Proximate Analysis Of Feeds Of Fingerlings Of *Clarias Gariepinus* (Catfish) Fed Locally Produced Feeds.

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Abstract: A 12 weeks (3 months) experiment was conducted in the biological garden of the department of biological sciences, university of Abuja, main campus to determine the differences in growth rate (length and Weight) of the African catfish *Clarias gariepinus* fed with one commercial feed (Coppen) which served as the control in tank A and two locally produced feeds, using soybean, tiger nut, date fruits, corn bran and fish meal for treatment B and date fruit, tiger nuts and fishmeal for treatment C. All the experimental feeds were studied under laboratory conditions, with the aim of establishing the best quality feed in terms of specific growth rate, total weight and percentage survival rate, for a period of 12 weeks. Ninety (90) fingerlings of *Clarias gariepinus* were grouped into 3 tanks with replicates. They were fed for the period of 12 weeks. Fishes in tank A were fed coppens which serves as the control with proximate analysis of 42% crude protein, 13% fat, 1.9% crude fibre, and 8.9% ash. Tank B were fed feeds with proximate analysis ranging from 1.56 - 40.0% crude protein, 1.49 - 23.2% fat, 3.0 - 16.26% and 2.13% - %.64. Fishes in Tank C were fed with 1.56 - 2.2% crude protein, 0.6 to 1.49% fat, 6.9 - 16.26% crude fibre and 2.13 - 5.61% ash respectively. They were fed 2% of their body weight twice daily, 8.00am and 4.00pm. The growth performance and physiochemical parameters were measured weekly. Results showed that fishes fed with coppens in tank A (5.02) had the best growth performance while fishes fed with formulated feeds in tank B (2.96) and C (0.437) showed appreciable growth performance.
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Introduction.

Feed, being part of the general input of production in extensive and semi-intensive sustainable aquaculture system, has been reported to account for 40-60% of the total recurrent cost of production (Falaye, 1992).

The culture of fish is receiving a lot of attention in Nigeria with the result that new cultivation techniques are being introduced and adopted. Over the last decade, spectacular growth has taken place in aquaculture in Nigeria. Fish farming activity in Nigeria started about 50 years ago (Olagunju *et al.,* 2007) and as at now aquaculture in the country is in the developing stage, because it has not been able to meet the demand of the ever increasing population (Ojutiku, 2008).

Fish feeds are used in aquaculture to increase production and maximize profit. Feeds in intensive fish culture consume about 60% of the capital cost (Eyo, 2001).

For aquaculture to be highly successful in Nigeria there is need for good quality and affordable feed, which can also encourage small scale farmers in the field of aquaculture for sustainable production and also meet the demand for fish. Presently, in Nigeria, there are different fish feeds with different compositions ranging from Coppens, Eurofeeds and others but there is competition among them more so they are imported. The amount of feed consumed, age, body size and temperature are the most important factors that limit maximum growth of fish (Machiels and Henken, 1985).

Fish is a major source of animal protein source and an essential food item in the diet of many people in Nigeria. Fish is also a good source of thiamine, riboflavin, vitamins A and D, phosphorus, calcium and iron. It is also very high in polyunsaturated fatty acids which are important in lowering blood cholesterol level. It is therefore suitable for complementing high carbohydrate diets typical of the low income group in Nigeria (Areola, 2008).

Apart from being food, fish is also an important source of income to many people in developing countries including Nigeria (FAO, 2008).

FAO (1996a) confirms that as much as 5% of the African population (some 35 million people) depends wholly or partly on fisheries sector for their livelihood.

Some decades ago, fish was mainly the diet of poor and low income people. As a protein source, it is an important component in the building blocks for growth and development in man and other animals. It is nutritionally better than beef in protein, it has high essential minerals, and low in saturated fats (Babbitt, 1990).

Fish improve the defense mechanisms in human and assist in life prolongation, thus prevent diseases

such as diabetes and cancer, and enhances growth and development in human, especially children (Babbit, 1990).

Imported commercial fish feed have been ranked as the most favoured feed for fish since the inception of fish culture or aquaculture technology in Nigeria, because they support satisfactory growth in fish. However the exhorbitant cost of imported fish feeds has been reported to be as high as 60-70% of production cost (Eyo, 2003).

This has made catfish feeding economically unattractive for the small-scale fish farmers.

Fish is a vital source of food for people. It is one of the cheapest source of animal protein in Nigeria and constitute about 40% animal protein intakes by average Nigerians (Afolabi *et al.,* 1984; Sadiku and Oladimeji, 1991).

It is man's most important source of high-quality protein, providing approximately 16% of the animal protein, consumed by the world's population, according to the Food and Agriculture Organization (FAO) of the United Nations (1997).

It is particularly an important protein source in regions where livestock is relatively scarce. Fish supplies 10% of animal protein consumed in the North America and Europe, but 17% in Africa, 26% in Asia and 22% in China (FAO, 2000).

The African catfish (*Clarias gariepinus*) is choice food specie in Nigeria. It commands high demand from consumers and is mostly preferred by aqua culturists. This is due to the ideal characteristics of this species (Eding & Kamstra, 2001), which include, high growth rate at high stocking densities, a high food conversion, good meat quality, and smoking characteristics as well as year round production (Ita 1985).

Six out of 10 Nigerians do eat catfish on weekly basis. That's a whooping percentage of about 65. The production of catfish in Nigeria however, from current studies showed that catfish production, distribution and marketing are way lower than its demand.

In Africa, especially in Nigeria, the species mostly cultured are *Clarias gariepinus, Heterobranchus species* and their hybrids. The reasons for their culture are based on their fast growth rate, disease resistance high stocking density, aerial respiration, high feed conversion efficiency among others. Catfish are cultured conveniently under mono and polyculture systems (Reich 1975).

Fish culture production in Nigeria includes stocking of lakes and production in ponds, cages and tanks (Ita, 1985).

It is observed from reports that the African catfish, *Clarias gariepinus* is an important food fish culture in Nigeria. But it is quite unfortunate that the water quality characteristics (physio chemical parameters) of the pond water affects the growth of this species (Stirling, 1985).

This report presents the quality parameters affecting the growth of catfish (Clarias gariepinus) and suggests the most optimum condition for the rearing of the African catfish.

Furthermore, this report also examines the different feeds of the African catfish (*Clarias gariepinus*) due to exorbitant cost of fish meal as feed inputs is a major problem to fish culturists in Nigeria (Madu *et al*., 2003).

Plant protein sources contain low essential amino acids, due to high fiber contents, and the presence of anti-nutrient factors which hinders its use by forming a 'shield effect' on the protein molecules preventing proteases and similar 3 digestive enzymes from reaching them (Eyo, 2003).

