World Journal of Zoology 7 (2): 113-117, 2012
ISSN 1817-3098

DOI: 10.5829/idosi.wjz.2012.7.2.56111

Reproductive Performance and Correlations Among Egg Traits of Two Ectotypes of Adult Snail (*Archachatina marginata* Var. *Saturalis*) in the Humid Tropics

[1]L.A. Ibom, [1]B. Okon, [2]B.I. Adinya and [3]F.I. Okon

[1]Department of Animal Science, University of Calabar, Calabar, Nigeria
[2]Department of Agricultural Economics/Extension, Cross River University of Technology, Obubra Campus, Nigeria
[3]Department of Environmental Health, College of Health Technology, Calabar, Nigeria

Abstract: Eighty (80) adult or sexually mature land snails, *A. marginata* var. *saturalis* (P.), forty each of the black-skinned (BS) and white-skinned (WS) ectotypes with weight ranging from 56.22-67.38 g and 55.54-67.02 g for the BS and WS ectotypes respectively were reared in pairs (two snails) for twelve weeks to evaluate reproductive performance. Correlations between the traits of produced eggs were also estimated. Assessed reproductive traits included clutch size, mean egg weight at lay and weekly, mean egg length and width at lay and weekly, incubation period (days), number of hatched eggs, percent hatchability and hatchlings weights at hatch. Results of reproductive performance showed that considerable reproductive differences exist between snail ectotypes of a particular breed. This is because significantly different ($P<0.05$) variations existed between the number of eggs laid by the BS ectotypes and those laid by the WS ectotypes. The BS ectotypes were actually more prolific (laid more eggs) than the WS ectotypes. Results of correlations between traits estimated on eggs from the mating of the respective ectotypes (BS X BS and WS X WS) revealed that all traits correlated positively and significantly ($P<0.05$) in both ectotypes. The egg length (EL) and egg width (EH) had perfect positive relationship ($r = 1.00$) in the BS X BS mating group. The pairs of egg weight (EW) and egg length (EL) and egg weight (EW) and egg width (EH) were mildly correlated ($r = 0.49$) in the same mating group. Egg width (EH) and egg length (EL) were closely correlated ($r = 0.89$) in the WS X WS mating group, while egg weight (EW) and egg length (EL) and egg weight (EW) and egg width (EH) were moderately correlated ($r = 0.59$ and $r = 0.70$) respectively in the same mating group.

Key words: Ectotypes · Correlations · Snail Egg · Traits · Reproductive Performance

INTRODUCTION

Snails have consistently contributed to the diet of our ancestors, especially those living in the humid tropical rainforest. The snails consumed by our ancestors were gathered from the wild by villagers [1]. There has been increasing interest and awareness in snails (especially *Archachatina marginata*, *A. degneri*, *Achatina achatina, A. fulica*, *Thapsia species* and *Limicolaria species*) domestication/production in recent years. This could be as a result of the decline of snail population in the wild, coupled with the alarm raised by the Food and Agriculture Organization on the animal protein intake deficit status of Nigerians in the early 1980s [2]. Snails have a high reproductive potential (i.e. high fecundity and prolificacy). The reproductive performance of snails is a very important feature that determines the efficiency of production. This is because though hermaphrodites, snails practice sexual reproduction. This act enables snails of the same species to mate with one another, fertilizing each other simultaneously before laying eggs [2- 7]. It means that cross-fertilization is the rule with the act. Cobbinah [3] and [4 and 6] noted that the possibility of self-fertilization in some snail species like *Achatina achatina* and *A. fulica* cannot be absolutely ruled out.

