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Morphometric measurement of *Dutch clarias* fed with bambara nut and coconut chaff.

Chinakwe N.L. and Solomon R.J.*
Department of Biological Sciences, Faculty of Science, University of Abuja, Abuja, Nigeria.

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Abstract: The length weight relationship and diet of Dutch *Clarias* was investigated in the University of Abuja, permanent site. 60 Dutch *Clarias* (fingerlings) of weight 0-20g and length (0-10cm) were grouped into three replicated tank, and fed for twelve weeks with a local formulated feed (Bambara nut and Coconut Chaff) and Coppen. Tank A had Coppen feeds which served as the control with a 42% crude protein, 13% Carbohydrate, 29% crude fibre, and 8% Ash, while Tank B has 42.25% protein, 48.41% Carbohydrate, 1.9% crude fibre, and 2.9% Ash, 10.8% crude lipid and 9.40% moist, fed Bambara nut and Coconut chaff at a ratio of 70to 30%. Tank C was served Bambara nut and Coconut chaff at a ratio of 30 to 70%, with an analysis of 42.18% crude protein, 58.37% Carbohydrate, 10.80% crude lipid, and 2.45% Ash, 0.5% crude fibre. Body and were fed 4% body weight twice daily (6 to 8 am, and 6 to 9pm). Their total weight and length were measured weekly and converted into log to calculate the relationship between them. Treatment A had a significant growth ($p<0.05$), followed by Tank B and C subsequently.

Key words: Bambara nut; Coconut chaff; *Dutch Clarias*.

Introduction

Dutch Clarias belong to the group of the air breathing catfishes. It belongs to the Kingdom: Animalia, Phylum: Chordate, Class: Actinopterygii, Order: Siluriformes, Family: Clariidae, Genus: *Clarias*. (Burchell, 1822). In Nigeria, fishing is decreasing in importance and trend is towards intensive fish culture. The rapid growth of Nigerian population has led to insufficiency in supply of animal protein source of food. Consequently, this also has led to tremendous effort resulting in increasing animal production. Fish is a major source of animal protein and an essential food item in the diet of many people in Nigeria. Fish is also a good source of thiamine, riboflavin, vitamin 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 diet typical of 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) depend wholly or partly on fishery sector for their livelihood.

The consumption and demand for fish as a cheap source of protein is on the increase in Africa. Majority of fish supply I most countries comes from the rivers in the continent as capture fisheries based of species that are presently exploited seem to have reached their natural limits (FAO,1996a) FAO (2004).

In "The State of The World Fisheries and Agriculture" concludes that in the state of the world's fisheries and agriculture during recent years have continued to follow the trends that were already becoming apparent at the end of 1990s: capture fisheries production is stagnating and aquaculture output is expanding faster than any other animal based food sector., therefore, development policies increasingly perceives aquaculture is an engine for economic growth and prospect for future fish supply. As aquaculture becomes more and more intense in Nigeria, fish feed will be a significant factor in increasing the production and profitability of agriculture (Akinrotimi *et al.,* 2007). Jamiu and Ayinola (2003) opined that feed management determines the viability of the cost of fish production. The need to intensify the culture of fish so as to meet the ever-increasing demand for fish has made it supplementary forms for ponds or as a complete feed in tanks (Olukunle, 2006) for the purpose of nutritional and economic benefits. Previous research has made attempt at increasing the use of non-conventional plant and animal to replace conventional feed ingredient in fish feed (Baniah *et al.,* 2003). According to Olorun *et al.,* (2006).

Justification of the research

This research was carried out in order to create a means of reducing cost of fish production in Nigeria by reducing cost of feeding through the use of local formulated feeds with adequate nutritional content (Bambara nut and coconut chaff) which is gotten at a cheaper rate to substitute the standardized fish feed (Coppen) with higher leading to higher rate of production.

***Corresponding Author**:
Mr. Solomon J.R.
Department of Biological Sciences,
Faculty Science, University of Abuja,
Abuja, Nigeria.
E-mail: johnsol2004@yahoo.com

The main reason for this study is to investigate the growth rate and survival of catfish (Dutch Clarias) using local formulated feeds (Bambara nut and coconut chaff) as a replacement for Coppens.

Literature review

Feed and feeding of catfishes in grow out ponds are perhaps the most documented in literature (Ayinla, 1998). Various efforts have been made to establish the crude protein and amino acid requirement of *Dutch Clarias*. Ayinla (1998), recommended 35- 40% crude protein (CP) for raising table size and brook stock respectively. (Ayinla, 1997) stated that the protein consumed in Nigeria comes from the wild. According to Lim and Dominy (1993), Rumsey (1993), fish meal supply was likely to decline between1900MT and 200MT and this could no longer meet the demand of the expanding fish feed industry. Therefore, the need to find suitable replacement to fish meal in fish feed is of great importance.

