EFFECT OF SWEET POTATO LEAVES, WATER LEAVES AND MORINGA LEAVES ON THE BODY WEIGHT OF AFRICA GIANT LAND SNAIL (*Archachatina Marginata*)

+

BY

IBIKUNLE, MORADEKE TITILAYO

MATRIC NO: ASC/13/0968

SUBMITTED TO

THE DEPARTMENT OF ANIMAL PRODUCTION AND HEALTH,

FACULTY OF AGRICULTURE,

FEDERAL UNIVERSITY OYE EKITI, EKITI STATE, NIGERIA

IN PARTIAL FULFILMENT OF THE REQUIREMENTS

FOR THE AWARD OF

BACHELOR OF AGRICULTURE (B.AGRIC) IN ANIMAL PRODUCTION AND HEALTH

FEBRUARY, 2019

DECLARATION

I, **IBIKUNLE MORADEKE TITILAYO**, hereby declare that this project is my own original work done within the period of August to October and it has neither been submitted before nor being currently submitted in any other institution. All citations and sources of information have been clearly acknowledged by means of references.

....

Ibikunle Moradeke Titilayo Date

CERTIFICATION

This project entitled "EFFECT OF MORINGA LEAF, WATER LEAF AND SWEET POTATO LEAF ON THE BODY WEIGHT OF AFRICAN LAND SNAILS." by T.M. Ibikunle, meets the regulation governing the award of the degree of Bachelor of Agriculture in Animal Production and Health of the Federal University Oye-Ekiti, Ekiti State.

SUPERVISORS	Signature & Date
Prof. A.A AGANGA	AAAganga 20-03-19
DR. A.H. EKEOCHA	20/3/19
MR. F.A. ADEJORO	.....

.....

DR. ANTHONY EKEOCHA
Head of department

20/3/19

DATE

DEDICATION

This project is dedicated to God Almighty, my shield, my buckler, savior, potter, provider, advocate, rose of Sharon, intercessors, my all in all for giving me the privileged and enablement throughout the period of my studies. Also to my unbeatable, loving parents Mr. and Mrs. Ibikunle Adedeji. As well as my dearest siblings and also to my family in Christ All Christian Campus Fellowship (ACCF), Ikole-Ekiti) for grooming me in the way of the Lord. God bless you richly in Jesus name (AMEN).

ACKNOWLEGEMENTS

I owe this wonderful project to Almighty God, who sustained and protected me from the beginning till the end of my staying as an undergraduate may His name be praised. Immense appreciation goes to Professor A.A Aganga for her motherly care and corrections where needs be and to my HOD a person of Dr. Anthony Ekeocha and more so to MR F.A Adejoro, this project wouldn't have been completed without you, thanks so much for your supervision, love and care.

In addition, I won't forget to appreciate my school father a person of Dr. Adewale Daniel, your fatherly love can't be underestimate, you are so loving, caring and humble. Thanks for the support, the fatherly love and your help during the cause of this project. To my priceless late father MR. ADEDEJI FALADE I say thank you for your fatherly care, be it financially, emotionally and spiritually and many lot more when you were alive. My darling father, I miss you and you will forever be in my memory. Also, to my IYANIWURA the person of Mrs. Grace Ibikunle, thanks for been there during the dark and thin, thanks for your support is it financially, spiritually, emotionally and counseling all through my staying as an undergraduate.

Also, to my wonderful siblings; Olugbenga, Olayinka, Olaniyi, Olamide and Odunayo, I say a big thanks to you. To the Ayeni's family (my landlord and landlady) I say thank you... Also to Ayeni Emmanuel and Bodunde Tayo Benjamin, thanks for helping me during my filed work. How can I forget these ladies of virtue, Oreoluwa Aishat Alison, Oyebanji Adeola, Oluwadahunsi Mary and Arabamibi Alimot Bimbo, thanks for being my friends and always putting smile on my face.

Furthermore I want to use this medium to appreciate Mr and Mrs Jonah Ogah, Mr and Mrs Alison, well as my dearest siblings and also to my family in Christ All Christian Campus Fellowship (ACCF), IKOLE-EKITI) for grooming me in the way of the Lord. God bless you richly in Jesus name (AMEN).

ABSTRACT

Field experiment was conducted on the effect of four different diets on growth performance of African giant land snail (*Achachatina marginata)*. The experimental diets consist of vegetable leaves that are common within the warm humid tropical environment of Ekiti State, Nigeria. A total of eighty snails were purchased from local markets within Ikole-Ekiti metropolis of Ekiti state and stratified according to weight. The snails were subsequently allocated randomly into four experimental treatments T1, T2, T3 and T4 with twenty snails per treatment in a clutch of four snails per group and five groups per treatment. Snails in the respective treatments received T1) fresh sweet potato leaves (ipomea batatas) T2) fresh moringa leaves (Moringa oleifera), T3) fresh water leaf (Talinum triangulare) and T4) combination of fresh moringa leaf and fresh water leaf in equal weights. There is no significant difference among the four treatments for initial body weight, final body weight, average shell length, average shell width. The result of the study showed that higher growth performance for all parameters for Archachatina marginata was favored by the combination of the fresh leaf vegetables (water leaf, moringa leaf, sweet potatoes leaf). While moringa leaves (T2) had the least for all the parameters. There was significant difference ($P<0.05$) in weight gain while there was no significant difference in the average shell length and width across the treatment

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURE

CHAPTER ONE

1.0 INTRODUCTION

In West Africa, the market supply of snails is mainly from the gatherers that handpick them from their habitat in the wild. The supply of snails is thereby affected by season, but also not sustainable. The natural habitat of snails is faced with increasing deforestation and degradation due to human activities such as logging, urbanization and expanding human communitys. However, little or no concrete measure towards snail management may results in drastic reduction in supply of this micro livestock in no distant future. Farming of snail has been in existence in other parts of the world long ago. It is equally been recognized as a successful business in many European countries (Mead, 1981).

