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Short Communication

Effect of stocking density on the growth and haemolymph biochemical value of *Archachatina marginata*

Ademolu, K. O.*, Idowu, A. B. and Agbelusi, O. M.

Biological sciences department, University of Agriculture, P. M. B. 2240, Abeokuta, Ogun State, Nigeria.

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The growth performance and haemolymph properties of the African giant land snail *Archachatina marginata* fed *ad libitun* with pawpaw leaves and reared under different stocking densities were investigated in an eight week experiment. Four different stocking densities of 5, 10, 15 and 20 snails per cage (0.5 m x 0.5 m x 0.2 m) were used with each group replicated. The cage with 15 snails per cage recorded the best growth performance in relation to weight gain, shell length gain as well shell circumference gain, while the cage stocked with 20 snails recorded the least growth performance. There is a strong relationship between stocking density and the concentration of the haemolymph protein, glucose and lipids. However, there was no difference in the concentration of the mineral elements across the stocking densities.

Key words: *Archachatina marginata,* stocking density, haemolymph biochemical values.

INTRODUCTION

Archachatina marginata (Swainson) is a nocturnal animal which is active at night and in dark places during the day. The snails spend most of the day time under stones, soil or litter of decaying organic matter (Ajayi et al., 1978). In West Africa, species of *A. marginata* are found in the dense high forest and in the fringe of the derived Guinea Savanna which is a favourable habitat for the survival of the species (Segun, 1975). Snail meat is highly relished and considered a delicacy in the forest zone of West African, especially in Nigeria and Ghana (Agbelusi and Ejidike, 1992). Apart from its nutritional value, it is also used in traditional medicine. Mead (1961) reported that the orthocalcium phosphate extracted from the snail could cure kidney disease, tuberculosis, anaemia, diabetes and asthma. However, impact of human activities such as deforestation, slash and burn agricultural practices and indiscriminate snail hunting have reduced the population of these species in existence (Ejidike, 2002).

Snails consume and convert many household and farm wastes into body nutrients. Ademolu et al. (2004) observed that snails fed with poultry dropping recorded higher weight gain and protein content than those fed with plant materials. For a good performance of snails under captivity, optimal stocking density must be considered. Overcrowding affects both growth and sexual development of snails (Orisawuyi, 1989). Agbelusi and Adekugbe (1999) reported that space plays an important role in survival of *A. marginata* and that mortality is population dependent. Similarly, Akegbejo-Samson and Akinnusi (1999) observed that egg-laying capacity of *A. marginata* and growth of *A. marginata* were adversely affected under a very high population density. However there is no information on the effect of stocking density on the biochemical value of *A. marginata* haemolymph.

*Corresponding authors E-mail: kennyademolu@yahoo.com.

Table 1. Growth performance of Snails on different stocking density.

Parameters	T_1	T_2	T_3	T_4
Mean weight gain (g)	3.15^b	5.69^b	7.85^a	1.45^c
Shell length gain (cm)	0.47^b	0.34^c	0.60^A	0.19^d
Shell circum gain (cm)	0.48^a	0.55^a	0.50^a	0.38^b

Treatments T_1, T_2, T_3 and T_4 were stocked at the rate of 5, 10, 15 and 20 snails, respectively.
Mean values in each row with the same superscript are not significantly different (P<0.05).

Table 2. Metabolites composition of haemolymph of *A. marginata* under different stocking densities.

Parameter	T_1	T_2	T_3	T_4
Glucose (mg/l)	16.8^a	12.6^b	16.7^a	12.5^b
Protein (g/l)	40.9^a	24.5^c	35.5^b	19.1^c
Lipids (mg/dl)	18.2^b	18.2^b	21.8^a	14.5^b

Treatments T_1, T_2, T_3 and T_4 were stocked at the rate of 5, 10, 15 and 20 snails, respectively.
Mean values in each row with the same superscripts are not significantly different (P<0.05).

Table 3. Mineral composition of the haemolymph of *A. marginata* under different stocking density.

PARAMETER	T_1	T_2	T_3	T_4
Sodium (mmol)	62.0	56.0	62.0	64.0
Potassium (mmol)	2.4	2.8	2.9	2.9
Calcium (mg/dl)	10.5	10.4	10.6	10.6
Chloride (mmol/l)	7.3	5.2	7.2	5.6
Phosphate (mg/dl)	3.5	1.6	3.5	1.5

Treatments T_1, T_2, T_3 and T_4 were stocked at the rate of 5, 10, 15 and 20 snails, respectively.

MATERIALS AND METHODS

The study was carried out in the Animal House of the Department of Biological Sciences, University of Agriculture, Abeokuta, Ogun State, Nigeria. The wooden cages used were partitioned into four equal compartments having the same dimension; 0.5 m x 0.5 m x 0.2 m with an area of 0.25 m^2. Loamy soil was used to fill all the four compartments up to 2 cm. One hundred *A. marginata* with an average weight of 57.76 g (three months old) were obtained from snail pen of Department of Forestry and Wildlife Management in the University of Agriculture, Abeokuta and were divided into four treatments with two replicates. The treatments, T_1, T_2, T_3 and T_4 and their replicates, were stocked at the rate of 5, 10, 15 and 20 respectively. The snails were fed *ad libitum* with fresh pawpaw leaves at 5 – 6 pm daily.

