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The effects of dietary, energy and feed utilization of compounded feed *(*vital chicken feed and fish meal*)* on the growth rate of *Clarias gariepinus*

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ABSTRACT: The experiment was conducted at the research unit of the Biological science Department, University of Abuja for a period of Twelve weeks. The experiment was set up to determine the effects of chicken feed (vital chicken feed) in the diet of *Clarias gariepinus.* The effects variables and nutrient utilization were determined from the practical diets using varying levels of 100% coppens in tank A (42% protein,13% crude fibre,6.7% ash),50% of vital chicken feed with 50% of fishmeal in tank B (20% crude protein,10% ash,9%crude fibre) and a combination of 30% vital chicken feed plus 70% fish meal in tank C (25% crude protein,12% fats,13% crude fibre,8% ash). The feeds were formulated and fed to *Clarias gariepinus* fingerlings with lengths (0 to10 cm) and weights (0 to 20 g). They were fed at 4% body weight twice daily. The optimum growth and survival rate were calculated.

Key words: Chicken feed, fish meal, growth rate.

INTRODUCTION

Over the past decades aquaculture has grown in leaps and bounds in response to an increasing demand for fish as a source of protein globally (Akinrotimi et al., 2007; Bard et al., 1976; Halver, 1978). According to FAO (2006), fish supplies from capture fisheries will therefore not be able to meet the growing global demand for aquatic food. Hence, there is need for a viable alternative fish production system that can sufficiently meet the demand and aquaculture fits exactly into the role (De Silva and Davy,1992; De Silva and Anderson,1995).

As aquaculture production becomes more and more intense in Nigeria, fish feed will be a significant factor in increasing the production and profitability of aquaculture (Akinrotimi et al. 2007; Anyanwu and Clifford, 2007). There is an increasing demand for fish and fish protein which resulted in widespread over fishing in wild fisheries (Fagbenro, 1997). The global returns for fish farming recorded by the FAO in 2008 totalled 33.8 million tones worth about US 60 billion (Fishery and Aquaculture statistics: Aquaculture Production, 2008, FAO Year book Rome).

There are two major categories of aquaculture; extensive aquaculture based on local photosynthetical production and intensive aquaculture, limiting growth here is the available food supply by natural sources, commonly zooplankton feeding on pelagic algae or benthic animals such as crustaceans and mollusces. In order to tap all available food sources in the pond, the aquaculturist will choose fish species which occupy different [places in the pond ecosystem e.g a filter algae feeder such as tilapia, a benthic feeder such as carp or catfish (De Silva and Davy,1992; De Silva and Anderson,1995). In intensive aquaculture, the optimal water parameters for cold and warm water fish includes; Acidity; pH 6 – 9, Alkalinity > 20mglL, ammonia,<0.02 mglL; calcium: >5 mglL, carbondioxide <5-mmglL; chloride >4.0mglL, chloride: 0.003 mglL etc. In these kinds of systems, fish production per unit of surface can be increased at all will as long as sufficient oxygen, fresh water and food are provided. The cost of fish feed which must contain a much higher level of protein (up to 60%) than cattle food and a balanced amino acid composition as well. However, these higher protein level requirements are a consequence of the higher food conversion efficiency (FCE – kg of feed per kg of animal product) of aquatics animals; fish like salmon have FCE's in the range of 1.1 kg of feed per kg of salmon, whereas, chickens are in the 2.5 kg of feed per kg chicken range.

Essential here is aeration of the water; as fish need a sufficient oxygen level for growth. This is achieved by bubbling, cascade flow or aqueous oxygen. Catfish, *Clarias spp* can breathe atmospheric air and can tolerate much higher levels of pollutants than trout or salmon which makes aeration and water purification less necessary and makes *Clarias species* especially suited for intensive fish production. In most Clarias farms about 10% of the water volume can consist of fish biomass. Within intensive and extensive aquaculture methods there are numerous specific types of fish farms each has benefits and applications unique to its design; Some of includes: the cage system, Irrigation ditch or pond systems, indoor fish farming etc. The indoor fish farming is an alternative to outdoor open ocean cage aquaculture, is through the use of a recirculation aquaculture system (RAS). A RAS is a series of culture tanks and filters where water is continuously recycled and monitored to keep optimal condition of water quality. The water is treated mechanically through the removal of particulate matter and biologically through the conversion of harmful accumulated chemicals into non-toxic ones. Through this system, many of the environmental drawbacks of aquaculture are minimized including escaped fish, water usage and the introduction of pollutants. The practices also increased feed use efficiency growth by providing water quality (Adeniji and Ovie, 1990; Timmon, 2002). Others include classic farming, Animal slaughter etc. When fish are reared in high density indoor systems or confined in cages and cannot forage freely on natural feeds, they must be provided a complete diet. In contrast, supplemental incomplete, partial diets are intended only to help support the natural food (insects, algae, small fish). Supplemental diets do not contain a full complement of vitamins or minerals, but are used to help fortify the naturally available diet with extra protein, carbohydrate and / or lipid. In an attempt to the objective of culturing fish, two main sources of fish feed have been identified for meeting nutritional requirement of fish. These include the fish on farm feed and the commercial feed.