The shortage in food supply that is prevalent in most countries of tropical and sub-tropical Africa is more serious with deficiency in protein when compared to the availability of other classes of food. The population explosion implies that many people require the supply of protein in their diet because of its important role in human wellbeing, which includes growth, maintenance of hormonal and enzymatic activities and improvement of the defense mechanism of the body (Ademolu *et al.*, 2004). Imevbore and Ademosun, (1988) accessed the nutritive value of snail and observed that it has a protein content of 88.37%. Snail meat is a source of calcium, magnesium and zinc. Hence it is used in the treatment of anaemia and hypertension.

The high calcium content and polyunsaturated fatty acid of snail meat is the reason why it is recommended for cases of rickets. The low lipid content of snail makes it to be about the only meat apart from fish to be recommended for a liver–diseased patient (Mogbo *et al.*, 2013). Osemeobo (1992) listed 15 health conditions that are believed to be curable with the

meat, fluid and shell of African giant snails. Snail farming can conveniently be done in our back yards; this is due to the fact that snail farming is environmentally friendly and can be done with little skill (Akinnusi, 1998; NRC, 1991). The fecal matters neither smell nor make the environment filthy in any way. Snails are also good converter of vegetable protein to useful animal protein (Obi et al. 2001). They provide a very cheap source of high quality animal protein for human consumption. Snail farming is also a high profit-yielding venture and requires little capital when compared to other forms of animal farming. Thousands of land snails can be raised in a small land space if intensively managed and there is always less need for vaccination and therapeutic drugs. Hence, predators, parasites and diseases can easily be prevented through proper housing, management and sanitation.

Rebecca and Sheldon (2004) reported that snail production has gone to an advanced stage in America, Europe asnd Asia but in Africa, much research work has not been carried out. In West Africa, Archachatina marginata of Nigeria and Achatina achatina, produces the largest number of egg of about 100-500 eggs per clutch. Other snails of African origin produce less number of eggs of between 5-15 eggs per clutch. Achatina achatina is also known to be the tropical species of snail that is most accepted in the World (Amusan and Omidiji, 1998).

Similar to most other livestock production enterprises, feeding accounts for a reasonable percentage of the cost of production and a major factor that determines the inability and profitability of livestock farming ventures, With high cost of feed ingredients and competition between humans and animals for available feed resources, many studies have recognized that non-conventional feed resources are a key to sustainable livestock production. Feedstuffs such as roots, leaves, tubers and their by-products, which can probably reduce feed

cost and ultimately the reduction in the cost of livestock farming, are becoming increasingly important in meeting the dietary needs of conventional farm animals including fishes, snails and micro livestock's (Agbabiaka *et al.*, 2013).

1.1 JUSTIFICATION OF THE STUDY

Most of the developing countries of the World, especially in Nigeria is currently been plagued with the alarming drop in per capital income and food production. Thus, the food deficient situation is indeed more serious with protein when compared with the availability of calories. According to Ademolu et al. (2004), the alarming increase in population implies that more people require the supply of protein in their diet because of its important role in human wellbeing which includes growth, maintenance of hormonal and enzymatic activities and improvement of the defense mechanism of the body.

With a crude protein content of up to 88.4%, snail meat has the potential of contributing to the dietary protein supply of the populace. However, one of the major problem facing farmers in rearing snail is the non-availability of food that will meet the nutrient requirement of snails at cheaper cost. Hence, to solve this problem, there is a need to investigate the food and feeding habit of snails in order to provide their nutritive requirement at a cheaper cost and enhance their growth performance.

1.2 AIM AND OBJECTIVES OF STUDY

Aim: To determine the dietary effects of different tropical forages/vegetables on the growth performance of the African giant snail *Archachatina marginata.* The specific objectives of the study are:

1. To evaluate the effect of varying forage diet on body weight up to 8 weeks of rearing.
2. To evaluate the effect of varying forage diet on shell length and shell circumference after 8 weeks of rearing.

1.3 STATEMENT OF PROBLEM

Protein deficiency in human diet has been persistent in West African due to high cost of livestock products such as chicken, beef, pork, mutton among others, which are the basic sources of animal protein for man. The prices of the protein foods are so exorbitant that average households have difficulty in meeting their daily allowance. Akinyemi *et al.* (2007) recommended that production and consumption of micro livestock products such as snails can enhance the physiological growth and development in humans due to its nutritive value. Poor attitude to snail production such as the general perception that snails do not mature very fast, coupled with overdependence on snail gathering from the wild have ensured that the price of snail remains very high in the market. Few farmers that are into snail farming have a poor skill of feeding snails with many kinds of feed, not knowing the feed that could stimulate or quicken growth development and egg production.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 HISTORICAL BACKGROUND

