Feed Intake and Survivability of Edible Land Snail Species under two Moisture and Temperature Conditions

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Abstract

The effects of moisture and temperature on the feed intake and survivability of the giant African land snails (*Archachatina marginata* and *Achatina achatina*) housed under cage system were investigated using 60 juvenile (5-month-old) snails of each species. The experiment was based on a 2 x 2 x 2 factorial design with 3 replicates of five snails per replicate, that is, snails (Archachatina *marginata* vs. *Achatina achatina*), moisture (high moisture defined by 65 ml of water to moisten the soil on daily basis vs. 65 ml of water on 2-days intervals), and temperature (ambient vs. controlled temperature unit). The temperature, relative humidity of the experimental unit, feed intake and mortality rate in percentage were recorded. The experiment was carried out between the months of October and April. From this study, a difference of 6 ^{o}C was observed between the average daily temperatures of the units, with average of 29.40 ^{o}C and 22.61 ^{o}C for ambient and controlled units respectively. Average daily relative humidity of 62.7% and 73.3% for ambient and controlled temperature units respectively were observed. Feed intake was significantly affected by temperature and species ($p < 0.05$). The interaction between temperature, moisture and species was highly significant on feed intake of the snails ($p< 0.001$). feed intake was higher under ambient temperature than in controlled temperature (1.50±0.03 vs. 1.17±0.03 g/snail/week). Difference of 0.50 g/snail/week was observed, *A. marginata* consuming more. Mores so, the overall mortality rate was 23.3%, of which *A. marginata* and *A. achatina* had 4.2% and 19.1% respectively. This result showed higher mortality under controlled unit for *A. marginata* compared to that of ambient unit (46.7% vs. 30.0% respectively). The rate was low with high moisture compared with low moisture either under controlled or ambient temperature unit. In conclusion, this paper relates the significant effects of temperature and moisture on the feed intake and mortality rate of giant African land snails. Thus, ambient temperature, and moistening the soil with 65 ml of water on daily basis increase feed intake and reduced the mortality rate of these snails, thereby increasing their survivability.

Keywords: *Archachatina marginata, Achatina achatina*, feed intake, moisture and temperature, mortality rate, survivability.

Introduction

Snails have been eaten by man across the globe as a delicacy in the diet from the time immemorial. It is an important source of protein. The meat of snail in high in protein, low in calories, and has almost no fat or cholesterol (Cheney, 1988). Snails can be grown by anyone, without using large tracts of land or large amount of cash/capital. Thus, their propagation has the advantage of being a low input industry.

In Africa, the snail species most acceptable and available for consumption and to farmer are the giant African land snail, that is, *Archachatina* marginata and *Achatina achatina, Achatina fulica*. With these benefits derivable from snail, efforts are been made at its large scale production. However, there are factors limiting the accomplishment of this, of which temperature and humidity are of great importance. The cyclic biological mechanism of activeness during wet season and inactiveness in dry season of snail was as a result of changes in moisture and environmental temperature in a year. During aestivation (the period of dormancy or inactiveness of snails imposed by unfavourable relative humidity and temperature conditions), snails endure long period of dryness through numerous behavioural, biochemical and physiological adaptations which support long term aestivation [1- 3] that aid water retention within the body or increase dehydration tolerance [4]. Under this adaptation mode, there is always reduction in weight, regression of reproductive organs, hence, loss of valuable growing time and/or eventually death of the animals if he adverse conditions persist for a very long time. Obviously, it is not possible to control temperature and humidity, which are some of the factors affecting rearing and production under an outdoor situation because of the fluctuation in the magnitude of temperature and humidity. However, these can be control in relatively undisturbed forest, fairly dense vegetation cover or in an intensive culture system. Imevbore (1990) observed that this mechanism could be disrupted through application of water. For these reasons, this study was conducted in a culture system to determine the feed intake and survivability of the snails species as affected by these micro-climatic conditions during dry season (between late raining and late dry season - the period of which aestivation is likely to occur).