Most commercial feeds are formulated with cereals (maize, wheat, guinea corn, soybeans, walnuts, tigernuts, corn chaff) and host of others, which are largely utilized in human nutrition; hence the high cost of such feeds (Balogun *et al*., 2004).

The African Catfish (*Clarias Gariepinus*) Classification

Kingdom	Animalia
Phylum	Chordata
Sub-phylum	Vertebrata,
Class	Actinopterygii (ray-finned fishes)
Order	Siluriformes (catfish),
Family	Clariidae (Airbreathing catfishes)

The family Clariidae is divided into two genera viz: *Clarias* and *Heterobranchus*. There are over hundred species in this family occurring naturally throughout most of Africa and the Southern half of Asia to Java and the Philipines (Little et al, 1999).

Clarias gariepinus is generally considered to be one of the most important tropical catfish species for aquaculture. It has an almost Pan-African distribution, ranging from the Nile to West Africa and from Algeria to Southern Africa. They also occur in Asia Minor (Israel, Syria and South of Turkey). *C. gariepinus* at various geographical locations bears different names. It is called *C. lazera* in Northern and Central Africa, *C. senegalensis* in East Africa, *C. masambicus* in West Africa and *C. gariepinus* in South Africa (Viveen et al, 1985).

Clarias gariepinus is characterized with naked skin and elongate with fairly long dorsal and anal fins. The dorsal fin has 61-80 soft rays and the anal fin has 45-65 soft rays. They have strong pectoral fins with spines that are serrated on the outer side (Teugels 1986).

It possess nasal and maxillary barbels and somewhat smallish eyes. Their coloring is dark grey or black dorsally and cream colored ventrally. Adults posses a dark longitudinal lines on either side of the

head; however, this is absent in young fish. Adult's heads are coarsely granulated, while the head is smooth in the young. The head is large, depressed, and heavily boned. The mouth is quite large and subterminal (Skelton, 1993; Teugels, 1986).

In *C. gariepinus*, exchange of respiratory gases (i.e. oxygen and carbon dioxide) takes place through the gills. Like any other mudfish, it has accessory breathing (arbores cent) organ which enables the fish not only to live in stagnant pools but to travel over damp ground. *C. gariepinus* differs from other catfishes in having an auxiliary breathing organ in this special pocket attached to the second and fourth gill arches and are responsible for the ability of *C. gariepinus* to live out of water much longer than other catfishes (Haylor, 1993).

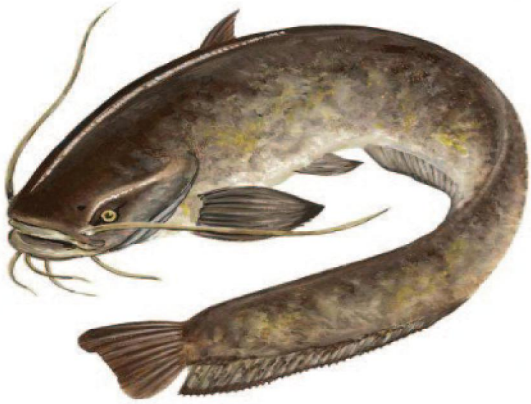

Plate 1: Typical representation of C. gariepinus

Proximate Composition of Some Conventional Fish Feeds

In order to enhance aquaculture production and to improve food security, and reduce the level of poverty in developing countries, a search for inexpensive and locally available feedstuffs is required. Fish feed play a major role in aquaculture viability and profitability because it accounts for at least 40 – 60% of the total cost of fish production (Shang, 1992; Jamu and Ayinla, 2003).

In order to meet the increasing demand for fish, a low cost – effective and high quality fish feed is necessary (Gabriel *et al*., 2007).

Locally produced feed reduces the cost of production and hence, cheaper means of meeting the protein requirement, improved food security and reduce the level of poverty in developing countries, thus inexpensive and locally available feedstuffs are to be identified, and furthermore the search for alternative proteins sources should be focused on by-products and materials which are not suitable for direct human consumption (Hoffman *et al*,. 1997).

Several agricultural and agro – industrial by – products available in the tropical region around the world have been evaluated for their production potential in poultry and livestock feed (Beker, 1985; Lema, 1992; Adugna, 2007; Negesse 2009 and Ajebu, 10 2010).

However, only few data are available which cover the suitability of this resource for fish feed (Adamneh *et al*, 2007).

Supplying energy from suitable sources in order to satisfy the energy requirements of fish that will save dietary protein for growth (Jauncey 1998, Sang-Main and Tae-Jun 2005).

High dietary fiber concentration can lead to growth depression, due to various factors, such as faster gastric emptying, reduced feed intake, digestibility and nutrient utilization (NRC 1993).

Recently, the analysis of nutritional value of wild plant materials attracted attention, they have shown to contain significant amount of essential nutrients, (proteins, amino acids, vitamins minerals oils and carbohydrates) that can be used for the formulation of fish feeds.

Nutrient Requirement Of Fish.

The qualitative nutritional requirement of fish provide relevant information on the nutrient needs of fish species in order to supply adequate amount of these nutrients in formulated diet for optimum fish performance (Falaye, 1992).

With the exception of water and energy, the dietary nutrient requirements of all aquaculture species can be considered under five different nutrient groups;

- Proteins
- Lipids
- Carbohydrates
- Vitamins, and minerals.

The science of aquaculture nutrition and feeding is concerned with the supply of these dietary nutrients to fish or shrimp either directly in the form of an exogenous ‘artificial’ diet or indirectly through the increased production of natural live food organisms within the water body in which the fish or shrimp are cultured (FAO,1987).

Carbohydrates Requirement of Fish.

Carbohydrates represent a broad group of substances which include the sugars, starches, gums and celluloses. The common attributes of carbohydrates are that they contain only the elements carbon, hydrogen and oxygen, and that their combustion will yield carbon dioxide plus one or more molecules of water. Carbohydrates make up three-fourths of the biomass of plants but are present only in small quantities in the animal body as glycogen, sugars and their derivatives. No dietary requirement for carbohydrates has been demonstrated in fish. However, carbohydrates present a cheap

energy source that would "spare" the catabolism of other components such as protein and lipids to energy. Warm water fish can use much greater amounts of dietary carbohydrate than cold water and marine species (NRC, 1993).

Lipid and Fatty Acids Requirement of Fish.

Dietary lipids are important sources of energy and fatty acids that are essential for normal growth and survival of fish. Although fish have a low energy demand, and is thus susceptible to deposition of excessive lipid (Earle, 1995). Lipids do have a role as carriers for fat-soluble vitamins and sterols. Lipids are important in the structure of biological membranes at both the cellular and sub cellular levels. They are components of hormones and precursors for synthesis of various functional metabolites such as prostaglandins, and are also important in the flavor and textural properties of the feed consumed by fish (NRC, 1983).

