# FORAGING BEHAVIOUR RESPONSES IN THE AFRICAN GIANT LAND SNAIL *Achatina achatina*

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## Abstract

*The study was carried out to determine the conditioning procedure of tentacle lowering to determine foraging behaviour responses in Achatina achatina. Snails were exposed to unripe fruit odour of paw paw and pear as conditioned stimuli (CS), while they ingested carrot as unconditioned stimulus (US). There were 4 treatments of 10 snails each replicated 3 times. During experimentation (conditioning), all snails ate carrot as US, but exposed to the odour of carrot in control treatment (T1); paw paw in T2; pear in T3; pair of paw paw and pear in T4 as CS respectively. Responses were measured through posterior tentacle lowering to sensory stimuli from experimental vegetable odour during feeding. Results indicated T1 with highest tentacle lowering; T2 indicated an acquisition effect; T3 indicated latent inhibition effect; T4 indicated over shadowing effect between paired odour. The A. achatina demonstrated at least 7 days of odour memory retention. The immediate significance of this study is that snail farmers should feed their stock with a diet in which snails will develop habituation and hence optimal performance.*

**Key words**: *Land snail, tentacle lowering, foraging behaviour*

## Introduction

The principal olfactory organ of terrestrial snails is located at the tip of the posterior (superior) tentacles. Snails sample the environment by moving their head, thus their tentacles from side to side in tandem movements that are smooth but neither periodic nor stereotype (Chase, 1982). The tentacle retractor nerve is entirely responsible for carrying the central motor signal from the initial, fast component of the tentacle withdrawal.

There are two types of tentacular movements, twitch and quiver. A twitch is a brief retraction sufficient to cause disappearance of the eyespot, while a quiver is a rapid sideways movement involving mainly the tip unaccompanied by retraction (Chase and Lamaire, 1998). Snails exhibit high level of tentacle lowering when they feed (Loy *et al.,* 2006). Bending of the tentacles occur during withdrawal of tentacle as well as during the orientation to learned food odour.

According to Unglass, (2001) it seems likely that the learning process associated with odour and unilateral consequences are important because an animal come to establish its dietary preferences. In nature, we rarely observe a conditioned reflex in as "pure" a form as in the laboratory (Manning, 1980). However, Gillette *et al.,* (2000) reported an underlying mechanism in the dynamic organization of foraging behaviour, suggesting that, a snail can predict the cost-benefit values of feeding attempts from the appetant and noxious characters of a stimulus and as own state of satiation. The terrestrial slug *Limax valentianus* has a highly developed ability to acquire an aversive response to the odour of some food once it is presented in combination with an aversive stimulus (Sahley *et al.,* 1981).

Foraging behaviour in snail is less affected by sexual arousal (Ebenso *et al.,* 2002), but responses are modified if snails are exposed to toxic feed (Ebenso *et al.,* 2004; Ebenso and Ebenso, 2011). According to Omole *et al.,* (2011), snails should be fed cheap house hold waste and industrial agro-by products. The conventional feeds of snails are mainly of plant origin, especially fruits and leaves of pawpaw, mango (Odunaiya, 1991; Akegbejo and Akinnusi, 2000; Ebenso and Okafor, 2002).

Conditioning in invertebrate has provided important information relevant to the understanding of the physiological bases of learning and memory (Burrell and Sahley, 2001).

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The aim of this study was to establish the reliability of tentacle lowering during foraging (feeding) as a learning procedure in *Achatina achatina* under controlled laboratory conditions.

## Materials and Methods

The *A. achatina* snails (20.00±0.50g) from wild population were housed in plastic snaileries 12 x 12 x 8.5cm$^3$ on the laboratory bench under controlled laboratory conditions of temperature 25$^o$C, relative humility 75% and photoperiod of 12hrs light: 12hr darkness. Snailery had their lid covered with mosquito netting. Plastic sample bottle with a 1cm diameter hole perforated on the bottle cover was used as apparatus in which a slice of fruit was placed for snails to perceive fruit odour, but without access to taste/bite the fruit.

