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Phenotypic Characterization of Two Snail Breeds *Archachatina marginata*(S) and *Archachatina fulica*(L) in Calabar, Cross River State

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ABSTRACT---- ***Phenotypic qualities of two snail species commonly found in Calabar, Cross River State were studied. The snail species studied for comparing the differences and relationships between their phenotypic traits were Achachatina marginata(S) and Achatina fulica(L). A total of 100 snails were obtained and selected based on the presence of four whorls shells and used for the study. Parameters studied included body weight, body length, body width, shell mouth length and shell mouth width. Data collected were analyzed to obtain simple statistical values and phenotypic correlations between the two species. Data were also subjected to regression model for body weight predictions. Mean(X) body weights recorded were 135.250g and 137.554g for A. marginata and A. fulica, respectively. Only T-test results for body weight and shell mouth width were significantly($P<0.05$) different; high, medium and low positive phenotypic correlations were observed between parameters measured. The highest positive, strong and closely related response($R=0.722$) between width and body length was recorded by A. marginata. Results of this study could be harnessed for the characterization of snail species in Calabar for breeding purposes***

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1. INTRODUCTION

Snails are soft-bodied molluscs with flat, broad, muscular foot and a distinct head which bears two pairs of tentacles or stalks with eyes positioned at the tips of the upper tentacles[1]. There are about 40,000 species of snails found throughout the world in the wild, out of which a few species have been found culturable[2]. *A. marginata*, commonly known as the giant African snail is native to West Africa – Cameroon through Democratic Republic of Congo[3]. *A. fulica*, on the other hand is native to East Africa especially Kenya and Tanzania, but has been gradually introduced to other parts of the world through the pet trade and as a food source[4]. The species, *A. marginata* (Fig. 1), has the potential to grow up to 120mm in length and 130mm in diameter with 6-7 whorls. The shell has a brownish yellow colouration with fairly uniformly arranged bands and zig-zag lines or spots that are dark-brown or reddish brown in colour. The columella, outer lip and inside the aperture (mouth) are white or pale blue. The apex of the shell is likely flattened, bulbous and pale or pinkish. The body colour of the animal is variable(albino or tan to ash to grey)[5;6;3]. The adult *A. fulica* (Fig. 2) has a height of about 7cm and can reach a length of 20cm or more. The shell has a conical shape, being about twice as high as it is broad. Either clockwise (sinistral) or counter clockwise(dextral) directions can be observed in the coiling of the shell although, the right-handed (dextral) cone is more common. Shell colouration is highly variable and diet – dependent. Typically, brown is the predominant colour and the shell is branded.[7].

Snails are known as a potential sustainable food source for humans. [8] stated that about 38% of snails' total weight, representing the foot, is edible. The foot, which is the meat, is highly nutritious with a protein content of 37.51%, iron content of 45-59mg/kg, fat content of 0.05-0.08%, making it the ideal meat for hypertensive patients[9]. Snails have also been recorded as aiding the treatment of ailments like whooping cough, anemia, ulcer, asthma, age problems and rheumatism [10]. A qualitative measure of the animals' conformation is desirable as this will enable reliable genetic parameters for a given trait to be estimated and therefore allow its inclusion in breeding programmes[11]. [12] and [13] state that the body weight and body parameters such as shell length, shell width, shell thickness, shell mouth length and shell mouth width are the quantitative traits mostly used to measure snail growth and growth rates. The number of whorls is also often measured as an important factor in marketing and breeding of the best quality of snail stocks.

Fig. 1: *A. marginata*

Fig. 2: *A. fulica*

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2. MATERIALS AND METHODS

The phenotypic qualities investigated in this study include body weight, body length, body width, shell mouth length and shell mouth width. A total of one hundred (100) adult snails, fifty (50) of each breed, were used for this study. The snails were procured from a local market in Calabar, Cross River State, Nigeria. The snails were randomly selected based on active appearance, presence of four (4) whorls, no foot injuries and shell type of the base population. Phenotypic qualities of the selected snails were obtained for further analyses using conventional methods. The body weights were collected using a sensitive electronic weighing balance while the other parameters were measured using a Vernier caliper. Analyses was done using T-test, simple statistics including calculating means, standard deviations and coefficient of variability. Others were phenotypic correlations and multiple regressions function for predicting body weight from body components. Analyses were carried out using the SPSS V. 18 statistical package.

3. RESULTS AND DISCUSSION

The results of this study are presented on Tables 1, 2, 3 and 4 and on Figure 3. Table 1 shows the statistical analyses of the phenotypic parameters investigated. Mean BWT for *Af* is slightly higher than but not significantly different (P>0.05) from BWT of *Am*, however, the co-efficient of variability (C.V.) for *A. marginata* (18.98%) is relatively higher than that of *A. fulica* (13.58%). Mean BOL of *Am* (10.55) was higher than that of Af (10.45). Mean BOW for Am (5.29) was also higher than that of *Af* (5.09). Values for SML for *Am* and *Af* were 5.37 and 5.29 respectively and 3.18 and 2.99 for SMW respectively. Coefficient of variability were higher for *Am* than for *Af* for all parameters investigated. Table 2 shows T-test results between the quantitative parameters of *Am* and *Af*. From these results, BWT, BOL and MSL were higher in *Am*, though not significantly (P>0.05) different between the two breeds. However, significant (P<0.05) differences were observed in BOW and SMW of the two breeds.