The use of lipids (fats and oils) in catfish feeds is desirable because lipids are highly digestible sources of concentrated energy containing about 2.25 times as much energy as does an equivalent amount of carbohydrate (Eyo, 2002).

Protein and Amino Acids Requirement of Fish.

Proteins are large, complex molecules made up of various amino acids that are essential components in the structure and functioning of all living organisms (NRC,1983). Protein is the major constituent of fish diet. Knowledge of the protein requirement of fish is essential for the formulation of a well balance artificial diet for an economical fish feeding. Protein comprises about 15-20% of the dry weight of fish muscle (Eyo, 2002).

Brown (1977) recommended cheap complete catfish feed for various weight categories. Better feed efficiency may be obtained from a well-balanced diet containing 24% protein than from a poorly balanced diet containing 36% protein. Fed free choice and balanced in amino acids and energy, 25-30% protein is adequate for larger fish; Fingerlings respond to higher protein levels of 30-36%. Fish meal, soybean meal, fish hydroxylase, skim milk powder, legumes, and wheat gluten are excellent sources of protein. According to Caesar (2000) unlike domesticated farm animals, many fish species currently being cultured have high dietary protein requirement (30%-50%), which vary for each species and with each particular life stage. For example, fish will require less protein at lower temperature and pH and higher protein content at higher temperature and pH levels. Also fish at a fry state will require a protein level of 40% and above, fingerlings will require 40% and adult will require the protein of about 35% (Eyo and Olatunde, 2001).

The first need regarding protein requirements of fish is to supply the indispensable amino acid requirement of the animal, and secondly to supply dispensable amino acids or sufficient amino nitrogen to enable their synthesis (Macartney, 1996).

In term of nutrients required by fish for optimum growth performance and yield, protein is the most expensive single nutrient in fish diets preparation. Over 200 amino acids occur in nature among which are the dispensable amino acids which can be synthesized by catfish. Thus must be incorporated in the diet e.g. arginine, histidine, threonine, isoleucine, leucine, lysine, valine and phenylanaline. If they are in the diet, energy is saved in their synthesis and some dispensable amino acids can partially replace an indispensable amino acid e.g. cystine can replace about 60% of the methionine and tyrosine can replace about 50% of the phenylalanine (Edwin and Meng, 1996).

Vitamins Requirement of Fish.

Vitamins are a heterogeneous group of organic compounds essential for the growth and maintenance of animal life. The majority of vitamins are not synthesized by the animal body or at a rate sufficient to meet the animal's needs. They are distinct from the major food nutrients (proteins, lipids, and carbohydrates) in that they are not chemically related to one another, are present in very small quantities within animal and plant foodstuffs, and are required by the animal body in trace amounts. Approximately 15 vitamins have been isolated from biological materials; their essentiality depending on the animal species, the growth rate of the animal, feed composition, and the bacterial synthesizing capacity of the gastro-intestinal tract of the animal.

In general, all animals display distinct morphological and physiological deficiency signs when individual vitamins are absent from the diet.

Craig and Helfrich (2002) reported that vitamin C is the most important since it is a powerful antioxidant and helps in the immune system of fish. The fat soluble vitamins A, D, E and K perform useful function in fish body. Vitamin A (retinol) is important in vision; vitamin D (cholecalciferols) ensures bone integrity; vitamin E (tocopherol) is antioxidant and vitamin K (such as menadlone) help in blood clotting and skin integrity (Craig and Helfrich, 2002).

Minerals Requirement of Fish.

Minerals are inorganic elements required by fish for tissue formation and various functions in metabolism and regulation (NRC, 1977).

Of all the minerals required by fish, phosphorus is one of the most important because it is essential in growth, bone mineralisation and lipid and carbohydrate metabolism. It is needed in the diet due to low content in natural water.

Energy Requirement of Fish.

Energy is defined as the capacity to do work, and is derived by animals through the catabolism of dietary carbohydrates, lipid and protein within the body. Although many forms of energy exist in nature (i.e. radiant, chemical, mechanical, heat, and electrical energy), all have the capacity to do chemical, electrical and mechanical work. Energy is therefore essential for the maintenance of life processes such as cellular metabolism, growth, reproduction, and physical activity. In particular, life on earth is dependent on radiant solar energy and its subsequent fixation and conversion by green plants during photosynthesis into stored chemical energy (i.e. carbohydrates) for use as an energy source by plants themselves or for animals that consume them through respiration. Major food nutrients (i.e. carbohydrates, proteins and lipids) are required by animals, not only as essential materials for the construction of living tissues, but also as sources of stored chemical energy to fuel these processes as work. The ability of a food to supply energy is therefore of great importance in determining its nutritional value to animals.

Materials And Methods.

The experiment was conducted in the biological garden, university of Abuja, main campus.

Collection and Acclimatization of Experimental Fish.

Ninety (90) fingerlings of (*Clarias gariepinus*) were bought from Agricultural Development Programmed, (ADP), located in Gwagwalada, Abuja. The fishes were transported in plastic containers covered with mosquito netting and on arrival at the experimental site were allowed to remain in the bucket for at least three hours to allow them recover from transportation stress and acclimatize to their new environment.

Experimental Fish Feeds.

Coppens, Date (Phoenix dactylifera), Tiger nut (Cyperus esculentus), Soybean (Glycine max), corn bran and fish meal are the experimental feed stuff used to formulate the diet for the feeding trial.

Diet formulation and composition.

The crude protein values of date fruit, soybean. Corn bran and tiger nut derived from the proximate analysis were used to formulate feed at a crude protein level of 40% using Pearson Square method as shown in Table 1 and 2 below. From the analysis carried out on the different processed samples Diet 1 – served as "positive control diet´. Diet 2 and 3 contains the formulated meals which served as negative control.

Diet preparation.

Five experimental diets were prepared through mixing of various ingredient based on the percentages of crude protein required. The proportion of the ingredients was weighted separately. Each of the mixture was first mixed dry and later with just enough hot water to obtain homogenous hard dough. The mixture was then molded and pelleted using a local pelleting machine. The local pelleted measured about 0.2cm in diameter and 2cm in length. The locally made palp served as the suitable binder. The finished products were sun dried and stored in labeled polyethylene bags. Sample of each diet was analyzed in the laboratory for proximate composition of the fish feed pelleted following standard method of analysis (AOAC, 2005).