Aquaculture is one of the fastest growing food production systems in the world, with huge output currently being produced within developing and developed countries of the world and especially with expectation for aquaculture to continue its contributions to food security and poverty alleviation (Tobor, 1996). The vast majority of aquaculture practices around the world have produced significant nutritional and social benefits and generally with little or no environmental cost over the last two decades. In aquaculture, fish require adequate food supply in the right proportions and with proper nutritional contents needed for growth, energy, reproduction, movement and other activities which they carry out. Aquaculture therefore remains the only viable alternative for increasing fish production in order to meet the protein need of the people (Ayinla, 1997). In the review of Oresegun *et al*., (2007), it was stated that early fish farmers in Nigeria raised their fish in burrows and pits, abandoned minefield and in earthen ponds on extensive production system. The introduction of concrete tanks allows for manageable pond size and the modification of the environment through a water flow through system and supplementary feeding thus allowing for higher fish yield. The advent of the indoor water re-circulatory system (WRS) has ushered in a new prospect for aquaculture.

The introduction of WRS has created a turning point in the production of catfish in Nigeria. It was observed that of the over 30,000MT of various fresh water and brackish water fish species caught in the year 2000, catfishes were more abundant next to tilapia. FAO (1993), reported that 27,488MT of catfishes produced in 1990 were consumed locally. This implies that there is still great need for higher production for both local and international markets.

In order to formulate and compound aqua feeds that will meet the nutrient requirement of the catfish at affordable cost, several conventional and non-conventional animal by-products and plant residues have been tested to substitute or replace fish meal. Feeding development has moved from the use of single ingredient, broadcasting un-pelleted meal to use of pelleted feeds. However, the use of pelleted feeds has made remarkable difference to aquaculture development in Nigeria as *Dutch Clarias* is being raised to maturity within months.

The culture of catfish (*Dutch clarias*)

African catfish appears as the major specie cultured in the tropics followed by tilapia (Tobor, 1996). According to Hepher (1990), fish yield and profitability per pond area of a culture unit depends to a large extent on the amount of supplementary feed used. The reasons for their culture are based on their fast growth rate, disease resistance, and high stocking growth, high stocking density, aerial respiration and high speed conversion among others. Weatherly and Gill, (1977) stated that fish meal is commonly used in feed formulation to supplement the high cost of protein in culture diets due to its nutritive value.

This is obviously related to continual improvement in mass propagation techniques and the development of water re-circulatory systems along quality feed development. African catfishes are produced almost exclusively on private lands and in systems that takes environmental balance into consideration. The most common habits of catfishes are flood plains, swamps and pools. The catfish can survive during the dry season due to the accessory air breathing organ (Bruton, 1979, Clay, 1979).

Catfishes has been cultured both at small-scale (for household consumption) and at commercial scale for the generation of income by the practitioner in fish holding devices such as earthen ponds, concrete tanks, fibre tanks and other fish holding devices (Otubusi, 1996) which are usually determined by the financial capacity of the investor and the managing capability of the farmer.

Over the last decade, non-farmers have been found to be investing in aquaculture than most other agricultural sector sectors and more research is being carried out to improve the profitability of African catfish culture in aquaculture so as to justify the effort of the investors (Nath, 1995).

Preview on bambara nut and coconut.

Vigna subterranea which is also known by its common name as Bambara nut or Bambara groundnut, Bambara bean, earth pea, Congo goober or hog-peanut is a member of the family fabaceae, it belongs to the kingdom plantae, order fabales, Genus *vigna* and specie *Vigna subterranean.* It originated in West Africa. *Vigna subterranean* ripens it pods underground much like peanuts (groundnuts) they can be eaten fresh or boiled after drying.

Names of Bambara nut in other Languages.

Different languages have different names for Bambara nuts. In Hausa language, it is variously referred to as Gurijiya or Kwaruru, in Goemai language; it is known as Kwam, the Kanuri people referred to it as Ngamgala. In Ibo language, in eastern Nigeria, it is referred to as Okpa, in Yoruba it's commonly known as Epa-kuta. In the Gha language, spoken by the people in greater Accra Ghana, it is called Akwei, in Silozi, they are called Lituu, in Swahili, Njugumawe, in republic of Zambia it is either called Ntyo or mbwiila, in Shangaan it is called Tindluwa, in Malagasy, in the language of Madagascar it is called Vonjobory.

Origin and Region of Cultivation Bambara Nut

The **o**rigin of Bambara nut is West Africa and the region of cultivation is Sub-Saharan African's warm tropics.