Data collection

Data were collected on the following parameters every week for eight weeks; weight gain (using a sensitive weighing balance), shell length (using calibrated ruler) and shell circumference (using canvas tape).

Chemical analysis of the haemolymph

The apex of the snails shell was broken by method of Akinloye and Olorode (2000) in order to collect the haemolymph. The protein concentration of each sample was determined immediately by the biuret method as described by Henry et al. (1974). The glucose content was determined by colorimetric method of Baumniger (1974). The lipids assay was done following method of Grant et al. (1987). The haemolymph sodium (Na^+), potassium (K^+), calcium (Ca^{2+}), phospate (PO_4^-) and Chloride (Cl^-) were determined by the method of AOAC (1990).

Statistical analysis

The data obtained were analysed using one-way analysis of variance (ANOVA) and Duncan multiple range (Steel and Torrie, 1980). Correlation analysis was carried out on weight gain and shell parameters.

RESULT

All the experimental snails, *A. marginata* gained appreciable weight, with treatment T_3 having the highest mean weight gain (7.85 g). Treatment T_4 had the least weight gain (1.45 g) (Table I). Measurements of the shell parameters revealed that treatment T_3 had the highest shell length gain (0.60 cm) followed by treatment T_1, while treatment T_4 recorded the least shell length gain (0.19 cm). Similar trend was observed in the shell circumference gain except treatment T_2 having the highest shell circumference gain (0.55 cm) though not statistically different from treatment T_3 (Table 1).

Haemolymph metabolites

Of all the metabolites tested for, protein had the highest concentration in all the treatments; while glucose is the least metabolite (Table 2). Stocking density had a significant effect on the metabolites tested for, with cage stocked with 5 snails (treatment T_1) recording highest values in glucose and protein (16.8 mg/l and 40.9 g/l, respectively), and cage stocked with 20 snails recording the least values (12.5 mg/l and 19.1 g/l, respectively). Similar observation was made in lipids concentration except that treatment T_3 had the highest value.
The mineral analysis of the snails' haemolymph under different stocking densities is shown in Table 3. The mean haemolymph mineral values were not statistically different (P<0.05) in all the treatments.

DISCUSSION

There was appreciable increase in the growth performance of the experimental snails. The growth performance was more pronounced in the body weight gain than the shell parameters. Adeparusi and Agbelusi (1998) had earlier reported that increase in the growth of *A. marginata* was concentrated in the body weight followed by the shell length and aperture length. There was significant difference (P<0.05) in the body weight gain by the experimental snails; treatment T_3 recorded the highest weight gain, while treatment T_4 had the least weight gain. Similar trend was observed in the shell parameters. This poor growth performance in treatment T_4 is obviously due to higher stocking density compared to the other treatments. This confirms that growth is density dependent (Akegbejo-Samson and Akinnusi, 2000). High stocking density accelerates shell rasping and stunted growth in snails (Odaibo, 1997).

Changes in the physiological state of snail can affect the biochemical value of the haemolymph (Akinloye and Olorode, 2000). The present study confirms this as stocking density has a significant effect on the concentration of protein, glucose and lipids in the haemolymph. Though the reason for higher metabolites concentration in treatment T_3 cannot be ascertained now, it is noteworthy that higher lipids and glucose concentration in haemolymph may contribute to the higher weight gain recorded by this treatment. Lipids and glucose are rich energy sources which can be stored as glycogen and glycerol in the body for later use. The concentration of protein is relatively higher than other metabolites. This corroborates South (1992) observation that protein is the most abundant solute in the snails' haemolymph. Similarly, snails have been reported to be a good source of protein (Akinnusi, 2002; Amusan and Omidiji, 1988; Imeuevbove and Ademosun, 1988). Density significantly affected the protein concentration in the haemolymph. Treatment T_1 had the highest protein concentration while treatment T_4 recorded the least value. This is likely due to the large space available to the snails in Treatment T_1 which make them to be more active. The major protein in the snail haemolymph is haemocyanin, a respiratory pigment which is high in active snails (South, 1992).

The present study revealed the presence of calcium, sodium, potassium, chloride and phosphorus in the snail haemolymph as previously reported by Ademolu and Idowu (2005). The low phosphate content in the haemolymph of the experimental snail was earlier noted by Akinyeye (1996) who observed that the mineral is more concentrated in the shell of the animal than in the other parts. The value of Na^+ was more than other minerals tested for. South (1992) reported that K^+ and Ca^{2+} were the most variable ions in the blood of slug *Arion Ater*, while Na^+ was the most constant. The mean haemolymph mineral compositions were not statistically different (P<0.05) in all the treatments. Akinloye and Olorode (2000) made similar observation and this may be due to the duration of the exposure of the animals to the experimental condition. Hence for optimal utilization of both the flesh and haemolymph of *A. marginata* stocking should be done at 60 snails per m^2.

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