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Phenotypic analysis and correlation of eggs laid by two ectotypes of giant african land snails (*Archachatina marginata var. saturalis)* in calabar, Nigeria

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ABSTRACT

The phenotypic analysis and correlations of the eggs laid by black-skinned and white-skinned ectotypes of giant African land snails (*Archachatina marginata var. saturalis)* in Calabar, Nigeria were evaluated. Two hundred (200) snails, One hundred (100) each of black-skinned and white-skinned ectotype were used to generate eggs used for this study. The snails were divided into two mating groups, black-skinned x black-skinned and white-skinned x white-skinned. The results of the study on phenotypic traits of the eggs revealed a high significant ($P<0.05$) mean number of egg, mean egg weight, mean egg length and mean egg width between the black-skinned and white-skinned ectotypes. The variations in mean egg traits between the two ectotypes in this study may indicate variation in genetic composition of the snails. The results of correlation among the egg traits revealed positive and highly significant phenotypic correlation (rp) within egg traits for the two ectotypes studied. The correlation could suggest that there are direct relationships between the traits, and that selection for one trait will lead to improvement in the other trait. It is recommended that intensive production and domestication of black-skinned be carried out since it seems to have high production rate to meet the animal protein supply of the populace then the white-skinned. This is due to its larger size.

Introduction

Archachatina marginata is the largest known snail kept and reared in Nigeria (Okon *et al*., 2012). It is a noiseless, herbivorous and non-selective scavenger that dwells naturally in the forest litters of tropical rainforest of the South and the fringing riparian derived guinea savannah zones of Nigeria (Adedire *et al:* 1999). The two known ectotypes snail based on the foot (skin) colour are; the black-skinned and the White-skinned. Ebenso (2003), Ibom *et al*. (2008) and Okon *et al*. (2012) reported that the white-skinned ectotype is highly discriminated against by many ethnic consumers in Nigeria. The reason for this discrimination according to the authors is that the consumers belief that the white-skinned snails are used by "witch doctors" in their activities. This has led to the species being found in abundance in any environment it thrives (Okon *et al*., 2009).

Snail production holds lots of potentials in the Nigerian livestock industry and can serve as a means to alleviate the acute protein shortage. This owes to the fact that snails have high rate of productivity or fecundity (Ibom *et al*., 2008). Snails are hermaphrodites, but practice sexual reproduction (Cobbinah, 1993; Payne and Wilson, 1999; Akinnusi, 1997, 2004). Unlike chickens that lay one egg per day, snails lay 4 – 18 eggs within 1 -2 minutes (Omole and Kehinde, 2005). Akinnusi (1997) opined that *Archachatina marginata* lays 5 – 11 eggs within the same period. Plummer (1975), Reid (1989) and Ogogo (1989, 2004) reported that *A. marginata* lays 3 – 16 eggs per snail. Ogogo (2004) described the egg as being spherical and cream yellow in colour. Whereas Rant and Barker (2002) stated that the colour of eggs from *A. marginata* is chalky white, Okon and Ibom (2012) opined that the eggs of *A. marginata* are spherical, translucent and yellowish in colour

There is need to assess the phenotypic characteristics of these eggs and correlate them, as the two ectotypes (black-skinned and white-skinned) of *A. marginata* may differ/similar in many production characteristics.

This study therefore focused on the phenotypic characteristics (number of eggs lay, egg weight, egg length and egg width) and correlation of the eggs laid by the white-skinned *A. marginata* for comparison with those laid by the black-skinned ectotype.

Materials and methods

The study was conducted at the Botanical garden, University of Calabar, Calabar- Nigeria. Calabar is situated within the geographical area between latitude 4^{o} 58^{1} and 15^{o} 39^{1} N, and longitudes 8^{o} 17^{1} and 10^{o} 43^{1}E of the equator with annual temperature and rainfall ranges from 25^{o}C to 30^{o}C and 1260 to 1280mm respectively. The Botanical garden as described in Okon *et al*, (2009a, b) is planted with trees like citrus, mango, almond, paw-paw, plantain and banana and crops like cassava, yam and maize. These trees and crops provide a micro-environment similar to the natural habitat of snails as well as shade that protects the hutches used for the study from direct sunlight. The trees and crops also protect the hutches from direct impact of heavy rainfall.