Importance in the world food system.

Bambara groundnut represents the third most important grain legume in semi-arid Africa. It is resistant to high temperature and is suitable for marginal soils where other leguminous crops cannot be grown In addition, it makes very little demand on the soil and has a high nutritive value with 65% carbohydrate and 18% protein content. For these reasons, it is not prone to the risk of total harvest failure even in low and uncertain rainfall regions. Due to its high protein value, it is a very important crop for poorer people in Africa who cannot afford expensive animal protein. Despite its nutritional value, it is still considered as one of the prioritized neglected and underutilized species in Benin.

Product use

The seeds are used for food and beverage because of its high protein conten and for digestive system applications. The entire plant is known for soil improvement because of nitrogen fixation. In West Africa, the nuts are eaten as a snack, roasted and salted, or as a meal, boiled similar to other beans.

Production

World production of *Vigna subterranea* increased from 29'8000 tonnes in 1972 to 79'155 tonnes in 2005, while the yield during this period did not increase. "As an under-utilised crop, Bambara groundnut has not received sustained research" until recent years and therefore no yield increase occurred.

Coconut

The coconut tree (*Cocos nucifera*) is a member of the family *Arecaceae* (palm family). It is the only accepted species in the *genus Cocos*. It belongs to the Kingdom plantae, Order Arecales, Sub family Arecoideae, Tribe Cocoeae, Genus Cocos, Specie *Cocos nucifera The* term coconut can refer to the entire coconut palm, the seed, or the fruit, which, botanically, is a drupe, not a nut. The spelling cocoanut is an archaic form of the word Found throughout the tropic and subtropics area, the coconut is known for its great versatility as seen in the many uses of its different parts. Coconuts are part of the daily diets of many people. Coconuts are different from any other fruits because they contain a large quantity of "water" and when immature they are known as tender-nuts or jelly-nuts and may be harvested for drinking. When mature, they still contain some water and can be used as seed nuts or processed to give oil from the kernel, charcoal from the hard shell and coir from the fibrous husk. The endosperm is initially in its nuclear phase suspended within the coconut water. As development continues, cellular layers of endosperm deposit along the walls of the coconut, becoming the edible coconut "flesh". When dried, the coconut flesh is called copra. The oil and milk derived from it are commonly used in cooking and frying; coconut oil is also widely used in soaps and cosmetics. The clear liquid coconut water within is potable. The husks and leaves can be used as material to make a variety of products for furnishing and decorating. It also has cultural and religious significance in many societies that use it.

Origin

The origin of the plant is the subject of debate. O.F. Cook was one of the earliest modern researchers to draw conclusions about the location of origin of *Cocos nucifera* based on its current-day worldwide distribution.[1] He hypothesized that the coconut originated in the Americas, based on the fact that American coconut populations predated European contact and because he considered pan-tropical distribution by ocean currents improbable. *Thor Heyerdahl* later used this hypothesis of the American origin of the coconut to support his theory that the Pacific Islanders originated in South America. However, more evidence exists for an Indo-Pacific origin either around Melanesia and Malesia or the Indian Ocean.

Materials and Methods

Feed formulation

Bambara nut and coconut and coconut were bought from Gwagwalada market, Abuja. They were washed. The Bambara nut was grinded and boiled in water while the coconut was grinded and sieved to get the chaff. The boiled powder of Bambara nut and the grinded coconut chaff were mixed and pap was added to make it solid. Vita feed was added for healthy purpose. The formulated feed was then dried to make it pellets.

Experimental design

The experimental fish (fingerlings) *Dutch Clarias* of about 0-10cm in length and 0-20g in weight was transported from Gbagalada axis in Nyanya, Abuja in a plastic bowl with well oxygenated water at the early hours of the morning to avoid mortality due to high temperature. A total number of 120 fingerlings catfish were randomly distributed into 3 circular tanks (20 fishes per circular tank). With replicate each

The fingerlings nearly of the same size were acclimatized for seven days and fed with Coppens at 2% body weight. At the end of acclimatization period, the fishes were starved for 24 hours to empty their content and prepare them for the experimental feed. This makes the fish very hungry and easily adapt to the new diet before stocking the fish randomly. The individual length (cm) of the fish and mean weight of the fish were recorded before placing them in the rearing containers. The fingerlings were subsequently fed 4% body weight twice daily (8am) and (6pm) respectively

Proximate analysis of fish meal

Proximate analysis also known as nutritive value is applied to know if the sample could be formulated into a diet as a source of protein or energy.

Crude lipids: This includes the extraction of fats and oil from the sample using the appropriate organic solvent.