Mating in snails occurs only when sexual maturity is attained and this is usually after several hours of courtship [2]. High degree of variations had been reported by several workers for age at sexual maturity. For instance, [6, 8] reported 5-6 months and 7-12 months respectively as ages at sexual maturity for black-skinned snails (*A. marginata*). Omole *et al*. [9] reported 8-12 months as age at sexual maturity for the same strain of snails. Ibom [2] reported 6.32 months and 7.02 months as

Corresponding Author: L.A. Ibom, Department of Animal Science, Ebonyi State University, Abakaliki, Nigeria.
Tel: +2348033508663.

ages at sexual maturity for white-skinned and black-skinned strains respectively of the same snail breed (*A. marginata*). It could therefore be inferred that age at sexual maturity in snails is breed or strain specific, following the variability in their genetic resource pool. Omole and Kehinde [7] reported that snails are sometimes uninterested in mating with other snails of the same species that originated from a considerable distance away. On the other hand, [6, 8] reported that mating, egg laying and active growth generally occur during the rainy season from February/March to October/November in the wild. In the contrast, [2, 7, 10] reported that mating, egg laying and active growth occur all year round (dry and rainy seasons) under proper management in confinement.

When the atmosphere is conducive, two active, sexually-mature snails come together for courtship ceremony that culminates in copulation [2, 4, 6, 8]. The frequency of mating is species- and weather- dependent [8]. Clutch sizes resulting from such mating are affected by genetic composition and thus vary among breeds and/or strains. Adegbaju [11] and [7, 12-14] reported that a clutch or cluster or batch of eggs contains 8-16 eggs, 4-18 eggs, 1-16 eggs, 4-6 eggs and 4-8 eggs for the black-skinned strains of *A. marginata*. Whereas, [2] reported 2-13 eggs and 1-9 eggs as clutch sizes for black-skinned and white-skinned strains of *A. marginata* respectively. Okon *et al*. [15] reported 4-6 eggs and 3-5 eggs respectively as clutch sizes for the same strains of *A. marginata*. Ibom and Okon [16] reported 2-4 eggs and 1-3 eggs respectively as clutch sizes for the same strains, while [17] reported 2-14 eggs as clutch size for albino (white-skinned) strain of the same breed. Akinnusi [6] and [2] noted that snail eggs are deposited in shallow (1-2 cm) burrows in the ground, in moist or cool areas to prevent desiccation. The snail covers the hole in which eggs are laid with a mixture of soil and slime it secrets and leaves the eggs with no further maternal care [4, 6]. Ejidike [18] and [2] stated that it takes 24 hours for the snail to lay a clutch or cluster of eggs. Omole and Kehinde [7] and [12] reported a shorter duration (1-2 minutes) for a snail to deposit a clutch of eggs, unlike poultry that lays at least two eggs in three days.

In view of the reported variable ages at sexual maturity and clutch sizes resulting from mating snails, the present study assessed the reproductive performance of the *Archachatina marginata* var. *saturalis*. The correlations between traits of eggs laid by this micro-livestock were also estimated.

MATERIALS AND METHODS

This study was conducted at the Snailery Unit, Department of Animal Science Teaching and Research Farm, Cross River University of Technology (CRUTECH.), Obubra Campus, Nigeria. The location, temperature and mean annual rainfall of Obubra had been previously described by [2, 12, 16]. These authors also described the micro-environment of the study area.

Eighty adult or sexually mature land snails [*A. marginata* var. *saturalis* (*Philippi*)], forty each of the black-skinned (BS) and white-skinned (WS) ectotypes with weight ranging from 56.22-67.38 g and 55.54-67.02 g for the BS and WS ectotypes respectively were used for this study. The snails were allowed a stabilization period of four weeks. During this time, it is believed that eggs from mating that occurred in the wild would have been shed before the commencement of the study. The snails were grouped into two treatments on the basis of skin (foot) colour, namely; BS x BS and WS x WS. Each treatment was replicated twenty times in the completely randomized design (CRD). Snails were marked and reared in pairs (two snails) of similar weights to a hutch compartment measuring 40 sq. cm by 30 cm dept for purposes of reproduction. The pair was allowed together in one hutch compartment (cell) for one week and then separated for another one week before being returned in that cycle until they laid eggs.

The snails were fed an average of 10 g of formulated diet and some quantity of pawpaw leaves per head, once daily at 5-7 pm through out the twelve weeks the present study lasted. The formulated diet contained 24 % crude protein (CP) and 2650 Kcal/Kg ME. It was formulated using maize (41.6 %), soybean meal (30.3 %), fish meal (7.6 %), bone meal (2.0 %), wheat offal (10.0 %), oyster shell (8.0 %) and vitamin/mineral premix (0.5 %).