Two hundred (200) adult *Archachatina marginata* snails, One hundred (100) each of black-skinned ectotype and white-skinned ectotype were used to generate the eggs used for phenotypic analysis and correlation. The weights of the parent breeder snails range from 85 – 153.9g and 32.10 – 72.1g for

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black-skinned and white-skinned ectotypes respectively. The snails were selected based on active appearance and no active appearance and no injury on the foot and/or shell of the base population. One hundred and fifteen (115) and one hundred and five (105) eggs were generated from black-skinned and white-skinned ectotypes respectively after three (3) months of the study.

The description of the management of the snails and mating pattern were as prescribed in Ibom (2009), Okon *et al;* (2009a, b) and Okon *et al;* (2010a, b). Data collected were number of eggs laid by either ectotype as counted egg weight (g), egg length (cm) and egg width(cm). An electronic balance, scout™ pro-scale with o.o1g to 1000g sensitivity was used to measure weights, while vernier caliper was used to measure length and width. Phenotypic correlations and simple statistics among egg traits were determined according to methods outlined by Ibe (1998).

Plate 1: Black-skinned ectotype

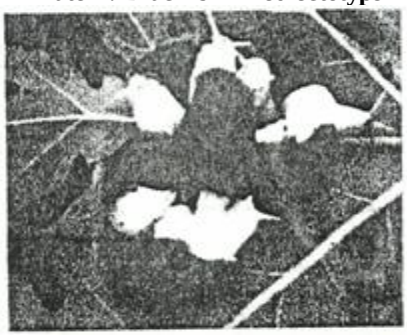

Plate 2: White-skinned ectotype

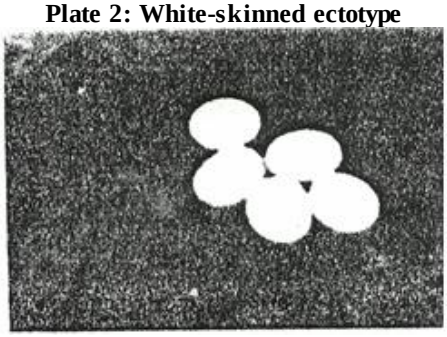

Plate 3: Eggs from white-skinned A. marginata

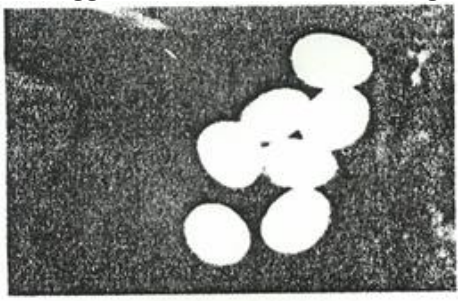

Plate 4: Eggs from black-skinned A. marginata

Results and Discussion

The values of analyzed phenotypic characteristics of the eggs of black-skinned and white-skinned *Archachatina marginata* ectotypes are presented in Table 1. The results were expressed as mean ± standard error, standard deviation and coefficient of variation for each phenotypic trait of the eggs measured. The eggs of black-skinned ectotype had higher values for measured phenotypic traits than eggs of white-skinned ectotype. There was a large disparity which was significantly different (P< 0.05) between the mean egg member of these two ectotypes 8.21 ± 0.53 for black-skinned ectotype and 5.25 ± 0.32 for white-skinned ectotype (Table 1 and 2). It indicates that black-skinned snails lay many eggs than white-skinned snails as this was confirmed by the test of significance of the difference (t-test) between the eggs of the two ectotypes (Table 2).

