CASSAVA AND COCOYAM PEELS SUBSTITUTION FOR MAIZE IN THE DIETS OF AFRICAN GIANT LAND SNAIL

(*Archachatina marginata*)

BY

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CERTIFICATION

We certify that this study was carried out by EHIGIE OSAROBO HENRY in the Department of Fisheries and Wildlife, School of Agriculture and Agricultural Technology, Federal University of Technology, Akure.

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DEDICATION

This research work is dedicated to the Almighty God who gave me strength and encouragement to complete the work, including my parents Deacon and Mrs. E. O Arase.

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Dr. K. Oke is not left out of the econium for his advice and accommodation.

Finally I give praise to the Almighty God for all He has done and all He is yet to do.

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ABSTRACT

Two experiments were conducted to determine the performance of African land giant snail *Archachatina marginata* fed varied levels of cassava peels and cocoyam peels in replacement for maize. Four diets were compounded for each peels at 0%, 20%, 40% and 60% and fed to juvenile A. *marginata* replicated three times for 14 weeks in 24 perforated baskets containing 4 samples each i.e. 12 baskets for each experiment . Growth performance and nutrient utilization based on body weight gain, shell length, shell breath, shell thickness, feed intake, feed conversion, and carcass characteristics were determined. In the result of snails fed cassava peels there was no significant difference ($P > 0.05$) among the final mean shell thickness, and the feed conversion ratio. But there was significant difference ($P< 0.05$) in the final mean weight gain, final mean feed intake, final mean shell length and the final mean shell breadth, between diets 0%, 40% and 60%.

The result for the snails fed cocoyam peel showed that there was significant difference ($P< 0.05$) in the final mean shell length between diets 40% and 60%. While there was no significant difference ($P>0.05$) among the final mean weight gain, final mean feed intake, final mean shell thickness, final mean shell breadth and the feed conversion ratio. Feed efficiency decreased with the increased level of cassava and cocoyam peels in the diet.

It is concluded that at lower levels cassava and cocoyam peels could be used to replace maize in the diet of African giant land snail without any adverse effects.

CHAPTER ONE

INTRODUCTION

The term Wildlife implies all things that are living outside the direct control of man and therefore includes all non-cultivated plants and non domesticated animals (Ayodele *et. al.* 1999). Ajayi (1979) has estimated that wildlife meat which includes various insects, caterpillars, maggots, snails, snakes, rodents, monitor lizard and various antelopes, accounts for between 20-90% of animal proteins consumed by people living in the coastal regions of West Africa.

In Nigeria one of the main national wildlife management objectives is the production of "bush meat" to increase the animal protein available in rural and urban areas of Nigeria with particular emphasis on rural areas (Afolayan, 1987). Prior to the findings of FAO (1996), the present animal protein intake per day per individual in Nigeria was about 60g as against the recommended rate of 200g/individual/day. And taking a critical look at the patterns of animal protein production in Nigeria, it appears that improvement is necessary and indeed desirable for a variety of indigenous species. According to Ayeni and Ajayi (1983) the only virgin area hitherto non-conventional animal protein resource capable of solving the shortage in the animal protein demand is wildlife domestication and farming. CTA (1991) has warned that such wildlife farming must be the ones already existing in the area i.e. local species, because non-indigenous animal could become serious pest and might not be able to adapt to the environmental condition. Therefore one prominent promising local species available here in Nigeria is the African giant land snail *Archachatina*

marginata found mostly in cool moist environment of the forested region of the country and West Africa in general.

Socially well accepted in many parts of the country, snail meat which is commonly known as "Congo meat" is consumed in most meals and snack in fast food especially in the Southern part of the country. (Bubu, 1993). It belongs to the family of mollusks, some other members of which are slugs, periwinkles, whelks, mussels, oysters, e.t.c. Many species of snails are recognized in Nigeria but the most common ones are *Achatina* species and *Archachatina* species. They are mostly found in cool moist environments especially in burrows (Bubu, 1993).

The growing interest in snail farming (heliculture) has created more pressing need on information regarding its husbandry. Though snails are slow-growing animals, but with patience and good management they will bring a substantial reward on the long run. Portsmouth (2001) saidthe African giant land snail is prized as a source of protein in the diet of many African tribes and has been introduced to many tropical areas such as Thailand, Hawaii and many pacific Islands where it is now considered as pet. In these countries more laws are in force forbidding the ownership of these animals as pets.

There are three main systems of snail farming which are, extensive system (out door pasture) semi-intensive (outdoor fed and indoor fed) and intensive system (indoor fed) The extensive system allows very little control over the performance of the snails, on weeds, diseases and parasites. It requires low labour and general management input, mostly fed on natural food materials. The outdoor fed (Semi intensive system) is a combination of the pasture and the indoor system fed on natural and synthetic diets

(Amusan and Omidiji, 1999). The yield is low. The indoor (intensive system) is regarded as the best system for snail domestication. Here snails are fed with concentrates and sometimes with a mixture of fresh vegetables. Though capital intensive, utilizes small space with enough ventilation and good sanitation (Bubu, 1993).

1.1 JUSTIFICATION

The need for the study is of great significance because the cost of animal production is very high due to exhorbitant prices of feeds. As a result of this, the average Nigerian hardly has access to animal protein, in order to curb this trend, scientists are now looking into the use of farm waste products to replace conventional feed ingredients, so as to reduce the cost of production. With this ultimate aim of increasing animal protein production, it is hoped that eventually there will also be an increase in animal protein in-take in Nigeria.

Cassava and Cocoyam peels are waste products which are produced in farms with little or no monetary value, so their use in snail feed production will greatly reduce the cost of snail production. And few studies have been done on their use in animal production in this part of the world in the past, therefore, there is an urgent need for this study.

1.2 OBJECTIVES

The general objective is to determine the effect of replacing maize with different levels of cassava and cocoyam peels in the diet of snails.

The specific objectives are to determine:-

i the performance of snails fed varied levels of cassava and cocoyam peels.

ii the optimum levels of cassava and cocoyam peels substitution in the snails diet.

iii the carcass characteristics of snails fed cassava and cocoyam peels in the diets.

CHAPTER TWO

LITERATURE REVIEW

2.0 Taxonomy of *Archachatina marginata.*

Classification-

Kingdom – Animalia

Phyllum – Mollusca

Class – Gastropoda

Subclass – Pulmonata

Order – Stylommatophora

Suborder – Sigmurethra

Family – Achatinidae

Genus – *Archachatina*

Specie – Marginata

Common name – African Giant Land Snail

Source: The World Book Encyclopedia, (1997), Meglitsch and Federick (1991).

2.1 Origin and Distribution of African Giant Land Snail

The African giant land snail is a native of the continent of Africa, they vary in sizes, colour, adaptability and performance (Amusan *et al,* 1999). In South Western Nigeria, *Archachatina marginata* or African giant land snail is the most common breed reared and readily found in the market throughout the year.

Segun (1975) stated that the African giant land snail is the largest among the terrestrial Gastropoda living in Africa. This snail species is found mostly in the high forest zone and also inhabits the moist area of the riparian vegetation in the savanna area.

Ajayi, (1979) reiterated that Land Snails habitat ranges from the dense tropical high forest in Southern Nigeria to the fringing riparian forests of the derived Guinea Savanna.

2.2 Ecology of Land Snails

Snails live almost everywhere in forests, deserts, rivers, ponds, and all parts of the ocean. They can be divided into three groups, according to where they live on land, fresh water or in salt water. Land snails are found in damp, shady places under logs and stones, at the edges of ponds and rivers, and in woods, while some live on the ground, but in tropical forests, many large colourful kinds are found in the trees. All land snails have lungs, subclass (Pulmonata). Freshwater snails live in rivers, ponds lakes, and hot springs. There are about 5,000 kinds of fresh water snails, some of which have lungs and breath in oxygen from the air by coming to the surface of the water. Others have gills, which take in oxygen from the water subclass (Prosotranchia or the Opisthobranchia). Salt water or marine snails are the largest group of snails. There are about 55,000 kinds, while some live along the seashore, some live on the ocean floor in the deepest parts of the ocean (The World Book Encyclopedia, 1997).

Annette (2002) stated that the ideal temperature for a snail's tank should be between 18^{0c} and 29^{0c} -the best temperatures are from 21-23^{0c}. Also Cobbinah (1983) concluded that snails are cold blooded and therefore sensitive to changes in atmospheric humidity and temperature. They thrive best in areas which have moderate temperatures and high humidity. In West Africa region temperatures where

most edible species are found do not fluctuate greatly, but when humidity falls below 75% especially in the dry season the snails become inactive.

2.3 Soil Characteristics

Cobbinah (1983) reported that sandy soil, with a low water holding capacity and acidic soils should be avoided. Soils with high organic matter support the growth and development of snails and the calcium and water content should be high. Soil is important for snails in the wild, at times they live on the soil, while at other times they live in the soil. And when snail are not in the soil they are in the plants which grow on the soil, therefore the soil must be good and rich in nutrient for the kind of plants that snail wants. When snails are in the soil they are either resting or laying eggs as a result the right amount of water must be present for the hatchlings to come out of the soil easily. Snail finds it difficult to dig clay soil because of its hardness while sandy is equally not favourable to them because it does not retain water for eggs to hatch.

2.4 Aestivation of Land Snail.

Aestivation is a physiological way by which land snails shrink back into their shell and covered by a thin whitish membrane called epiphragm formed from a calcified slime (Segun, 1975). Amusan and Omidiji (1999) defined aestivation as a state of dormancy that occurs when the relative humidity of the environment is very low as in the dry or warm season (i.e less than 75%). The snail becomes in-active, seals itself into its shell with a white calcareous layer (epiphgram) and aestivates to prevent total loss of water from the body. Domesticated snails should not be allowed to aestivate for a long time and this is made possible by constant watering of the pens

or cages with enough food. Snails do not grow or produce eggs during aestivation, which further lead to death if aestivation is unduly prolonged.

2.5 Food and Feeding Habit of *Archachatina marginata.*

For a successful snail farming feeds and feeding are an important requirement. Portsmouth (2001) reported that snails are vegetarian. Most snails will eat pawpaw leaves and fruits, lettuce, cabbage, salad vegetables, cucumber, and cuttle fish bone for calcium e.t.c. The following food items are recommended by Cobbinah (1983) leaves: Cocoyam, Kola, *Bokoboko*, paw-paw, cassava, Okra, eggplant, *loofa*, centrosema, cabbage and lettuce. Fruits: Pawpaw, Mango, banana, egg plant, pear, oil palm, fig, tomato and cucumber. Tubers: Cocoyam, cassava, yam, sweet potato and plantain flowers: pawpaw e.t.c.

Amusan and Omidiji (1999) formulated a compounded ration that comprises carbohydrates – 46%, protein 41%, Fat – 11%, Minerals 1.6%, Vitamins – 0.4%, for snail feeding. They fed at night mostly or early in the morning. Generally a snail can consume 3-4% of its body weight of food per day, which means a snail weighing 100gm will require 3-4gm of food per day for proper growth and regular production.

Ejidike (2001) reported that two complete rations containing 20% or 25% crude protein were fed to African giant land snail *Archachatina marginata* and compared with the same specie of snails fed a supplemental diet of pawpaw leaves (reference diet). The result stated that there was no significant difference among the final mean weight of the snails. Mortality was zero percent in all the treatments with no significant differences among each parameter.

Hamzat and Longe (2001) reported that four treatments were fed on snails i.e A (fresh pawpaw leaves), B (fresh Kola testa,), C (fresh water leaves), and D (fresh maize chaffs). The result showed that there were no significant differences ($P > 0.05$) in feed intake, shell breadth and carcass analysis of the snails. But statistical significance ($P < 0.05$) occurred in weight gain, aperture radius and shell length. Performance and carcass parameters studied were best on diet A> B> D> C in that order, therefore establishing that it is highly advantageous to feed fresh Kola testa to snails under Kola plantation most especially by way of adequate utilization of Kola testa which is hither to wasted in Kola farms in Nigeria.

Kehinde *et al* (2002) discovered that *Archachatina marginata* fed with rations containing 10% and 15% levels of pawpaw leaf and fruit were significantly different ($P < 0.05$) in the efficiency of feed utilization, feed to gain ratio and feed intake. While weight gain was not significantly affected ($P > 0.05$), thus showing that growth rate and weight gain were not adversely affected.

The findings of Adeyemo and Akeredolu (2002) showed that snails raised on compounded feed had the highest body weight gain but this was not significantly different ($P > 0.05$) from those fed Cocoyam and waterleaves. The snails fed potato leaves had significantly lowest ($P > 0.05$) body weight gain. Mean flesh weight of snails fed compounded diets and Cocoyam leaves were 158 ± 4.04g, respectively ($P > 0.05$). These were significantly different from those fed water leaf (140 ± 1.00g) and sweet potato leaf (139 ± 1.10g). It was concluded that African giant snail can be raise successfully on Cocoyam leaf without adversely affecting performance.

Adu *et al,* (2002) stated that T1, T2 and T3 were snails fed with pawpaw leaves as the basal diet with chicks mash, layers mash and broilers starter as supplements respectively. While T4 were snails fed with pawpaw leaf alone. The highest feed intake was obtained from T2 and T3 while the snails in T4 (control) consumed the least feed ($P< 0.05$). T2 had the highest weight gain of 0.64g/snail/day while the least weight gain was reported for snails fed the control diet ($P< 0.05$). However similar efficiency of feed utilization values of 0.07, 0.06, 0.07 and 0.08 were obtained for snail on T1, T2, T3 and T4 respectively. Carcass analysis showed that the edible portion of snails fed with chicks mash and pawpaw leaves are higher than those of the other treatment groups ($P< 0.05$). The dressing percentage and weight of offals of the snails in all the treatment groups did not differ significantly ($P> 0.05$).