Table 1: Descriptive Statistical Analyses of Phenotypic Parameters of both *A. Marginata* and *A. fulica*

Quantitative Traits	*A. Marginata*			*A. fulica*		
	Mean ± SE	Standard Deviation	C.V.%	Mean ± SE	Standard Deviation	C.V.%
Body Weight(BWT)	135.250±3.631	25.67	18.92	137.5±2.64	18.68	13.58
Body Length(BOL)	10.55±0.110	0.779	7.38	10.44±0.066	0.464	4.445
Body Width(BOW)	5.29±0.053	0.373	7.04	5.087±0.031	0.217	4.304
Mouth Shell Length(MSL)	5.368±0.059	0.417	7.76	5.291±0.031	0.217	4.304
Mouth Shell Width(MSW)	3.184±0.55	0.391	12.27	2.99±0.032	0.224	7.476

Table 2: T-test values for Phenotypic Traits of *A. marginata* and *A. fulica* snail breeds found in Calabar Municipality.

Quantitative Traits	T-values	Significance
BWT	-0.497	P>0.05
BOL	0.775	p>0.05
BOW	3.286	P<0.05
MSL	1.070	p>0.05
MSW	2.843	P<0.05

P>0.05 – Non- significant; P<0.05 - Significant

The results of the phenotypic correlations among the quantitative parameters of the two breed of snails evaluated indicated a positive correlation within each breed (Table 3). In *Archachatina marginata*, highly Positive phenotypic correlation (r_p) was observed between BWT and BOL(r = 0.722). Between BWT and BOW, r = 0.602 was observed while for BOW and BOL, r = 0.701. For MSW and MSL, r = 0.538; BOL and MSL, r = 0.493. Low positive correlations were observed for BOW and MSW (r = 0.375), BOL and MSW (r = 0.318), BOW and MSL (r = 0.397), BOW and MSW (r = 0.356). In *A. fulica*, positive high correlations were obtained between BWT and BOL (r =0.717), BWT and BOW(r = 0.674), and BOW and BOL had r= 0.662. BOL and MSL showed r = 0.618. BWT and MSL, BOW and MSL showed positive, medium correlations, r= 0.556 and r = 0.557, respectively. Low positive relationships were recorded between BOW and MSW(r=0.360) and MSL and MSW(r=0.134).

Table 3: Phenotypic Correlations in the two snail breeds *A.fulica and A. marginata*

	BWT	BOL	BOW	MSL	MSW
BWT	1.000	0.722	0.602	0.538	0.375
BOL	0.717	1.000	0.701	0.493	0.318
BOW	0.674	0.662	1.000	0.397	0.356
MSL	0.556	0.618	0.557	1.000	0.634
MSW	0.360	0.251	0.352	0.134	1.000

BWT - Body weight
BOL - Body length
BOW - Body width
MSL - Mouth shell length
MSW - Mouth shell width

Table 4 shows the multiple regression equation for body weight as predicted by the other quantitative parameters (body length, body width, mouth shell length and mouth shell width) for *A. marginata* and *A. fulica*. Coefficients of determinations were relatively high for both breeds. For *A. marginata*, R^2 = 57.942% and for *A. fulica*, R^2 = 60.742%. Figure 3 shows a comparison between the actual and predicted weights of the two breed of snails.

Table 4: Regression Analyses of body weight on the other phenotypic traits (BWT, BOL, BOW, MSL and MSW) for *A. marginata* and *A. fulica*

Breeds	Prediction equation(multiple regression)	R(%)	R^2(%)
A.marginata	$Y=171.580 + 11.031X_2 + 13.128\ X_3 + 1.651\ X_4$	7.612	57.942
A.fulica	$Y=250.849 + 17.074X_1 + 23.475\ X_2 + 10.486\ X_3 + 11.762\ X_4$	7.797	60.742

Where: Y = Body Weight
X_1 = Body Length
X_2 = Body Width
X_3 = Mouth Shell Length
X_4 = Mouth Shell Width