Archeologist has reported the discovery of roasted snail shells, thus indicating that snails have been eaten since prehistoric time (Rebecca et al., 2004). The act of farming snail is claimed to have started about 50 B.C. when snails were raised in small confined units called cochlear garden. Snails belong to the kingdom animalia and phylum Mollusca, which is the second largest invertebrate. They are characterized by the possession of shells. They can also be aquatic or terrestrial i.e. they can be found on dry land or inside the water. Snails (especially the African giant land snail Archachatina marginata which is mostly found in Nigeria) are classified as micro-livestock (Ebenso, 2006) that serves as important source of animal protein in the diet if both urban and rural households in many parts of Nigeria (Adinya, 2010; Agbogidi 2011; Nwandu, 1999). It is one of the largest body sized specie of 18 snails and it lays large sized eggs which range from 5-15 eggs per clutch. Snail's meat has a high nutritive value of 60% protein on dry matter basis, rich in essential amino acid and also high in iron up to about 45-50mg/kg (Imevbore, 1990; Stievenart, 1992; Ebenebe, 2000).

2.2 SCIENTIFIC CLASSIFICATION OF *Archachatina marginata*

Kingdom: Animalia

Phylum: Mollusca

Class: Gastropoda

Super family: Achatinoidea

Family: Achatinidae

Genus: Archachatina

Species: Archachatina marginata

Subspecies: Archachatina marginata marginata

Archachatina marginata ovum

Archachatina marginata suturalis

Archachatina marginata egregia

Archachatina marginata eduardi

Archachatina marginata candefacta

Archachatina marginata gravillei

Archachatina marginata icterica

2.3 Description of *Archachatina marginata*

Archachatina marginata has a distinct set of attributes, which made it different from Achatina species. Achachatina marginata has a bulbous protoconch that is large and broad, as compared to the narrow, pointed spire of Achatina species (swainson, 1821). The shell of giant land snail can grow up to 21 centimeters in height and 13 centimeters in diameter. The shell when magnified has the appearance of a woven texture (USDA, 2015). Moreover, it is distinguished from related Archachatina species by two principal character; its subsutural, usually strongly marked engraved line separated from the suture by a narrow depressed area covered with irregular, low vertical folds, the suture itself being straight or very slightly wavy, not crenulated.

The engraved line starts on the fourth or fifth whorl and it is often deep and prominent, particularly on the body whorl; the second feature is a peculiar micro-sculpture of the body-whorl only visible to the proper magnification. It consists of numerous extremely fine, close-set or crisscross lines, making the surface of the periostracum look as if it had been pressed with a very finely woven cloth. The embryonic whorls, when well preserved are densely covered with regular spiral and vertical rows of minute granulations, which become coarser on the first post-embryonic whorls (Bequaert; 2001).

2.4 Geographic distribution of *A. Marginata*

Archachatina marginata mostly found occur in western African: Cameroun through Democratic Republic of the Congo and can be found in the Carribean, in Martinique (U.S. D.O.A.; 2015). It is still unknown how the specie reached Martinique but it is possible they are intentionally introduced as pets or by workers returning from West Africa (Robinson et. al.; 2015). Whereas, the natural spread of this species is very slow; however, unintentional spread by individuals for

foods and as folk medicine is very common (Science Daily; 2009). This specie has not yet become established in the United States, but it is considered to represent a potential threat as a pest and invasive species which could negatively affect agriculture, natural ecosystem or commerce. Therefore it has been suggested that this species be given top national quarantine significance in the United States (Cowie *et al.*, 2009).

2.5 Mating, egg laying and hatchling

Snails are hermaphrodites; meaning is that one snail possesses both male and female reproductive organs but must mate with another snail of the same species before they lay eggs. Some snails may act as males one season and as females the next season (Rebecca and Sheldon, 2004). Other snails have been identified to play both roles at once and fertilize each other simultaneously. Mating is preceded with a courtship that involves the suitor piercing the body of the other individual with a stimulating dart. This can sometimes be seen as a white splinter sticking out of the skin. Giant snails begin breeding at about a year old and mating occurs in the late spring or early summer after several hours of courtship. Second mating sometimes occurs in the summer. Mating process is usually slow like everything snails do and it can take up to 12 hours. Once mating is completed, the sperm can remain in the body of the snail for up to a year, but usually snails lay eggs within two weeks after mating. Amusan and Omidiji (1998) observed that fullness of flesh within the shell is an indication of good health and those healthy snails cannot withdraw its body far into the shell when irritated but the starved or snails that are not in good condition usually withdraw its body far into the shell. In tropical climates, mating may occur several times a year. After mating, the snail can store sperm received for up to a year but it usually lays eggs

within few weeks. Snails are sometimes interested in mating with another snail of the same species that originated from considerable distance away (Rebecca and Sheldon, 2004). Achatina marginata can lay between 4-18 eggs per clutch. Eggs are laid in the soil at a depth of about 10 cm and are comparatively large at 17 × 12mm with an average weight of 4.8g. Incubation period, from egg to hatchling is 4weeks. Hatchlings have a have a thin, transparent shell.

2.6 Growth of snails

In a snail population, some snails tend to grow faster than the others under the same conditions. Some will take longer time to mature. The long maturity period has been suggested to help the species survive harsh weather condition. Various factors greatly affects the growth of snails; they are population density, stress such as noise, light, vibration, unsanitary conditions, irregular feedings, being untouched etc., feed, temperature, moisture and the breeding technology used. Snails tend to go into aestivation with storage of water and a covering of epiphragm to prevent such external clout. A broken epiphragm can be rapidly rebuilt in 2-3 days, while it can take two weeks for a broken epiphragm to fully disintegrate.

