WATER UPTAKE DURING INCUBATION OF EGGS OF *Archachatina marginata* AND *Achatina achatina* IN A HUMID ZONE

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ABSTRACT

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Eggs from gravid *Archachatinc marginata* and *Achatina achatina*, were incubated in soil differing in water content of control (0), 5, 10, 15, 20 and 25% w/w in air tight plastic containers, 0.12 x 0.12 x 0.06m, in the laboratory. Eggs of both species hatched after 31 days. All eggs in the control chamber desiccated. The uptake of water was lower in *A. marginata* with thicker egg shell than *A. achatina*. Snail eggs require higher water uptake up to 10 days to hatching.

Key words: Snail eggs, incubation, water uptake.

INTRODUCTION

Snails are land plumonates, nocturnal herbivore and require warm and very humid condition for good growth. Snail meat is a good source of animal protein (Ebenso and Okafor, 2002)

Most Land plumonates are simultaneous hermaphrodite and usually oviparous (Tompa, 1984; Leonard, 1991; Stievenart, 1992). Achatinids are adichogamous hermaphrodites producing both sperm and ova from the beginning of maturation (Tomiyama, 1996). The duration of copulation in *Achatina achatina* may continue for 12 hours (Hodasi, 1979), while *Archachatina marginata* lasts 3.30 hours (Ebenso *et al*, 2002).

The "gestation" and incubation periods are the time from fertilization of the ova till oviposition (in snail body) and from oviposition till hatching (outside snail body) respectively (Stievenart, 1992). The eggs of Achatinidae are generally deposited in "nests" evacuated in the soil by gravid snail, but occasionally may simply be deposited in moist crevices among plant litter, stones or other debris in the ground (Raut and Barker, 2002). After oviposition, the eggs remain in the same place for the entire incubation period. Incubation period of *A. marginata* ranges between 29 – 32 days (Akinnusi, 1988), while that of *A. achatina* is between 27 – 35 days (Zongo *et al*; 1990).

Calcium is important in snail breeding and for egg shell development (Ebenso, 2003). There is insufficient calcium in the albumen during incubation to allow for body-shell formation, hence embryo utilizes calcium from egg shell (Raut and Barker, 2002).

Therefore, for normal development of the embryo, the water content of egg apparently must increase during development (Packard *et al*; 1977).

Snail farmers have low hatchability from incubated snail eggs. Previous study (Ebenso and Solomon, 2004) evaluated egg – water uptake in *A. marginata* snails. The aim of this study was to determine water uptake during incubation of two African giant land snails, *A. marginata* and *A. achatina* that have similar physiological, morphological and adaptation s to environmental conditions.

MATERIALS AND METHODS

Freshly laid eggs were used in this study. These were obtained from gravid snails (Table 1), collected locally from snail breeders (Ebenso, 2002) in Uyo, located within the Cross River Basin

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wetland ecosystem of guinean forest of Niger Delta, Nigeria with mean values of 1500mm rainfall and 90% relative humidity.

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Table 1: Means and SD (±) of mass of snails obtained from various treatments.

Parameter	*A. marginata*	*A. achatina*
Snail shell length	9.90±0.41 (5)[a]	8.00±0.24 (5)
Snail mass (g)	100.52±12.30 (5)	73.39±6.58 (5)
Egg mass at oviposition (g)	1.66±0.22 (25)	1.47±0.06 (25)
Egg shell dry mass (mg/cm^{-2})[b]	3.12±0.22 (5)	2.62±0.18 (5)

[a]Mean and standard error (number sampled)
[b]Egg surface area (cm^{-2}) = $4.835 \times \text{egg mass}^{0.662}$
(Source: Paganelli *et al;* 1974).

The experiment was carried out in plastic boxes (incubation chambers), 0.12 x 0.12 x 0.06m, with lid tightly covered to reduce evaporation. The incubation chambers in duplicates were kept in the laboratory under conditions of temperature cycle of 28°C and 20°C, with a photoperiod of 12 hour light: 12 hours darkness, comparable with temperature and light conditions within the guinean forest wetland ecosystem.

Loam soil dried to constant temperature of 60°C for 48 hours was used as substrate. Homogenous aliquot of the soil (200g) was placed up to 5cm as described by Ebenso (2004) in the chambers to represent six treatments, control (o) and distilled water was added to bring the water content to 5, 10, 15, 20 and 25% w/w (grams water per grams soil, % weight per weight) Calcium source of 5g powdered limestone was mixed onto soil in each chamber.

In each chamber were 3 randomly alloted eggs of each species completely buried in the soil. Eggs were marked with inedible coloured inks for individual recognition. The control chamber (with no water) represented adverse condition during the dry season, while 25% chamber (saturated with water) represented wet soil condition during the rainy season.

