March 2013. Vol. 2, No. 4 ISSN 2305-8269

International Journal of Engineering and Applied Sciences

www.eaas-journal.org

ENVIRONMENTAL TOXICITY OF BLACK TONER WASTE ON THE GROWTH PERFORMANCE OF *ACHATINA ACHATINA* (GIANT TIGER LAND SNAIL) SPECIES

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ABSTRACT

The effect of black toner waste (BTW) on the growth performance of *Achatina achatina* was investigated. The snails were reared in specially constructed cages. The experiment lasted for 6 weeks during which various growth parameters (body weight, feeding ability), and body measurements (shell length, shell width), were measured. Results showed that snails treated with 5%, 10%, 20%, 40% black toner waste (BTW) were not significantly different ($p>0.05$) with the control. It is therefore concluded that the treatment of snails with black toner waste (BTW) does not have any harmful effect on the growth characteristics of *Achatina achatina* snails (AAS).

KEYWORDS: Black toner, *Achatina achatina* snails, Environmental, Toxicity, Growth, Traits

INTRODUCTION

Achatina achatina are the spirally coiled shaped gastropods and are the largest land snails in the world, they are widely sought after due to their sizes, dictinct marking and lack of availability, they are more difficult to breed than other African snails. These snails can be found within the dense forest floors in the forest zone of Ghana and also in humid riparian forest floor (Abwak, 1980). They are believed to have a 3 years breeding cycle which is longer than other snails. This coupled with deforestation and snails picking for consumption has caused the number to dramatically fall over the last 10-15 years in West Africa and in Ghana this snail is considered by many people to be the most prize snail (Dutta, 1979). Report by local people suggest that at one time snails were in abundance and could be picked from anywhere including people's garden. But the people indiscriminately eat these snails of any size, nowadays giant African snails caught in recent times are on average much larger than in past, suggesting that, they are breeding less, and the juvenile are not surviving and breeding population is vastly reduced. Among soil invertebrates, terrestrial snail *A. achatina* are herbivorous and detritivorous organism exposed to polluted soil by both digestive and autonomous routes. Several ecotypes (locally adapted populations of *A. achatina*) can be found, with differences in growth rates, size, aestivation (dormancy) patterns, colour and even flavour. The differences in size may be explained partly by differences in the length of the aestivation period; the shorter the aestivation period, the longer the feeding period and the larger, therefore, the ecotype. The species prefers warm conditions, 25-30 °C and a relative humidity of 80-95%. *A. achatina* is said not to be the easiest species to farm because of the very steady conditions it is used to in the wild: a practically constant 12/12 photoperiod, only extending to 13/11 for about 3 months, and a temperature difference between night and day of only 2-4 °C. Even in the most humid areas of West Africa the snail, in its natural habitat, buries itself for aestivation during the drier months.

International Journal of Engineering and Applied Sciences

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***Achatina achatina* snails**

Black toner can be washed off from skin and garments with cold water, hot or warm water soften the toner, causing it to bond in place. Toner fused to skin eventually wears off, or can be partially removed using abrasive hand cleaner. Toner particles have electrostatic properties by design and can develop static- electric charges when they rub against other particles, objects or the interior of transport systems and vacuum hoses. Because of this and the small particle size, toner should not be vacuumed with conventional home vacuumed cleaner (Morawska *et al*., 2007). A static discharge from charged toner particles can ignite in the vacuum cleaner bag or create small explosion if sufficient, toner is airborne. This may damage the vacuum cleaner or state a fire (Kittelberger *et al*., 2003). Toner waste exposed to air can cause environmental impediment on human health resulting to respiratory tract infect and most especially people suffering from asthmatic condition may seriously be affected during inhalation. An unpublished study at the university of Rostock in Germany is reported to have found that the microscopic particles in toners are carcinogenic; similar to abestor. Several technicians who had been moving with printers and copiers on a daily basis have been observed for several years developing lung problem (Mahabadi *et al*., 2006). Interestingly, this present study was aimed at assessing the growth performance of *Achatina achatina* on black toner waste polluted soil.

MATERIALS AND METHODS

Experimental site

The experiment was carried out at the Botanical Garden, University of Calabar, Calabar. The environment is surrounded by trees which then provide shade, by providing a cool and conducive environment for snail rearing.

Experimental Animal

Sixty *Achatina achatina* snails (AAS) comprising of 12 in each treatment (5%, 10%, 20% and 40% of carbon waste with a control) the snail weighed between 18-23 grams. The criteria for selection were based on appearance, activity and snail completely fill the shell and snails with the same size were selected.