Calcium helps in the growth of snails. According to Amubode and Ogogo (1995), a mixture of 70% bone meal and 30% oyster shell in diets of *Archachatina marginata* resulted in significant increase in growth rate. Rebecca and Sheldon (2004) reported that snails might eat paint or attack walls of buildings and even eat dirt in while seeking calcium. Hence, the size of the shell of a newborn snail will depend on the egg size since the shell develops from the egg's surface membrane. As the snail grows, the shell adds and eventually it will develop a flare or reinforcing lip at its opening. This shows that the snail is now mature and there will be no further growth.

African land snails can live for 5-6 years although; just a few manage to live up to 15 years before they die (Akintomide, 1997).

2.7 Feeding of snails

Snails are vegetarian and will eat many types of feed. They are known to feed on decaying materials such as dead plants and animal carcasses; thus; they are termed as good end-converters. Snails also feed on their own wastes (caprophagia) and eat up their dead or weak mates under certain conditions (cannibalism). Some of the plant material which they feed on include; tubers: such as carrots, cocoyam, yam and sweet potatoes; fruit such as avocado pear, guava, oil palm, ripe pawpaw, ripe plantain, pineapple, orange, mango and bread fruit. Other materials include; plant leaves such as pawpaw, sweet potato, and cocoyam, fluted pumpkin and household wastes: yam peel, cassava, bread, and remnant foods without table salt, rotten plantain cannibalism and death. However, the growth obtained through feeding young Archachatina marginata on plant materials supplemented with compounded feed was significantly better than that obtained through feeding it with only plant food materials (Ejidike *et al.*, 2002). The growth of snails like other animals differs with respect to what they are fed. There is also a strong and positive relationship between nutrient content of the feed and the growth of snails (Okonkwo *et al.*, 2000). Adu *et al.* (2002) pointed out the need for research studies on the use of compounded ration for snails in order to maximize their growth potential in meeting the animal proteirn needs of the populace. Amusan and Omidiji (1998) pointed out the need to avoid salt in snail feed since it possibly coagulates the slimy salivary systems and deadens the foot or flesh of the snail resulting to instant death. Other studies have equally shown that snails may eat during the day, but they are more active and prefer to eat at night. Domesticated snails readily consume food that is high in protein and low in fats

with poultry droppings resulting in significant improvement in growth and weight gain (Ademolu et al, 2005).

2.8 Climatic conditions and soil characteristics

The countries in which Archachatina marginata is established have tropical climates with warm, mild year round temperatures and high humidity (Raut *et al.*, 2002). This specie occurs in agricultural areas, coastal areas and wetlands, natural and planted forests, riparian zones, Scrub lands and urban areas (Raut *et al.*, 2002). These snails thrive in forest edge, modified forest and plantation habitat (Raut *et al.*, 2002). Rebecca and Sheldon (2004) reported that a mild climate (59-75°F) with high humidity (75%- 95%) is best for snail farming; though most varieties can stand a wider range of temperatures. Thus, humidity that is lower than required will disturb the production due to excessive evaporation from the body of the animal. Such a condition can lead to the emergence of illness and can cause death. They pointed out that the optimal temperature is 70°F for many varieties. When the temperature falls below 45°F, snails hibernate. Fewer than 54°F, the snails are inactive and under 50°F, all growth stops. When the temperature raises much above 80°F or conditions become too dry, snails aestivate. Wind increases moisture in snails, hence, to prevent snails from drying, snailery should be situated in sites that are protected from wind since it affects the humidity and temperature of the environment. In addition, wind can be held by planting big trees around the farm. Trees, apart from reducing wind, can also provide shade and increase the humidity. Snails also need damp, not wet environments, although, snails need moisture, wet or water logged, soil must be drained to make it suitable for them. Snails breathe air and may therefore be drowned in overly wet surroundings. Rebecca and Sheldon (2004) reported

that snails need soil in which to lay eggs. Dry soil is not suitable for the preparation of a nest nor is soil that is too heavy. In clay soil that becomes hard, reproduction may 28 decrease because the snails are unable to bury their eggs and the hatchlings have difficulty emerging from the nest? Hatchability of eggs also depends on soil temperature, soil humidity and soil composition. Soil consisting of 20% to 40% organic material is good (Rebecca and Sheldon, 2004). Ejidike (2002) reported that snail soil tolerance differs and that while some species prefer acid soil of low pH of about 4.5, most species prefer slight alkaline soil with a pH range of 7.0-8.0. Snailery soil is considered a good breeding site for most infectious microorganisms and pest of land snails. Snailery soil is advised to be heat treated either wet or dry. Sterilization is necessary to destroy soil ants and their eggs because of the devastating nature of the ants on snails. Akintomide (1997) advised that the use of disinfectants or other chemicals is better avoided to prevent toxicity or drug accumulation within the body of the snails since they are in frequent contact with the soil and often taking in soil particles. Akintomide (1997) further emphasized that periodic heat treatment of the soil should be carried out twice a year or when some ants or pest are sited therein.