As a result, on farm feeds are mostly used in Nigeria this according to Fagbenro, (1997) amount to 67% of estimated total of 35,570 tonnes of feed produced in the year 2000. Due to the increase in fresh water farming in Nigeria and globally, there could be intense competition for fish meal and fish oil (FAO, 2006), hence the need for alternative source of protein to replace fish meal without reducing the quality of the feed.

Poor feed leads to slow growth, high feed conversion ratio, low survival, disease and poor harvest (Eyo, 2003). Good quality conditions that are adequate leads to profitability in fish culture managements. In Nigeria today, aquaculture seeks to improve fish yield and fish productivity. Its benefits range from rural development income generation, farm sustainability as well as reduction in vulnerability. This practice also makes use of land which is considered unsuitable for agriculture such as swamps or salure. (Ayinla and Akande, 1988) stated that protein consumed in Nigeria comes from the wild (Eyo, 1996) reported that since aquatic resources are finite although renewable, every effort should be made towards increased fish production through improved resources management and conservation and also intensive aquaculture practices.

Currently, aquaculture production in Nigeria has witnessed slow pace of development aquaculture contributes only about 2500MT of fish annually which is about 69% of domestic fish production, whereas, the projected requirement for fish products by the year 200 was 4 million MT (Ita,1998). Nigeria has high potential in aquaculture which is hardly tapped (Ayinla and Akande, 1988) stated that aquaculture provided food of high animal protein generated income and employment thereby promoting the socio-economic development of Nigerians.

Fish production when combined with improved inland fisheries management to eliminate fish importation and earn substantial foreign exchange. Feeding of catfish in grow out are perhaps the most documented in literature, various efforts have been made to establish the crude protein and amino acid requirement of *Clarias gariepinus* (Ayinla and Akande, 1988). It was observed that hybrids exhibited a high degree of cannibalism and resulting in high individual growth rate with a corresponding low production (yield) due to high mortality rate. Solomon, (2006) stated that there is a wide range of food and feed stuff that are suitable for fish feeding and their quality is primarily assessed on their nutrient composition such as protein levels. According to Hepher and Pruginin,(1981) protein requirements for optimal growth and feeding of juvenile fishes usually range from 35-55% depending on species stated that typical herbivores such as tilapia require dietary protein. Shephard, 1988) stated that difference in growth increment between monoculture of one specie and Polyculture of several species within the same period. However, one specie might affect the environment to improve the growth condition for the other species therefore. Diet supplementation is an important aspect aquaculture management especially in intensive fish culture end is promising for fish production (Abdelghamy and Ahmad, 2002) in aquaculture, diet is often the single largest operating cost item and can represent sent over 50% of the operating cost in intensive aquaculture (Dolgado et al., 2003). The cost depends on many factors such as protein level, the source and type of ingredients that could be derived from plants and animal resources and manufacture practices.

Apart from developing low cost diet, different feeding management strategies such as on demand feeding regimes and good pond management and husbandry (Abdelghamy and Ahmed, 2002; Bascinar *et al*., 2007) could improve fish growth. The optimum feeding regime of culture fish is an important aspect of achieving efficient production and also could lead to insignificant saving diet cost. Fish is one of the major inputs in aquaculture production. It is one of the fundamental challenges facing the development and growth of aquaculture. According to Huet (1970); it is observed that the research on inexpensive feed ingredients has not contributed greatly to aquaculture development and suggested that more research on how best plant protein can be used as fish feed is required.