Akinnusi (2002) reported that snails fed four types of diets namely *Carica papaya* leaves (Diet A), concentrate feed (Diet B), *Carica papaya* fruits (Diet C) and Amaranthus leaves (Diet D), produced the following results. The highest mean live weight and mean weight gains were obtained on Diets B and C. The mean live weights of the snails were significantly higher ($P< 0.05$) with Diets B and C than with Diets A and D. Diet D produced the least weight gain and the lowest egg production among the four diets. The results of this study indicated that diets containing unripe *Carica papaya* fruits and home made concentrates could be used for large-scale production of *Archachatina marginata* snails.

Adeyemo and Borire (2002) reported that there was no significant difference ($P< 0.05$) in feed intake between snails fed at 0% and 20% YPM diets. However, significant differences ($P< 0.05$) were observed between snails raised on (0% 40% and

60%) YPM diets in feed intake, body weight gain, feed gain ratio, and edible flesh weight. There was no significant difference (P> 0.05) between snails raised on the 40% and 60% YPM diets in all the parameters tested. The values obtained for shell thickness and shell length was 10-12cm while that obtained for shell thickness was 1.14mm. Percentage mortality was similar in all the treatments. It is concluded that snails can be raised on diets in which maize is replaced by 20% YPM.

2.6 Other Recommended Diet and Supplementary Minerals

Cobbinah (1983) recommended that to enhance growth African giant land snail should be fed with a mixture of food such as vegetables and concentrates. He further stated that leafy vegetables appears best for the hatchlings while diets made up of the following ingredients below appears best for older snails.

- Cocoyam leaves contains Protein (2.9%), Calcium (60mg/kg), and Phosphorus (52mg/kg), with moderate amounts of thiamine (Vitamin B1) and Riboflavin (Vitamin B2).
- Pawpaw fruits contains moderate carbohydrate and high amount of ascorbic acid i.e. a stimulant.
- Bokoboko i.e flame flower plant, protein (2.4%), phosphorus (67mg/kg), Iron (5mg/kg), moderate amounts of ascorbic acid and riboflavin.
- Oil palm mesocarp is high in carbohydrates, fats and palmitate (Vitamin A).
- Vitamin D, E and K from sunflower D, wheat germ lettuce e, cabbage and African spinach K.
- Calcium from the soil, powder oyster, and snail shells bone meals, ground limestone e.t.c.

- Minerals can be provided by placing salt licks in the pen.

Matured African giant land snail should be fed the same diet while yet in the hatchling stage, but if changes is imminent the new diet have to be given gradually.

2.7 Growth of Land Snails

Okonkwo *et al.* (2000), reported that growth of snails like other animals differs with respect to what they are fed with growth in body tissue and shell marks out weight gain in snails both of which are influenced by the nutritive value of feeds. According to Olomu (1995), protein functions mainly in tissue growth. Carbohydra (in nitrogen free extract) provides the necessary energy for metabolic activities, while calcium function in shell growth (Akinnusi, 1988). Ejidike (2001) reported that in producing animal protein, feed constitutes the greatest proportion of the production cost, and its success depends largely on the level of management and the availability of less cost effective feeds.

Adeparusi (2001) also reported that the growth of *Archachatina marginata* is influenced by the prevailing weather conditions. Before the rains the growth rate was an average of 0.31g/day, then at the beginning of the rains it increased to 0.76g/day. But during the Harmattan period the snails went into aestivation and the growth after aestivation was found to be half the rate before the onset of aestivation.

2.8 Reproduction of *Archachatina marginata*

Many snails that live on land have both male and female sex organs in the same animal. In other words most snails are hermaphrodite, they contain ovo-testis which produces both eggs and sperm, while in some species there is self fertilization. In most edible snails fertilization is done by sperm interchange between two compatible

partners. Annette (2002) also stated that African giant land snails are hermaphrodites. Maturity age varies from species to species *Archachatina manginata* becomes mature between 9-10 months and can stretch on to 18 months (Bubu, 1993).

2.9 Breeding Season

Three phases are involved in *Achatina achatina* in West Africa and they are pre-spawning phase – immediately after aestivation i.e. March – April and ford consumption is high. The next phase is spawning phase – egg laying period which last from April-July, but food consumption is low. While the last phase is post spawning phase which last form July-October and food consumption here is very high so that there will reserve in lieu of dormancy period (Cobbinah, 1983).

Annette (2002) reported that African giant land snails breed by shooting white 'love darts' into each other sometime it can be seen as a white bulge on the neck, just behind the snails eye, on the right side.

2.10 Clutch size, incubation and Hatching

Bubu (1993) reported that the clutch size for *Achatina achatina* is between 37 and 305 eggs. While *Archachatina marginata* can produce eggs about 3-16, 6-12 or 8-16, 6-16 eggs and of course this size is bigger than others e.g. *Achatina achatina*, the incubation period varies with species of snails. It is between 10 and 13 days for *Achatina achatina*, and between 19 and 32days or 24 and 37 days in *Archachatina marginata*.

Eggs laid are usually buried in the soil and with no further maternal care eggs hatch out within the specified days depending on the species. The hatchlings remain in the soil for 3-5 days and feed on their eggshells, before they emerge on the surface

of the soil. Hatchlings on emergence at the soil surface are already active and start to feed on vegetables and other feeds. For artificial hatching eggs are buried about 3-5 cm deep in moist soil. Temperature should be about 25-28^{0}C and a relative humidity of about 80%, with adequate temperature and relative humidity hatchability is usually between, 80-100%.

CHAPTER THREE

MATERIALS AND METHODS

3.1 Experimental Site and Facilities

This study was carried out at the Delta State College of Agriculture, Ozoro (Now Delta State Polytechnic) Delta State. The State lies roughly between longitude 5^0 00' and Latitude 6^0 30' North and shares common boundaries with Edo, Ondo, Anambra, Rivers and Bayelsa States to the North, North-West, East and South- east respectively. It is generally low lying and has a deep coastal belt inter-laced with rivulets and streams which form the Niger Delta. The River Niger washes the shores of Asaba, the State capital, at the northern fringe of the State (Planner, 1997).

The State experiences a tropical climate that is marked by two distinct seasons – the rainy and the dry seasons-with the later occurring between December and April, characterized by a dry and dusty worth-easterly harmattan – wind. The average annual rainfall is about 2665 mm in the coastal areas and 1905 mm in the northern part with an average temperature of 30^0C. The vegetation varies from the mangrove swamps in the coastal regions, through rain forest in the middle, to derived savannah in the north.

The experiment was carried out in a snail pen in the College of Agriculture Farm raised with 0.45m from the ground level covered with zinc and ceiling from the top. The Dimension of the spaces is 4mx1.5m adequately protected with rod and wire netting from predators with the climbing cowpea *Vigna uguiculata* growing along the rod to act as shade.

Twenty–four (24) perforated basket with a cover each measuring 30x30x17cm were used, covered with fresh loamy soil to the half.

3.2 Experimental Snails

The snails were hatched from eggs collected from a reputable snail farm in Benin. The eggs numbering three hundred and fifty (350) were incubated for more than four weeks (4 weeks) from which ninety-six (96) grower snails were obtained for the experiment. During this period the incubation temperature was kept at room temperature i.e 26 – 30^{0}C with a thermometer and the soil was constantly moistened.

3.3 Snail Stocking Rate

Ninety-six (96) juvenile snails weighing 30g were divided into two experiment involving the replacement of maize supplement with cassava and cocoyam peels differently (Appendix 13and 14). Each experiment required forty-eight (48) snails with four (4) samples in each basket comprising of three replicates.

3.4 Experimental Treatment and diet

The following ingredient, maize, palm kernel cake, cassava peel, cocoyam peel, blood meal oyster shell, and bone meal, were used in the preparation for the diets. The cassava peel and cocoyam peel were sun-dried and milled separately in a milling machine. Both were stored differently in a polythene bag for subsequent feed preparation. The feed ingredients were mixed, and the diets were proportionally assigned to each group of snails in the two experiment. In the two experiments varying levels of cassava and cocoyam peels were used to replace maize in the different percentages for the four treatments at 0%, 20%, 40% and 60% respectively (Tables 1 and 2.)

3.5 Feeding Procedure

The snails were fed ad libitum for 14 weeks and the feed were sprinkled with water to aid feed intake and digestibility and supplied with water regularly. The feeding and water trough were thoroughly washed before new replacement. The left over feed were carefully weighed and removed to calculate feed intake.

3.6 Data Collection (Parameters)

The following Parameters were determined.

Initial weight (instrument used is Camry Kitchen Scale) Feed Intake, Weight gain (was measured with a measuring scale), while shell thickness, shell length and shell breath was measured by using vernier caliper. The feed conversion ratio was determined.

At 14 weeks 2 snails was randomly selected from each of the treatment and slaughtered to determine edible carcass, visceral organ and empty shell weight.

Table 1: Experimental diets I with the calculated crude protein in percentage and the calculated metabolizable energy (Kcals/g).

Ingredients	0%	20%	40%	60%
Maize	60.5%	48.4	34.6	22.5
Palm kernel cake	20.0	19.9	19.8	19.7
Cassava peel	0	12.1	24.2	36.3
Blood meal	13.5	13.6	15.4	15.5
Oyster shell meal	3.0	3.0	3.0	3.0
Bone meal	3.0	3.0	3.0	3.0
Calculated Crude Protein (%)	19.85	19.18	19.72	19.06
Calculated ME (Kcals/g)	5490.49	4638.74	3692.02	2840.86

Table 2: Experimental diets II with the calculated crude protein in percentage and the calculated metabolizable energy (Kcals/g).

Ingredients	0%	20%	40%	60%
Maize	60.5	48.4	35.7	23.6
Palm Kernel cake	20.0	19.9	19.8	19.7
Cocoyam peel	0	12.1	24.2	36.3
Blood meal	13.5	13.6	14.3	14.4
Oyster shell meal	3.0	3.0	3.0	3.0
Bone meal	3.0	3.0	3.0	3.0
Calculated Crude protein (%)	19.85	19.42	19.43	19.01
Calculated ME (Kcals/g)	5490.49	4644.79	3765.57	2919.86

Statistical Analysis

All necessary data were subjected to one-way analysis of variance (ANOVA) as described by Steel and Torie (1980). While significant differences among the means were determined by using LS.D Test. Graphical presentations were given at appropriate points for further explanations and data analysis.

CHAPTER FOUR

RESULTS

Results of Experiment 1

The Proximate Composition of all diets used were determined by using the A.O.A.C (1990) methods. The proximate composition of cassava peel is presented in table 3a. It shows that it is fairly high in crude protein and the carbohydrate content is also high, this means that it can be easily used for supplying metabolizable energy requirement of animals.

Table 3a: Proximate composition of cassava peels

Moisture Content	Ash %	Protein %	Crude fibre %	Fat%	Nitrogen Free Extract
14.60	3.93	6.73	10.69	0.95	77.7

The proximate composition of experimental diets with cassava peel is presented in table 3b. The protein content is fairer in 0% diet without cassava peel in substitution of maize, but decreases in protein content as the cassava peel level increases.

Table 3b: Proximate composition of experimental diet with cassava peels

Diets	0%	20%	40%	60%
Dry matter	87.24	88.26	88.71	89.84
Moisture	12.76	11.74	11.29	10.16
Crude protein	22.80	21.56	19.99	19.21
Crude fibre	15.02	15.75	15.60	15.98
Ether extract	1.75	1.06	1.05	1.06
Ash	20.09	20.82	22.49	22.96
Nitrogen Free Extract	40.34	40.81	40.87	40.79

Table 3c Growth performance of *Archachatina marginata* fed varied levels of cassava peels

	I	II	III	IV
Mean weight gain (g)	13.31 ± 2.41^{a}	11.87 ± 1.80^{a}	10.73 ± 1.15^{a}	12.38 ± 1.53^{a}
Mean feed intake (g)	12.24 ± 0.49^{ab}	11.25 ± 0.44^{bc}	10.54 ± 0.40^{c}	12.76 ± 0.47^{a}
Mean shell length (cm)	0.608 ± 0.009^{a}	0.596 ± 0.007^{a}	0.554 ± 0.014^{b}	0.375 ± 0.013^{b}
Mean shell thickness (mm)	0.143 ± 0.014^{a}	0.136 ± 0.013^{a}	0.164 ± 0.013^{a}	0.136 ± 0.013^{a}
Mean shell breadth (cm)	0.386 ± 0.006^{a}	0.372 ± 0.004^{a}	0.322 ± 0.007^{a}	0.35 ± 0.008^{a}
Mean feed conversion ratio (g)	1.075 ± 0.171^{a}	1.083 ± 0.167^{a}	1.07 ± 0.143^{a}	0.986 ± 0.075^{a}
Survival rate (%)	100.0	100.0	100.0	100.0

Means bearing different superscripts are significantly different ($P<0.05$) from each other.

Mean Weight gain – Weight gain increased in all the diets with age however the highest body weight gain was observed in diet 0% while the least mean weight gain was in diet 60%.

Mean feed intake - There was a significant difference ($P<0.05$) in the feed intake between snails fed with diet 0%, 40% and 60% cassava peel.

Mean shell length - There was a significant difference ($P<0.05$) in shell length between snail raised on 0%, 40% and 60% cassava peel.

Mean shell thickness – There was no significant difference ($P<0.05$) in the mean shell thickness among the diets of snail. However the highest value was observed in diet 0% while the lest was in diet 60%.

Men shell breath – Significant difference ($P<0.05$) existed between diets 0%, 40% and 60%.

Mean feed conversion ratio - Significant difference was not observed in this case ($P<0.05$) although most efficient utilization of feed was recorded in diet 0% while diet 60% was the least efficient.

The following (table 3d) shows the carcass characteristics of snails fed varied levels of cassava peels.

Table 3d Carcass characteristics of *Archachatina marginata* fed varied levels of cassava peels.