Crude protein: this is for the amount of protein present in the food.

Moisture: it is essential in monitoring the moisture percentage in powdered food sample to avoid risk of contamination by bacteria, and fungi during storage.

Ash: this consists of oxidizing organic matter in the sample of the ash remaining.

Proximate analysis of formulated fish meal (bambara nut and coconut chaff).

The proximate analysis of the fish meal containing Bambara nut and coconut chaff in the ratio of 70:30 is; 27.2% crude protein, 48.41% carbohydrate, 11.0% crude lipid, 2.99% ash, 0.5% fibre.

While the proximate analysis of the fish meal containing Bambara nut and coconut chaff in the ratio 30: 70 is; 18.48% crude protein, 58.37% carbohydrate, 10.80% crude lipid, 2.45% ash, 0.5% crude fibre.

Feeding and measurement.

Tank A: Coppen feed for agriculture (floating diet) containing 42% crude protein, 13% crude fat, 1.9% crude fibre and 8.9% ash was used to control feed for the first treatment which serve as the control treatment.

Tank B: Boiled Bambara nut and coconut chaff at a ratio of 70: 30 containing 42.52% crude protein, 48.41% carbohydrate, 11.0 crude lipid, 2.99% ash and 0.5% crude fibre.

Tank C: Boiled Bambara nut and coconut chaff at a ratio of 30:70 containing 42.48% crude protein, 58.37% carbohydrate, 10.80% crude lipid, 2.45% ash and 0.5% crude fibre.

The fingerlings were fed 4% of their body weight twice daily, morning and evening (9am-10am) and (6pm-9pm). Samplings of fish for length and weight measurement were carried out by using a scoop net.

Circular tank management

The circular tank was bought from Gwagwalada markets, which are of the same size with 60 litres per each capacity. The tanks were washed thoroughly with salt to kill pathogen and thereafter filled with tap water to 50 litres capacity. 20 fingerlings (D*utch Clarias)* were introduced into each of the tanks. The tanks were covered with mosquito net to prevent fingerlings from jumping out, as well as preventing the intrusion of insects and other foreign bodies (lizards, geckos, etc.). The tank water was changed every three days' interval to avoid the accumulation of toxic waste that are harmful to the fishes. The fish weight (g) was taken using a top loading balance (model: ohause precision plus). The fingerlings were weighed individually once a week. The standard length of the fish was taken to the nearest cm with the aid of a measuring board and was also done once in a week.

Length weight relationship

The conventional formula described by Le Cren (1951), was used for calculating the length weight relationship.

$$W=aL \quad .... (1)$$

The above equation (1) and the data were transformed into logarithms before the calculations were made.

Therefore equation (1) becomes;

$$\text{Log} = \log a + b \text{ Log } L \quad .... (2)$$

Where

W = weight of the fish (g)
L = Length of the fish (cm)
a = constant and b = an exponent.

The result of the length and weight correlation analysis is calculated, this shows that the fish exhibits allometric growth. The correlation co-efficient were high and significant at 0.001 level. The log-log graphs of weight length relationship were also drawn, the graph shows increase in weight with increasing length. The condition factor <k> was also calculated using the conventional formulae by Washington and Richard (1930).

$$K= \frac{W \text{ X } 100}{L^3} \quad .... (3)$$

Nutrients utilization parameters

Growth and nutrient utilization parameters were calculated as measures of the effectiveness of utilization of Bambara nut and coconut chaff as a replacement for Coppens in the dirt's of catfish. This was done with the method of Brown (1975)

i. Mean Weight Gain (%).

$$MWG\% = \frac{\text{Final Mean Weight}}{\text{Initial Mean Length}} \text{ X } 100$$

ii. Mean Length Gain (%).

$$MLG\ \% = \frac{\text{Final Mean Weight}}{\text{Final Mean Weight}} \text{ X } 100$$

iii. Specific Growth Rate (SGR)

$$SGR = \frac{LnWt - Lnwt}{T - t} \times 100$$

Where:

WT = Final Weight
Wt = Initial Weight
T = Final Time
t = Initial Time

iv. Food Conversion Efficiency (FCE)

$$FCE = \frac{\text{Weight Gain}}{\text{Food intake}} \times 100$$

v. Mean Growth Rate (MGR)

$$MGR = \frac{W_2 - W_1}{0.5\,(W_1 \times W_2)} \times 100$$

Where
W1 = initial weight
W2 = final weight
t = period of experiment in days
0.5 = constant

vi. Survival Rate (SR)

$$SR = \frac{\text{Total Fish Number Harvested}}{\text{Total fish number socked}} \times 100$$

(Akinwole *et al.,* 2006)

Statistical analysis

Data generated from the experiment were subjected to analysis of variance (ANOVA) and was carried out to test the effect of the treatments on the fish growth rate separated using the Duncan multiple range Test.