International Journal of Engineering and Applied Sciences

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Experimental diet

These snails were fed with experimental diet compounded with 19.01% of crude protein and 2980kcal/ME. The protein and energy like starch cellulose, hemicelluloses and peptic substance. They contain polysaccharide and monosaccharide, involving photosynthesis by leaves in carbon dioxide accordance with the requirement state. The diet were supplemented with pawpaw leaves (*Carica papaya*)

Composition of the experimental diet

Ingredient	Percentage (%)
Fresh palm fruits	60.50
Soybean	20.00
Bone meal	10.45
Vitamin	9.05
Total	100

Experimental procedures

The snails were reared in cages comprising of 24 compartments. The cage was made of wooden frame with the based lined with wire mesh such that the base is perforated to permit good drainage. The cage had a length of about 80cm wide and 30cm deep in each compartment. Standing 10cm from the ground with the legs placed in cans partly filled with condemned engine oil to keep away predators. The cover of the cage was hinge, fixed with hinge, staple and padlock, at the start of the experiment, the snails weigh 15-20g. The soil that was used was sterilized to kill microorganisms which may cause harm to the snails. Sterilized soil was used as a bedding material inside the subdivided compartments. The soil was poured to level of 15cm deep and water sprinkle to moisten the environment. The snails were kept 3 in each compartment for two weeks, this is to enable the snail adapt to the new environment. The compounded feed was given to the snails' everyday and pawpaw leaves. The left over feed were collected for measurement. Body weight was measured using weighing balance scale and vernier caliper was used to measure shell length and width.

Data collection and analysis

The snails weighed at the start of the experiment and every seven days thereafter, data were collected on the body weight, feeding ability, shell length, shell width.

Data collected were subjected to analysis of variance (ANOVA) using a completely randomized design. The significant means were separated using least significant difference (LSD) test.

RESULT AND DISCUSSION

Weight of juvenile

The result on the juvenile weight of the snail in each treatment group shows no significant difference ($p>0.05$). The mean weight of the snail treated with 5% of BTW was 18.9±0.27, 10% treatment had a mean of 19.05±0.25, 20% treatment had a mean of 19.08±0.30, 40% treatment had a mean value of 19.45±0.25 and 19.75±0.39 in the control group. This is in line with the work of Ahmed (1991) who reported the weight of 150 juvenile snails of *Achatina achatina* species as 0.71g (0.10-0.15g) there was significant difference ($p<0.01$) between the concentration or treatment. The no significant effect recorded in this work is an indication that the black carbon toner waste does not have any mutative or deleterious effect on the weight of the snail, which however implies that this waste may not have any effect on the weight of human who may directly or indirect come in contact or consumed the waste.

Weight gain

The weight gain for juvenile in each treatment after 7 days shows that there were no significant difference ($p>0.05$) in the mean weight gain. The treatment of the snails with 5% of the black toner waste had a mean weight gain of 2.10±0.24, 10% treatment had a mean of 3.05±0.79, 20% had a mean weight gain of 1.70±0.76, 40% treatment had a mean of 0.95±0.16 and 0.40±0.18 for the control group. This result correspond with the report of Aoki (1978) who reported weight gain of 0.5g for Achatina fed with concentrated diet and plant food. There was significant difference ($p<0.05$) in weight gain between the juveniles in treatment. From the result of this analysis it implies that the BTW contributed to the weight gain of the snails as compared with the control values.

Percentage Feeding intake

The result of the analysis indicated that there were significant difference ($p<0.05$) in the percentage feeding intake of the snail in the treated groups. The mean values of the control group was 9.28±0.11% significantly ($p<0.05$) higher, than 5%, 10%, 20%,

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40% have mean values of 6.25±1.55, 7.20±0.13, 6.78±0.11, 5.78±0.11 respectively. This values differs significantly ($p<0.01$) from that reported by Bequaert (1950), who reported 5.75g/d for *Achatina achatina*. The reason for the difference could be due to the composition of the compounded feed.

Growth rate

It was observed from the result obtained that there were no significant difference ($p>0.05$) in the growth rate of *Achatina achatina*. The mean values of the group treated treatment with 5% of black toner waste was 0.16±0.02, group treated with 10% black toner waste was 0.16±0.03, the treatment of 20% black toner waste was 0.18±0.03, while 40% treatment group had a mean of 0.19±0.01 and the control had a mean value of 0.17±0.02. Abwak (1998) reported that the growth rate of juvenile snail was much but changes for the first six months. Initial growth was 0.7 in 5%, 0.8 in 10%, 0.7 in 20%, 0.9 in 40% and 0.9 in control.

