applesnail.net. Downloaded 6th April, 2009.