Results and Discussion

Results of the study on the growth rate of *Dutch Clarias* fed with a mixture of Bambara nut and coconut chaff for a period of twelve weeks are presented in the table 1, 2, 3, figure 1, 2 and 3 below. Tank A represents *Dutch Clarias* fed with 100% of Coppen, Tank B is *Dutch Clarias* fed with 70% Bambara nut and 30% of coconut chaff while Tank C is *Dutch Clarias* fed with 30% Bambara nut and 70% of coconut chaff. Analysis of variance (Anova) for weight of fishes in the three tanks shows that there was no significance difference between the weight of the fishes in the three tanks (p>0.05) after the twelve weeks of study. Fishes in tanks A, B and C were significantly different (P <0.05) at the beginning of the study with tank B having the highest total weight (69.36g) and tank C having the lowest total weight (62.14g). By the end of week 1 to the end of week 3, total weight of fishes in all the tanks were significantly different from each other (P< 0.05) with tank A having the highest total weight (161.02g) and tank C recording the lowest total weight (150.00g).

However, from week 4 to 12, total weight of fishes in the three tanks was significantly different (P< 0.05) from each other with tank A having the highest weight and C recording the lowest. Analysis of variance (Anova) for weight gain of fishes in the three tanks shows that there is no significance difference between the weight gain of the fishes in the three tanks (p>0.05), also for length gain of fishes in the three tanks there was no significance difference between the length gain of the fishes in the three tanks (p>0.05).
Analysis of variance (ANOVA) for length of fishes in the three tanks shows that there is no significance difference between the length of the fishes in the three tanks (p>0.05) after the twelve weeks of this study. In the first two weeks of study, length of the fishes in the different tanks were significantly different (P<0.05) from each other with tank A having fishes with longer body length than fishes in other two tanks. By week 3, length of fishes in tanks 'A' 'B' and C were significantly different from each other (P< 0.05). By week 5, the length of fishes in all the tanks were significantly different (P<0.05) from each other and remained so until the end of the study based on weekly analysis.

The mean total weight ranged from 2.5g (initial) to 126.83g (twelfth week) with a mean of 9.76 g in tank A. The mean total weight of tank B ranged from 2.52g (initial) to 12.876g (twelfth week) with a mean of 8.87g. The mean total weight of tank C ranged from 2.505g (initial) to 12.105g (twelfth week) with a mean of 8.55g. The mean total length ranged from 4.37cm to 16.48cm with a mean of 11.41cm in tank A. The mean total length ranged of tank B from 4.395cm to 14.115cm with a mean of 10.21cm. The mean total length of tank C ranged from 4.365cm to 12.53cm with a mean of 8.61cm. Weight gain in tank A ranged from 0.00g to 2.256g with a mean of 0.92g, Weight gain in tank B ranged from 0.00g to 2.633g with a mean of 0.797g, Weight gain in tank C ranged from 0.00g to 2.309g with a mean of 0.74g. Length gain in tank A ranged from 0.00cm to 3.84cm with a mean of 0.95cm, Length gain in tank B ranged from 0.00cm to 2.977cm with a mean of 0.75cm, Length gain in tank C ranged from 0.00cm to 2.025cm with a mean of 0.71cm. The mean of gross specific growth rate was highest in tank B and C which recorded the same value (0.41) and lowest in A (0.16). The feed conversion efficiency was highest in tank A (22.93%) and lowest in tank C (18.46%). The survival rate was similar in all the tanks.

Table 1: Production parameter for treatment A.