The assessed reproductive performance traits included clutch size counted as number of laid eggs, mean egg weight at lay and weekly measured using Scout™ Pro electronic scale having a sensitivity of 0.01 g, mean egg length and width at lay and weekly measured using Vernier caliper, incubation period in days (counted as number of days eggs took to hatch from the day of lay), number of hatched eggs counted as emerged hatchlings (juveniles), percent hatchability was calculated. Hatchlings weights at hatch were also taken. Correlations between the egg traits were estimated.

RESULTS AND DISCUSSION

The results of reproductive performance obtained in this study are presented on Table 1. The results showed that the black-skinned snails laid 2-6 clutches per cell to give a total of 38 clutches. On the other hand, the white-skinned snails laid 1-7 clutches per cell to give a total of 33 clutches. These results showed that the black-skinned snails laid more eggs and were therefore more prolific than the white-skinned (albino) snails. Ibom [2] reported that the prolificacy might be due to inherent genetic potentials of the black-skinned snails. The clutch sizes ranged from 2 to 13 eggs per snail for black-skinned strains and 1 to 9 eggs per snail for white-skinned strains. It was observed that some of the egg clutches were laid on the soil surface (Plate 1), contrasting the position of Ibom [2] and Akinnusi [6] who reported that snails deposit clusters or clumps of eggs in shallow (1-2 cm) burrows in the ground.

Table 2 shows that the black-skinned snails laid a total of 289 eggs from 38 clutches, while the white-skinned snails laid fewer clutches and number of eggs, 33 and 174 respectively. This gives an average clutch size of 1.90 per cell and 0.95 eggs per black-skinned snail. On the other hand, the white-skinned snails laid 33 egg clutches, giving an average clutch size of 1.60 per cell and 0.80 eggs per albino snail. These observed variations differed (P<0.05) significantly (Tables 1). It can therefore be inferred that considerable reproductive differences exist between snail strains of a particular breed. The clutch size obtained in the current study is in agreement with previous reports [5, 6, 19, 20].

Table 1: Reproductive performance of adult snails mating groups

Parameter	BS X BS	WS X WS	SEM
Total number of clutches	38.00	32.00	
Av. number of clutches/cell	1.90[a]	1.60[b]	0.26
Av. number of clutches/snail	0.95[a]	0.80[b]	0.13
Total number of laid eggs	289.00	174.00	
Av. number of eggs/clutch	7.61[a]	5.44[b]	0.40
Av. number of eggs/snail	3.81[a]	2.72[b]	0.23
Av. egg weight at lay (g)	1.82[a]	1.07[b]	0.10
Av. egg length at lay (mm)	1.61[a]	1.43[b]	0.04
Av. egg width at lay (mm)	1.29[a]	1.05[b]	0.03
Av. incubation period (days)	29.54[a]	24.73[b]	1.48
Av. egg shell thickness (mm)	0.002	0.002	0.00
Hatchability (%)	71.030	70.210	8.78
Survivability (%)	93.950	93.740	10.41

[ab] Means within the same row with different superscripts are significantly (P<0.05) different

SEM = Standard Error of Mean

BS = Black-Skinned ectotype, WS = White-Skinned ectotype

Plate 1: White-skinned (albino) adult snail depositing eggs on the surface (pawpaw leaves)

Table 2: Egg production pattern, mean clutch sizes (±S.E.), Standard Deviation and Coefficient of Variability (%) of adult snails mating groups