Table 1: Diet two and the percentages used to formulate the feed

Treatment / feed	**Crude protein (%)**
Tigernut (TN)	18
Soybean (SB)	45
Corn bran (CB)	10
Date (D)	5
Fish meal (FM)	60

Table 2: Diet three and the percentages used to formulate the feed

Treatment/ feed	**Crude protein (%)**
Fish meal (FM)	60
Tigernut (TN)	18
Date (D)	5

Table 3: eight of feed ingredient for Preparation of 25kg

Treatment / feed	FM	D	TN	SB	CB
2 (tank B)	8.74	2.60	2.60	8.74	2.60

Table 4: Weight of feed ingredient for Preparation of 25kg

Treatment / feed	FM	D	TN
3 tank ©	14.69	5.16	5.16

Experimental Design.

Six aquaria with dimensions of 60 x 30 x 30cm were used, each was thoroughly washed, cleaned and disinfected with dettol containing thirty five (35) liters of dechlorinated water, which provide a water environment for the fish. fifteen (15) *Clarias gariepinus* were stocked randomly in each of the three treatments with two replicates each, giving a total of 90 fishes. The set – up was covered with mosquito nets on the top to avoid fingerlings from jumping out.

Feeding Rate and Practices.

Feeding of fish was done twice daily at 8:00am in the morning and 6:00pm in the evening (i.e. 2% in the morning and 2% in the evening of their body weight). Fish were weighed after every two weeks and amount of feed to be given was adjusted or increased

to reflect the new body weight of fish. Feeding trail lasted for 8 weeks.

Analysis of water quality.

Water samples were analyzed to check for some important parameters such as Temperature, pH and Dissolved Oxygen. Both surface water temperature and atmospheric temperature were read to the nearest ℃ with the aid of a digital thermometer. Dissolved oxygen was determined once a week by titration with 0.1 Sodium Hydroxide and Azide modification of Winkler method. (American Public Health association, 1976).

pH was also determined with a digital pH meter.

Proximate Analysis.

The proximate composition (moisture, ash, crude lipids, crude proteins and crude fats and crude fibre) of date fruit, tiger nut, and soybean; experimental fish before and after the experiment were determined using the standard methods of the Association of Official Analytical Chemists (AOAC, 2005).

Moisture determination.

This was done based on the difference between the wet weight and the weight after drying to a constant at 100℃ for 24 hours.

Procedure: Crucibles were washed and dried to a constant weight in an oven at 100℃, they were later removed and cooled in the desiccators and weight (W1). 2 grams of the grounded sample were placed in the crucible (W2) and kept in an oven at 100℃ for 24 hours. It was reweighed after about 3 hours to ensure a constant weight (W3). The moisture content was calculated in percentage as:

$$\% \text{ moisture} = \frac{W2 - W3}{W2 - W1} \text{x}100$$

Where

W_1 = weight of an empty crucible

W_2 = weight of a known amount of fresh sample + crucible

W_3 = weight of oven dried sample

Determination of lipid content AOAC (2005).

This is the continuous extraction of fat content from the sample using suitable solvent e.g. petroleum ether (40 – 60°C) in a Soxhlet extractor.

Procedure: Two round bottom flask were clean and few anti bump granules were added to prevent bumping. 300mls of petroleum ether (40 – 60°C) boiling point were poured into the flask. This were fitted into the Soxhlet extraction units. Extraction thimble was weighed and twenty milliliters of the sample was placed into it and weighed (W1), the thimble was fixed into the Soxhlet extraction unit with forceps and cold water in circulation. The heating mantle was switched on and solvent refluxing was adjusted at a steady rate. Extraction was carried out for eight hours. The thimble was removed and dried to constant weight in an oven at 70°C and was weighed (W2). The extractible lipid was calculated as:

$$\% \text{ Lipid} = \frac{\text{Weight of extracted lipid}}{\text{Weight of dried sample}} \times 100$$

Where the weight of lipid extracted is given by the loss in weight between w1 – w2 of thimble content after extraction.

Determination of Crude Fiber (AOAC, 2006).

The bulk of roughage in foods is referred to as Fiber. This is the non – digestible portion of the carbohydrate contained in the sample and was estimated as crude fiber.

Procedure: Two grams of the grounded samples were placed in a round bottom flask. 100ml of 0.25M H_2SO4 was added and the mixture boiled under reflux for 30 minutes. The insoluble water was washed several times with hot water until it was acid free. Thereafter, it was transferred into a flask containing 100ml of hot 0.312M NaOH solution. The mixture was boiled again under reflux for 30 minutes and filtered under section, the insoluble residues was washed with hot water until it was base free. It was dried to constant weight in an oven at 100℃, cooled in a desiccator and weighed (C_2). The weighed sample was incinerated in furnace at 550℃ for 2 hours. It was put off and allowed to cool down. It was removed cooled in a desiccator and weighed (C_3). The crude fiber was calculated as the loss in weight on ashing:

Weight of the original sample = W%Crude fibre

$$= \frac{C2 - C3}{W} \times 100$$

Determination of Ash Content (AOAC 2005).

The ash content was determined from the loss in weight that occurs during igniting at 550℃ in muffle furnace which was enough to allow all organic matter to burn off without permitting any appreciable decomposition of the ash constituent.

Procedure: Crucibles were cleaned and dried in the oven. After drying they were corked in the desiccator and weighed (W_1). 2g of the grounded sample was placed in the crucible and weighed (W_2) they were transferred into furnace and set to 550℃. The crucible containing the ash was removed and cooled in the desiccator and weighted (W_3). The weight of the residue in the crucible corresponds to the organic matter content.

% Ash and organic matter was calculated as:

$$\% \text{ Ash} = \frac{\text{Weight of ash}}{\text{Weight of sample}} \times 100 = \frac{W3 - W1}{W2 - W1} \times 100$$

$$\% \text{ Organic matter} = \frac{\text{loss of weight}}{\text{Weight of sample}} \times 100 = \frac{W3 - W1}{W2 - W1} \times 100$$

Determination Nitrogen and Crude Protein.

These are the major compounds containing nitrogen (minor nitrogenous ingredients of food includes Amino acids, Purines, Ammonium salts and Vitamin B1). So nitrogen was used as an index of

protein termed 'crude protein' as distinct from true protein.

Procedure: Proteins determination was carried out in three stages, as follows

A. Digestion: two grammes of sample was weighed and placed into a 50ml digestion – flask and the Kjeldahl mixture which acts as a digestion catalyst was added. The flask containing the sample mixture was heated gently at an inclined angle in a Kjeldahl digestion rack until frothing subsided. It was then boiled until the solution became colorless. Heating of the mixture released the nitrogen in the various samples which was then converted to ammonia with the concentrated Sulphuric acid. It was later allowed to cool. The sample was transferred to a 100ml volumetric flask and diluted with distilled water to the mark. It was then mixed thoroughly. The mixture was further allowed to cool before distillation. A blank containing only the Sulphuric acid and catalyst was also heated.