2.9 Predators, parasites and diseases

A snail farmer must be aware of predators, parasites and diseases of snail in order to reduce mortality to the barest minimum. The predators of snail include the field mice, rats, frogs and toads, domesticated birds such as ducks and turkeys, lizards and snakes, beetles, millipedes and centipedes. The frogs have been observed to take only the young snails while the reptiles eat both the eggs and the snails. Cover nets over the pens can prevent bird predation. While other predators can be kept out of the pen by building fences between 15 and 30 cm high and digging well into the ground around the pens. Left over feed must always be removed regularly from pens since some predators like rat and field mice are attracted by the uneaten feed. A fly, Alluaudihella flavicarous

has been identified as the major parasite on snails. This fly belongs to the same family as the housefly and the adult resembles the adult housefly. The fly lays 20-40 eggs in the snail's shell or on the snail. The eggs hatch in about 1 week and the small, cream-colored worms start feeding on or in the body tissue. They feed until the body is reduced to a putrefying mass, and then pupate within the shell. After a 10-day incubation period, the adults emerge. Snails can best be protected against these flies by covering the pens with nylon mesh. Ectoparasitie. Mites are also found on the snails in hutch boxes. These appear to be secondary parasites usually occurring on inactive snails. Obi *et al.* (2001) identified several entero-pathogenic bacteria and fungi among African giant land snails around Ibadan metropolis. Akintomode (1997) also reported that bacteria, particularly entero-bacteria may be transmitted to people who handle or eat snails. In Italy, wild snails are no longer considered as food source due to the stringent health regulation for consumption of food (Sonya, 2003). This is necessary to protect the consumer against collected snails that may have ingested toxic plants or potentially harmful chemicals. Two major diseases have been identified to attack snails. The first disease is a bacterial diseases caused by pseudomonas. This leads to intestinal infections, which may spread rapidly amongst dense populations of snails. The second disease is caused by fusarium, which parasitizes the eggs of snails. The affected eggs turn reddish brown and development stops. This disease is referred to as rosy egg disease. Basic hygiene is known to prevent the spread of diseases. Pens should be cleaned out regularly to remove excreta and uneaten feed, as well as any other decaying matter that may serve as substrate for pathogenic organism. The soil in the hutch boxes should also be sterilized. Akintomide (1997) 31 suggested that newly purchased snails should be given an alum, lime or lemon solution bath before finally bringing them in since the astringent property of the solution reduces the level of snail ecto-parasites and keeps them clean.

2.10 Economic importance of *A. Marginata*

Snails feed on a large variety of plants, mainly fruits. Plants included in the snail's diet are bananas, lettuce, peanuts and peas, some of which are important crops in certain economies. The giant West African land snail Archachatina marginata is one of the worst invasive species in the world and it's extremely devastating to any species that it affects. However, the more prevalent problem with the spread of the snail as invasive species is that it is often a carrier of the disease rat lungworm. Within humans this causes the disease Eosinophilic meningoencephalitis, which is what makes the snails spread to North America problematic. If the snail continues to spread, it could potentially be a problem to the health of people all throughout North America from Cuba to the United States (Vazquez, 2015). Archachatina marginata can live up to 10 years and attain sexual maturity at 9-10 months under laboratory conditions. In addition to being agricultural pest, they act as the reservoir host of rat lung parasite which causes Eosinophilic meningo encephalitis in humans and are seen as a threat to public health because of this (White-Mclean, 2011).

2.11 Processing and consumption of snail meat

Snails usually need to grow for at least one year to reach their proper size and weight. It is recommended to harvest snails by the time they reach two years, because after this age their rate of growth slows down. Snails are picked by hand, at nightfall, when they become active and are easier to find and collect. They need to be put carefully into a basket, box, crate or sack, to avoid damaging the shell, which would lower their market value. It is advisable not to put more than 10 kg snails together in whatever storage receptacle, to avoid cracking or crushing the shells in the lower layers. Snails, whether for household consumption or for the market, can be stored safely for up to 6-8 weeks in a box or crate, if they are not to be collected daily.

2.12 Processing of snails

2.12.1 Harvesting and storage

The age and size at which snails should be collected from the snailery obviously depends on the farming objectives: whether the snails are grown for personal use or for the market. Snails grown for personal use can be harvested according to the farmer's needs; whereas customer preferences dictate the optimum size and consequently age of snails harvested for the market. Snails usually need to grow for at least one year to reach their proper size and weight. It is recommended to harvest snails by the time they reach two years, because after this age their rate of growth slows down.

2.12.2 Washing

Put the snails in a bucket of water; add some amount of salt or lime to wash it. Soon, the snail will discharge their lime: a milky whitish

CHAPTER THREE

3.0 MATERIALS AND METHOD

3.1 Location of study

The experiment was conducted at the Animal Science teaching and research farm in Federal University, Oye-Ekiti, and Ikole Campus Ekiti State. The rainy season is between April to October and dry season between November to March.

Feed sources: Leafy vegetables were the test feed used for the experiment. All the fresh feeds were gotten from a farm in Ikole Ekiti.

3.2 Experimental animals

Eighty African giant land snails (*Achachatina marginata*) points of lay snails were used for this study, and were subjected to four (4) dietary treatments in five (5) replicate of four (4) snails per replicate. Thus each treatment had twenty snails and a total of eighty snails for the study. The snails were purchased from Advic farms, Ibadan, Oyo State. The snails were left for one week to acclimatize. During the acclimatization period, they were fed with *Talinum triangulare* (water leaf).