Development and management of fish feed play very vital role in aquaculture growth and expansion, it is a major factor that determines the profitability of aquaculture venture. Jamiu and Ayinla, (2003) reported that feed count for at least 60% of the total cost of fish production which at a large extent determines the viability and profitability of fish farming enterprise. Fish production involves both the intensive and semi – intensive system of production. For any aquaculture venture to be viable and profitable, it must have a regular and adequate supply of balanced artificial diet for the cultured fishes. This is so because the dissolved nutrients that promote primary and secondary production in the natural environment are seasonal and might be insufficient or may not occur in required proportion to meet the nutritional demand of cultured fishes. There is therefore the need to develop and encourage fish farmers to make use of ideal pond fertilization, non-conventional feed resources, feed stuff processing, refinement and formulations that take cognizance of the requirement of the various species and their stages (Ibiyo and Oluwasegun, 2004). Fish feed is important in the efficiency and overall performance of fish in the pond and which will reduce cost of production of fish. This is why any attention toward the production of effective and cheap feed will benefit farmers (Gabriel et al., 2007).

Clarias gariepinus (Burchell, 1822) farming clandare is generally considered to be one of the most important tropical catfish species for aquaculture in West Africa other species includes Heterobrachus and their hybrids. The reasons for their culture are based on their fast growth rate, disease resistance, high stocking growth, high stocking density, aerial respiration, high speed conversion efficiency among others (Oyelese, 2007). Streams, rivers, swamps to flood plains, many of which are subjected to seasoned drying catfishes are cultured conveniently under monoculture and Polyculture system. The monoculture is the culture of the same fish species while Polyculture is the culture of two or more fish species of different habits and ecological niches. This type of culture is favored in pond system (Maar et al., 1966; Wu et al., 2004). There are therefore, the culture of two species of fish; a system that could be referred to as duo culture. Also, there is the culture of three closely related species of the same family and the same feeding habit, this type of culture could be referred to as trio culture system. Most culturists in Africa especially Nigeria have practiced any of this culturing different species of catfish together or separately have little or no effect on their growth performance (Houlihan et al., 2001). The work of Ogunsanmi and Yunusa, (2008) show that clariid catfish culture under the monoculture system gave weight gain followed by duo culture and least in the tri culture. This result also show that hybrid had the best weight gain in all the three culture systems followed by *Clarias gariepinus* and least with Heterobrachus longifillis (Faturoti et al., 2002).

MATERIALS AND METHODS

Feed formulation

Vital chicken feed was bought from Agro-kings vet, Gwagwalada, Abuja and fish meal from ideal fish farm in Kado fish market in Abuja. The experimental feed was formulated by binding the vital chicken feed and fish meal with pap in the ratio 1:1 and 3:7, it was then pelleted locally using a tin with holes and then kept under the sun to dry.

Experimental fingerlings

The experimental fish (fingerlings) *Clarias gariepinus* of about 0 – 10 cm and 0 – 20 g were transported from Agricultural Development Project (ADP), Gwagwalada in Abuja in plastic bowls with well oxygenated water at the early hour of the morning to avoid mortality due to high temperature. A total number of 39 fingerlings of catfish (*Clarias gariepinus*) of size 0 – 10 cm and 0 -20 g were randomly distributed into 3 circular tanks (13 fish per circular tank). The fingerlings of nearly the same size were acclimatized for seven days and fed with coppens at 4% body weight. The circular tanks were well aerated. At the end of acclimatization period, the fishes were starved for 24hours to empty their content and prepare them for experimental feed. This also makes the fish hungry and thus receptive to the new diet before randomly stocking the fish. The initial total length (cm) of individual fish and mean weight of the fish was recorded before placing them in the rearing containers. The fingerlings were fed 4% body weight daily (6:00am and 6:00pm) respectively.