	BS X BS							WS X WS							
	Clutch size							Clutch size							
Cell number	1	2	3	4	5	6	Total eggs	1	2	3	4	5	6	7	Total eggs
1	7	8					15	5	5	5	6				21.0
2	11	2					13	5	1	6					12.0
3	9	9	2	8			28	4	5						9.0
4	9	9	9	11			38	5	6	6	7	5	7	8	44.0
5	7	10	8	10			35	6	5	6	6				23.0
6	11	7	9				27	5							5.0
7	5	8	4	7	8		32	5	5	2					12.0
8	10	3	4	3			20	5	6	5	6				22.0
9	7	9	9	6	8	9	48	5	6	6	8				25.0
10	8	9	3	13			33	9							9.0
Total	84	74	48	58	16	9		54	39	36	33	5	7		
$\bar{x}$	8.4±0.62[a]	7.4±0.86[a]	6.0±1.07[NS]	8.256±1.26[NS]	8.0±0.00[a]	9.0±0.00[a]		5.4±0.43[b]	4.88±0.58[b]	5.14±0.55[NS]	6.6±0.89[NS]	5.0±0.00[b]	7.0±0.00[b]	8	
SD	1.95	2.72	3.02	3.35	0.00	0.00		1.35	1.64	1.46	0.89	0.00	0.00	0	
CV%	23.21	36.76	50.33	40.58	0.00	0.00		25.00	33.61	28.40	13.48	0.00	0.00	0	

BS = Black-Skinned ectotype, WS = White-Skinned ectotype, SD = Standard Deviation, CV = Coefficient of Variation

[ab]Means along the same row bearing different superscript are significantly different (P<0.05), NS = Non-significant

Table 3: Correlations among traits of eggs from the adult snails mating groups

	BS X BS		
	EW	EL	EH
EW		0.49	0.49
EL	0.59		1.00
EH	0.70	0.89	
	EW	EL	EH
	WS X WS		

BS = Black-Skinned ectotype, WS = White-Skinned ectotype, EW = Egg Weight, EL = Egg Length, EH = Egg Width

The correlation estimates of egg traits obtained from the mating of the adult snails (BS X BS and WS X WS) are presented in Table 3. The results showed that all evaluated eggs traits of the two studied strains had positive and significant ($P<0.05$) correlations. The egg length (EL) and egg width (EH) had perfect positive relationship ($r = 1.00$) in the BS X BS mating group. The pairs of egg weight (EW) and egg length (EL) and egg weight (EW) and egg width (EH) were mildly correlated ($r = 0.49$) in the same mating group (Table 3). Egg width (EH) and egg length (EL) were closely correlated ($r = 0.89$) in the WS X WS mating group, while egg weight (EW) and egg length (EL) and egg weight (EW) and egg width (EH) were moderately correlated ($r = 0.59$ and $r = 0.70$) respectively in the same mating group. The values reported here are in agreement with the values reported previously [2, 21] for black-skinned ectotype of *A. marginata* and white-skinned ectotype of the same snail breed respectively.

CONCLUSION AND RECOMMENDATION

The two mating groups (BS X BS and WS X WS) expressed considerable variations in egg production ability. Perhaps the BS ectotype is genetically and inherently endowed for higher egg production. Therefore, it is recommended that intending snail farmers patronize the BS ectotypes because of their prolificacy.