Conc H_2SO_4 $(NH_4)\ SO_4$

B. Distillation: A known aliquot (10ml) was transferred to the sample addition funnel of the distillation apparatus and then introduced to the sample chamber 10ml of 40% sodium hydroxide was added to the sample addition tunnel and released to the sample chamber at a slow rate. The ammonia was entrapped in a receiving solution containing 10ml 2% boric acid solution into which 4 drops of bromocresol green/2 drops of methyl red indicator had been put. Distillation was continued until the pink colour turned greenish.

(NH4)

C. Titration: The back titration method was employed i.e. the ammonia reacts with the Boric acid in the receiving flask and the amount of excess acid was determined by titration with HCl.

(NH4)3BO3 + 3HCl NH4Cl + H3BO3

The percentage total nitrogen was calculated and crude protein was estimated by multiplying the percentage nitrogen with standard conversion factor 6.25. (i.e. % crude protein (cp) = 6.25 x N

$$\%N = \frac{V1 - Vo \times M \times 14 \times 100}{0.2 \times 1000 \times 10} \times 100$$

V_o= Vol. of HCl require for blank

V_1 = Vol. of the HCl required for 10ml sample solution

M = Molarity of acid (0.1M)

14 = atomic weight of N2

100 = total volume of digest

100 = % conversion

10 = Volume of distillate

0.2 = amount of sample taken in gram

Note: protein contains 16% N2. This makes the general conversion factor to be 6.25.

Nutrient Utilization Parameters.

Mean Weight Gain (%). This was calculated as

$$MWG\% = \frac{\text{final mean weight}}{\text{Initial mean weight}} \times 100$$

Mean Length Gain (%). This was calculated as

$$MNG\% = \frac{\text{final mean length}}{\text{Initial mean length}} \times 100$$

Specific Growth Rate (SGR). This was calculated from the data on the changes of body weight over a given time interval according to the method of Brown, 1957 as follows

$$G = \frac{\text{Ln WT - Ln Wt}}{T - t} \times 100$$

Where

WT = final weight

Wt = initial weight

T = final time

t = initial time

G = specific growth rate expressed in percent per unit time

L_n = natural log

Food Conversion Efficiency (FCE). The food conversion efficiency was calculated as;

$$\frac{\text{Weight gain}}{\text{Food intake}} \times 100$$

(Utene, 1979)

Mean Growth Rate (MGR). This was computed using the standard equation

$$MGR = \frac{W2 - W1}{0.5\ (W1W2)} \times 100$$

Where

W_1 = initial weight

W_2 = final weight

t = period of experiment in days

0.5 = constant

Percentage weight gain (%WG) this is expressed by the equation;

$$MGR = \frac{Wt - W0}{W0} \times 100$$

Where

W_0 = initial weight

W_t = weight at time t

Survival Rate (SR). The survival rate (SR) was calculated as total number of fish harvested / total number of fish stocked and expressed in percentage.

$$SR = \frac{\text{Total number of fish harvested}}{\text{Total number of fish stocked}} \times 100$$

(Akinwole and Faturoti. 2006)

Mortality Rate (MR). This was computed as

$$M\ (\%) = \frac{D}{No} \times 100$$

Where D = total number of dead fish (s) at the end of the experiment

No = total number of stocked fish (s) at the beginning of the experiment

Statistical Analysis

Analysis of the growth data were subjected to analysis of variance (ANOVA) and was carried out to

test the treatments on the fish growth rate separate using the Duncan multiple Range Test.

Result.

Proximate Composition of Feed Meals.

Table 4.1 shows the result for the proximate analysis of date fruit, soybean, tiger nut, and corn bran. Soy bean had the highest crude protein (40.0%%) followed by maize bran (4.5%), date fruit, (2.2%) and the least was tiger nuts with (1.5%). Date fruit had the lowest fat content (0.6%), followed by tiger nut (1.49%), maize bran, (2.17%) and soybean had the highest fat content of (23.2%). The fiber content values ranged from 3.0 -44.60%. Maize bran recorded the highest value of 44.60% while soybean recorded 3.0%%. The ash content value ranged from 1.10% - 5.64%.

Growth Response Parameters

The data on growth response, of *Clarias gariepinus* fingerlings to the various diets is shown in Table 4.3, 4.4 and 4.5 respectively. In terms of total weight gain, fishes stocked in tank A, fed with Coppens gave the best growth (30.11g) followed by those stocked in tank B fed with formulated feed of soybean, tiger nut, date fruit and corn bran (17.73g), while those stocked in tank C, fed with tiger nut and date fruit had the lowest weight gain (2.57g). The highest SGR (0.76) was obtained in C. gariepinus fed Coppens followed by those in tank B, and those in tank C gave the lowest SGR. The SGR of fingerlings fed with coppens was significantly different from those fed with the local formulated feeds ($P<0.05$).

Physio-Chemical Parameters of Water.

The Weekly temperature, hydrogen ion concentration (pH) and dissolved oxygen (DO) during the twelve weeks feeding period of *Clarias gariepinus* is presented in Table 4.

Table 5: Proximate analysis of experimental diets.

Feed	Date fruit	Soybean	Tiger nut	Maize bran
Moisture (%)	14.1	13.1	12.27	11.6
Crude Protein (%)	2.2	40.0	1.56	4.5
Crude Fibre (%)	6.9	3.0	16.26	44.60
Fat (%)	0.6	23.2	1.49	2.17
Ash (%)	2.13	5.0	5.64	1.10
Carbohydrate (&)	55.0	30.0	62.79	69.60

Table 6: Mean values of physiochemical parameters of water in the experimental tanks for 12 week.

Production parameters	**Treatment A**	**Treatment B**	**Treatment C**
Water temperature ^{0}C	24.62	24.62	24.62
Dissolved oxygen mg/l	6.42	4.81	3.82
pH	7.068	7.044	7.062
Ammonia	0.561	0.842	0.920
Nitrite	0.018	0.036	0.045

The water temperature in the experiment ranged from (24.93 - 26.35°C). The highest temperature was recorded in tank A while the lowest was recorded in tank C. There was no significant difference ($P>0.05$) within the range of temperature during the experimental period. pH ranged from (7.044 - 7.68) with highest value of 7.068 in tank A. The dissolved oxygen was within the range of (3.82 - 6.42mg/l. Tank A recorded the highest value while tank C had the least value of 3.82. There was no significant difference ($P>0.05$) between the pH values and Dissolve oxygen values throughout the experimental period.

Table 7: Mean values of growth parameters for treatment A.