Table 1: Mean ± standard error, standard deviation, coefficient of variability of egg quality traits of black-skinned and white-skinned ectotypes of snails (*Archachatina marginata var, saturalis)*

	Black-skinned ectotytpe			White-skinned ectotype		
Egg quality trait	**X±S.E**	**S.D**	**CV(%)**	**X±S.E**	**S.D**	**CV(%)**
Number of eggs	8.21±0.53	1.97	23.96	5.25±0.32	1.45	27.54
Eggs weight(g)	0.98±0.005	0.06	5.94	0.97±0.005	0.054	5.58
Eggs Length(cm)	1.40±0.004	0.04	2.87	1.30±0.002	0.15	1.70
Eggs Width(cm)	1.16±0.009	0.09	8.54	0.98±0.02	0.022	15.13

n = Total number of eggs laid, **x±S.E =** Mean ± standard error, S.D = Standard Deviation, CV = Coefficient of variability.

Table 2: T-test values of egg quality traits between Black-skinned and White-skinned ectotypes of snails (*Archahchatina marginata var. saturalis)*

Egg Quality traits	BS	WS	SEM
Number of eggs	8.21^{a}	5.25^{b}	0.342
Egg weight (g)	8.06^{a}	5.13^{b}	0.312
Egg length(cm)	11.52^{a}	6.82^{b}	0.638
Egg width (cm)	9.53^{a}	5.17^{b}	0.515

^{ab} Means along the same row bearing different superscripts are significantly different (p<0.05). Bs = Black-skinned, WS = white-skinned SEM = Standard error of mean.

However, these results agreed with the views of Ibom *et al.* (2008) and Okon *et al.* (2011) that black-skinned ectotype lays large number of eggs that are heavier than eggs laid by the white-skinned ectotype. This might be attributed to the fact that black-skinned ectotype is larger in size than the white-skinned ectotype. There was also significant differences (P<0.05) within and between the eggs traits (i.e egg weight, number of eggs, egg length and egg width) for black-skinned and white-skinned ectotypes.

The results of phenotypic correlation among egg traits of the two ectotypes evaluated (Table 3) indicated positive, strong and very high significant (P<0.001) correlation coefficients (rp) between number of eggs and all egg traits studied for the two ectotypes.

The highest correlation among egg traits of the two ectotypes were between egg length (EL) and egg width (ED) (r = 0.995) for black-skinned ectotype and between egg length (EL) and number of eggs (NE) (r = 0.994) for white-skinned

ectotype, whereas egg width (ED) and weight (EW) had the least positive correlation in white-skinned ectotype (r = 0.892) (Table 3).

Table 3: Phenotypic correlation (rp) of egg quality traits of black-skinned and white-skinned ectotypes of snails (*Archachatina marginata var. saturalis)*

	Black – skinned ectotype				
		NE	**EW**	**EL**	**ED**
White-skinned ectotype	NE	1	O.977**	0.991**	0.933**
	EW	0.970**	1	0.979**	0.981**
	EL	0.994**	0.967**	1	0.995**
	ED	0.972**	0892**	0.953**	1

NE = Number of eggs, EW = egg weight, EL = Length, ED = egg width,

** = P< 0.001 (Highly significant level)

The high significant correlation among egg traits of black-skinned white-skinned ectotypes of *Archachatina marginata* is similar to the reports of Ibom (2009) and Okon *et al*. (2012). The positive correlation values recorded among these egg traits could imply that the traits are influenced by the same genes in the same direction

Conclusion

The study on phenotypic analysis and correlations of eggs laid by two ectotypes of giant African land snails (*Archachatina marginata var. saturalis)* in Calabar indicated that high significant differences existed in mean egg number, egg weight, egg length and egg width between black-skinned and white-skinned ectotypes, revealing that the black-skinned ectotype is naturally superior in size and weight than the white-skinned ectotype, hence, production of large egg quality traits of the black-skinned ectotype

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