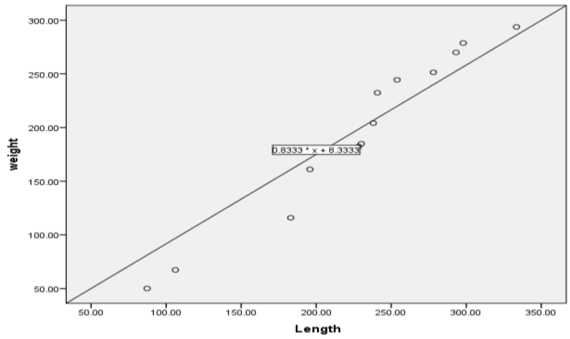
Week	Total weight (g)	Mean total weight	Total length(cm)	Mean total length	Weight gain	Length gain	GSGR	FCE	SR
0	50.0	2.50	87.31	4.37	0	0	0	0	100
1	67.25	3.363	106.15	5.31	0.863	0.94	-0.064	21.575	100
2	115.9	5.795	183.0	9.15	2.165	3.84	0.34	54.125	100
3	161.02	8.051	195.8	9.75	2.256	0.6	0.353	56.40	100
4	182.3	9.115	228.2	11.41	1.064	1.66	0.027	26.6	100
5	184.89	9.245	230.0	11.5	0.13	0.09	0.00	3.25	100
6	204.1	10.205	238.1	11.91	0.96	0.41	-0.018	24	100
7	232.43	11.62	240.8	12.04	1.415	0.13	0.151	35.375	100
8	244.5	12.23	253.9	12.70	0.61	0.66	-0.181	15.25	100
9	251.5	12.58	278.1	13.91	0.35	1.21	-0.456	8.75	100
10	270.01	13.50	293.2	14.66	0.92	0.75	-0.036	23	90
11	278.8	13.94	298.0	14.9	0.44	0.24	-0.357	11	90
12	293.82	14.69	333.5	16.68	0.75	1.78	-0.125	18.75	90
TOTAL	2536.52	126.83	2966.06	148.29	11.92	12.31	2.11	298.08	1270
MEAN	195.12	9.76	228.16	11.41	0.92	0.95	0.16	22.93	97.69

Table 2: Production parameter for treatment B

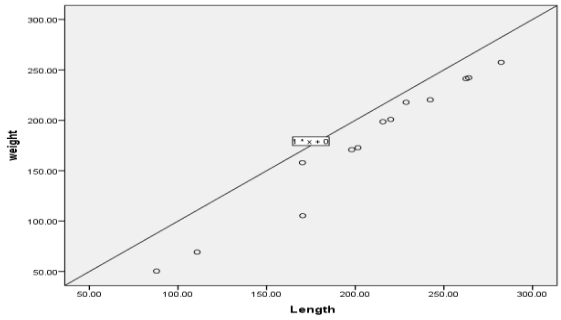
Week	Total weight (g)	Mean total weight	Total length(cm)	Mean total length	Weight gain	Length gain	GSGR	FCE	SR
0	50.4	2.52	87.9	4.395	0	0	0	0	100
1	69.26	3.463	110.8	5.54	0.943	1.145	-0.026	23.575	100
2	105.34	5.267	170.34	8.517	1.804	2.977	0.256	45.1	100
3	158.0	7.9	170.2	8.51	2.633	-0.007	0.421	65.825	100
4	170.8	8.54	198.0	9.9	0.64	1.39	-0.194	16.00	100
5	172.8	8.64	201.5	10.075	0.1	0.175	-1.00	2.50	100
6	198.6	9.93	215.6	10.78	1.29	0.705	0.11	32.25	100
7	200.8	10.04	220.0	11	0.11	0.22	-0.96	2.75	100
8	217.8	10.89	228.7	11.435	0.85	0.435	-0.071	21.25	100
9	220.3	11.015	242.3	12.115	0.125	0.68	-0.903	3.125	100
10	241.2	12.06	262.5	13.125	1.045	1.01	0.019	26.125	90
11	242.23	12.11	264.0	13.2	0.05	0.075	-1.30	1.25	90
12	257.52	12.876	282.3	14.115	0.766	0.915	-0.116	19.15	90
TOTAL	2305.05	115.25	2654.14	132.71	10.36	9.72	5.38	258.90	1270.00
MEAN	177.31	8.87	204.17	10.21	0.797	0.75	0.41	19.92	97.69

Table 3: Production parameter for treatment C.

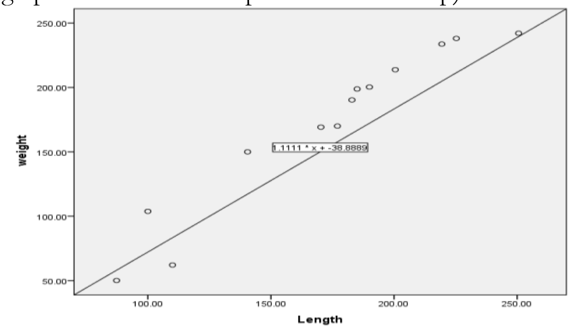
Week	Total Weight	Mean total weight	Total length(cm)	Mean total length	Weight gain	Length gain	GSGR	FCE	SR
0	50.10	2.505	87.3	4.365	0	0	0	0	100
1	62.14	3.107	110.0	5.5	0.602	1.135	-0.22	15.05	100
2	103.82	5.191	100.0	5	2.084	0.5	0.319	52.1	100
3	150.00	7.5	140.5	7.025	2.309	2.025	0.363	57.725	100
4	169.2	8.46	170.3	8.515	0.96	1.49	-0.018	24	100
5	170.00	8.5	177.0	8.85	0.04	0.335	-1.398	1.00	100
6	190.3	9.515	182.9	9.145	1.015	0.295	0.007	25.375	100
7	198.8	9.94	185.0	9.25	0.425	0.105	-0.372	10.625	100
8	200.3	10.015	190.0	9.5	0.075	0.25	-1.125	1.875	100
9	213.8	10.69	200.5	10.025	0.675	0.525	-0.171	16.875	100
10	233.7	11.685	219.4	10.97	0.995	0.945	-0.002	24.875	90
11	238.1	11.905	225.3	11.265	0.22	0.295	-0.658	5.50	90
12	242.10	12.105	250.6	12.53	0.2	1.265	-0.699	5.0	90
TOTAL	2222.36	111.12	2238.80	111.94	9.6	9.16	5.35	240	1270
MEAN	170.95	8.55	172.215	8.61	074.	0.71	0.41	18.46	97.69