Weight of empty shells in (g)	16.67	16.67	13.33	13.33
Weight of visceral organ in (g)	18.33	16.67	16.67	15.00
Weight of edible carcass in (g)	51.67	50.00	46.67	43.33

Weight of empty shell at the 14th week was highest in diets 0% and diets 20% while the least weight was observed in diets 40% and 60%. The weight of visceral parts i.e kidney, heart, reproductive system etc. was highest in diet 0% followed by 20% and 40% respectively, while the least weight was observed in diet 60%. Edible carcass weight was highest in diet 0% followed by diets 20%, 40% and 60% in that order

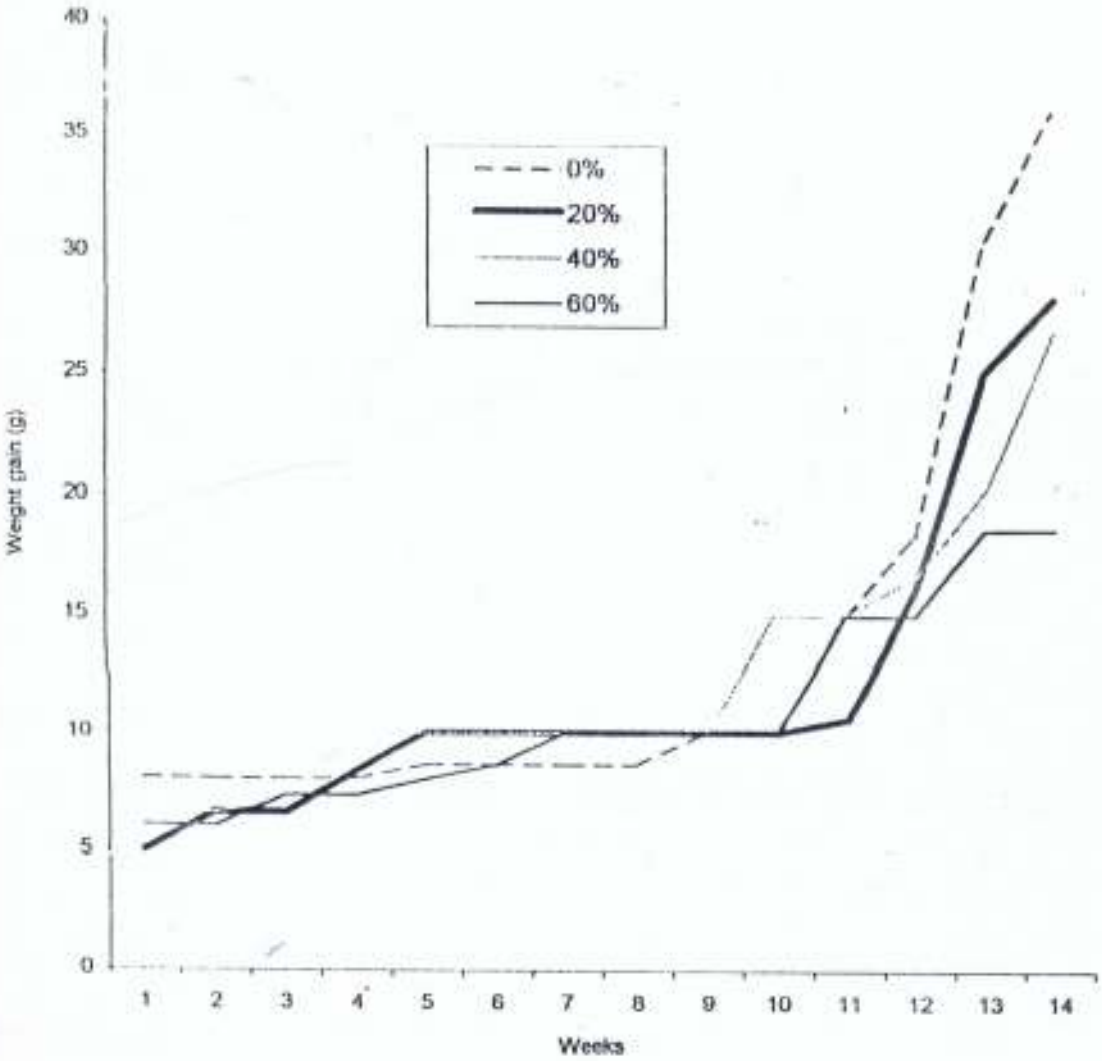

Figure 1: Mean weight gain of snails fed on varying levels of cassava peels

Mean weight gain increased with age in all the treatments. It shows that snails raised on 0% cassava peels had the highest weight gain. While those in 60% cassava peels had the least weight gain. It is clear that weight gain reduced with the level of cassava peel in the diets.

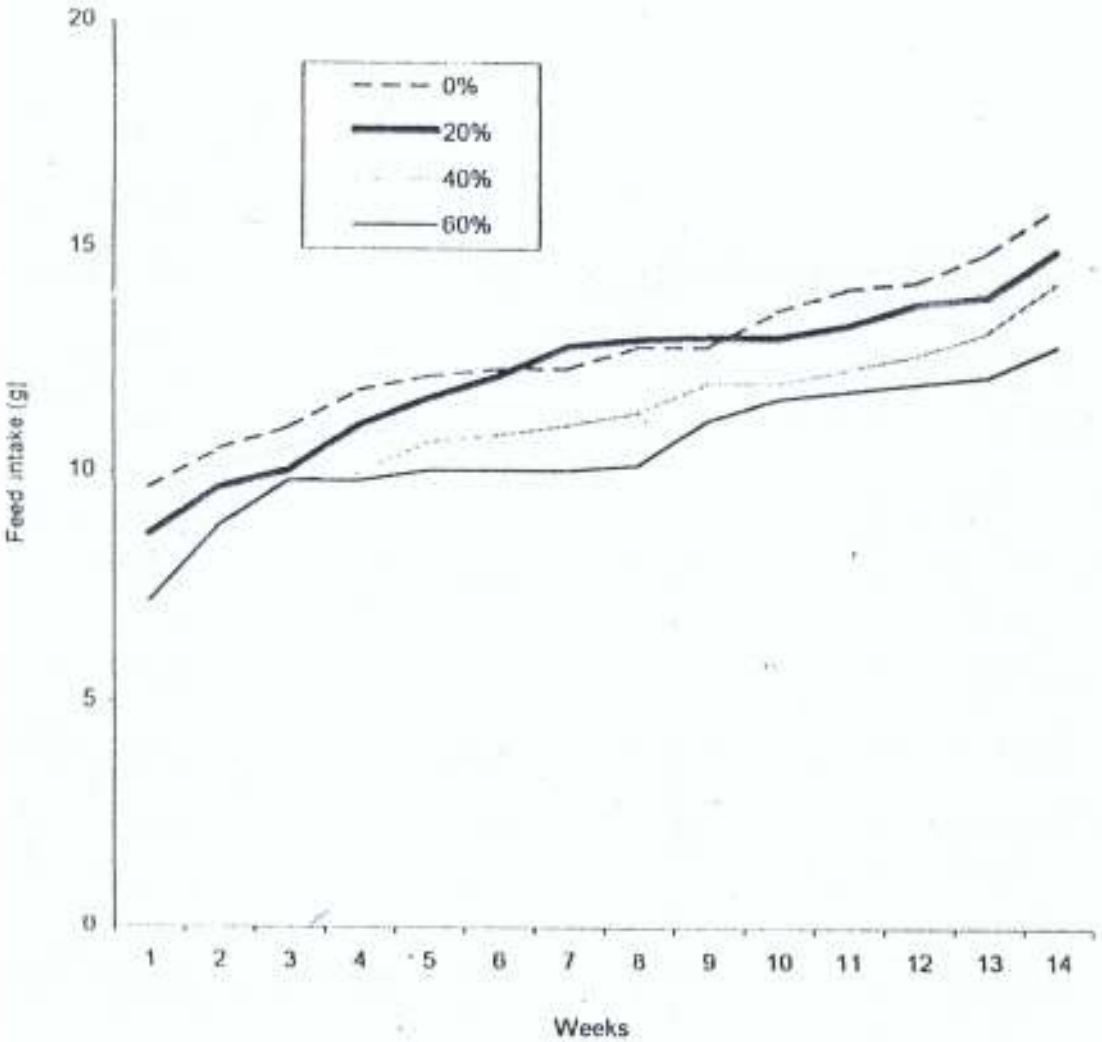

Figure 2: Mean feed intake of snails fed on varying levels of cassava peels

The mean feed intake increased with age in all the treatment. Snails raised on 0% cassava peel had the highest feed intake, but those raised in 60% cassva peel had the least feed intake. This shows that feed intake reduced with increased of cassava peel levels in the diets.

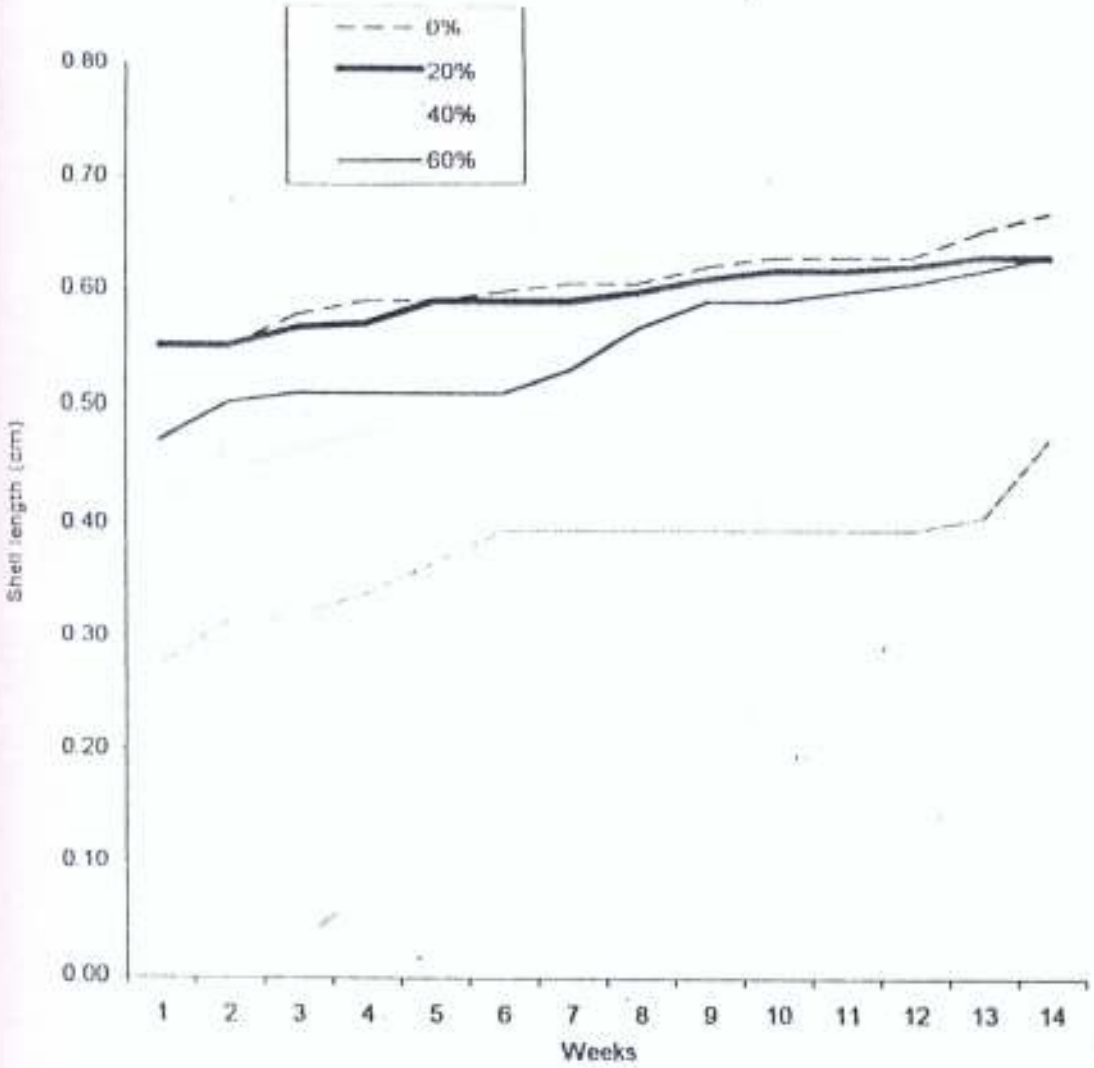

Figure 3: Mean shell length of snails fed on varying level of cassava peels

The mean shell length increased in all the diets used and that of 0% was highest while the least was obseved in diets 40%.