Parameters	**Total**	**Mean**
Total weight (g)	2383.6	340.45
Mean total weight (g)	338.3	48.33
Total length (cm)	1261.4	180.2
Mean total length (cm)	136.32	19.47
Wight gain (g)	30.11	5.02
Length gain (cm)	2.93	0.48
Gross specific growth rate (g)	5.3	0.76
Food conversion efficiency	86.05	12.29
Mean growth rate	0.0153	0.002
Survival rate	656.65	93.81

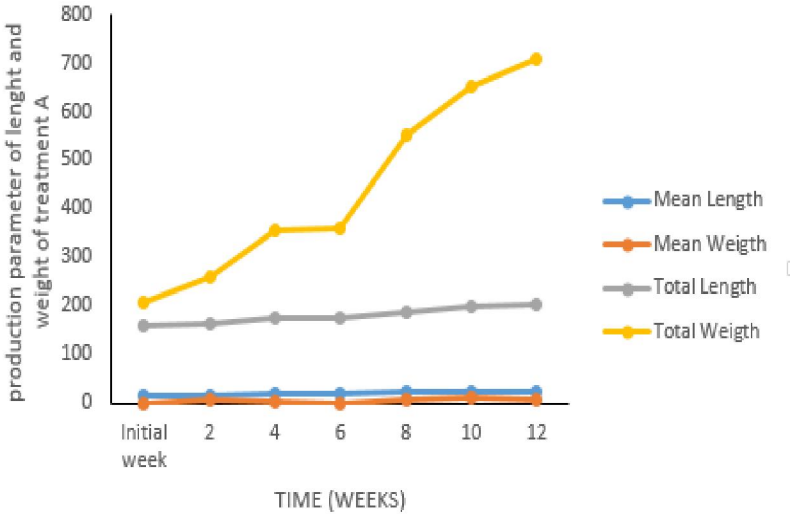

Figure 1: Production Parameters of Treatment A.

There was an increase from the initial week to week 4, a drop in week 6 and then a steady growth was observed to the 12th week.

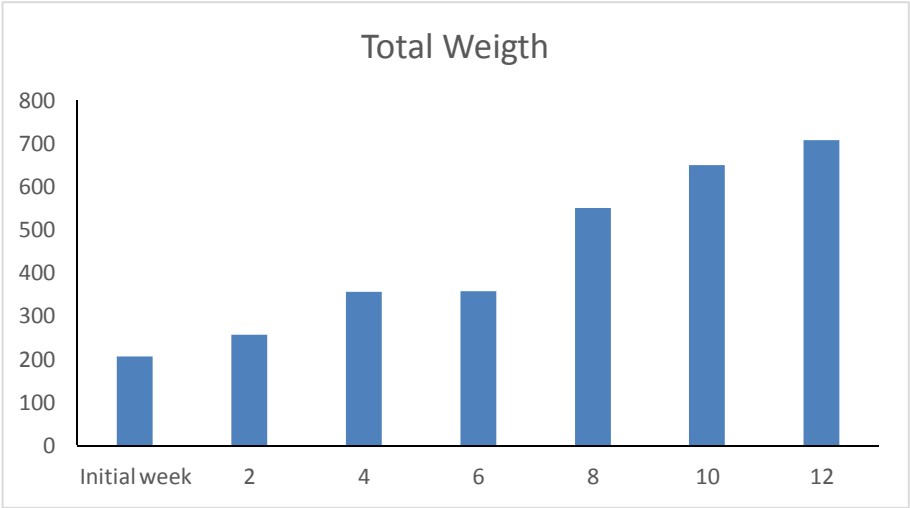

Figure 2: Production parameter of weight for treatment A.

Table 8: Mean values of growth parameters for treatment B.

Parameters	Total	Mean
Total weight (g)	2182	311.714
Mean total weight (g)	233.65	33.379
Total length (cm)	1164.3	166.329
Mean total length (cm)	105.4	15.057
Wight gain (g)	17.73	2.963
Length gain (cm)	1.2	0.171
Gross specific growth rate (g)	2.14	0.306
Food conversion efficiency	58.95	8.421
Mean growth rate	0.091	0.013
Survival rate	636.65	90.95

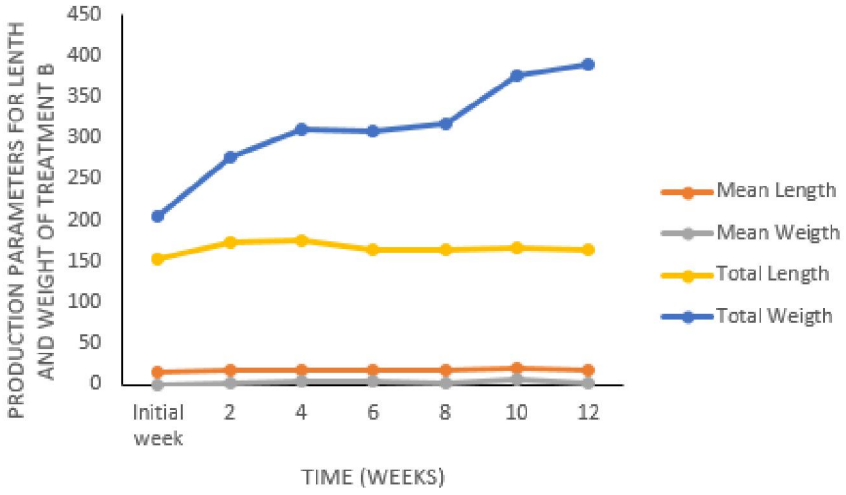

Figure 3: Production Parameters for treatment B

There was an increase in the initial week, a drop from week 2 to 8, an increase in week 10 and then a drop in week 12.

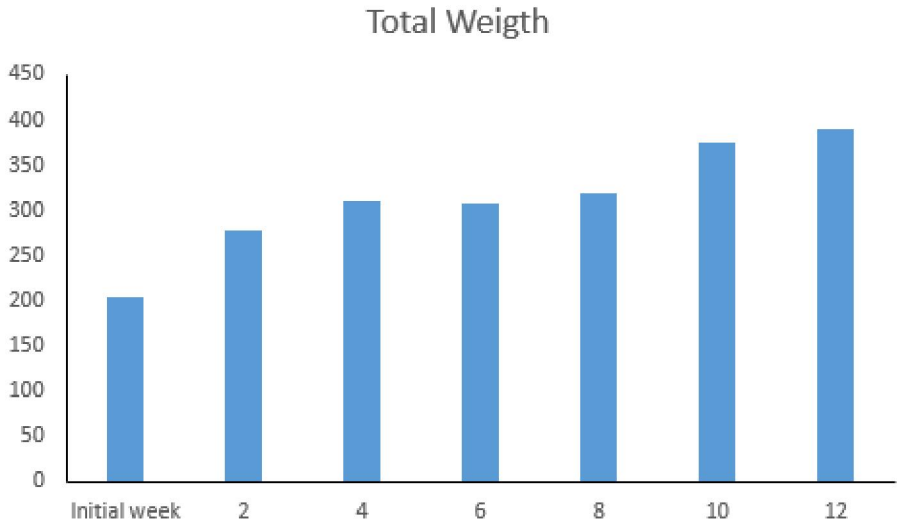

Figure 4: Production parameter of weight for treatment B.

