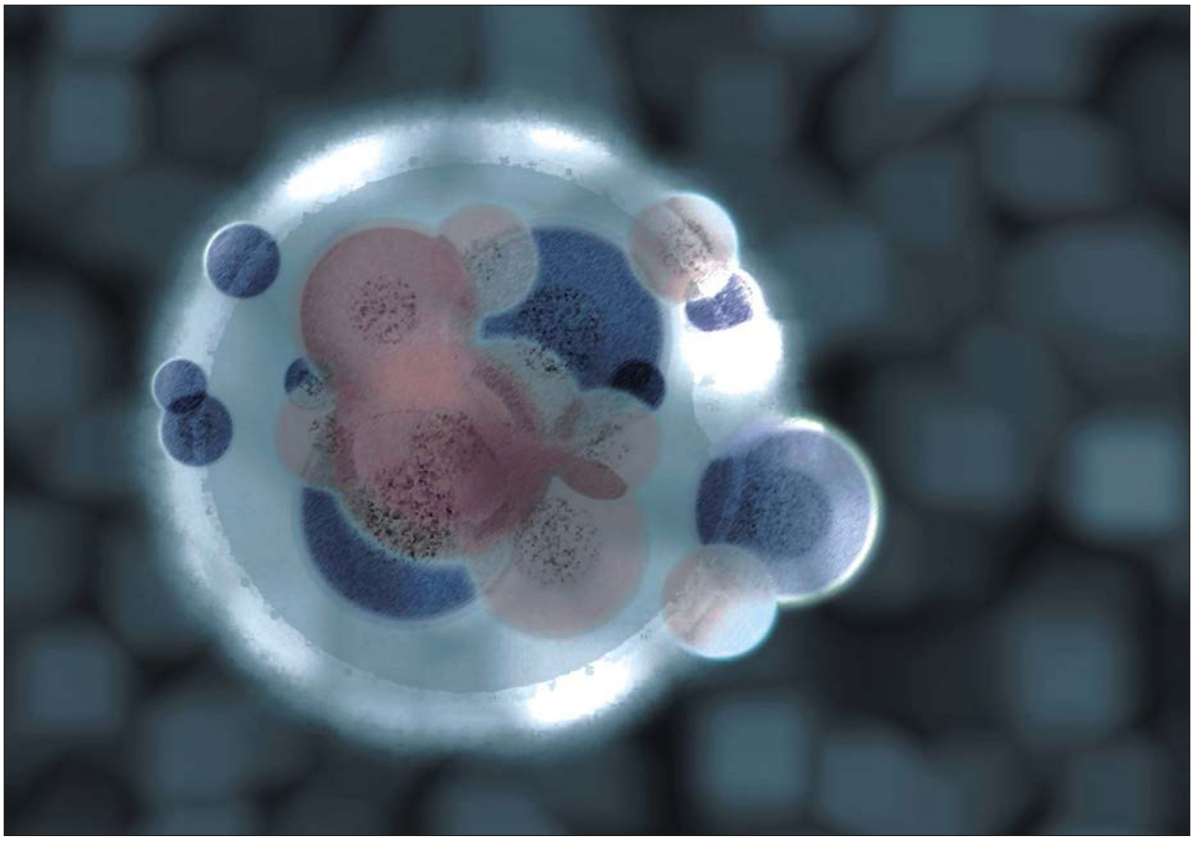

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Comparative Study of Egg Quality Traits of Black-Skinned and White-Skinned Ectotypes of Snails (*Archachatina marginata*) Based on Four Whorls in Calabar, Nigeria

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ABSTRACT
The comparative study of egg quality traits of black-skinned and white-skinned ectotypes of snails (*Archachatina marginata*) based on four whorls were studied using sixty adult snails. The snails were managed in captivity for three months using hutches, embedded with steriled, loamy soil to generate eggs for the study. Egg quality traits evaluated include number of eggs laid, egg weight, length and width. The snails were divided into two mating groups, black-skinned x black-skinned and white-skinned x white-skinned ectotypes of snails. Data collected were subjected to t-test. Results showed that the black-skinned ectotype laid 112 eggs from 13 clutches, while the white-skinned ectotype laid 98 eggs from 11 clutches. The results of the egg quality traits analyzed showed high significant differences ($p<0.05$) between the two ectotypes of snails based on four whorls. The results of the phenotypic correlation of the egg quality traits also revealed a highly significant ($p<0.001$) mean number of egg, mean egg weight, length and width between the two ectotypes of snails. The highly and positive correlation between the egg quality traits could suggest that there are direct relationships between the traits and selection for one trait leads to improvement of the other trait. It is recommended that snails with 5, 6 and 7 whorls should be used for analysis of egg quality traits since the number of whorls are yet to be used as a standard for estimating the age of snails.