Shell length

The snails in 5% treatment with black toner waste had a shell length ranged from 4.2cm to 5cm and 10% had 4.0cm to 5.3cm, 20% had 4.0 to 5.5cm, 40% had a ranged of 4.3 to 3.4cm, and the control had a ranged of 4.5 to 5.8cm. There were significant difference ($p<0.05$) between the four treatments, the reason for this difference can be due to the supplementary feeding. This is in accordance with the report of Affa (2001) who stated that snail that feed on pawpaw leaves were reported to have better shell length than those fed with other diet such as bone meal etc. the initial shell length of juvenile snails of *Achatina achatina* was 4.2cm in 5%, 4.2cm in 10%, 4.1cm in 20%, 4.2cm in 40% and 4.3cm in control.

Shell width

The juvenile *Achatina achatina* had a shell width ranged from 2.0 to 3.0cm in 5%, 2.2 to 3.0cm in 10%, 2.3 to 3.1cm in 20%, 40% ranged from 2.5 to 3.2cm while the control group ranged from 2.0 to 3.2cm. There was no significant difference ($p>0.05$) between the various treatment levels. The difference could be attributed to the environment. This conformed with the report of Abwak (1980) who illustrated that if the environment is made conducive for the juvenile snails and the rate of the food intake is increased the shell width will increase. The initial shell width of the snails was 1.5cm in 5%, 1.7cm in 10%, 1.9cm in 20%, 1.8cm in 40% and 1.9cm in the control group.

CONCLUSION

It can therefore be concluded that the different concentrations of black toner waste used in the study did not significantly affect the growth performance of the snails.

Table 2 Growth performances of *A. achatina* snails (AAS) treated with black toner waste (BTW)

Growth parameters	5% BTW	10% BTW	20% BTW	40% BTW	Control
Body weight	18.9^{a}±0.27	19.05^{a}±0.25	19.8^{a}±0.30	19.45^{a}±0.25	19.75^{a}±0.39
Final body weight (g)	21.00^{a}±0.50	22.10^{a}±1.04	20.78^{a}±1.04	20.4^{a}±0.16	19.23^{a}±0.5
Weight gain	2.1^{a}±0.24	3.05^{a}±0.79	1.70^{a}±0.76	0.95^{a}±0.16	0.4^{a}±0.18
Feed intake	6.25^{d}±1.55	7.2^{b}±0.13	6.78^{c}±0.11	5.78^{e}±0.11	9.28^{a}±0.11
Growth rate	0.16^{a}±0.02	0.16^{a}±0.03	0.18^{a}±0.03	0.19^{a}±0.01	0.17^{a}±0.02
Reproductive egg weight	0.82^{a}±0.05	0.86^{a}±0.04	0.79^{a}±0.02	0.81^{a}±0.03	0.79^{a}±0.02

Means with different case letter on the horizontal array indicates significant difference ($p<0.05$).