Prior to commencement of experimentation, snails were starved for 2 days while at the same time subjected to a sensory pre-condition stimulus effect of paw paw odour. At the commencement of experimentation, snails were randomly assigned to 4 treatments with 3 replicates; each replicate consisted of 10 snails. On day 3, immediately prior to conditioning, the snails were dipped in water for 1 min, according to Ebenso and Ikon, (2007), snails become active upon sensory stimuli of contact with water. Snails were then returned into the snailery.

An aversive conditioning procedure was employed in which odour from unripe fruit was used as the condition stimulus (CS), presented in plastic sample bottle, while a taste/ingestion of carrot was used as the unconditioned stimulus (US). Control treatment (T1) had carrot; T2 had paw paw; T3 had pear; T4 had a pair of paw paw and pear as CS respectively. All snails were allowed to taste/ingest US (10cm in diameter) 6hrs after learning of the CS. The conditioning lasted 4 days.

On the 7$^{th}$ day all snails were subjected to memory retention test with paw paw as CS following same procedure as above.

Each response was scored as the movement of the posterior tentacles below an imaginary line over the top of the snail's head. The number of responses was recorded 1hr daily during stimuli presentations.

Data collected are presented as means using descriptive statistics according to methods of Steel and Torries, (1980).

## Results and Discussion

Snails did not show high level of tentacle lowering before conditioning rather higher level of response were recorded on the 7$^{th}$ day (memory retention test) after conditioning (see Figure 1). According to Teyke, (1996) *Helix aspersa* showed that naïve snails recorded inferior tentacles lowering in response to novel odours. *Limax* holds memory for 7 days at least (Kasai *et al.,* 2006).

In Figure 2, the lowering of tentacle by *A. achatina* in T2 was inferior when compared with the control. This was similar to results of Loy *et al.,* (2006), these authors postulated that *H. aspersa* were found to lower their tentacle when they perceived the odour of the CS that was paired with the eating of carrot, and thus condition response was not due to attenuation of response habituation. This effect is known as acquisition.

The *A. achatina* in T3 recorded the least values of tentacle lowering in this study, affirming consistently fewer condition responses than in other treatments. According to Lubow, (1989) when a subject is repeatedly exposed to a neutral stimulus, subsequent conditioning is retarded, this effect is known as latent inhibition, therefore snails in T3, are said to reflect a loss of attention to a familiar stimulus, presumably an irrelevant odour.

In T4, this involved pairing of pear and paw paw odour in which the results indicated tentacle lowering was higher than in T3 but inferior to snails in T2. As proposed by Rescorla and Wagner, (1972) the pairing of odour led to the formation of an association between the odours and the nutritional consequences of eating carrot. It appears that odour of pear overshadowed the memory of paw paw odour, hence snails showed less appetitive response than the controlled snails.

## Conclusion

Associative learning has played a role in the snails foraging behaviour, and that dietary preference may be linked to prior odour training. This research will suggest that contrary to feeding of combinations of vegetables as diet (not even household waste), snail farmers should feed a diet that snails developed dietary preference and habituation at a time.

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**Figure 1: Tentacle Lowering during pre and post conditioning of *A. achatina***

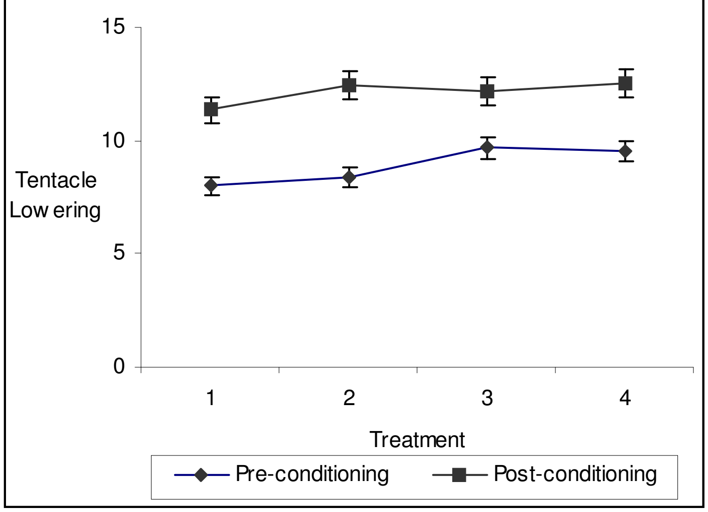


**Figure 2: Tentacle Lowering during conditioning of *A. achatina***