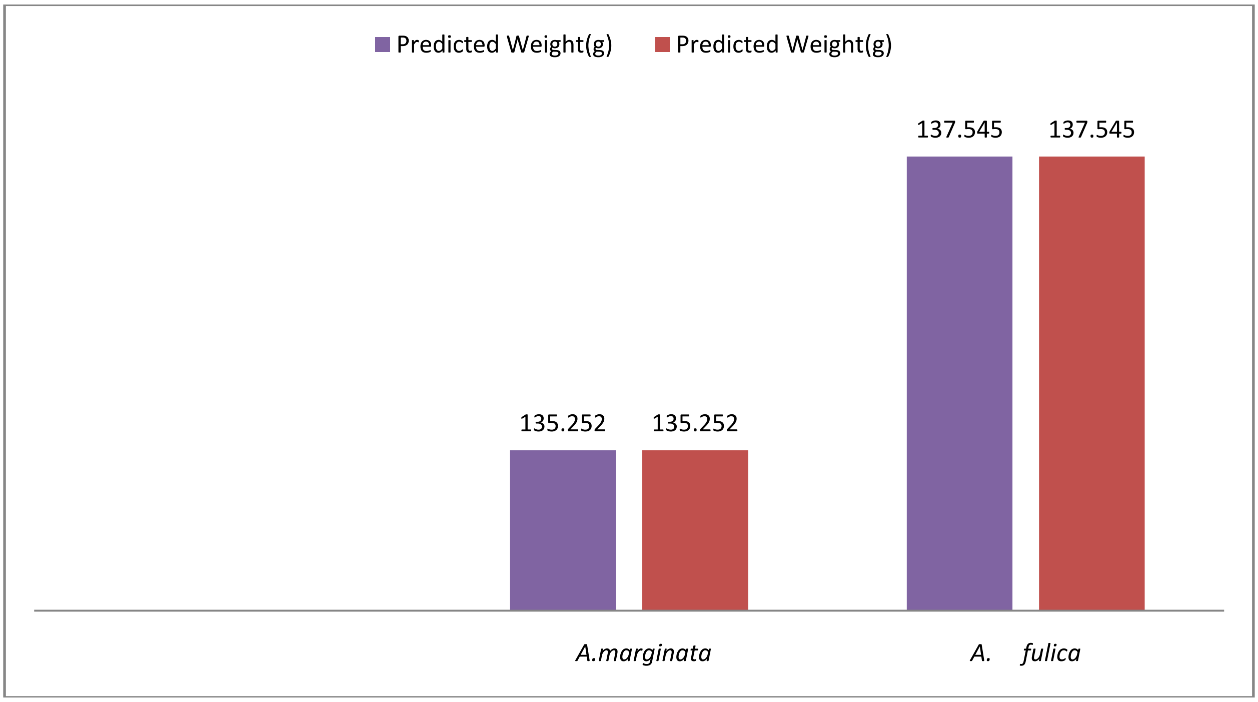

Figure 3: Comparison of actual and predicted body weight of *A. marginata* and *A. fulica* using multiple regression equation

On Table 1, standard deviations showed significantly different (P<0.05) results between the two snail breeds. Where a higher SD with a lower mean weight of *A. marginata* against *A. fulica* is obtained, it may be attributed to a variation in the range of snails selected as seen in the coefficient of variability of the group. On Table 2, significance in the body width and mouth shell width maybe as a result of the natures of the shell type of the two snail breeds. *A. fulica* has a more compact-like shell with a smaller aperture while *A. marginata* has a more elongated and broadened shell with larger aperture. The highest positive and closely correlated response (r = 0.722) shown on Table 3, between BDW and BDL was recorded by *A. marginata*. This agrees with results recorded by [11], [12] and [14]. The positive, significant correlations denote that the pairs of traits have direct relationships or at least are controlled by the same genes in the same direction, thus selecting for one trait will lead to improvement of the other. Furthermore, this result confirms earlier views by [15] of high correlated responses for morphometric traits as the best for selection and cross-breeding for genetic improvement as well as being better predictors of body weight. Correlations obtained in this study are however lower than the strong, positive and highly significant correlation value of r = 0.96 obtained by [15] in their study between hatchling body weight and body shell length for the purebred white-skinned (albino) and purebred dark-skinned snails raised in Obubra, Nigeria. In another study [11], recorded correlations as high as r =0.78 between hactchling body weight and body shell length for *A. marginata* and *A. achatina.* The differences in correlations here could be as result of the age of the snails used. Again, the snails considered in this study were growing snails with four whorls only and besides, they were growing snails not juveniles or hatchlings used by the other authors. These variations could also be implicated in the correlation results obtained. Table 4 and Figure 3 indicate that the phenotypic traits assessed, predicted the body weights accurately as there was no differences between the actual and predicted body weights of the snails (Figure 3). Coefficients of determinants were also very high and could be an indication that variation in body weights of the two breeds is as a result of the variations in the snail breeds. These results have been presented for improved breeding purposes. For optimal output, snail farmers are advised to harness the morphometric traits of these snail species as a tool for the improvement of the breeds for investment purposes.

4. CONCLUSION

Two snail breeds common to the Calabar populace, *A. marginata* and *A. fulica*, were assessed for differences and similarities in their phenotypic qualities and to predict their body weights using these qualities. Relatively higher but non-significant means were observed between the growth and qualitative traits of the two breeds. T-test results revealed significant differences only in the body width and the mouth shell width. There was also a high and low positive significant correlation values among the morphometric traits(Body weight, Body length and Body width) and aperture (Mouth shell length and Mouth shell width) respectively for both snail breeds for prediction of body weights using multiple regression equations, the combination of all the qualitative parameters studied were used. The results show that body weights of the *A. marginata* and *A. fulica* can be predicted accurately using morphometric traits of the snails. Thus further characterization of these snail breeds in Calabar, Cross River State, using these phenotypic traits is being proposed, for optimal breeding purposes.

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