Proximate analysis of formulated feed

Proximate analysis of the formulated feed was carried out at the Institute of Agricultural Research, Zaria. The proximate analysis also known as Weende analysis or nutritive value is a quantitative method to determine different macronutrients in a feed. They are categorized into moisture (crude water), crude ash (CA),crude protein (CP),fats and lipids and crude fiber. The feed sample was initially dried at 103°C for four hours, the weight loss of the sample was determined and the moisture fraction is calculated. Ashing the sample at 550°C for four hours removes the carbon from the sample, all organic compounds are removed. Also calculating the weight loss of the feed sample (Vital chicken feed mixed with fishmeal) from the dry matter to crude ash content mathematically determines the organic matter fraction. The Nitrogen content of the food is the basis for calculating the crude protein content of the feed. The method established by Kjeidahi converts the nitrogen present in the sample to ammonia which is determined by titration. The carbohydrate in the feed sample was retrieved in two fractions; Crude fibre and nitrogen-free extractives of the proximate analysis. The fraction which is not soluble in a defined concentration if alkalis and acids is the crude fibre (CF), the fraction which contained cellulose, lignin, sugars, pectin and hemicelluloses are the Nitrogen-free extractives(NFE). This fraction was therefore calculated by subtracting crude protein, crude ash and crude fibre from the organic matter.

Feeding and measurement

The proximate analysis of the formulated feeds Coppens feed used in aquaculture (floating diet) contains 42% protein, 13% crude fibre, 6.7% ash, 0.9% phosphorus, 1.0% calcium, 0.2% sodium was used as the control feed for the first treatment tank (tank A) which serves as the control treatment (Lovell, 1998). Vital chicken feed starter mixed with fish meal containing crude protein of 20%, 10% fat, 9% crude fibre, 1.0% calcium, 0.45% phosphorous, 2800kcal metabolized energy for the second treatment (Tank B), vital chicken feed starter mixed with fish meal in 3:7 for the third treatment (Tank C) containing crude protein of 25%, 12% of fats,13% of crude fibre,2.0% calcium,8% of ash,2850 kcal metabolized energy. The fingerlings were fed at 4% body weight twice daily, morning (6am – 8am) and evening (6pm – 8pm). Samplings of fish for weight and length measurement were done by reducing the water volume with a rubber siphone before the fish are collected with a scoop net. Fish weight was taken using a top loading balance (pocket scale), the fingerlings were weighed in groups once a week. The standard length of the fish was taken to the nearest cm with the aid of a measuring board; this was done once a week depleted water was replaced with fresh water to an effective depth of 50 cm after each cleaning.

Physiochemical parameters

Both surface water and atmospheric temperature were read daily (between 6-8am) to the nearest degree centigrade with the aid of mecury-in-glass thermometer. Dissolved oxygen was determined once a week by titration with 0.1 NaOH the azide modification of the Winkler method (American Public Health Association; 1990). Using the phenylydrochlorite method (Stirling, 1985). pH and Nitrite were determined using the combi-II Urinalysis strip.

Food utilization parameters

Specific Growth Rate (SGR)

This was calculated from data on changes of the body weight over the given time intervals according to the method of Brown, (1957) as follows;

$$\text{SGR\%} = \frac{\text{LnW2} - \text{LnW1}}{\text{T} - \text{t}} x100$$

Where; W1 is the initial weight (gram at t) and W2 is the final weight (gram at T).

Food conversion efficiency

$$\text{FCR} = \frac{\text{Weight of food consumed per fortnight (g)}}{\text{Weight gamed by fish per fortnight (g}}$$

Weight gain (g)

Weight gain (g) is calculated as the difference between the initial and final mean weight gain values of the fish in the aquarium.

$$\text{Weight gain \%} = \frac{\text{Final weight}}{\text{Initial weight}} x100$$

Survival rate (SR)

The survival rate was calculated as the total number of fish harvested /total number of fish stocked expressed in percentage.

$$\text{Survival \%} = \frac{\text{Number of fish harvested}}{\text{Number of fish stocked}} x100$$

Relative Weight Gain

$$\text{Relative Weight Gain (RWG)} = \frac{\text{W2} - \text{W1}}{\text{W1}} x100$$

Mean Growth Rate (MGR)

This was computed using the standard equation.

