

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

Ebenso, I. E.¹ * and Adeyemo, G. O.²

¹Department of Animal Science, University of Uyo, Nigeria

²Department of Animal Science, University of Ibadan, Nigeria

*Corresponding author: imeebenso@yahoo.com

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 a 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 data of posterior tentacle lowering. 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.

Keywords: Land snail, tentacle lowering, foraging behaviour

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 Lemaire, 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 and 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 exposes to toxic feed (Ebenso *et al.*, 2004). Conditioning in invertebrate has provided important information relevant to the understanding of the physiological bases

of learning and memory (Burrell and Sahley, 2001).

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 ± 0.50 g) from wild population were housed in plastic snaileries $12 \times 12 \times 8.5$ cm³ on the laboratory bench under controlled laboratory conditions of temperature 25°C, relative humidity 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 and then returned into the snailery, while being placed on their sides to induce activity.

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 7th 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 7th day (memory retention test) after conditioning (see Figure 1).

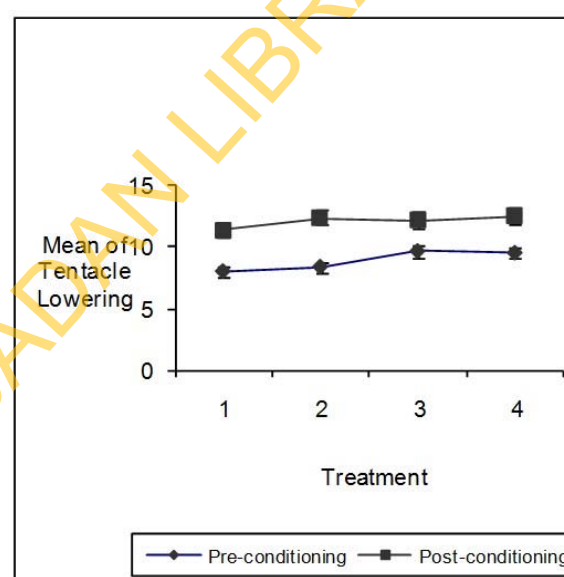


Figure 1: Tentacle Lowering during pre and post conditioning of *A. achatina*

According to Teyke, (1996) *Helix aspersa* showed that naïve snails recorded inferior tentacle 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.

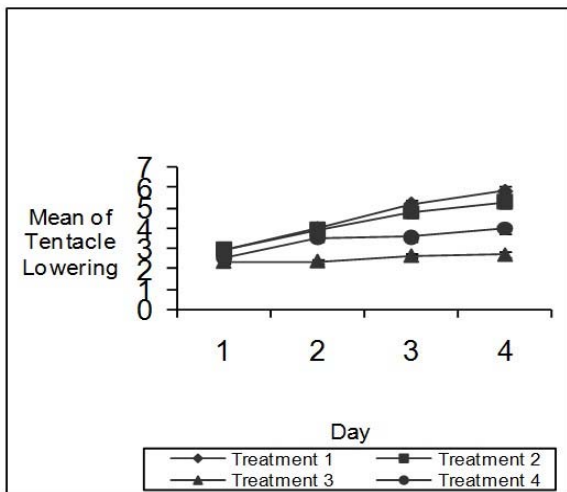


Figure 2: Tentacle Lowering during conditioning of *A. achatina*

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 be feed a diet that snails developed dietary preference and habituation at a time.

REFERENCES

- Burrell, B. D. and Sahley, C. L. (2001). Learning in simple systems. *Current Opinion In Neurobiology* 11: 757 - 764.
- Chase, R. (1982). The olfactory sensitivity of snails *Achatina fulica*. *Journal of Comparative Physiology*. 148: 225 – 235.
- Chase, R. and Lemaire, M. (1998). Twitching and quivering of the tentacle during snail olfactory orientation. *Journal of Comparative Physiology* 182: 81-87.
- Ebenso, I. E., Isaac, L. J. and Obasi, O. L. (2002). Mating behaviour of African giant land snail *Archachitina marginata*. *Nigerian Journal of Forestry* 32(1): 72-75.
- Ebenso, I. E., Chukwu, S., Udo, S., Ukpai, C. U., Udo, M. T., Umanah, U., Isang, A. and Akam, A. (2004). Some behavioural responses of *Limicolaria aurora* exposed to gramoxone. *Nigerian Journal of Physiological Sciences* 19 (1-2): 82-85.
- Gillette, R., Huang, R. C., Hatcher, N. and Moroz, L. L. (2000). Cost-benefit analysis potential in feeding behaviour of a predatory snail by integration of hunger, taste and pain. *Neurobiology* 97 (7): 3585-3590.
- Kasai, Y., Watanabe, S., Kivino, Y. and Matsuo, R. (2006). The procerebellum is necessary for odour-aversion learning in terrestrials slug *Limax valentianus*. *Learning and Memory* 13: 482-488.
- Loy, I., Fernandez, V. and Acebes, F. (2006). Conditioning of tentacle lowering in the snail (*Helix aspersa*); Acquisition, latent inhibition, overshadowing, second-order conditioning and sensory pre-conditioning. *Learning and Behaviour* 34 (3) 305-314.
- Lubow, R. E. (1989). Latent inhibition and conditional

- attenuation theory. Cambridge University Press, Cambridge.
10. Manning, A. (1980). An introduction to animal behaviour, 3rd edition. The English Language Book Society, London.
 11. Rescorla, R. A. and Wagner, A. R. (1972). A theory of pavlovian conditioning. Current Research and Theory. Appleton Press, New York.
 12. Sahley, C. L., Gelperin, A. and Rudy, J. W. (1981). One-trial associative learning modifies food odour preferences of terrestrial mollusks. Proceedings of National Academy of Science 78: 640-642.
 13. Steel, R. G. D and Torrie, J. (1980). Principle and procedure of statistics. A biometric approach, 2nd edn. McGraw-Hill, New York.
 14. Teyke, T. (1996). Food attraction conditioning in the snail *Helix pomatia*. Journal of Comparative Physiology 177: 409-414.
 15. Ungless, M. A. (2001). Dissociation of food finding and tentacle lowering, following food attraction conditioning in snail *Helix aspera*. Behavioural Processes 53: 97-101

UNIVERSITY OF IBADAN LIBRARY