Materials and methods

The study area

The study was carried out at the Snail Research Unit of the College of Animal Science and Livestock Production (COLANIM), University of Agriculture, Abeokuta. Abeokuta lies within the Rain Forest vegetation zone of Western Nigeria at latitude 7 o 13' 49.46"N, longitude 3 o 26' 11.98"E [8] and altitude 76 m above sea level. The climate is humid with a mean annual rainfall of 1,037 mm, an average temperature of 34.7^{o}C and an average relative humidity of 82 % throughout the year (60 % in January and 94 % in July to September) [4]. The research unit was partitioned into units consisting of two compartments, of which one of the compartments was used for controlled temperature (with average temperature of 22.7 ^{o}C and 72.3% relative humidity) and ambient temperature (with average temperature of 29.4 ^{o}C and 62.7% relative humidity). The moisture conditions were defined as high moisture - 65 ml of water to moisten the soil on daily basis, and low moisture - 65 ml of water on 2-days intervals.

Animals and management

Data used for this study were obtained from two species of snails (*Archachatina marginata* and *Achatina achatina*). They were 5-month old juveniles comprising of 60 *A. marginata* and *A. achatina* species. The animals were housed in well ventilated covered plastic basket cages of dimension 40 X 30 X 25 cm each and fed a ration composed of layers' mash and oven-dried pawpaw leaves (1:1 w/w). The proximate analysis of the experimental diet is as state in Table 1. Fresh feed and water were provided in plastic feeding and watering trough daily. At the end of every month the cages were washed thoroughly and filled with fresh oven-dried soil. A preliminary period of 14 days was allowed for the snails to acclimatize to the new environment.

Other materials used were humus soil, sensitive electric weighing scale, wet and dry bulb thermometers, minimum and maximum thermometer, and indelible markers for snails identification. The study was carried out in between the month of October and April (between late wet and early wet season).

Experimental procedure and data analysis

The experiment was 2 X 2 X 2 factorial (Species vs. temperature vs. moisture) with three replicate of five snails each. 24 cages were assigned to each compartment and thereafter 5 snail of each species were randomly assigned into 12 cages per species. In each compartment, 3 cages were assigned for high moisture and other 3 for low moisture condition. Data were collected on weekly feed intake and mortality. The mortality rate was evaluated by the percentage of snails dying during the experiment in each series. The effects of temperature and moisture on feed intake were analysed using analysis of variance of SYSTAT program (version 5.02, 1993).

Table 1. Proximate analysis of the experimental diet

Composition	LM: DPL (%)
Dry matter	96.20
Crude protein	19.70
Ether extract	2.05
Crude fibre	9.69
Ash	7.96
Nitrogen free extract	60.60

LM = Layers' mash, DPL = Dried pawpaw leave

Result and discussion

Effects of temperature and moisture on feed intake

Temperature effect on the weekly feed intake was significant ($p<0.001$). The snail consumed more feed under ambient temperature than under controlled temperature (1.50+0.03 vr. 1.17+0.03 g/sail/week). Effect of species on weekly feed intake was highly significant ($p<0.001$). The feed intake for *A. marginata* was higher than that of *A. achatina* by 0.51 g/snail/week. There was difference observed for weekly feed intake under high and low moisture levels but not significant ($p>0.05$).