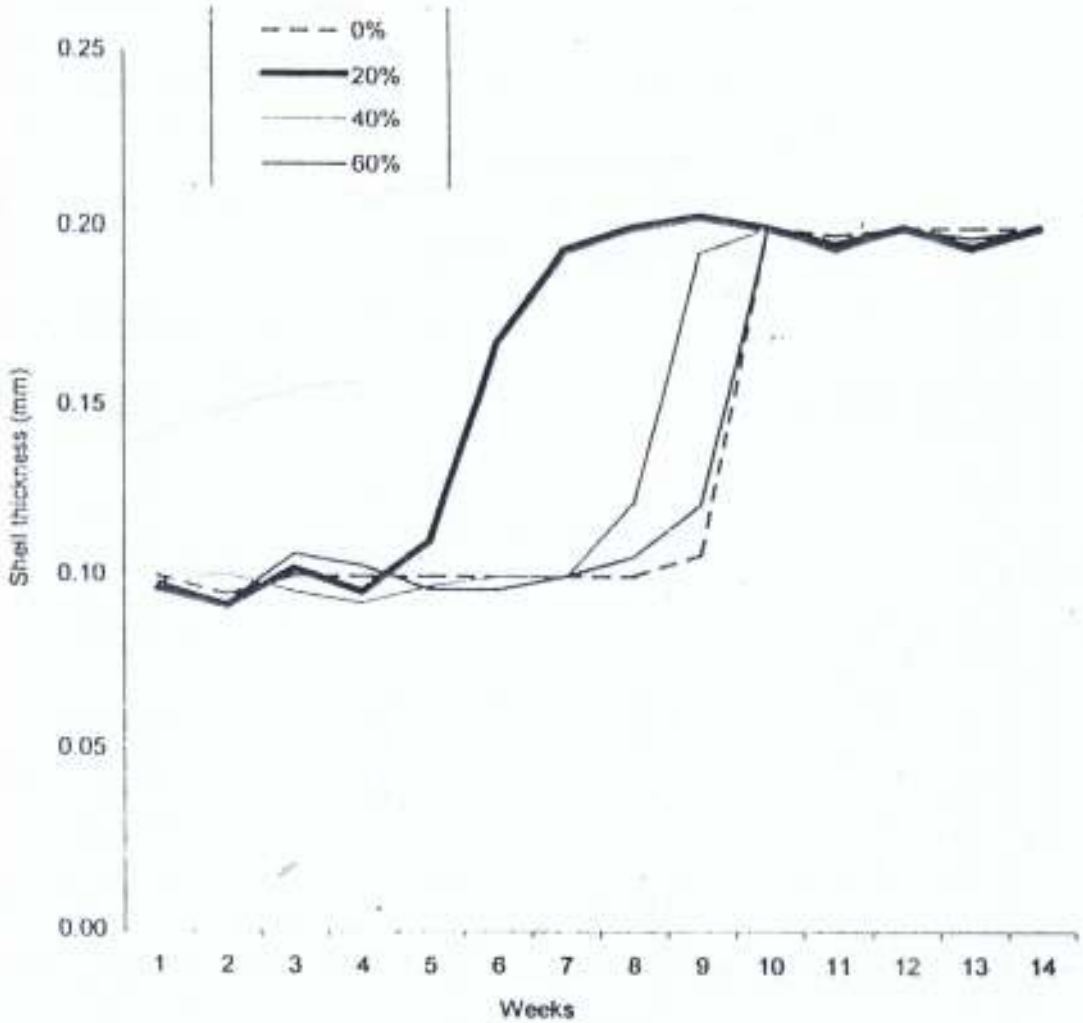

Figure 4: Mean shell thickness of snails fed on varying level of cassava peels

The mean shell thickness was the same at the 14th week in all the diets. That is diets 0%0.20mm, 20% 0.20mm, 40% 0.20mm and 60% 0.20mm respectively

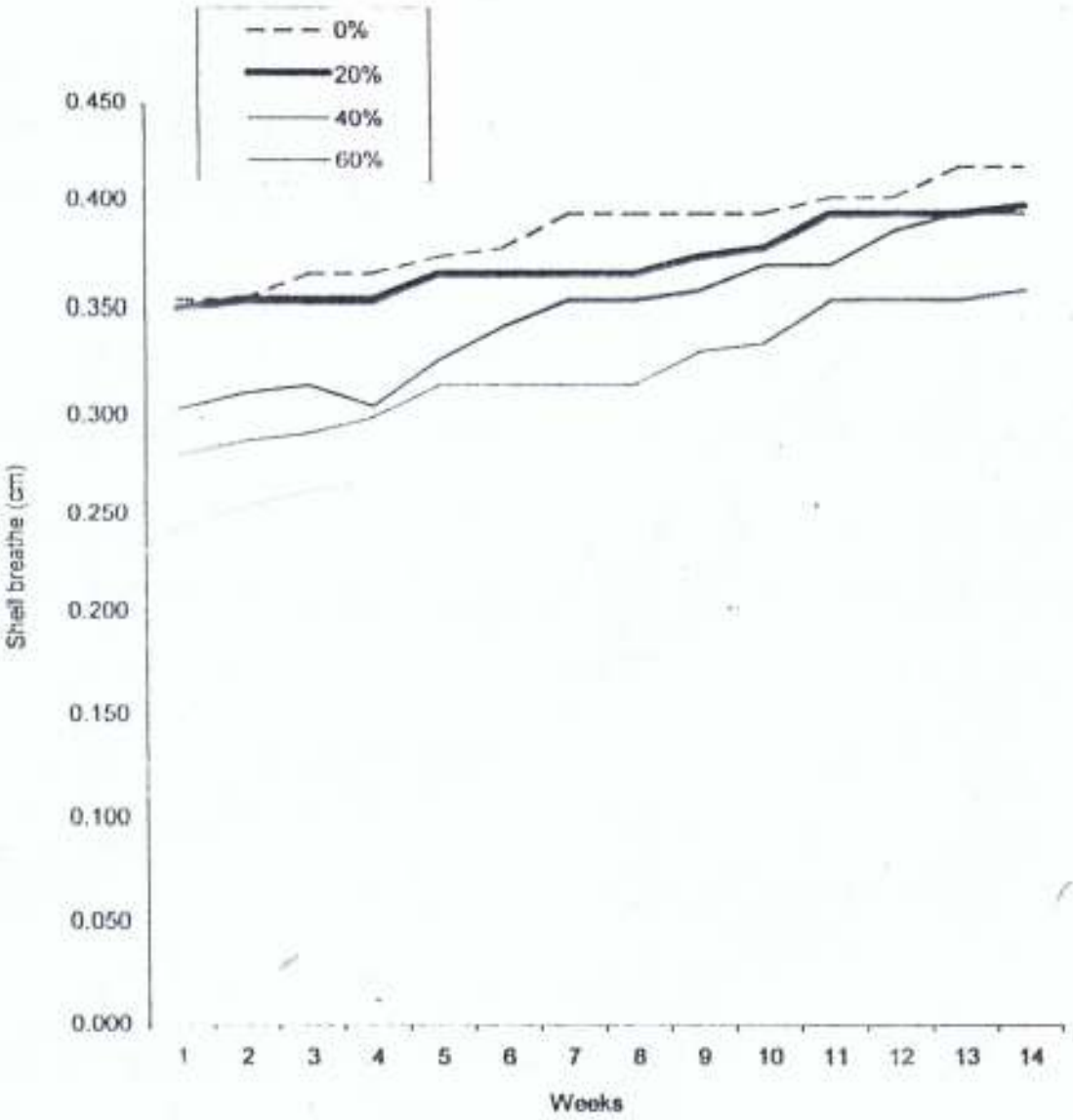

Figure 5: Mean shell breathe of snails fed on varying level of cassava peels

The mean shell breadth increased with age in all the treatment, this shows that snail raised on 0% and 20% cassava peel have the highest shell breadth, while those raised on 40% and 60% had the least shell breadth.

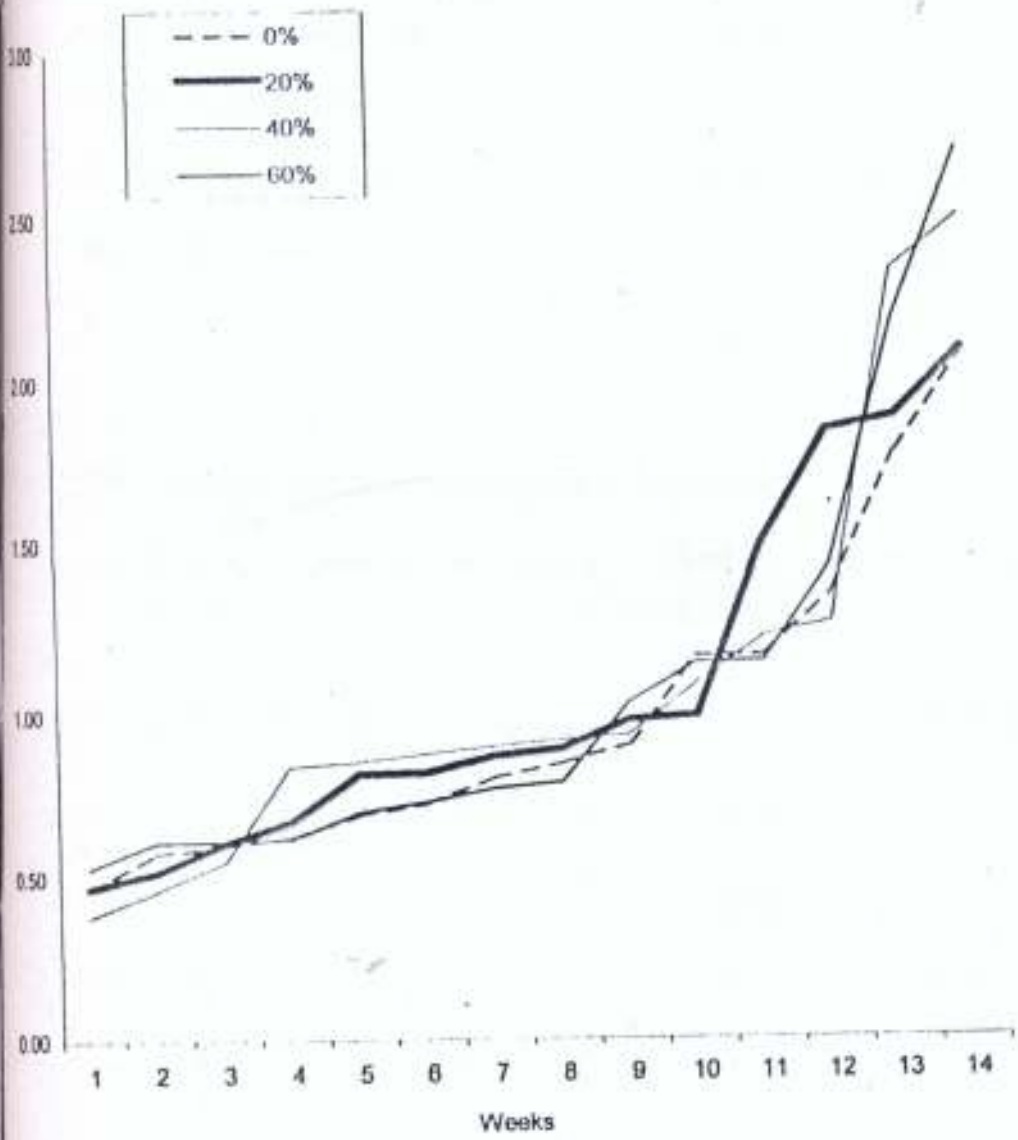

Figure 6: Mean feed conversion ratio of snails fed on varying level of cassava peels

The mean feed conversion ratio was highest in diet 60% while the least was in diet 0%, the higher the ratio the lower the efficiency which means that diet 0% had the highest feed utilization.

Results of Experiment II

The Proximate Composition of all diets used was determined by using the A.O.A.C (1990) methods. The proximate composition of cocoyam peel is presented in table 4a. It shows that it is high in crude protein and the carbonhydrate content is fairly high, this means that it can be easily used for supplying the metabolizable energy requirement of animals.

Table 4a: Proximate composition of cocoyam peels

Moisture Content	Ash %	Protein %	Crude fibre %	Fat %	Nitrogen Free Extract
14.42	1.86	7.22	7.98	0.87	82.07

The proximate composition of experimental diet with cocoyam peel is shown in table 4b. The crude protein is highest in diet 0% and reduces through to diet 60%, while the carbonhydrate follow the same.

Table 4b: Proximate composition of experimental diet with cocoyam peels

Diet	0%	20%	40%	60%
Dry matter	87.24	87.48	88.09	88.92
Moisture	12.76	12.52	11.91	11.08
Crude protein	22.80	21.37	20.53	19.59
Crude fibre	15.02	15.89	14.68	15.98
Ether extract	1.75	1.28	1.81	1.50
Ash	20.09	20.74	22.67	22.05
Nitrogen Free Extract	40.34	40.72	40.31	40.38

Table 4c Growth performance of *Archachatina marginata* fed varied levels of cocoyam peels.

	0%	20%	40%	60%
Mean weight gain	16.90 ± 2.54^{a}	14.80 ± 148^{a}	14.52 ± 2.271^{a}	14.52 ± 1.67^{a}
Mean feed intake	13.22 ± 0.62^{a}	12.93 ± 0.54^{a}	12.38 ± 0.54^{a}	12.11 ± 0.56^{a}
Mean shell length	0.632 ± 0.007^{a}	$0.609 \pm .009^{a}$	0.597 ± 0.006^{b}	0.565 ± 0.011^{c}
Mean shell thickness	0.164 ± 0.013^{a}	0.150 ± 0.014^{a}	0.150 ± 0.014^{a}	0.150 ± 0.014^{a}
Mean shell breadth	0.364 ± 0.010^{a}	0.364 ± 0.010^{a}	0.355 ± 0.013^{a}	0.341 ± 0.010^{a}
Mean feed conversion ratio	1.152 ± 0.125^{a}	1.179 ± 0.210^{a}	1.222 ± 0.160^{a}	1.423 ± 0.216^{a}

Means bearing different superscripts are significantly different ($P<0.05$) from each other

Mean Weight gain - Weight gain increased in all the diets with age however the highest body weight gain was observed in diet 0% while the least mean weight gain was in diet 60%.

Mean feed intake – Feed intake increased in all the diets with age however the higest feed intake was observed in diet 0% while the least mean feed intake was in diet 60%.

Mean shell length – There was a significant difference ($P<0.05$) in shell length between snail raised on 0%, 40% and 60% cassava peel.

Mean shell thickness – There was no significant difference ($P>0.05$) in the mean shell thickness among the diets of snail. However the highest value was observed in diet 0% while the least was in diet 20%, 40% and 60% respectively.

Mean shell breadth – No significant difference ($P>0.05$) existed in all the diets however the highest shell breadth was observed in diet 0% while the least was in diet 60%

Mean feed conversion ratio - Significant difference was not observed in this case ($P>0.05$) although most efficient utilization of feed was recorded in diet 0% while diet 60% was the least efficient.

The following (table4d) shows the carcass characteristics of snails fed varied levels of cocoyam peels.

Table 4d Carass characteristics of *Archachatina marginata* feed varied levels of cocoyam peels.