3.3 Experimental diet

The snails were given different vegetables as follows:

Treatment 1: Sweet potatoes leaf *(ipomea batatas)*

Treatment 2: Moringa leaf *(Moringa oleifera)*

Treatment 3: Water leaf *(Talinum fruticosum)*

Treatment 4: water leaf, moringa leaf and sweet potato leaf (mixture)

Table 3.1: The experimental snails in relation to how they were grouped on the experimental field

	TRT 1	TRT2	TRT3	TRT4
REP 1	4	4	4	4
REP 2	4	4	4	4
REP2	4	4	4	4
REP4	4	4	4	4
REP5	4	4	4	4
TOTAL	20	20	20	20

3.4 Housing

The snails were raised in old used car tyres. Car tyres were placed over each other with a mosquito net spread in-between the first and second tyre. The tyres were filled with sterilized loamy soil and this was done in other to prevent insects and parasites from affecting the snails.

3.5 Feeding and watering

Feed were given to snails by serving in trays, and water was given by sprinkling over the snails. This was provided to the animals *ad libitum*. Wood ash was used as a source of calcium by mixing with the sterilized soil. Remnants of feed offered were removed weekly and the trays were washed with water before fresh feed offering.

3.6 Data collection

Body weight of the snails in each replicate tyre was weighed bi-weekly and averaged for each snail up to 8 weeks of rearing. Shell length, and shell circumference was taken at the beginning and after 8 weeks of rearing using weighing scale and vernier calipers.

3.7 Statistical Analysis

Data collected were subjected to one way (ANOVA) using SAS statistical package and Tukey honestly test was used to assess the significance of difference within treatments means.

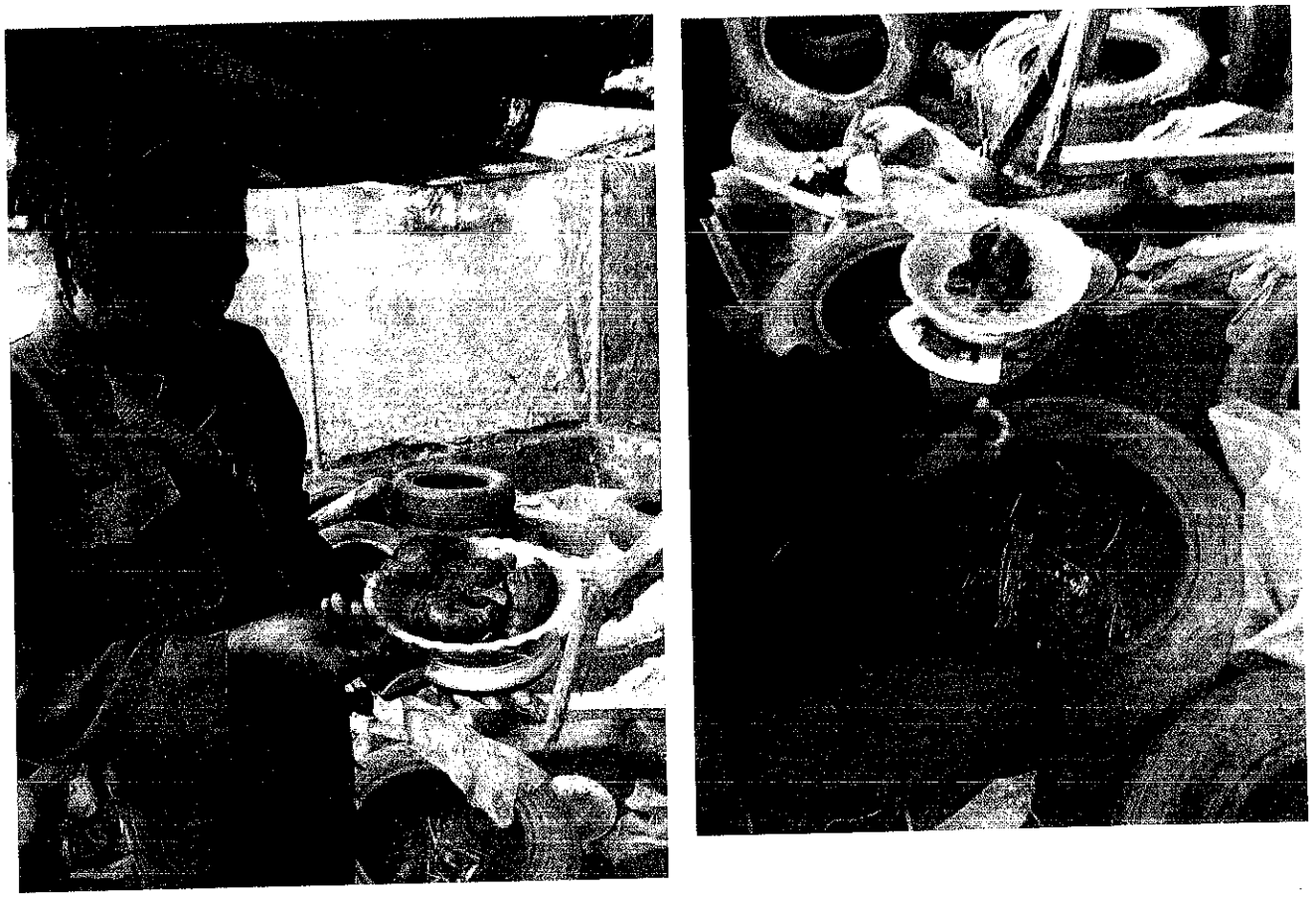

Figure 1: Weighing of snails using weighing scale

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

The table 4.1 shows the different varieties of edible vegetables that were fed to the *Archachatina marginata* in this study.