At 08 00 hour daily, eggs were weighed (nearest 0.01g) for changes in mass during incubation. According to methods of Andrew and Sexton (1981), when eggs were removed for weighing, each incubation chamber was also weighed separately, and distilled water added (if mass of chamber together with its contents were less than total mass at day 0) to bring the chambers back to its original mass (at day 0). Whether water was added or not, the soil in each chamber was stirred thoroughly (with a glass rod) to distribute the water in the soil.

Experimentation and data collection lasted 31 days when hatching was first notice in both species. Data were analysed for means, ANOUA and regression, according to methods of Steel et al; (1997).

RESULTS AND DISCUSSION

Water uptake by eggs of *A. marginata and A. achatina* during incubation are shown in Figures 1 and 2, respectively. Eggs gained mass on all treatments, except in the control chambers (with no water) that represented the driest conditions. All eggs in the control chambers desiccated during experimental period. In the last ten days of incubation, water uptake increased significantly, $P = 0.05$ (Fig 1 and 2). This is important for successful incubation of eggs. Tracy *et al;* (1978) in their study with lizard eggs, reported that increased heat production by developing embryo might further increase transpirational water loss later in the incubation period. Hence in this study, this had to be compensated for by higher water intake.

Eggs in the two wetter conditions (20 and 25%) died after mould formed on day 12 in these chambers. Water uptake in 25% chambers was lower for both species (Fig 1 and 2). Hatching of an egg was noticed on day 31 of this study for both species (differed significantly, $P = 0.05$) in the 10% incubation chambers. There was inverse relationship ($r = 0.340$; $P = 0.001$) between water uptake of *A. marginata* ($F = 12.27$, $df = 30$; $P = 0.05$) and *A. achatina* ($F = 1.51$, $df = 30$; $P = 0.05$).

Water uptake in 10% chamber in Fig 1 was lower than that in Figure 2. *A. achatina* eggs have higher water potentials than *A. marginata* eggs after oviposition. These are in agreement with the observations of Andrew and Sexton (1981) with reptile eggs, Paganelli *et al;* (1974) with avian eggs and Sexton *et al*; (1964) with amphibian eggs, that with greater density of fibrils, and a thicker matrix of calcium carbonate, egg shells may provide more resistance to movement of water. This interpretation is supported by value of shell dryness values in Table 1, in which eggs of *A. marginata* had a higher shell dryness value than *A. achatina* at oviposition.

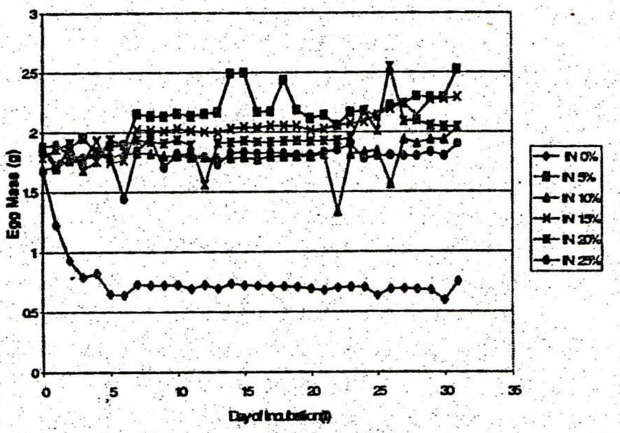

FIG1: Water Uptake of Incubated Archachatina marginata eggs

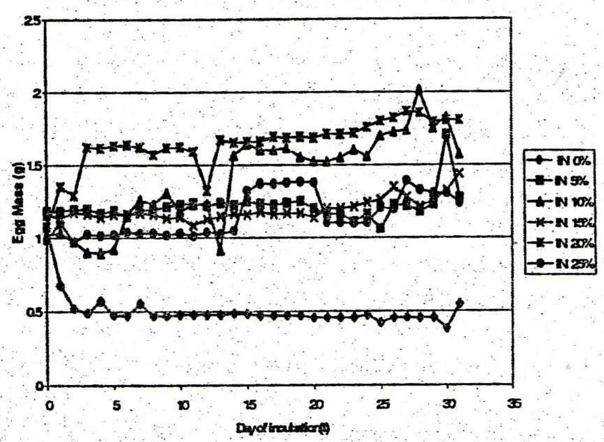

FIG2: Water Uptake of Incubated Achatina achatina eggs

CONCLUSION

This study reveals that, water content of incubation substrate is important for higher hatchability of snail eggs, especially if water becomes more available during the last 10 days of incubation.
Table 1: Data of adult snails and eggs of snail species

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