Key words: Correlation, genes, variability, strains, *Archachatina marginata*

INTRODUCTION

Giant African Land snails (GALs) consists of many species, the most common species found in Nigeria are *Archachatina marginata*, *Achatina achatina* and *Achatina fulica* (Okon and Ibom, 2012). The two known ectotypes of these species are graded based on their foot (skin) colour, namely; the black-skinned and the white-skinned ectotypes of snails. The white-skinned (albino) ectotype of snail is highly discriminated against by many ethnic consumers in Nigeria (Ebenso, 2003; Ibom *et al*., 2008; Okon *et al*., 2009). They are being discriminated against by some people because of taboos and superstitious beliefs associated with them. Such people believe that it is used by witch doctors, while some people associated them with deities (Okon and Ibom, 2012).

Giant African land snails can lay 4-18 eggs within 1-2 min unlike chickens that lay one egg per day (Omole and Kehinde, 2005). Akinnusi (1997) opined that *A. marginata* lays 5-11 eggs within the same period (1-2 min). Plummer (1975), Reid (1989) and Ogogu (2004), reported that *A. marginata* lays 3-16 eggs per clutch of snail within 24 h. There is need to assess the egg quality traits of these

ectotypes of snails (black-skinned and white-skinned) of *A. marginata* based on whorls on their shells as they may differ in many production qualities. This study is therefore focused on the comparative study of egg quality traits (number of eggs laid, egg weight, egg length and egg width) of two ectotypes of snails (*A. marginata*) based on four whorls on their shells. This can then be used as a standard for estimating the age of snails, which is yet to be established and also for commercial production and biodiversity conservation.

MATERIALS AND METHODS

Experimental procedures: The study was conducted at the Botanical garden of the University of Calabar, Calabar, Nigeria. The description of the area and climate as well as degrees were as prescribed in Okon *et al.* (2009) and Akpakpan *et al*. (2009).

Sixty adult breeder snails, thirty each of black-skinned and white-skinned ectotypes were used. The weight of the snails ranged from 57.60-60.0 and 50.20-56.30 g for the two ectotypes, respectively. The two ectotypes of snails were selected based on the number of whorls (four whorls) on their shells and also on active appearance with no injury on the foot and/or shell from a base population. The selected snails were grouped into two mating groups; Black-skinned ×Black-skinned (Bs×Bs) and White-skinned×White-skinned (Ws×Ws). Each treatment was replicated fifteen times on the Completely Randomized Design (CRD), with two snails to a cell measuring 40 square cm by 30 cm depth. Allowing two snails per cell was to be sure that eggs obtained were as a result of the mating between these two snails. The cell compartments where the snails were managed were kept under trees shade throughout the duration (3 months) of the experiment.

The snails were fed on a mixed feeding regime of pawpaw leaves supplemented with compounded diet. The diet contains, 24% CP, 26.50% ME and 15% Ca with the following ingredients; maize, soybean meal, fish meal, bone meal, Oyster shell and vitamin premix – feed and water in shallow troughs were given *ad libitum* throughout the study period. Egg quality traits assessed included number of eggs laid as counted, egg weight (g), egg length (cm) and egg width (cm). The egg weight was measured using a Scout^{TM} proelectronic scale with 0.01 g sensitivity while measurements of the egg length and egg width were done using vernier caliper.

Statistical analysis: Data collected were analyzed using the "student" t-test statistical tool as modified by Madukwe (2004). Phenotypic correlation among egg quality traits of black-skinned and white-skinned ectotypes based on 4 whorls were also compared according to methods outlined by Ibe (1998). This was done to determine whether same genes affected two or more traits and whether such relationship was high or low, positive, negative or neutral.

RESULTS AND DISCUSSION

The results of Mean±Standard Error, standard deviation and coefficient of variability of egg quality traits of black-skinned and white-skinned *Archachatina marginata* based on four whorls on their shells are presented in Table 1. The total of 112 numbers of eggs was laid by black-skinned ectotype from 13 clutches and 98 eggs from 11 clutches for the white-skinned ectotype. The average number of egg laid by the two ectotypes was similar to the report of Ibom and Okon (2012) for black and white ectotypes respectively.

The clutch size for black-skinned ectotype with four whorls on their shells ranged between 7 and 13 eggs with a mean of 7.23 while the clutch size for white-skinned ectotype with the same number of whorls ranged between 4 and 8 eggs with a mean of 4.34 (Table 1). There was a large disparity which was significantly different ($p<0.05$) between the mean number of eggs laid by the two ectotypes as revealed from the t-test in Table 2. The results obtained in this study agreed with that of Ogogu (1989) and Ibom *et al.* (2008), which observed that the black-skinned ectotype laid larger number of eggs with large clutch size and the white-skinned ectotype laid fewer numbers of eggs with fewer clutch size. The differences in the number of eggs laid by the two ectotypes with four whorls might be due to the age, the size of the snails and the period of mating.