The result of the proximate analysis of the experimental diet showed that diet Moringa leaves had the lead in the dry matter content for CP, EE. Crude fiber was highest in Sweet potatoes compared to other nutrients sources involved in the study. Moreover the highest ash content was obtained in Water leaf (Table 4.2). The fiber content of the feeds was in reverse order of the protein content of the feeds.

Table 4.1: Experimental vegetables with their scientific name

VEGETABLES	COMMON NAMES	SCIENTIFIC NAMES
Sweet potatoes	Sweet potato	*Ipomea batatas*
Moringa leaf	Moringa	*Moringa oleifera*
Water leave	Water leave	*Talinum fruticosum*

Table 4.2: Proximate analysis of selected forage vegetables fed to AGS

Parameters	Sweet potato (*ipomea batatas*)	Moringa oleifera	Water leaf
DM, %	13.0	26.2	9.7
CP, % DM	16.5	24.3	21.1
EE, % DM	4.8	5.4	1.5
CF, % DM	21.1	13.6	10.3
ASH, % DM	11.2	1.8	34.6

DM= Dry matter, CP=Crude protein, EE=Ether Extract, CF=Crude fiber,

The result of the growth performance in the present study showed an increase in weight gain by the experimental snails. Also, from the result in Table 4.3, *Archachatina marginata* tends to increase in body weight overtime. Snails in Treatment 1 (sweet potato leaf) increased in weight with an average daily gain of 8.625 g. The highest weight gain was recorded for snails fed with Diet T4 followed by snails fed with Diets T3. Also the snails fed Diet T1 and T2 gained. 8.625 and 5.604 respectively. There was significant difference between the initial body weights of snails in diets T1 to T4. There was no significant difference between the average shell lengths of the snail fed with Diet T1 to T4. However there was significance significant in the average daily gain between snails fed Diets T1, T2, T3,T4 ($P<0.05$) as shown in Table 4.3. The significant difference observed in the performance of snails raised on T4 i.e. combination of Water leaf, Sweet potatoes leaf, Moringa leaf in terms of growth may be to the palatabil':lity of the mixture. This is similar to the observation made by Adegbola and Smith due. However, it appeared that it c v knhlu T3(Water leaf)only improved the growth performance of the snails compared to Sweet potatoes leaf and Moringa leaf. Also, despite the facts that Moringa has the highest crude protein of 26.2 compared to Water leaf with 21.1, the snails may find water leaf palatable while rejecting or eat less of the Moringa leaves due to the presence of antinutritional factor; *Soetan et al 2016* reported the antinutritional factors present were phytate, oxalate, Saponins, tanins, alkaloids, flanoids, cyanogenic glycoside, phenol, trypsin inhibitor, haemagglutinin and chymotrypsin inhibitor.

Statistical analysis showed that there was no significant difference in the average width of snail fed on Diets T1, T2, T3 and T4 ($P<0.05$). The significant difference ($P<0.05$) observed in growth performance between those snails raised on Sweet potato leaf might be due to relatively high amount fiber and lower protein content which may affect digestibility and feed utilization as reported by Akeredolu *et al.,* (2014).

Table 4.3: Growth performance of Africa Giant Land snail (*Achachatina marginata*) fed with, water leaf, sweet potatoes leaf, moringa leaf and the combination of the three leaves.

Parameters	T1	T2	T3	T4	SEM	Significance
Initial body weight	195.2	189.35	197.35	186.35	4.28	Ns
Final body weight	224.0	209.6	246.75	251.35	13.06	Ns
Average daily gain	8.6^{c}	5.6^{c}	12.8^{b}	19.8^{a}	3.87	*
Average shell length	114.3	113.1	115.4	115.6	0.84	Ns
Average shell width	56.0	55.0	52.6	56.3	0.45	Ns

*Mean with the same superscript across a row are not significantly different (<0.05).NS, not significant. TI= Sweet potatoes leave, T2=Moringa leaf, T3= Water leaves, T4= Moringa leaf+Sweet potatoe leaves + Water leaf

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATION

5.1 CONCLUSION

This project has been able to look critically into the feeding of snail, by testing different feeds on their body weight, shell length and width. The summary of the results shows that there is a significant difference between the initial body weight and final body weight associated with the different types of vegetables offered to the animals. However, an equal mixture of Moringa leaf, waterleaf and potatoes leaf gave the highest average daily gain followed closely by snails fed with Water leaves.

5.2 RECOMMENDATION

I therefore suggest that Water leaves may therefore be incorporated into the common feed often given to snails to improve their growth performance. Water leaves could be harvested to support improved snailery production among small holder farmers for better nutrition and improved socio economic livelihood derivable for the sales of snail.

REFERENCES

Abakwam, L.O; Okorie, P.U. (2016). Food and feeding habit of giant land snail (Archachatina marginata)

Ademolu, K.O., Idowu, A.B., Mafiang, C.F., and Osinowo, O.A. (2004). Performance, proximate and Mineral analysis of African giant land snail (A. marginata) fed different nitrogen sources. African Journal of Biotechnology. 3(8):412-417.

Adeyeye, E.I., (1996). Waste Yield, Proximate and Mineral Composition of Three Different Types Of Land Snail Found In Nigeria. Int. J. Food Sci. And Nutr., 47: 111- 116.