	0%	20%	40%	60%
Weight of empty shells in (g)	22.67	13.33	10.00	10.00
Weight of visceral Organ in (g)	16.67	16.67	13.33	13.33
Weight of edible Carcass in (g)	50.00	38.33	35.0	33.33

Weight of empty shell at the 14th week was highest in diets 0% and diets 20% while the least weight was observed in diets 40% and 60%. The weight of visceral parts i.e. kidney, heart, reproductive system etc. was highest in diet 0% and 20% while 40% and 60% was the least. The highest edible carcass weight was observed in diet 0%. While the least edible carcass weight was observed in diet 60%.

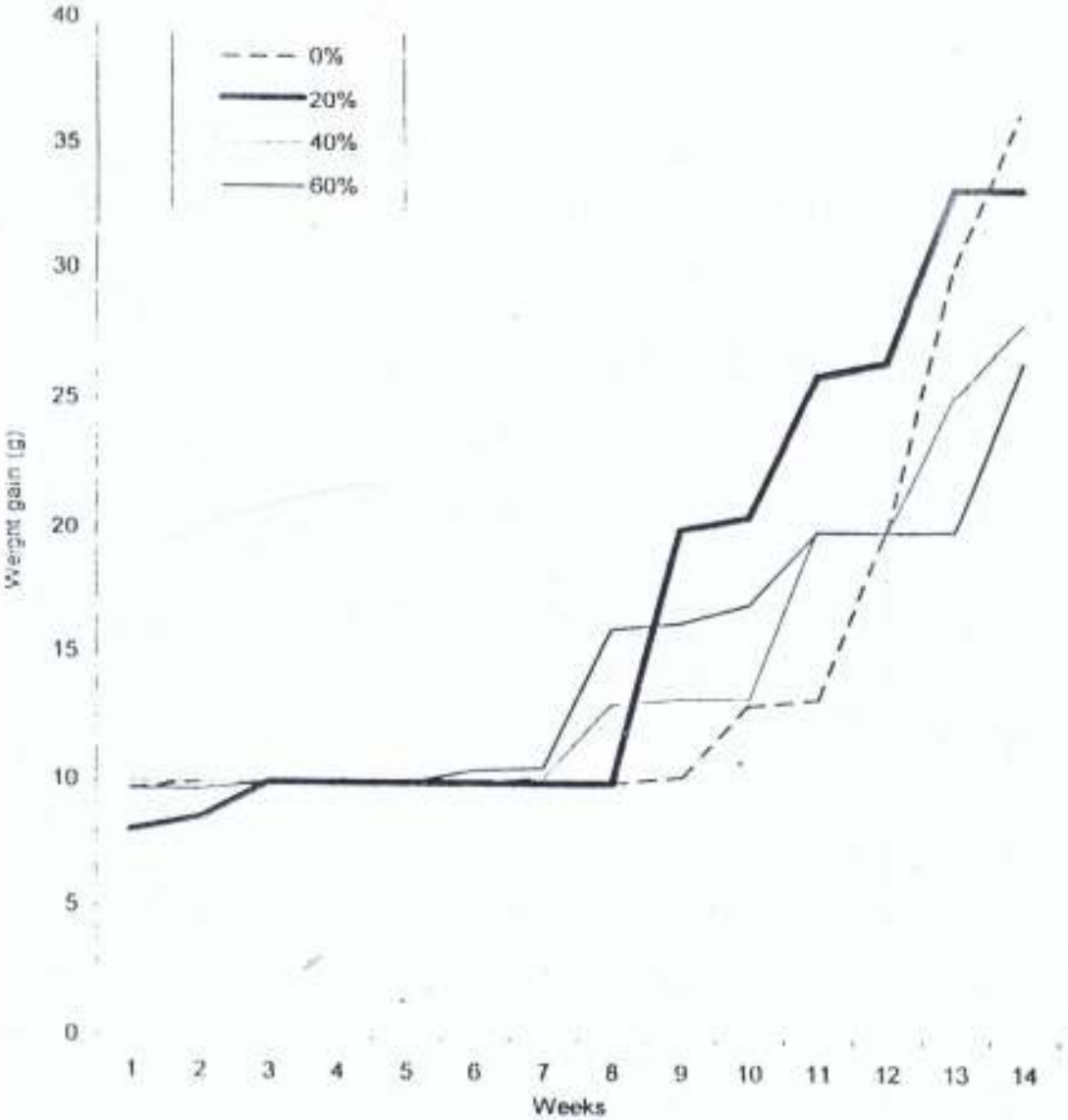

Figure 7: Mean weight gain of snails fed on varying levels of cocoyam peels

Mean weight gain increased with age in all the treatments. It shows that snails raised on 0% cocoyam peels had the highest weight gain. While those in 60% cocoyam peels had the least weight gain. It is clear that weight gain reduced with the level of cocoyam peel in the diets.

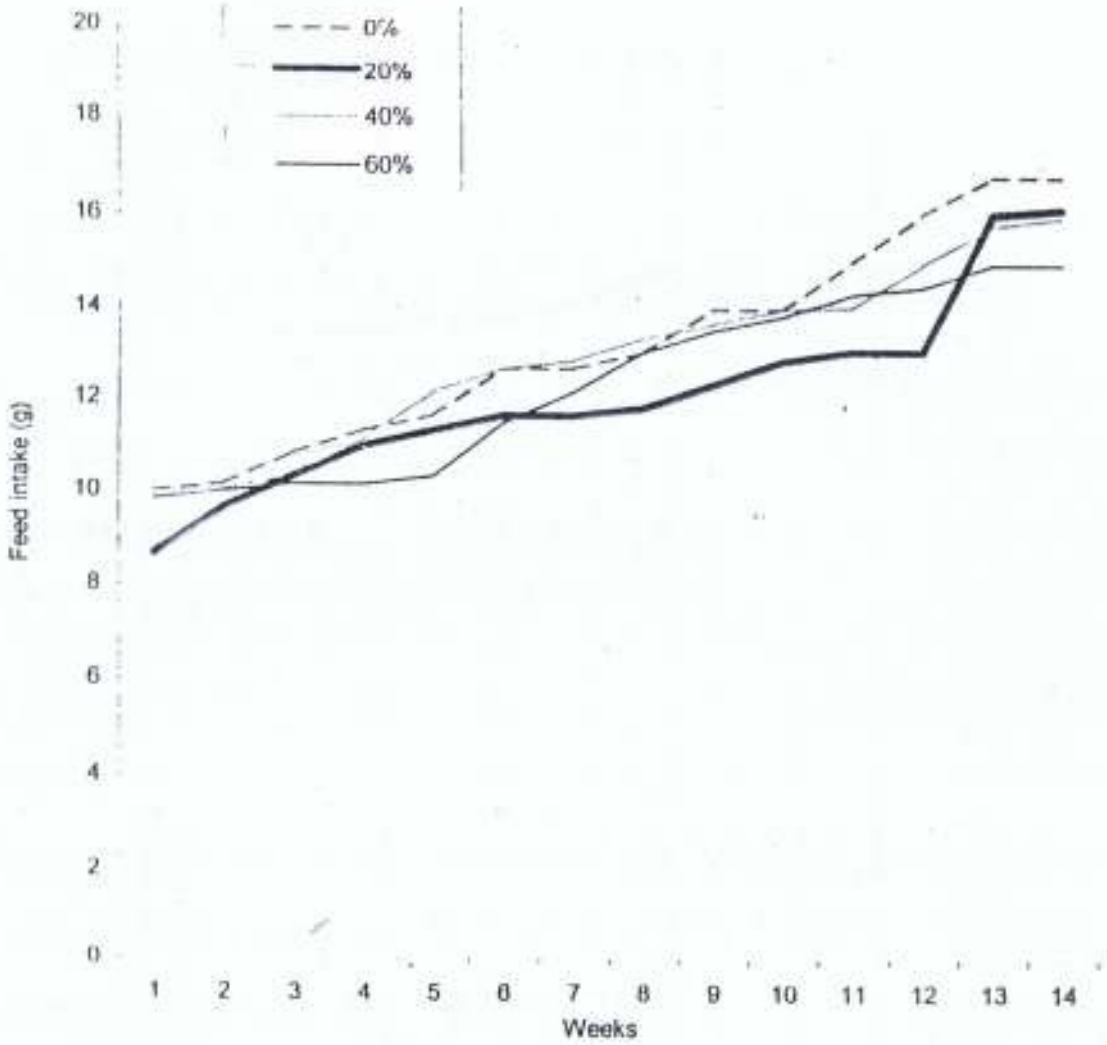

Figure 8: Mean feed intake of snails fed on varying levels of cocoyam peels

The mean feed intake increased with age in all the treatment. Snails raised on 0% cocoyam peel had the highest feed intake, but those raised in 60% cocoyam peel had the least feed intake. This shows that feed intake reduced with increased of cocoyam peel levels in the diets.

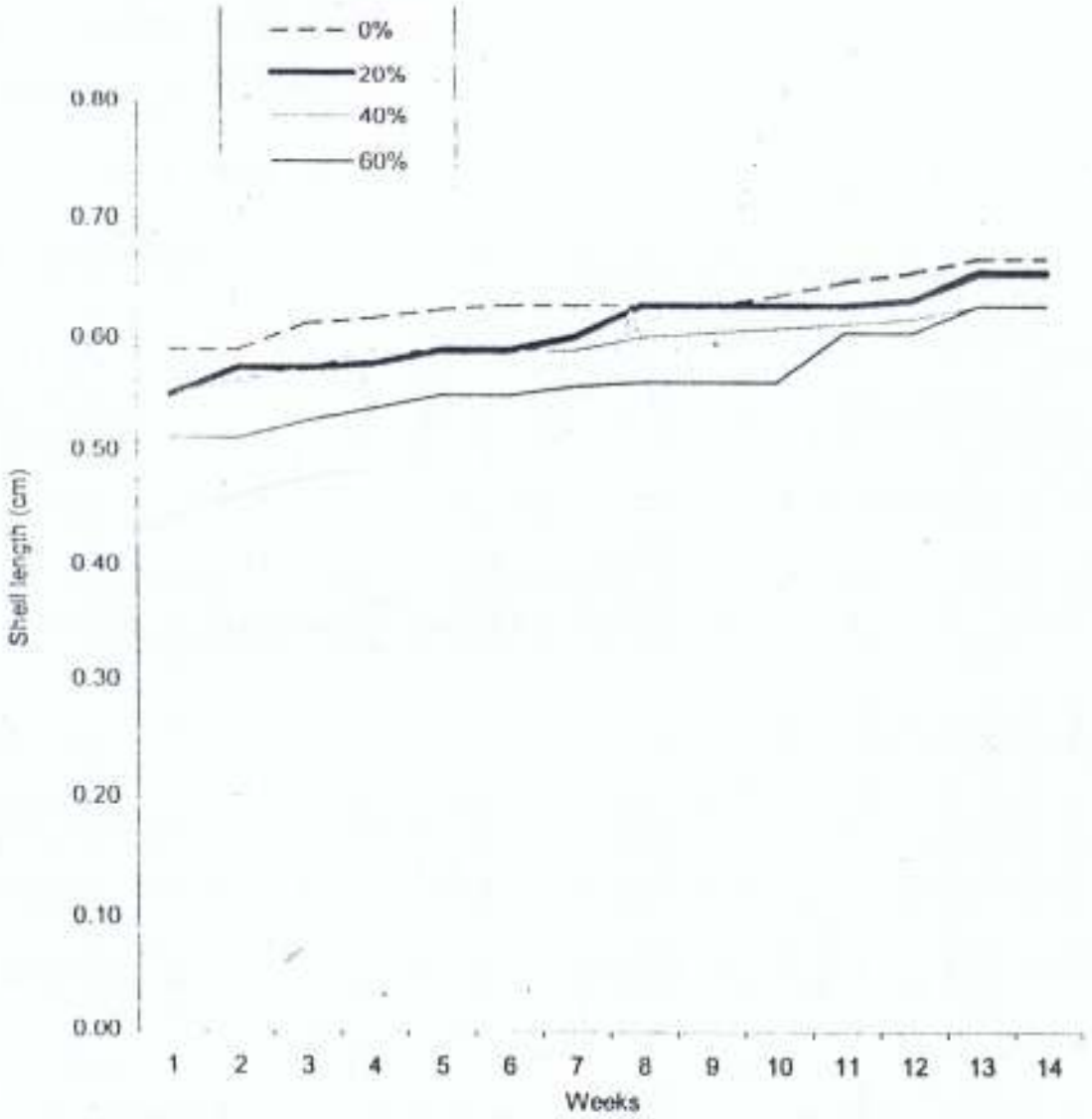

Figure 9: Mean shell length of snails fed on varying level of cocoyam peels

The mean shell length increased in all the diets used and that of 0% was highest while the least was obseved in diets 60%. This shows that shell length increased with lower level of cocoyam peel and vice versa