Table 9: Mean values of growth parameters for treatment C.

Parameters	Total	Mean
Total weight (g)	1593	227.57
Mean total weight (g)	180.73	25.82
Total length (cm)	1017.2	145.31
Mean total length (cm)	111.87	15.98
Wight gain (g)	2.57	0.376
Length gain (cm)	0.83	0.12
Gross specific growth rate (g)	2.16	0.308
Food conversion efficiency	67.2	9.6
Mean growth rate	0.04	0.005
Survival rate	599.98	85.711

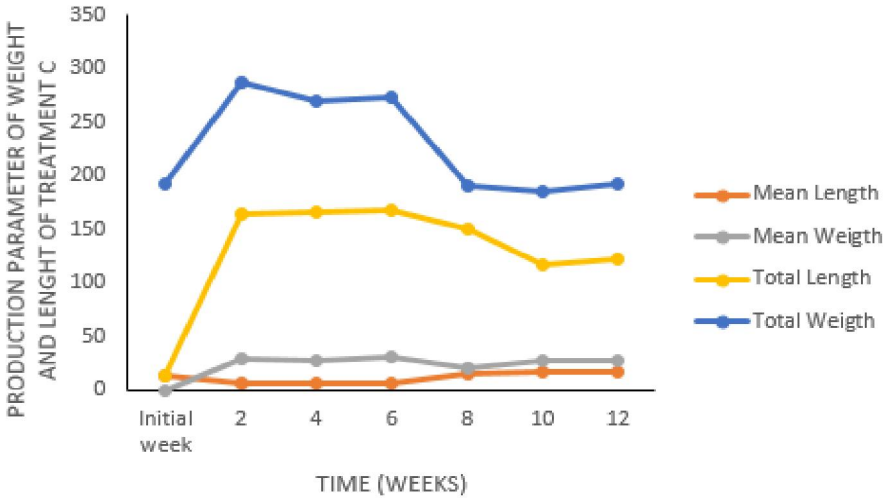

Figure 5: Production Parameters for treatment C.

There was an increase form the initial week to week 2, decrease in week 4, increase in week 6, decrease in week 8 to 10 and an increase in week 12.

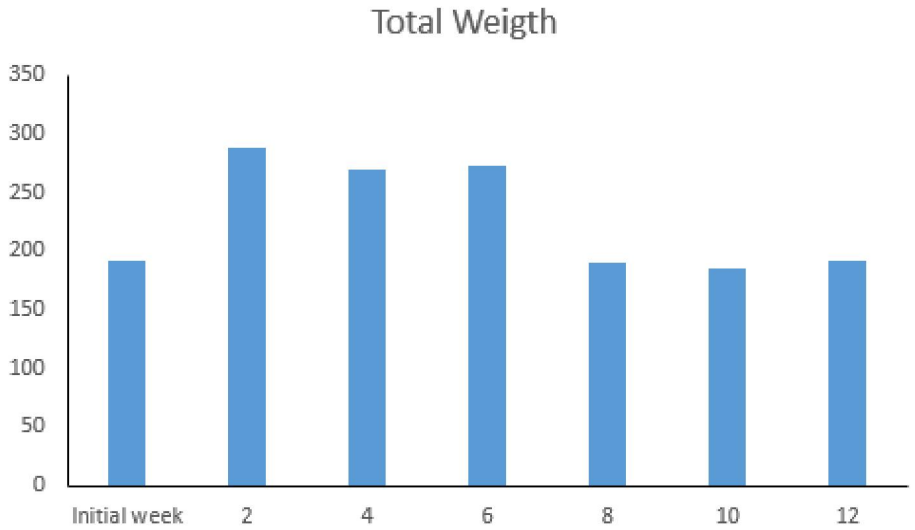

Figure 6: Production parameter of treatment C

Discussion, conclusion and recommendation.

Discussion.

The proximate analysis of the formulated feeds containing, date fruit, tiger nut, soybean and corn bran showed that crude fibre values ranged from 3.0% to 44.60%. Maize bran had the highest value while soybean had the lowest value. The protein content ranged from 1.5% to 40.0% with highest value obtained in soy bean, followed by maize bran, date fruit, and tiger nut recorded the lowest crude protein (1.56%).

The physiochecical parameters of water were also determined for abnormal concentration of any of these parameters if it may have been the cause of the fish death. However numerous and density stress are additional parameters for fish death, high survival rate and cannibalism.

The temperature readings from all treatments were within a permissible range.

Ayoola and Fredrick (2012) reported that pH of 6.5-9.0 and temperature of 22-27^{0}C gives the best growth in the culture of tropical fishes.

Growth Performances.

The increase in body weight and length of the experimental fish confirms that the fish responded positively to the diets.

The weight gain of fish fed coppens in the control treatment (5.02) was higher than fishes fed

processed tiger nut, soybean, corn bran, and date fruit (2.96) in treatment B and then the least weight gain was recorded in treatment C (0.37) containing fishes fed processed tiger nuts and date fruits. The higher weight gain was attributed to adequate consumption and utilization of the feed by the fish.

The fish showed good appetite to all the treatment diets; this is attested to the increase in body weight, total length and standard length.

However the greatest weight gain by the experimental fish fed experimental diet was (30.11g) achieved with the treatment A fed with coppen and the least weight gain (2.57g) was recorded with the treatment C fed with the locally produced feed containing date fruit, and tiger nut. The greatest mean daily weight gain (MWG) (338.3g) was achieved by the treatment A, and the least mean weight gain was recorded by the treatment C (180.73g). This is similar to the values obtained for *Oreochromis niloticus* by Faturoti and Akibote (1986).

The greatest specific growth rate, feed conversion efficiency and protein efficiency ratio were achieved in treatment A and the least specific growth rate, feed conversion efficiency and protein efficiency were recorded by the treatment B. This observation is similar to that reported by Oresegun and Alegbeleye (2001), for *Oreochromis niloticus* fed cassava peels.