Agbabiaka, L.A., Okorie, K.C., and Ezeafulukwe, C.F. (2013). Plantain peels as dietary supplement in practical diets for African catfish (Clarias gariepinus burchell 1822) fingerlings. Agriculture and Biology Journal of North America. 4(2):155-159.

Akinnusi O. (1998). Introduction to Snail Farming. Omega Science Publisher, Tinuoso House, Lagos, Nigeria.

Akinnusi O. (2002). Introduction To Snails And Snail Farming, Triolas Publishing Company, Abeokuta, Pp. 70.

Akintomide, T.O. (1997). The African Giant Land Snail. Alamsek Press Limited Ijebu Ode, Nigeria PP 2-14.

Akintomide, T.O. (2004). Tropical Snail Farming. 1st Ed. Oak Ventures Abeokuta, Nigeria.

Amusan, J.A., and Omidiji, M.O. (1998). Edible Land Snails. A Technical Guide to Snail Farming In The Tropics. Verify Printers Ibadan 19-22.

AOAC (1990). Association of Official Analytical Chemist, Official Methods, 13th Edition Washington DC.

Cowie R.H., Dillon R.T., Robinson D.G., Smith J.W. (2009). "Alien Non-Marine Snails and Slugs of Priority Quarantine Importance In The United States: A Preliminary Risk Assessment" American Malacological Bullentin 27: 113-132.

Dada, S.A.O., Abu, A.O., Okeowo, T.A., Badmus, O.R. (1999). A. J. Biomed. Resi 2: 2 (103-108).

Daouda, A.I.H.H (1993). The Calcium In The Nutrition Of Giant African Snail Achatina Achatina. B.E.D.M 1 (2): 25-26.

Ebenebe, C.I. (2000). Mini Livestock Production in Nigeria. The present and future. Proceedings of 5th Annual Conference.

Ebenso, I. E. and Okafor, N. M. (2002). Alternative diet for growing Archachatina marginata snails in south-eastern Nigeria. Tropical Science. 42(3):144-145.

Ejidike, B.N. (2000). Mini Livestock Production in Nigeria. The present and future Proceeding of 27th Annual Confe. Of NSAP.PP307-308.

Ejidike, B.N. (2004). Growth Performance and Nutrition Utilization of African Giant Land Snail (Archachatina marginata) Hatchlings fed Different Protein diets. Food, Agriculture and Environment vol.2 (1) 160-162.

Imevbore, E. and Ademosun, A.A. (1988). The nutritive value of African Giant Land Snail (Archarchatina marginata). Nigerian Journal of Animal Production. 15:109-112.

Ireland, M. P. (1991). The effect of dietary calcium on growth, shell thickness and Tissue distribution in the snail Achatina fulica. Comparative Biochemistry and physiology. 98(1): 111-116.

Soetan, K.O. and Aiyelaagbe, O.O. Proximate analysis, minerals and antinutritional factors of moringa oleifera leaves.

Mead, A.R. and Palcy, L. 1992. Two giant African land snails' species spread to Martinique, French West Indies. The Veliger. 35: 74-77.

Mogbo, T.C., Nwankwo, O.D., Nwuzor I.L. (2014). Growth Performance of Snails (Achatina Fulica) fed with Three Different Leaf Materials. *American Journal of Biology and Life Sciences.* 2(4):96-99.

Mogbo, T.C., Okeke, J.J., Ufele, A.N. and Nwosu, M.C. (2013). Effects of Housing Types on the growth performances of snail (Achatina achatina). American Journal of Life Science Researches. 1(3):102-110.

Nwogor U.A. 2015. Effect of Pawpaw (Carica Papaya) and Plantain (Musa Paradisiaca) Leaves on Growth Performance of Achachatina Marginata (African Giant Land Snail). European Journal of Biophysics. 3(4):23-26.doi:10.11648/j.ejb.20150304.

Obi, O.O., O.I Ayodeji, F.O., Adetoro, F.O., and Ogundola, F.I. (2001). An Assessment of Bacterial and Fungal loads in snails (A. Marginata) procured from Different locations within Ibadan metropolis Proc. 26th Annual NSAP Conf.

Okonkwo, A.G., Isaac L.J., Nkanga I., Usoro O.O. (2000). Effects Of Various Feeding Regimes On The Performance Of Snails (A. marginata). A Paper Presented At 25th Annual NSAP Conference, March 19-23, Umudike, Nigeria. Pp: 314-315.

Omole, A.J (2003). Nutrients requirement of different classes of snails (*Archachatina marginata*) at different stages.

Omole, A.J., Tewe, O.O., Makinde G.O., Adetoro F.O., Saka J.O., and Ogundola I. (2000). Preliminary studies on the response of growing snails (Archachadina marginata) to compounded feed as a supplementary ration. Tropical Animal Production Investigation, 3: 35-40. 29.

Osemeobo, G.H. (1992). Effects of land-use and collection on the decline of African giant snails in Nigeria. Environmental Conservation. 19:153-159.

Raut, S.K and Barker G.M. (2002). Achatina fulica Bodwich and other Achatinide as pests of tropical Agriculture. In: GM Basrker (ed), Mollusc as Crop pests. CAB publishing, Hamilton, New Zealand. pp 55-114.

Rebecca, T. and Sheldon C. (2004). References section. U.S Department of Agriculture, Agricultural Research service. National Agricultural library Beltville, Maryland 70705-2351.

SAS (2014). Users Guide. Statistical Analysis System Institute Inc. Cary, N.C.