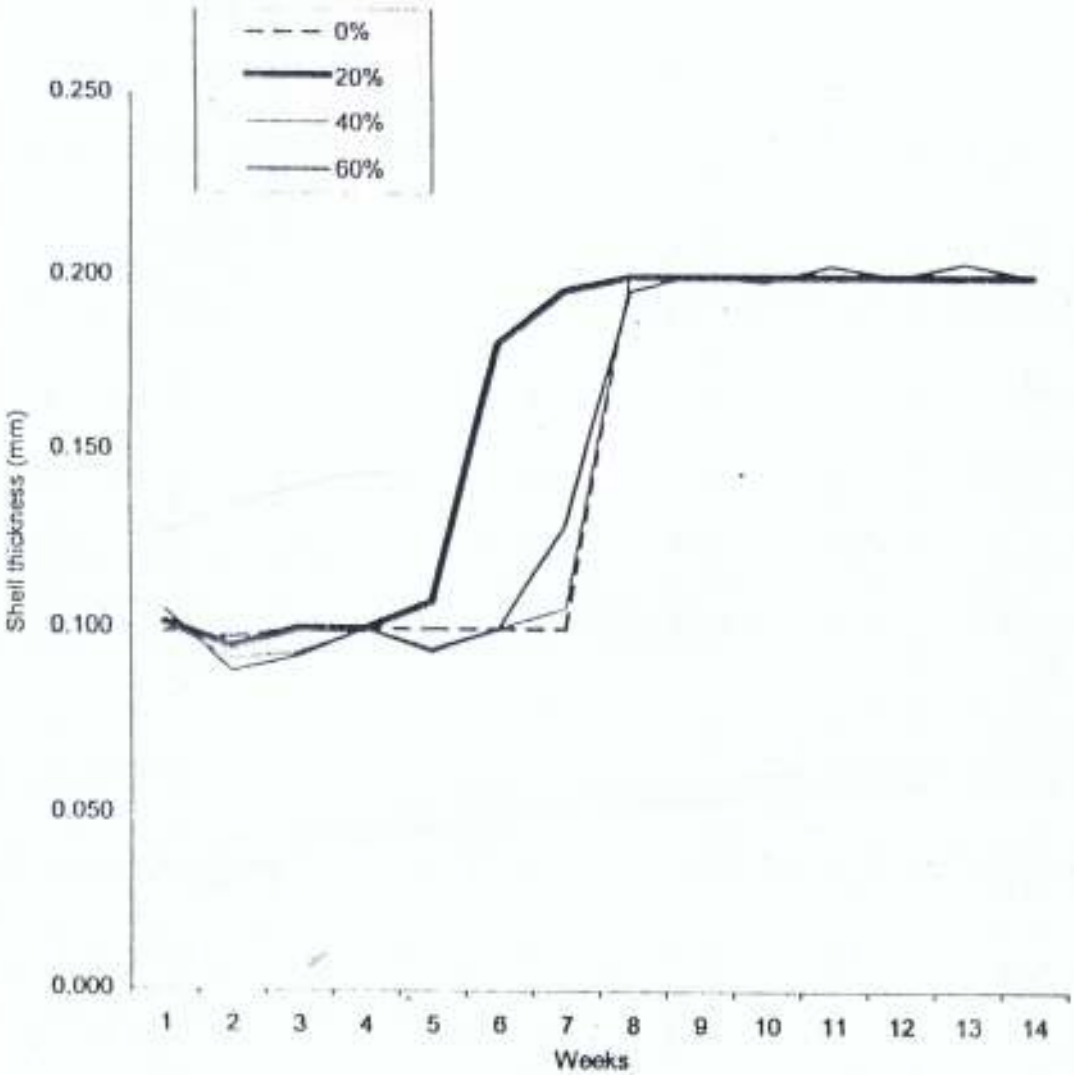

Figure 10: Mean shell thickness of snails fed on varying level of cocoyam peels

The final mean shell thickness at 14th week was the same in all the diets i.e. 0% 0.20mm, 20% 0.20mm, 40% 0.20mm and 60% 0.20mm respectively

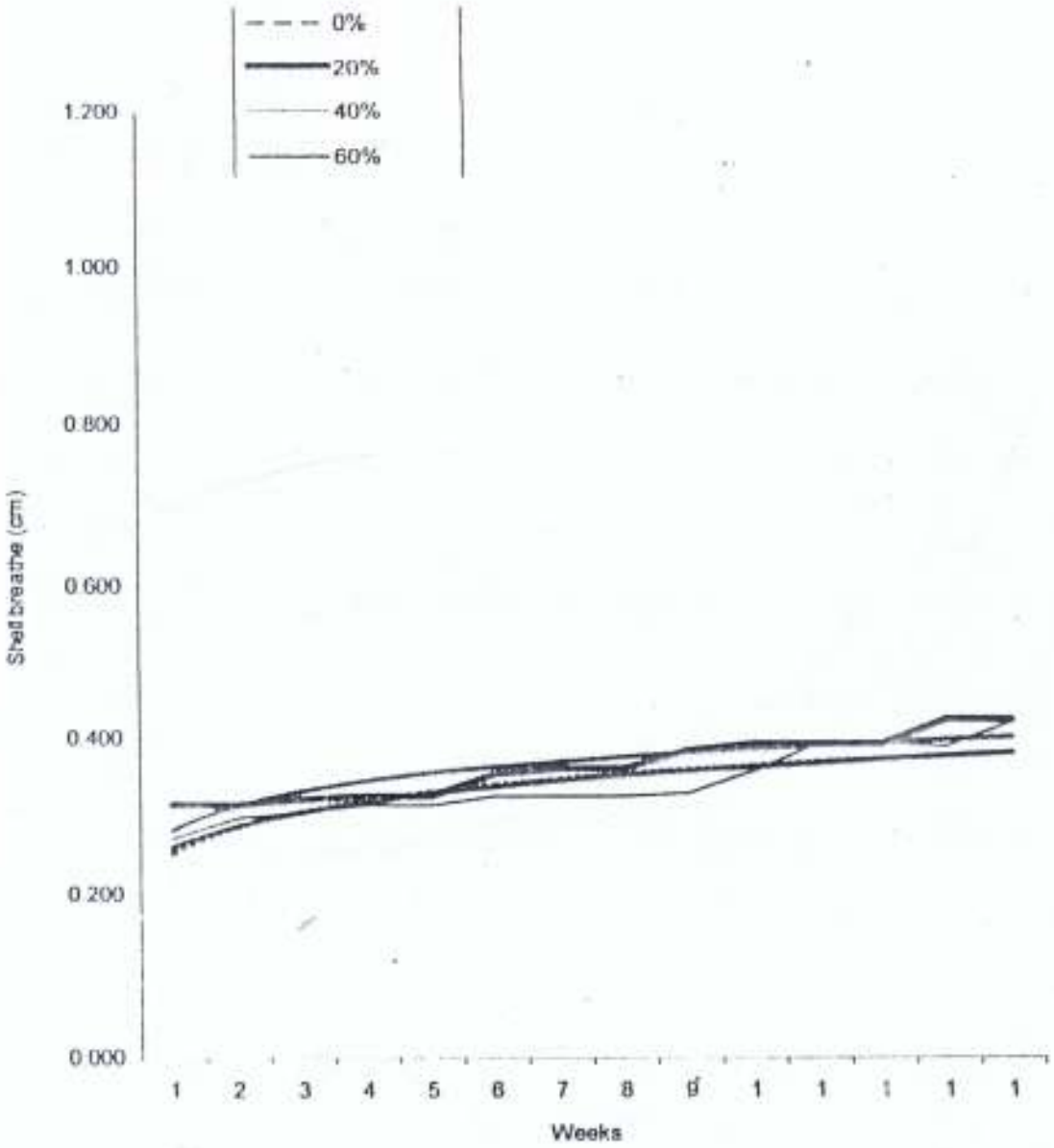

Figure 11: Mean shell breathe of snails fed on varying level of cocoyam peels

The mean shell breadth increased with age in all the treatment, but that of snail raised on 0% cocoyam peel have the highest shell breadth, while those raised on 60% had the least shell breadth.

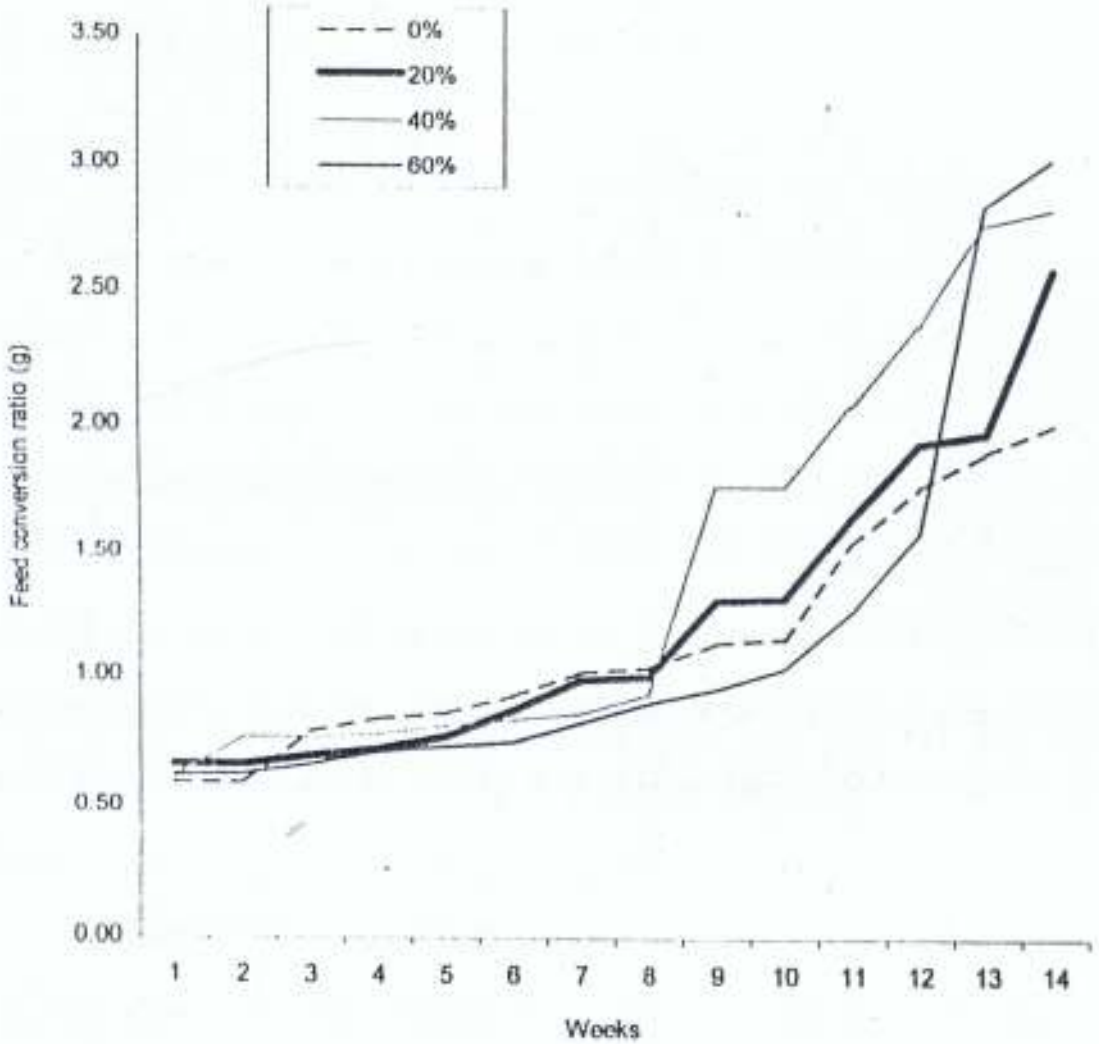

Figure 12: Mean feed conversion ratio of snails fed on varying level of cocoyam peels

The mean feed conversion ratio in the 14th week was highest in diet 60% 3.02g. But the least mean feed conversion ratio was observed in diet 0% with the ratio of 2.01g showing a better feed efficiecy.

CHAPTER FIVE

DISCUSSIONS

Experiment 1

The proximate composition of cassava peels are presented in table 3a which shows a fair amount of all the necessary nutrient needed for the growth of animals i.e crude protein, crude fibre, ash, fat etc. Fetuga and Tewe (1985) started that cassava peel can be substituted for maize in the diet of poultry, pigs, cattle and small animals.

Weight gain – weight gain increased in all the diet with age, this might be an indication that the cassava peel inclusion did not have any adverse effect on the body weight gain, but at higher inclusion there was a significant difference ($P<0.05$) (Fetuga and Tewe 1985) confirmed this.

Feed intake there was a significant difference ($P<0.05$) in feed intake between snails fed with diet 0%, 40% and 60% this may mean that maize is more palatable than cassava peels and this has reduced the intake with higher level of inclusion in the diet, this is in the line with the finding of Adu *et al* (2002) Adeyemo and Borire, (2002).

Mean shell length – shell length increase with age in all the treatments. There was a significant difference ($P<0.05$) among diets 0%, 40% and 60% which is inconsonant with the findings of Hamzat and Longe (2001). This might be due to an increase in cassava peel i.e at lower level, there was no significant difference among the diet. But at higher level it might become injurious.

Mean shell thickness –the shell thickness is an indication of the state of health in the snail the thicker the shell the healthier the snail. (Adeyemo and Akeredolu

2002). The non-significant difference (P>0.05) observed in the shell thickness is an indication of the state of health in the snail.

Mean shell breadth – significant difference (P<0.05) existed among diet 0%, 40% and 60%, but the highest mean shell breadth was observed in diet 0%. It has been established earlier that snails raised on 0% cassava peel have higher body weight gain therefore that of the shell length and breadth is expected.

Feed conversion – there was no significant difference in the feed conversion among the diet, this shows that the treatment has no adverse effect on the snail which shows moderate efficiency in the level of substitution which is in accordance in the findings of Ejidike (2001).

Weight of edible flesh – treatments have no significant difference therefore no adverse effect was observed on the snails, this shows that the use of cassava peel do not affect snail meat production for human consumption

Empty shell – This follows the same pattern of no significant difference.

Weight of visceral organ –the highest weight was observed in diet 0% and the least was in diet 60% without any significant difference in the diet.

Experiment 11

The proximate composition of cocoyam peels are presented in table 4a which shows a fair amount of all the necessary nutrient needed for the growth of animals i.e crude protein, crude fibre, ash, fat etc. Fetuga and Tewe (1985) started that cocoyam peel can be substituted for maize in the diet of poultry, pigs, cattle and small animals.

Weight gain – weight gain increased in all the diet with age, this might be an indication that the cocoyam peel inclusive did not have any adverse effect on the body weight gain, this was in line with the finding of Ejidike (2000) and Kehinde et al (2002).

Feed intake - there was no significant difference ($P>0.05$) in feed intake between snails in all the treatments, although diet 0% was highest in the feed intake while diet 60% was the least. This may mean that maize is more palatable than cocoyam peels and this has reduced the intake with higher level of inclusion in the diet, this is in the line with the finding of Ravindran et al (1986).