Fish in all the treatment diets indicated that growth due to increased protein was not significant ($P<0.05$). The best growth response was achieve in the fishes in tank A fed coppen and the least was recorded by the fishes in tank C fed tiger nut and date fruit with 30% fish meal inclusion. The lower growth response by fishes in tank C was probably caused by reduced palatability of the diet which causes reduced in feed intake. The lower weight gain attained in diets B might be associated with low utilization of the experimental feed by the fish compared to other rations; thus may have contributed to poor utilization of essential nutrients for growth and development. It indicates that the exclusion of soybean and corn bran in the diets of *C. gariepinus* in in treatment C may not assist desirable growth. The general feed acceptance in all the experimental tanks is appreciable. This appreciable performance may be due to the good composition of essential and non essential amino acids in the control feed (coppen) and the locally produced feeds. The good performance also attributed to the processing method and good experimental management during the feeding trial (Eyo, 2003). The protein efficiency ratio of all the diets were not significantly different from control ($P>0.05$). The apparent net protein utilization (ANPU) were not significantly different ($P>0.05$). Dietary levels of soybean and maize bran had nutritional attributes as feedstuff in the diet of *Clarias gariepinus* fingerlings.

Conclusion And Recommendation.

Based on the results of the study, Coppens are the best feeds that supported the growth of *Clarias gariepinus* cultured in glass aquaria tank. Economically, processed soybean and date fruits also performed well and is the cheapest in terms of price as such its preferred for most optimal growth and cost benefits.

Therefore, local feeds formulated with soybean, date fruit and corn bran are equally recommended for use in feeding of fingerlings of *Clarias gariepinus* in Nigeria as they can be manufactured locally and readily available.

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Appendix

One way ANOVA observations for Treatment A to determine the difference in the Mean Weight Gain (MWG)

Hypothesis:

H_0: There is no significant difference between the mean weight gain of Treatment A

H1: There is a significant difference between the mean weight gains of Treatment A

Level of significance: α - 0.05

Observation

	Sum of squares	Df	Mean square	F	Significance
Between groups	39122.782	7	5588.969	16.422	.000
Within groups	2481.246	52	47.716		
Total	41604.028	59			

P value (0.00) < α (0.5). Therefore, the null hypothesis H_0 is rejected

Thus we conclude that mean weight of the fish is not the same across the weeks.

One way ANOVA observations for Treatment B to determine the difference in the Mean Weight Gain (MWG) for Treatment B

Hypothesis:

H_0: There is no significant difference between the mean weight gain of Treatment B

H1: There is a significant difference between the mean weight gains of Treatment B
Level of significance: α - 0.05

Observation

	Sum of squares	Df	Mean square	F	Significance
Between groups	4681.261	7	668.752	4,642	.000
Within groups	546.441	42	13.011		
Total	5227.702	49			

P value (0.00) < α (0.5). Therefore, the null hypothesis H_0 is rejected
Thus we conclude that mean weight of the fish is not the same across the weeks.

One way ANOVA observations for Treatment C to determine the difference in the Mean Weight Gain (MWG)

Hypothesis:

H_0: There is no significant difference between the mean weight gain of Treatment C
H1: There is a significant difference between the mean weight gains of Treatment C
Level of significance: α - 0.05

Observation

	Sum of squares	Df	Mean square	F	Significance
Between groups	713.134	7	101.876	1.171	0.215
Within groups	4524.382	52	87.00		
Total	5237.516	59			

P value (0.215) > α (0.5). Therefore we do not reject the null hypothesis H_0 and thus conclude that, there is no significant difference between the mean weight gain in Treatment C.

Table 10. Production Parameters For Treatment A

Parameters	Initial week	Week one	Week two	Week three	Week four	Week five	Week six	Total	Mean
Total weight (g)	207	258	357	359	551	651	709	2383.6	340.45
Mean total weight (g)	20.7	25.8	39.67	39.80	61.22	72.33	78.78	338.3	48.33
Total length (cm)	159.5	164	173.6	175.8	187.7	198.2	202.6	1261.4	180.2
Mean total length (cm)	15.9	16.4	19.20	19.5	20.8	22.02	22.5	136.32	19.47
Wight gain (g)	0.00	5.2	1.47	0.22	5.66	11.11	6.45	30.11	5.02
Length gain (cm)	0.00	0.4	0.41	0.22	0.2	1.22	0.48	2.93	0.48
Gross specific growth rate (g)	0.00	0.5	0.4	0.2	0.3	2.8	1.1	5.3	0.76
Food conversion efficiency	0	25.3	5.25	0.7	14.9	26.5	13.4	86.05	12.29
Mean growth rate	0.00	0.01	0.002	0.0003	0.003	0	0	0.0153	0.002
Survival rate	100	100	93.33	93.33	93.33	93.33	83.33	656.65	93.81

Table 11. Production Parameters For Treatment B

Parameters	Initial week	Week one	Week two	Week three	Week four	Week five	Week six	Total	Mean
Total weight (g)	204	277	310	308	318	375	390	2182	311.714
Mean total weight (g)	20.4	27.7	31	34.22	35.33	41.67	43.33	233.65	33.379
Total length (cm)	152	174	176	164	165.1	167.5	165.4	1164.3	166.329
Mean total length (cm)	15.2	17.4	17.6	18.3	18.3	18.6	18.3	105.4	15.057
Wight gain (g)	0.00	2.1	3.3	3.22	1.11	6.34	1.66	17.73	2.963
Length gain (cm)	0.00	0.1	0.2	0.7	0.2	0.3	-0.3	1.2	0.171
Gross specific growth rate (g)	0.00	0.05	0.14	0.65	0.4	0.4	0.5	2.14	0.306
Food conversion efficiency	0.00	9.75	11.8	11.5	3.4	18.1	4.4	58.95	8.421
Mean growth rate	0.00	0.005	0.007	0.05	0.002	0.007	0.02	0.091	0.013
Survival rate	100	100	93.33	93.33	83.33	83.33	83.33	636.65	90.95

Table 12. Production Parameters For Treatment C

Parameters	Initial week	Week one	Week two	Week three	Week four	Week five	Week six	Total	Mean
Total weight (g)	192	288	270	273	190	188	192	1593	227.57
Mean total weight (g)	19.2	28.8	27	30.33	21.11	26.86	27.43	180.73	25.82
Total length (cm)	128.2	164.9	166.4	168	150.2	117.8	121.7	1017.2	145.31
Mean total length (cm)	12.82	16.49	16.64	16.8	15.02	16.8	17.3	111.87	15.98
Wight gain (g)	0.00	-1.2	-1.8	3.33	-9.22	5.75	0.57	2.57	0.376
Length gain (cm)	0.00	0.02	0.15	0.16	-1.78	1.78	0.5	0.83	0.12
Gross specific growth rate (g)	0.00	0.04	0.13	0.4	-2.2	2.8	0.99	2.16	0.308
Food conversion efficiency	0.00	3.3	6.4	11.9	27.9	16.2	1.5	67.2	9.6
Mean growth rate	0.00	-0.02	-0.004	0.07	-0.03	0.02	0.004	0.04	0.005
Survival rate	100	100	93.33	90	83.33	66.66	66.66	599.98	85.711

5/22/2018