The results of the mean egg weight presented in Table 1 revealed that numerical differences existed between the mean egg weights (0.87 and 0.85 g) of black-skinned and White-skinned ectotypes of *A. marginata* in this study. The differences in mean egg weights between the two ectotypes of snails based on T-test (Table 2) were significant ($p<0.05$). The results obtained in this study for the two ectotypes of snails

Table 1: Mean±Standard error, standard deviation, coefficient of variability of egg traits of Black-skinned and White-skinned ectotypes of *Archachatina marginata* based on four whorls

	Black-skinned ectotype (n = 112)		White-skinned ectotype (n = 98)	
Egg quality traits	$\bar{X}$±SE	CV(%)	$\bar{X}$±SE	CV (%)
Number of eggs	7.23±0.490	24.85	4.34±0.21	28.53
Egg weight (g)	0.87±0.004	6.83	0.85±0.004	6.57
Egg length (g)	1.42±0.003	3.68	1.32±0.002	1.76
Egg width (cm)	1.14±0.008	8.45	0.98±0.015	16.14

n: Total number of eggs laid, $\bar{X}$±SE: Mean±Standard error, CV: Coefficient of variability

Table 2: The t-test values of egg quality traits between Black-skinned and White-skinned ectotypes of *A. marginata* based on four whorls

Egg quality traits	Black-skinned	White-skinned	SEM
Number of eggs	7.23^{a}	4.34^{b}	0.034
Egg weight (g)	0.87^{a}	0.85^{b}	0.001
Egg length (cm)	1.42^{a}	1.32^{b}	0.004
Egg width (cm)	1.14^{a}	0.98^{b}	0.040

^{ab}Means along the same row bearing different superscripts are significantly different ($p>0.05$), SEM: Standard error of mean

Table 3: Phenotypic correlation (rp) of egg quality traits of black-skinned and white-skinned ectotypes of *A. marginata* based on 4 whorls

Correlation parameters	Black-skinned white skinned lectotype white-skinned ectotype			
	NE	EW	EL	ED
NE	1	0.975**	0.981**	0.990**
EW	0.960**	1	0.968**	0.970**
EL	0.992**	0.961**	1	0.993**
ED	0.969**	0.876**	0.946**	1

NE: Number of eggs, EW: Egg weight, EL: Egg length, ED: Egg diameter
**: p<0.001 (highly significant level)

with four whorls were lower than the mean values of 2.7 g (2.6-2.9 g) and 2.4 g (2.3-2.5 g) recorded by Okon *et al.* (2009) for the black-skinned and white-skinned purebreds of *A. marginata*, respectively. This was not also in corroboration with 1.83 and 1.15 g reported by Ibom *et al.* (2012); 59.39 and 54.26 g reported by Ibom *et al.* (2014) for the same strains of snails. Although, the average weights of the eggs were low in the present study, however, there were no much disparities with the findings of Okon *et al.* (2011a). The variation in mean egg weight between the two ectotypes based on four whorls in this study might indicate variation in genetic composition of the snails, especially as the black-skinned snails are naturally bigger than the white-skinned snails with the same number of whorls on their shells. The variation due to the environment might have also played a significant role in the results.

The results of the mean egg lengths and widths laid by black-skinned ectotype were also significantly different ($p<0.05$) from those by white-skinned ectotype (Table 2). They were 1.42 and 1.14 cm length and width, respectively for black-skinned ectotype and 1.32 and 0.98 cm, length and width, respectively for white-skinned ectotype. The egg length and width for the two ectotypes were lower than the findings of Ibom (2009), Ibom and Okon (2010), Okon *et al.* (2011b) and Ibom *et al.* (2012), for the same strains of snails. Generally, from the results obtained in this study, one could say that the egg quality traits of the black-skinned *A. marginata* are better than the white-skinned. This could be used as a strong premise for selective breeding.

Phenotypic correlation (rp) of egg quality traits of black-skinned and white-skinned ectotypes based on four whorls presented in Table 3 indicated a positive and highly significant ($p<0.001$) phenotypic correlation coefficient among the egg quality traits measured for the two ectotypes of snails. This is in agreement with the earlier report of Ibom and Okon (2012) that there were correlations between the egg quality traits of black-skinned and white-skinned *A. marginata.* The positive and highly correlated values recorded among these egg quality traits between the two ectotypes could imply that the traits are influenced by the same genes in the same direction.

CONCLUSION

The results of this novel study showed that the egg quality traits of the black-skinned and white-skinned ectotypes of *A. marginata* based on four whorls are significantly different ($p<0.05$) and also indicated positive and highly significant ($p<0.001$) correlated values among all the egg quality traits measured between the two ectotypes of *A. marginata* which could serve as a landmark for selective breeding. We recommend that snails with five, six and seven whorls should also be used for comparative study.

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