Mean shell length – shell length increase with age in all the treatments. There was a significant difference ($P<0.05$) among diets 0%, 40% and 60%, which is inconsonant with the findings of Hamzat and Longe (2001). This might be due to an increase in cocoyam peel i.e at lower level, there was no significant difference among the die, but at higher levels there was.

Mean shell thickness –the shell thickness is an indication of the state of health in the snail the thicker the shell the healthier the snail. (Adeyemo and Akeredolu

(2002). The non-significant difference (P>0.05) observed in the shell thickness is an indication of the state of health in the snail.

Mean shell breadth – there was no significant difference (P>0.05) among the diets of the treatment, but the highest mean shell breadth was observed in diet 0% and the least in diet 60%. It is a well known fact that when the mean weight gain and the mean feed intake is not significant, then there is every likelihood that other parameter would not. So the non significant of the shell breadth is expected. (Ejidike 2000, Kehinde et al 2002, Adeyemo and Akeredolu 2002).

Feed conversion – there was no significant difference in the feed conversion among the diet, this shows that the treatment has no adverse effect on the snail which shows moderate efficiency in the level of substitution which is in accordance in the findings of Ejidike (2001).

Weight of edible flesh – treatments have no significant difference therefore no adverse effect was observed on the snails, this shows that the use of cocoyam peel do not affect snail meat production for human consumption.

Empty shell – This follows the same pattern of no significant difference.

Weight of visceral organ –the highest weight was observed in diet 0% and the least was in diet 60% without any significant difference in the diet.

Therefore in both experiments it can be conclude that the optimum level of maize substitution for cassava and cocoyam peels is at in lower level inclusion. In order words maize can be conveniently substituted for cassava and cocoyam peels at moderate level of 20%.

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APPENDIX

Appendix 1: Weekly mean weight gain (g) of snails fed varying levels of cassava peels

Weeks	Nutrients level			
	0%	20%	40%	60%
1	8.00	5.00	6.30	6.03
2	8.00	6.60	6.60	6.03
3	8.00	6.60	7.03	7.30
4	8.00	8.30	10.00	7.30
5	8.60	10.00	10.00	8.00
6	8.60	10.00	10.00	8.60
7	8.60	10.00	10.00	10.00
8	8.60	10.00	10.06	10.00
9	10.00	10.00	10.06	10.00
10	10.00	10.00	15.00	10.00
11	15.00	10.60	15.00	15.00
12	18.30	16.00	16.60	15.00
13	30.60	25.03	20.06	18.50
14	36.00	28.00	26.60	18.50
Total	186.30	166.33	173.71	150.86
Initial weight	30.00	30.00	30.00	30.00

Appendix 2: Weekly mean feed intake(g) of snails fed varying levels of cassava peels

Weeks	Nutrients level			
	0%	20%	40%	60%
1	9.66	8.66	8.16	7.16
2	10.50	9.66	9.16	8.83
3	11.00	10.05	9.83	9.83
4	11.83	11.05	10.00	9.83
5	12.16	11.66	10.66	10.05
6	12.33	12.16	10.83	10.05
7	12.33	12.83	11.05	10.05
8	12.83	13.00	11.33	10.16
9	12.83	13.05	12.00	11.16
10	13.66	13.05	12.00	11.66
11	14.16	13.33	12.33	11.83
12	14.33	13.83	12.66	12.00
13	15.00	14.00	13.16	12.16
14	16.00	15.05	14.33	12.83
Total	178.62	171.58	157.90	148.20

Appendix 3: Weekly mean shell length (cm) of snails fed varying levels of cassava peels

Weeks	Nutrient levels			
	0%	20%	40%	60%
1	0.55	0.55	0.28	0.47
2	0.55	0.55	0.31	0.50
3	0.58	0.57	0.32	0.51
4	0.59	0.57	0.34	0.51
5	0.59	0.59	0.37	0.51
6	0.60	0.59	0.39	0.51
7	0.61	0.59	0.39	0.53
8	0.61	0.60	0.39	0.57
9	0.62	0.61	0.39	0.59
10	0.63	0.62	0.39	0.59
11	0.63	0.62	0.39	0.60
12	0.63	0.62	0.39	0.61
13	0.65	0.63	0.41	0.62
14	0.67	0.63	0.47	0.63
Total	8.51	8.54	5.65	8.36
Initial shell length	0.56	0.47	0.42	0.44

Appendix 4: Weekly mean shell thickness (mm) of snails fed varying levels of cassava peels

Weeks	Nutrient levels			
	0%	20%	40%	60%
1	0.10	0.10	0.10	0.10
2	0.10	0.10	0.10	0.10
3	0.10	0.10	0.10	0.10
4	0.10	0.10	0.10	0.10
5	0.10	0.10	0.10	0.10
6	0.10	0.20	0.10	0.10
7	0.10	0.20	0.10	0.10
8	0.10	0.20	0.10	0.10
9	0.10	0.20	0.20	0.10
10	0.20	0.20	0.20	0.20
11	0.20	0.20	0.20	0.20
12	0.20	0.20	0.20	0.20
13	0.20	0.20	0.20	0.20
14	0.20	0.20	0.20	0.20
Total	1.90	2.50	2.40	2.50
Initial shell thickness	0.3	0.2	0.2	0.3

Appendix 5: Weekly mean shell breathe (cm) of snails fed varying levels of cassava peels

Weeks	Nutrient levels			
	0%	20%	40%	60%
1	0.35	0.35	0.28	0.30
2	0.35	0.35	0.29	0.31
3	0.37	0.35	0.29	0.31
4	0.37	0.35	0.30	0.31
5	0.37	0.37	0.31	0.33
6	0.38	0.37	0.31	0.34
7	0.39	0.37	0.31	0.35
8	0.39	0.37	0.31	0.35
9	0.39	0.37	0.33	0.36
10	0.39	0.38	0.33	0.37
11	0.40	0.39	0.35	0.37
12	0.40	0.39	0.35	0.39
13	0.42	0.39	0.35	0.39
14	0.42	0.40	0.36	0.39
Total	5.41	5.41	4.90	5.49
Initial shell breadth	0.72	0.59	0.56	0.62

Appendix 6: Weekly mean feed conversion ratio(g) of snails fed varying levels of cassava peels

Weeks	Nutrient levels			
	0%	20%	40%	60%
1	0.47	0.47	0.38	0.53
2	0.58	0.52	0.46	0.61
3	0.60	0.61	0.55	0.62
4	0.63	0.68	0.84	0.62
5	0.70	0.82	0.86	0.71
6	0.73	0.83	0.88	0.74
7	0.81	0.87	0.90	0.78
8	0.85	0.90	0.92	0.80
9	0.91	0.98	0.94	1.04
10	1.17	1.00	1.09	1.15
11	1.17	1.49	1.23	1.15
12	1.35	1.84	1.26	1.43
13	1.77	1.88	2.33	2.19
14	2.08	2.09	2.50	2.70
Total	13.81	15.18	15.56	15.65

Appendix 7: Weekly mean weight gain (g) of snails fed varying levels of cocoyam peels

Weeks	Nutrients level			
	0%	20%	40%	60%
1	10.00	8.06	10.00	10.00
2	10.00	8.60	10.00	10.00
3	10.00	10.00	10.00	10.00
4	10.00	10.00	10.00	10.00
5	10.00	10.00	10.00	10.00
6	10.00	10.00	10.00	10.50
7	10.00	10.00	10.30	10.60
8	10.00	10.00	13.03	16.06
9	10.30	20.06	13.30	16.30
10	13.03	20.60	13.30	17.03
11	13.30	26.06	20.03	20.00
12	20.03	26.60	20.03	20.00
13	30.33	33.33	25.30	20.06
14	36.33	33.33	28.03	26.60
Total	203.32	236.84	203.72	207.75
Initial weight	30.00	30.00	30.00	30.00

Appendix 8: Weekly mean feed intake (g) of snails fed varying levels of cocoyam peels

Weeks	Nutrients level			
	0%	20%	40%	60%
1	10.00	8.66	10.00	9.83
2	10.16	9.66	10.05	10.00
3	10.83	10.33	10.33	10.16
4	11.33	11.00	11.16	10.16
5	11.66	11.33	12.16	10.33
6	12.66	11.66	12.66	11.50
7	12.66	11.66	12.83	12.16
8	13.00	11.83	13.33	13.00
9	14.00	12.33	13.66	13.50
10	14.00	12.83	14.00	13.83
11	15.05	13.05	14.05	14.33
12	16.05	13.05	15.00	14.50
13	16.83	16.05	15.83	15.00
14	16.83	16.16	16.00	15.00
Total	185.06	169.80	181.46	173.90

Appendix 9: Weekly mean shell length (cm) of snails fed varying levels of cocoyam peels

Weeks	Nutrients level			
	0%	20%	40%	60%
1	0.59	0.55	0.55	0.51
2	0.59	0.57	0.56	0.51
3	0.61	0.57	0.57	0.53
4	0.62	0.58	0.59	0.54
5	0.63	0.59	0.59	0.55
6	0.63	0.59	0.59	0.55
7	0.63	0.60	0.59	0.56
8	0.63	0.63	0.60	0.56
9	0.63	0.63	0.61	0.56
10	0.64	0.63	0.61	0.56
11	0.65	0.63	0.61	0.61
12	0.66	0.63	0.62	0.61
13	0.67	0.66	0.63	0.63
14	0.67	0.66	0.63	0.63
Total	8.84	8.73	8.76	8.51
Initial shell length	0.54	0.54	0.52	0.46

Appendix 10: Weekly mean shell thickness(mm) of snails fed varying levels of cocoyam peels

Weeks	Nutrients level			
	0%	20%	40%	60%
1	0.10	0.10	0.10	0.10
2	0.10	0.10	0.10	0.10
3	0.10	0.10	0.10	0.10
4	0.10	0.10	0.10	0.10
5	0.10	0.10	0.10	0.10
6	0.10	0.20	0.10	0.10
7	0.10	0.20	0.10	0.10
8	0.20	0.20	0.20	0.20
9	0.20	0.20	0.20	0.20
10	0.20	0.20	0.20	0.20
11	0.20	0.20	0.20	0.20
12	0.20	0.20	0.20	0.20
13	0.20	0.20	0.20	0.20
14	0.20	0.20	0.20	0.20
Total	2.10	2.50	2.50	2.70
Initial shell thickness	0.30	0.30	0.30	0.30

Appendix 11: Weekly mean shell breathe (cm) of snails fed varying levels of cocoyam peels

Weeks	Nutrients level			
	0%	20%	40%	60%
1	0.31	0.31	0.24	0.30
2	0.31	0.31	0.31	0.30
3	0.32	0.32	0.31	0.31
4	0.33	0.33	0.31	0.31
5	0.34	0.33	0.34	0.31
6	0.35	0.35	0.35	0.33
7	0.35	0.36	0.36	0.33
8	0.35	0.36	0.37	0.33
9	0.38	0.39	0.37	0.33
10	0.39	0.39	0.39	0.36
11	0.39	0.39	0.39	0.39
12	0.41	0.39	0.39	0.39
13	0.42	0.42	0.39	0.39
14	0.43	0.43	0.43	0.39
Total	5.10	5.29	5.37	5.38
Initial shell breadth	0.76	0.64	0.64	0.56

Appendix 12: Weekly mean feed conversion ratio (g) of snails fed varying levels of cocoyam peels

Weeks	Nutrients level			
	0%	20%	40%	60%
1	0.59	0.67	0.62	0.63
2	0.59	0.67	0.77	0.63
3	0.79	0.70	0.77	0.67
4	0.84	0.72	0.78	0.71
5	0.86	0.77	0.81	0.73
6	0.92	0.87	0.83	0.75
7	1.02	0.99	0.86	0.82
8	1.03	1.00	0.93	0.90
9	1.13	1.30	1.77	0.95
10	1.15	1.31	1.77	1.03
11	1.54	1.65	2.08	1.26
12	1.77	1.93	2.37	1.58
13	1.90	1.97	2.75	2.83
14	2.01	2.57	2.82	3.02
Total	16.13	17.31	20.32	17.11

Appendix 13: The total number of experiment (24) Twelve for each of the peels

Appendix 14: Stocking rate of four samples of *Achachatina maginata* fed on vaired nutrient percentage levels of cassava and cocoyam peels in the diet

APPENDIX 15

Statistical Analysis of snails fed varied levels of cassava peels in the experiment diet

Weight gain

Summary	Count	Sum	Mean	Variance
0%	14	186.30	13.31	81.92
20%	14	173.31	12.38	32.70
40%	14	166.13	11.87	45.27
60%	14	150.26	10.73	18.39

ANOVA TABLE

Source of variation	df	SS	MS	F	Sig.	
Intercept	1	8160.29	8160.286	183.088	0.0000	
Nutrient	3	48.38	16.126	0.362	0.781	Not Significant
Error	52	2317.66	44.570			
Total	56	10526.32				

R Squared = .020 (adjusted R Squared = - .036)

Table of difference between means for weight gain

Weight gain	Means	0%	20%	40%	60%
LSD	**4.24**	13.31	12.38	11.87	10.73
0%	13.31	0.00			
20%	12.38	0.93	0.00		
40%	11.87	1.44	0.51	0.00	
60%	10.73	2.58	1.65	2.58	0.00

Values in bold type are difference which are significant (P<0.05)

Feed intake

Summary	Count	Sum	Mean	Variance
0%	14	178.62	12.76	3.09
20%	14	171.38	12.24	3.31
40%	14	157.50	11.25	2.73
60%	14	147.60	10.54	2.27

ANOVA TABLE

Source of variation	df	SS	MS	F	Sig.	.
Intercept	1	7663.500	7663.500	2689.862	0.000	
Nutrient	3	41.373	13.791	4.841	0.005	Significant
Error	52	148.150	2.849			
Total	56	7853.022				

R Squared = .218 (Adjusted R Squared = .173)