Scatter plot showing the linear relationship between the weight and length of fishes in tank A (the value on the graph shows that it is a positive relationship)



Scatter plot showing the linear relationship between the weight and length of fishes in tank B (the value on the graph shows that it is a positive relationship)



Scatter plot showing the linear relationship between the weight and length of fishes in tank C (the value on the graph shows that it is a negative relationship)

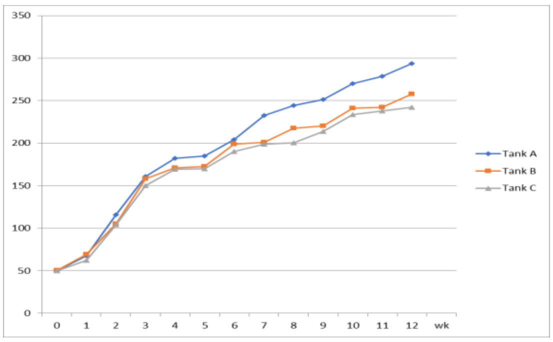


Figure 1: Increase in body weight of fishes in the three tanks for the twelve (12) weeks of study.

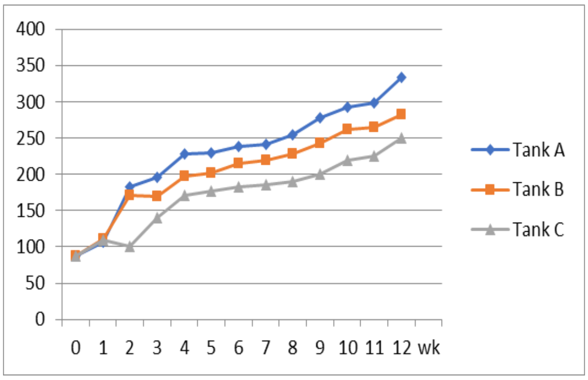


Figure 2: Increase in length of fishes in the three tanks for the twelve (12) weeks of study.

One way anova of production parameters determining the length weight relationship of *dutch clarias*

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	120.048	2	60.024	.264	.770
Within Groups	7287.681	32	227.740		
Total	7407.729	34			

One–way analysis of variance (Anova) for weight gain of fishes in the three tanks shows that there is no significance difference between the weight gain of the fishes in the three tanks (p>0.05)

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	191.637	2	95.819	.330	.721
Within Groups	9287.948	32	290.248		
Total	9479.585	34			

One –way analysis of variance (Anova) for length gain of fishes in the three tanks shows that there is no significance difference between the length gain of the fishes in the three tanks (p>0.05)

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	2282.084	2	1141.042	.249	.781
Within Groups	160107.776	35	4574.508		
Total	162389.860	37			

One –way analysis of variance (Anova) for weight of fishes in the three tanks shows that there is no significance difference between the weight of the fishes in the three tanks (p>0.05)

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	14903.367	2	7451.683	2.109	.136
Within Groups	123637.865	35	3532.510		
Total	138541.231	37			

One –way analysis of variance (Anova) for length of fishes in the three tanks shows that there is no significance difference between the length of the fishes in the three tanks (p>0.05).

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	80.847	2	40.423	404233.000	.000
Within Groups	.001	6	.000		
Total	80.847	8			

SPSS data sheet for analysis of variance (Anova) for week one weight in the three fish tanks, shows that there is a significant difference between the weight of the fishes within this week in the three tanks (p<0.05).

	Squares		Square		
Between Groups	4230.425	2	2115.212	622121.294	.000
Within Groups	.020	6	.003		
Total	4230.445	8			

SPSS data sheet for analysis of variance (Anova) for week twelve weight in the three fish tanks, shows that there is a significant difference between the weight of the fishes within this week in the three tanks (p<0.05).