REFERENCES

1. Okon, B. and L.A. Ibom, 2010. Commercialization of Snail production in Nigeria: Potentials, Viabilities and Challenges. J. Appl. Sci. (JAS)., 13: 9139-9158.
2. Ibom, L.A., 2009. Variations in Reproductive and Growth Performance traits of white- skinned x black-skinned African giant snail hatchlings [*Archachatina marginata* (Swainson)] in Obubra, Nigeria. Ph.D. Thesis, Department of Animal Science, University of Calabar, Calabar, Nigeria.
3. Cobbinah, J.R., 1993. Snail Farming in West Africa. A Practical Guide. U. K. Sayee Publishing. CTA Publication.
4. Amusan, J.A. and M.O. Omidiji, 1998. Edible Land Snail. A Technical Guide to Snail Farming in the Tropics. Ibadan. Variety Printers Limited.
5. Payne, W.J.A. and R.T. Wilson, 1999. An Introduction to Animal Husbandry in the Tropics. 5th ed. Osney Mead, UK. Blackwell Publishing Company, pp: 702-704.
6. Akinnusi, O., 2004. Introduction to Snails and Snail Farming. 2nd ed. Abeokuta, Nigeria. Triolas Exquisite Ventures.
7. Omole, A.J. and A.S. Kehinde, 2005. Backyard snail farming at a glance. Back to Agricultural series (1). Ibadan. Technovisor Agricultural Publications.
8. Akintomide, T.O., 2004. Tropical Snail Farming. 1st ed. Abeokuta, Nigeria. Oak Ventures.
9. Omole, A.J., A.A. Taiwo and J.A. Amusan, 2007. Technical Guide/Bulletin. Practical snail farming. Ibadan, Nigeria. Institute of Agricultural Research and Training, Moor Plantation.
10. Ogogo, A.U., 1989. The replacement of cassava flour with groundnut cake in the nutrition of the African Snail (*Archachatina marginata*) (Swainson). M. Sc. Thesis, Department of Wildlife and Fisheries. University of Ibadan, Ibadan.
11. Adegbaju, S.W., 2000. A Guide to a Successful Poultry and Snailery Business. Agrocare Series, pp: 22-29.
12. Ibom, L.A., B. Okon and A. Essien, 2008. Morphometric analysis of eggs laid by two ectotypes of Snails *Archachatina marginata* (Swainson) raised in captivity. Global J. Agric. Sci., 7: 119-121.
13. Okon, B., L.A. Ibom and E.E. Odido, 2011. Reproductive performance and Egg quality traits of crossbreeding between black and white skinned *Archachatina marginata saturalis*. Archivos de Zootecnia, 60: 153-156.
14. Okon, B., L.A. Ibom, M.E. Williams and O.M. Etukudo, 2010. Effects of Parity on Breeding and Morphometric Traits of Eggs and Hatchlings of F_1 Crossbred of Snails (*Archachatina marginata var. saturalis*). J. Agric., Biotechnol. and Ecol., 3: 36-43.

15. Okon, B., L.A. Ibom, M.E. Williams and I.E Akpakpan, 2009. Comparative evaluation of reproductive performance and some egg quality parameters of black and white skinned snails. Global J. Agric. Sci., 8: 77-80.
16. Ibom, L.A. and B. Okon, 2010. Variations in morphometric traits of eggs produced from the inter-mating of two ectotypes of snail [*Archachatina marginata* (Swainson)] in a humid tropical environment. Proceedings, 35th Annual Conference, Nigerian Society for Animal Production. (NSAP). March 14-17, 2010. University of Ibadan, Ibadan, Oyo State, Nigeria, pp: 28-31.
17. Okon, B., L.A. Ibom, M.E. Williams and N.T. Akwa, 2010. Parity Effects on Breeding and Morphometric Traits of Eggs and Hatchlings of Purebred Albino Snails [*Archachatina marginata* (Swainson)]. J. Agric. Biotechnol. and Ecol., 3: 44-54.
18. Ejidike, B.N., 2002. Snail Rearing practices in Southern Nigeria. Proceedings of the 27th Annual Conference of Nigerian Society for Animal Production (NSAP). March 17-21, 2002. Akure, Nigeria, pp: 307-308.
19. Ubua, J.A., 2004. Reproductive potentials of two snails-*Archachatina marginata ovum* and *Archachatina marginata saturalis* in the Swamp Forest Zone of Nigeria. M. Sc. Thesis. Department of Animal Science, University of Calabar, Calabar, Nigeria.
20. Ibom, L.A., B. Okon and B.O. Nweze, 2011. Egg Production Pattern of Purebred Black-skinned and White-skinned Snail ectotypes [*Archachatina marginata* (S)] Reared in Confinement. Proceedings, 36th Annual Conference, Nigerian Society for Animal Production. (NSAP). March 13-16, 2011. University of Abuja, Nigeria, pp: 87-89.
21. Okon, B., L.A. Ibom, M.E. Williams and N.T. Akwa, 2010. Parity Effects on Breeding and Morphometric Traits of Eggs and Hatchlings of Purebred Albino Snails [*Archachatina marginata* (Swainson)]. J. Agric. Biotechnol. and Ecol., 3: 44-54.