Table of difference between means for feed intake

Weight gain	Means	0%	20%	40%	60%
LSD	1.07	12.76	12.24	11.25	10.54
0%	12.76	0.00			
20%	12.24	0.52	0.00		
40%	11.25	1.51	0.99	0.00	
60%	10.54	2.22	1.70	0.71	0.00

Values in bold type are difference which are significant (P<0.05)

Shell length

Summary	Count	Sum	Mean	Variance
0%	14	8.51	0.608	0.0012
20%	14	8.34	0.596	0.0007
40%	14	5.25	0.375	0.0024
60%	14	7.76	0.554	0.0026

ANOVA TABLE

Source of variation	df	SS	MS	F	Sig.	.
Intercept	1	15.911	15.911	9157.302	0.000	
Nutrient	3	0.489	0.163	93.867	0.000	Significan
Error	52	0.090	0.00174			
Total	56	16.491				

R Squared = .844 (Adjusted R Squared = .835)

Table of difference between means for shell length

Weight gain	Means	0%	20%	40%	60%
LSD	**0.04**	0.608	0.596	0.375	0.554
0%	0.608	0.00			
20%	0.596	0.01	0.00		
40%	0.375	**0.233**	**0.221**	0.00	
60%	0.554	**0.054**	**0.042**	0.179	0.00

Values in bold type are difference which are significant (P<0.05)

Shell thickness

Summary	Count	Sum	Mean	Variance
0%	14	2.3	0.164	0.002473
20%	14	2	0.143	0.002637
40%	14	1.9	0.136	0.002473
60%	14	1.9	0.136	0.002473

ANOVA TABLE

Source of variation	df	SS	MS	F	Sig.	.
Intercept	1	0.0117	0.0117	466.082	0	
Nutrient	3	0.0001	2.56E-05	1.018	0.392	Not Signific
Error	52	0.0013	2.51E-05			
Total	56	0.0131				

R Squared = .055 (Adjusted R Squared = .001)

Table of difference between means for shell thickness

Weight gain	Means	0%	20%	40%	60%
LSD	**0.032**	0.164	0.143	0.136	0.136
0%	0.164	0.000			
20%	0.143	0.021	0.000		
40%	0.136	0.028	0.007	0.000	
60%	0.136	0.028	0.007	0.000	0.000

Values in bold type are difference which are significant (P<0.05)

Shell breadth

Summary	Count	Sum	Mean	Variance
0%	14	5.406	0.386	0.000
20%	14	5.209	0.372	0.000
40%	14	4.504	0.322	0.001
60%	14	4.894	0.350	0.001

ANOVA TABLE

Source of variation	df	SS	MS	F	Sig.	.
Intercept	1	7.151267	7.151267	11820.5017	0	
Nutrient	3	0.033237	0.011079	18.3128512	3.07E-08	Significant
Error	52	0.031459	0.000605			
Total	56	7.215964				

R Squared = .514 (Adjusted R Squared = .486)

Table of difference between means for shell thickness

Weight gain	Means	0%	20%	40%	60%
LSD	**0.02**	0.386	0.372	0.322	0.350
0%	0.386	0.000			
20%	0.372	0.014	0.000		
40%	0.322	**0.064**	**0.050**	0.000	
60%	0.350	**0.036**	**0.022**	**0.071**	0.000

Values in bold type are difference which are significant (P<0.05)

Feed conversion

Summary	Count	Sum	Mean	Variance
0%	14	13.8079	0.986	0.225
20%	14	14.98133	1.070	0.286
40%	14	15.053	1.075	0.412
60%	14	15.16094	1.083	0.386

ANOVA TABLE

Source of variation	df	SS	MS	F	Sig.	.
Intercept	1	62.16739	62.16739	189.961777	0	
Nutrient	3	0.08584	0.028613	0.08743186	0.967	Not Significant
Error	52	17.01766	0.327263			
Total	56	79.27089				

R Squared = .020(Adjusted R Squared = -.036)

Table of difference between means for shell thickness

Weight gain	Means	0%	20%	40%	60%
LSD	**0.678**	0.986	1.070	1.075	1.083
0%	0.986	0.000			
20%	1.070	0.084	0.000		
40%	1.075	0.089	0.005	0.000	
60%	1.083	0.097	0.013	0.008	0.000

Values in bold type are difference which are significant (P<0.05)

LSD RESULT: **Mean scores of cassava Peels**

Nutrient levels	Weight gain	Feed intake	Shell length	Shell thickness	Shell breadth	Feed conversion ratio
0%	13.31a	12.76a	0.608a	0.164a	0.386a	0.986a
20%	12.38a	12.24a	0.596a	0.143a	0.372a	1.070a
40%	11.87a	11.25b	0.375b	0.136a	0.322b	1.075a
60%	10.73a	10.54c	0.554a	0.136a	0.350c	1.083a

Values followed by the same letter are not significantly different at 0.05 level of significance

APPENDIX 16

Statistical Analysis of Snails fed varied levels of cocoyam peels in the experimental diet

Weight gain

Summary	Count	Sum	Mean	Variance
0%	14	236.64	16.90	90.33
20%	14	207.15	14.80	29.32
40%	14	203.32	14.52	38.85
60%	14	203.32	14.52	72.38

ANOVA TABLE

Source of variation	df	SS	MS	F	Sig.	.
Intercept	1	12914.84	12914.84	223.755	0	
Nutrient	3	55.70433	18.56811	0.322	0.322	Not Significant
Error	52	3001.373	57.71871			
Total	56	15971.92				

R Squared = .018(Adjusted R Squared = -.038)

Table of difference between means for weight gain

Weight gain	Means	0%	20%	40%	60%
LSD	**4.821**	16.90	14.80	14.52	14.52
0%	16.90	0.00			
20%	14.80	2.10	0.00		
40%	14.52	2.38	0.28	0.00	
60%	14.52	2.38	0.28	0.00	0.00

Values in bold type are difference which are significant (P<0.05)

Feed intake

Summary	Count	Sum	Mean	Variance
0%	14	185.06	13.22	5.44
20%	14	181.06	12.93	4.05
40%	14	173.30	12.38	4.06
60%	14	169.60	12.11	4.44

ANOVA TABLE

Source of variation	df	SS	MS	F	Sig.	.
Intercept	1	8976.953	8976.953	1995.755	0	
Nutrient	3	10.68836	**3.563**	**0.792**	**0.504**	Not Significant
Error	52	233.8972	4.498			
Total	**56**	9221.538				

R Squared = .044(Adjusted R Squared = -.011)

Table of difference between means for shell length

Weight gain	Means	0%	20%	40%	60%
LSD	**0.03**	0.632	0.609	0.597	0.565
0%	0.632	0.00			
20%	0.609	0.023	0.00		
40%	0.597	0.035	**0.012**	0.00	
60%	0.565	0.067	**0.067**	**0.032**	0.00

Values in bold type are difference which are significant (P<0.05)

Shell thickness

Summary	Count	Sum	Mean	Variance
0%	14	2.3	0.164	0.002473
20%	14	2.1	0.150	0.002692
40%	14	2.1	0.150	0.002692
60%	14	2.1	0.150	0.002692

ANOVA TABLE

Source of variation	df	SS	MS	F	Sig.	.
Intercept	1	1.320714	1.320714	500.77083	0	
Nutrient	3	0.002143	0.000714	0.2708333	0.846	Not Significant
Error	52	0.137143	0.002637			
Total	56	1.46				

R Squared = .015(Adjusted R Squared = -.041)

Table of difference between means for shell thickness

Weight gain	Means	0%	20%	40%	60%
LSD	**0.0607**	0.164	0.150	0.150	0.150
0%	0.164	0.000			
20%	0.150	0.014	0.000		
40%	0.150	0.014	0.000	0.000	
60%	0.150	0.014	0.000	0.014	0.00

Values in bold type are difference which are significant (P<0.05)

Shell breadth

Summary	Count	Sum	Mean	Variance
0%	14	5.098	0.364	0.00150
20%	14	5.094	0. 364	0.00147
40%	14	4.972	0.355	0.00246
60%	14	4.776	0.341	0.00142

ANOVA TABLE

Source of variation	df	SS	MS	F	Sig.	.
Intercept	1	45.81112	45.81112	4148.329	0	
Nutrient	3	0.031734	0.0106	0.958	0.420	Not Significant
Error	52	0.57425	0.0110			
Total	56	46.4171				

R Squared = .052(Adjusted R Squared = -.002)

Table of difference between means for shell breadth

Weight gain	Means	0%	20%	40%	60%
LSD	**0.125**	0.364	0.364	0.355	0.150
0%	0.364	0.000			
20%	0.364	0.000	0.000		
40%	0.355	0.009	0.009	0.000	
60%	0.341	0.023	0.023	0.014	0.00

Values in bold type are difference which are significant (P<0.05)

Feed conversion ratio

Summary	Count	Sum	Mean	Variance
0%	14	19.917	1.423	0.653
20%	14	16.509	1.179	0.618
40%	14	17.113	1.222	0.359
60%	14	16.134	1.152	0.218

ANOVA TABLE

Source of variation	df	SS	MS	F	Sig.	.
Intercept	1	86.68299	86.6830	187.6229	0	
Nutrient	3	0.629425	0.2098	0.4541	0.715	Not Significant
Error	52	24.02433	0.4620			
Total	56	111.3368				

R Squared = .026(Adjusted R Squared = -.031)

Table of difference between means for feed conversion ratio

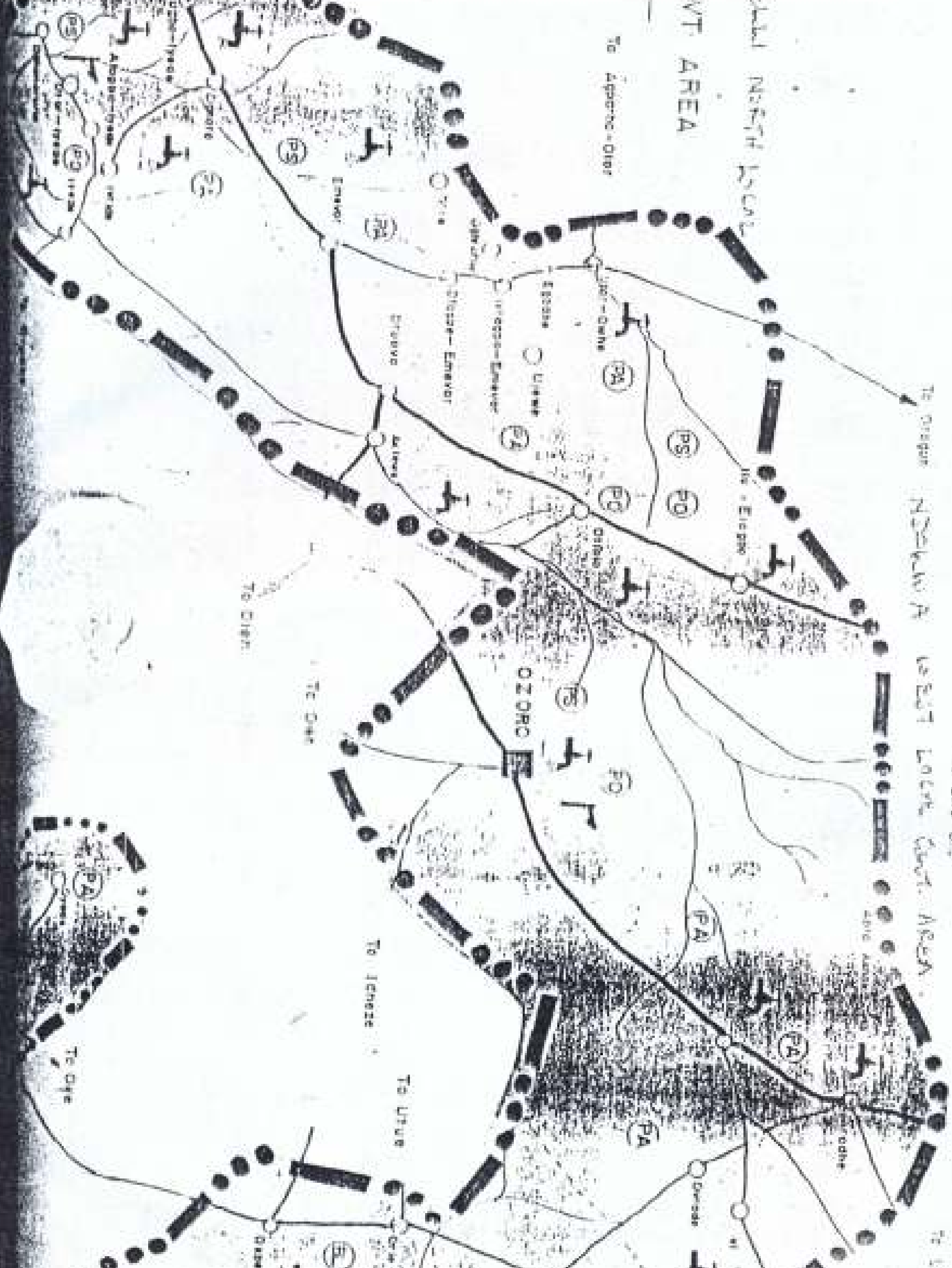
Weight gain	Means	0%	20%	40%	60%
LSD	**0.805**	1.152	1.179	1.222	1.423
0%	1.520	0.000			
20%	1.179	0.027	0.000		
40%	1.222	0.007	0.043	0.000	
60%	1.423	0.0271	0.244	0.070	0.00

Values in bold type are difference which are significant (P<0.05)

LSD RESULT FOR COCOYAM PEELS

Nutrient levels	Weight gain	Feed intake	Shell length	Shell thickness	Shell breadth	Feed conversion ratio
0%	16.90a	13.22a	0.632a	0.164a	0.364a	1.152a
20%	14.80a	12.93a	0.609a	0.150a	0.364a	1.179a
40%	14.52a	12.38a	0.597b	0.150a	0.355a	1.222a
60%	14.52a	12.11a	0.565c	0.150a	0.341a	1.423a

Values followed by the same letter are not significantly different at 0.05 of significance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