Sum of df Mean F Sig.

		Sum of Squares	df	Mean Square	F	Sig.
w2	Between Groups	259.660	2	129.830	37692.545	.000
	Within Groups	.021	6	.003		
	Total	259.680	8			
w3	Between Groups	194.561	2	97.280	145.913	.000
	Within Groups	4.000	6	.667		
	Total	198.561	8			
w4	Between Groups	306.420	2	153.210	15321.000	.000
	Within Groups	.060	6	.010		
	Total	306.480	8			
w5	Between Groups	375.720	2	187.860	55800.030	.000
	Within Groups	.020	6	.003		
	Total	375.740	8			
w6	Between Groups	289.580	2	144.790	14479.000	.000
	Within Groups	.060	6	.010		
	Total	289.640	8			

SPSS data sheet for analysis of variance (Anova) for week two to six weight in the three fish tanks all shows that there is a significant difference between the weight of the fishes within this week in the three tanks (p<0.05). The result was the same for length.

Discussion

Result of the growth rate of *Dutch Clarias* fed with Coppen, a mixture of Bambara nut and coconut chaff for a period of twelve weeks, revealed differential growth patterns as some of the fishes exhibited fast growth rate and others fair growth rate. This was seen in the wide size range of the fishes by week 12 when the study terminated, the fishes had a weight range of 242.10 – 293.82g. and a length range of 250.60 –333.50 cm. This evidently showed that growth was not uniform. This is probably the reason why some fish farmers have developed apathy in using some special feeds in their ponds. Fish fed with 100% Coppen had lower mortality (survival%) than those fed with Bambara nut and coconut chaff probably due to the quality of the feed since post mortem did not reveal any specific cause. Bambara nut and coconut chaff is manufactured locally as such their quality and nutritional value is questionable. The mean final body weight, mean weight gain, were highest (P < 0.05) for fish fed 100% of Coppen (A), followed by fish fed with 70% Bambara nut and 30% of coconut chaff (B) and fish fed with 30% Bambara nut and 70% of coconut chaff (C) diets. In spite of these, the mean final body weight for *Dutch Clarias* on B and C were just about some percent less than those in A, probably indicating fair protein utilization. Fundamental nutritional differences between the diets were probably responsible for the superior performance in these parameters for *Dutch Clarias* fed with A compared to those fed by B or C diets.

Usually, high quality or purified ingredients are used when diets with high nutrient density and content with almost 100% bioavailability are desired (NRC, 1993) as found in (Coppens, 2005). These results were similar to those obtained for fingerlings fed similar diets by Makinde *et al.,* (2007) and Olukayode *et al.*, (2012). The Bambara nut and coconut diet was more economical than Coppen diets in terms of feed cost and this was similar to results obtained for fingerlings by Mak-inde *et al.,* (2007). The advantage of the commercial feed (Coppen) might be apparent since Bambara nut and coconut chaff is locally produced and will have lower nutrient composition than the synthetic. The reduced productivity may be offset by the reduced costs. However, Makinde *et al.,* (2007) found fingerlings fed local diets inferior to synthetic and this probably suggests that juveniles were more stable in the efficiency of protein utilization than fingerlings despite that feed conversion efficiency decreases with age in catfish (Robinson *et al.,* 2001). Although, the expectation was not that juveniles on the blood meal diets will be superior to those on synthetic diets because of disparity in the quality of the ingredients, the comparison was necessary to evaluate the efficiency of fish feed made from locally available and underutilized ingredients. Coppen is high quality fish feed, which is extruded, imported, expensive and may not always be available. In contrast, the Bambara nut and coconut chaff diets used common feed ingredients and simply produced. These results indicate good potential for the vegetable-carried blood meals in catfish diets probably with improvement in nutritive value such as use of exogenous enzymes (e.g. xylanases, phytases, cellulases and proteases) on the crude fibre and protein components.

Conclusion

Bambara nut and coconut chaff provide potential alternatives for use as feed for *Dutch Clarias*. Improvement in the quality of Bambara nut and coconut chaff through chemical, physical or biological measures may contribute to potential as alternatives to expensive high quality fish feed based on fishmeal and fish oil.

Recommendation

In the light of the above results and conclusion the following recommendations are made;

- Further studies should be conducted with varying feed ratio of the Bambara nut and coconut chaff to ascertain their portability as fish feeds of economic importance.
- Ministry of Agriculture should develop and improve these potential fish feeds and make them available and affordable to local fish farmers.
- An enlighten campaign can be initiated to educate our indigenous fish farmers on the current development; that is the use of Bambara nut and coconut chaffs as fish feeds.

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