Table 2. Effects of moisture and temperature on feed intake of *A. achatina* and *A. marginata* (g/snail/week)

Temperature	**Moisture**	**Species**		**Overall mean**
		A. Marginata	*A. achatina*	
Controlled temperature	High level	1.44 ± 0.07^{b}	0.92 ± 0.07^{c}	1.18±0.05
	Low level	1.39 ± 0.07^{b}	0.94 ± 0.07^{c}	1.17±0.05
	Mean	1.41±0.05	0.93±0.05	1.17±0.03
Ambient temperature	High level	1.73 ± 0.07^{a}	1.38 ± 0.07^{b}	1.55±0.05
	Low level	1.81 ± 0.07^{a}	1.11 ± 0.07^{c}	1.46±0.05
	Mean	1.77±0.05	1.24±0.05	1.50±0.03
Overall mean		1.59±0.03	1.09±0.03	

[abc] Means (±SE) within the same column with different superscript are significantly different (p<0.05)

The interaction between moisture and temperature was significant on feed intake (p.05). the lest square means (Table 2), shows that there was no significant difference in the feed intake of *A. achatina* under controlled unit with either high or low moisture level. The feed intake of *A. marginata* under each temperature regime with high and low moisture level was not significantly different (p>0.05). The feed intake by *A. achatina* and *A. marginata* was not significantly different under controlled temperature within high and low moisture levels. This is in line with the report according to Akinnusi (1998) that less feed are consume by snail under cold environment, however, there were no snail that aestivated.

Effects of temperature and moisture on the mortality rate

This result shows that mortality was high for *A. marginata* with higher value under controlled unit compared to that of ambient temperature (46.7% and 30.0% respectively). However, A. achatina under controlled unit performed better that those under ambient temperature unit with 6.7% and 10.0% mortality respectively. In addition, there were no difference in mortality rate for *A. achatina* with either high or low moisture level under controlled unit, though, it varied under ambient temperature with higher value recorded at low moisture (6.7% vs. 13.3% for *A. marginata*, the mortality rate was low with high moisture compared with low moisture either under controlled or ambient temperature (40.2%vs. 58.6% for controlled, and 26.7% vs. 33.5% for ambient temperature respectively). Reduced activities was recorded in which all the *A. achatina* used for this experiment withdrawn into there shell occasionally.

Table 2. The percentage mortality of both species under different treatment

Temperature	**Moisture**	**No. of snail**	**Species**	
			A. marginata (%) mortality	*A. achatina* (%) mortality
Controlled temperature	High level	15	6 (40.5)	1 (6.7)
	Low level	15	8 (58.6)	1 (6.7)
	Mean	30	46.7	6.7
Ambient temperature	High level	15	4 (26.7)	1 (6.7)
	Low level	15	5 (33.5)	2 (13.3)
	Mean	30	30.0	10.0
Overall mean		60	23 (38.3)	5 (8.3)

The feed intake and percentage mortality in this study shows that each species performed best under ambient temperature than controlled temperature. This is expected for the two species under controlled temperature because all there activities would have been reduce due to reduced temperature and high relative humidity (dry environment), which could have resulted into reduced feed intake (Akinnusi, 1998), desiccation of the body fluids of the animal (Odiete, 1999) and eventual rate of mortality observed in the study. *A. achatina* survive more under controlled temperature compared with those under ambient temperature and more with high moisture level under ambient temperature, which is contrary to what has been reported by other that mortality rate is always higher for *A. achatina* than *A. marginata.* In the course of this present study, it was observed that *A. achatina* remain partially active, which could have been the reason for the low mortality rate. As a poikilothermic animal, the metabolic rate reduces with reduced ambient temperature and increase with increased ambient temperature (Nagabhushanam *et al.,* 1983). Hence, the behavioural mechanism exhibited by *A. achatina* in other to limit metabolic activity when the body water content is low and air is dry. There was no egg laid during this experiment, and no snail aestivated.

Conclusion

Physiologically, *A. achatina* could be more sensitive to temperature and humidity or changes in the environmental conditions than *A. marginata.* Temperature effect superseded the moisture effect; this could be as a result of lack of physiological thermal control because most of the heat of the body is derived from the environment rather than from metabolic source. More so, temperature and moisture were significant factors affecting snail's survivability in the dry season. Ambient temperature (29.4 ^{o}C) and moistening the soil with 65 ml of water on daily basis increase feed intake and reduced the mortality rate of these snails, thereby increasing their survivability.

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