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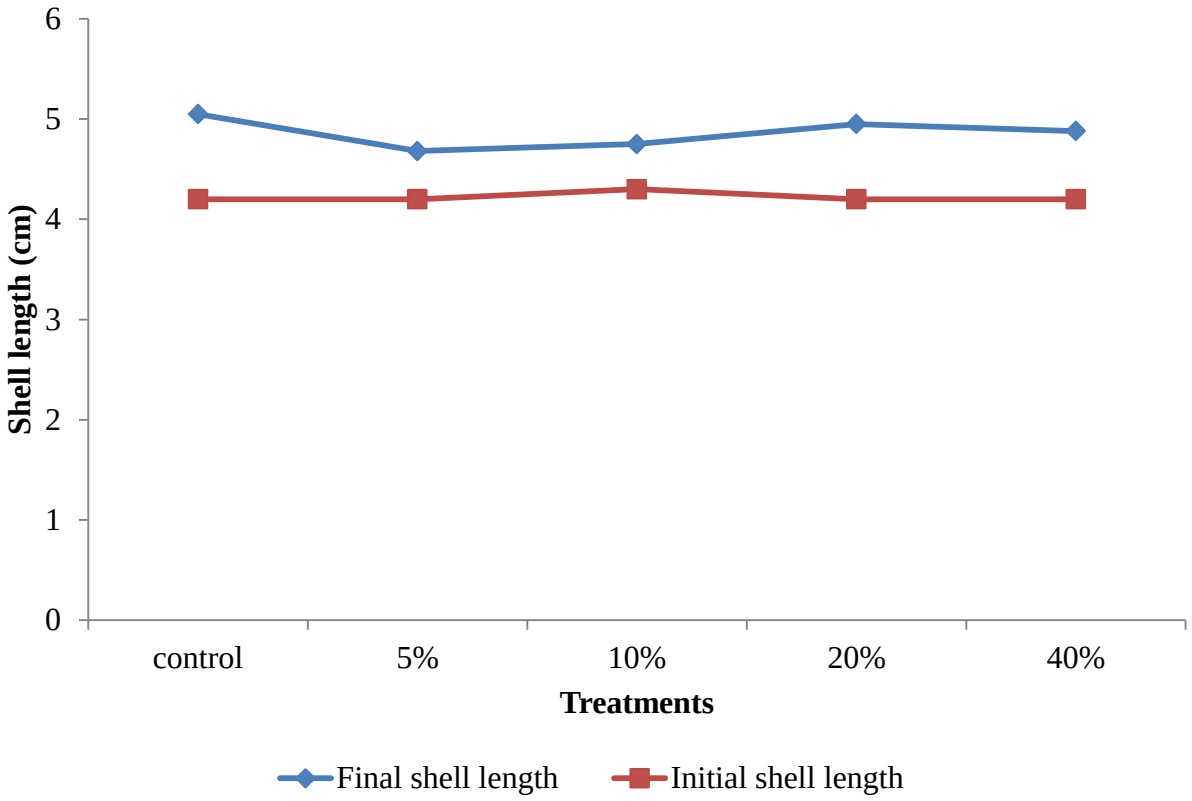

Fig. 1: Effect of black toner waste on the shell length of *Achatina achatina* snails

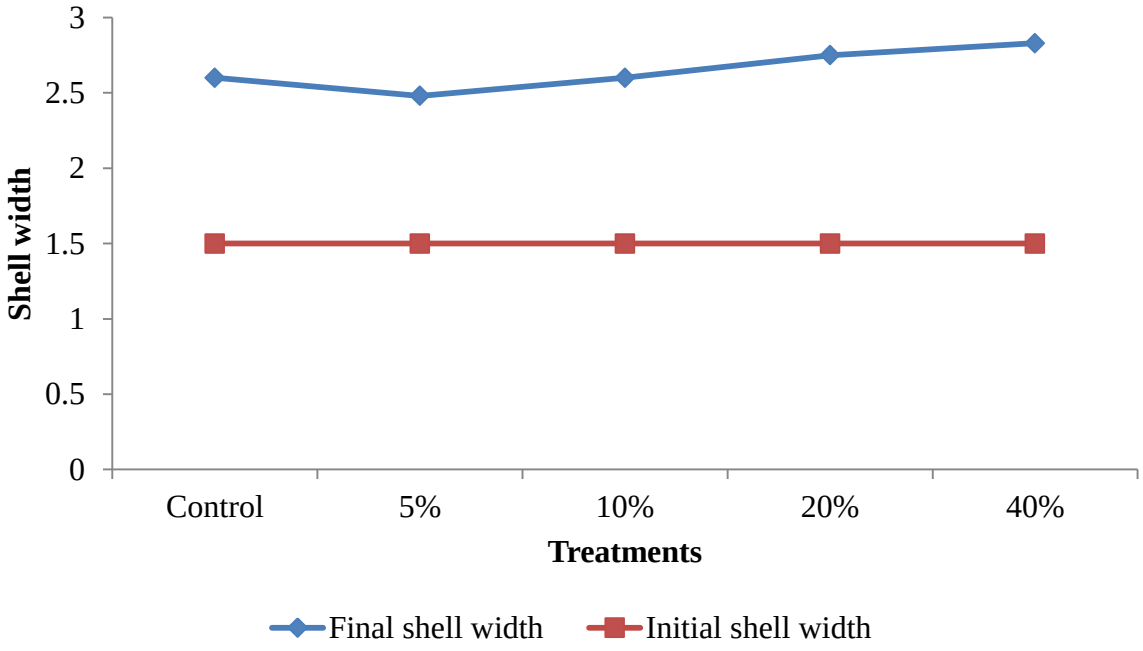

Fig. 1: Effect of black toner waste on the shell width of *Achatina achatina* snails

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