$$\text{MGR} = \frac{\text{W2} - \text{W1}}{0.5\ (\text{W1}.\text{W2})} x100$$

Table 1. Production parameters for treatment A

Parameters	Week0	Wk1	Wk2	Wk3	Wk4	Wk5	Wk6	Wk7	Wk8	Wk9	Wk10	Wk11	Wk12	total	mean
total weight (g)	106.48	112.67	122.15	129.12	137.74	147.77	149.15	153.2	164.21	175.02	180.6	188.39	201.99	1968.5	151.4223
mean weight (g)	8.19	8.66	9.39	9.93	10.59	11.36	12.42	13.92	14.93	15.91	16.41	17.12	18.36	167.19	12.86077
weight gain (g)	0	0.47	0.77	0.54	0.66	0.77	1.06	1.5	1.01	0.98	0.5	0.77	1.24	10.27	0.79
total length (cm)	99.75	104.5	110	115.61	123.29	128.1	132.5	134.59	138.5	146.55	153.1	160.48	173.7	1720.7	132.3592
mean length (cm)	7.67	8.03	8.46	8.89	9.48	10.19	10.67	12.14	12.59	13.32	13.91	14.58	15.79	145.72	11.20923
length gain (cm)	0	0.36	0.43	0.43	0.59	0.71	0.48	1.47	0.45	0.73	0.59	0.67	1.27	8.18	0.629231
feeding rate (g)	6.92	7.32	7.93	8.39	8.95	9.6	8.94	8.42	9.02	7	7.22	7.53	8.07	105.31	8.100769
specific growth rate (cm)	0	1.49	0.25	0.11	0.1	0.09	0.4	0.03	0.05	0.04	0.04	0.03	0.03	2.66	0.204615
mean growth rate (cm)	6	6.61	9.84	4.2	3.46	10.03	2.98	7.23	1.56	1.07	5.02	5.94	8.5	72.44	5.572308
food conv. Efficiency (%)	0	6.42	9.7	6.43	7.37	8.02	11.85	17.81	11.19	14	6.92	9.42	15.36	124.49	9.576154
survival rate (%)	100	100	100	100	100	100	90	80	80	80	80	80	80	1170	90

Table 2. Physiochemical parameters for treatment A

Parameters	WK 0	WK 1	WK 2	WK 3	WK 4	WK 5	WK 6	WK 7	WK 8	WK9	WK10	WK11	WK12
Temperature (°C)	26	26	27.5	27	28	27	28	29	27	28	27	28	27.5
Dissolved O_2 (mg/l)	6.42	6.3	6.1	6	5.93	6	6.2	5.9	5.85	6.1	5.8	5.9	6
pH	6	6	7	7.5	6.5	7	8	7	7	7.5	6.5	6	6
Ammonia (mg/l)	0.01	0.25	0.38	0.41	0.58	0.47	0.54	0.58	0.52	0.5	0.48	0.54	0.52
Nitrite (mg/l)	0.01	0.01	0.02	0.02	0.01	0.01	0.02	0.01	0.02	0.03	0.02	0.01	0.02

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

Percentage Weight Gain %

This is expressed by the equation.

$$\% \, WG = \frac{Wt - W0}{W0} x100$$

Where, Wt = Weight at time t and Wo = initial weight

Length – Weight relationship

$W = aL^b$ -----------------(1)

Log W= Log a + b Log L --------(2)

Where W = Weight of the fish (g), L= Standard length of the fish (cm), a= constant and b= Exponent

RESULTS AND DISCUSSION

Results of physiochemical parameters for treatments A, B and C are represented in (Tables 2, 4 and 6) while production parameters were given in (Tables 1, 3 and 5). The atmospheric temperature throughout the study period varied between 26 to 29°C but the highest temperature occurred in the seventh week of the experiment in treatment A. Treatments A and B recorded the highest concentration of dissolved oxygen at 6.42 mg/l and 6.84 mg/l respectively while the lowest was found in treatment C at 5.3 mg/l. Ammonia concentration in treatments A, B and C ranges between 0.01 and 1.0 mg/l. The various production parameters in the three treatments show that treatment A has the highest mean weight at 18.36 g. The highest mean length was observed in treatment C (16.26 cm). The results

Table 3. Parameters for treatment B.

Parameters	Wk0	Wk1	wk 2	wk 3	Wk4	wk 5	wk 6	Wk7	wk 8	wk 9	wk10	wk 11	wk 12	total	mean
total weight (g)	108	117.17	130.1	139.37	147.3	154.15	158.5	162.2	171.2	180.7	188.3	195.7	208.1	2060.82	158.5246
mean weight (g)	8.3	9.01	10.01	10.72	11.33	11.85	13.21	13.51	14.25	15.05	15.69	16.31	17.33	166.57	12.81308
weight gain (g)	0	0.71	1	0.71	0.61	0.52	1.36	0.3	0.75	0.79	0.64	0.62	1.02	9.03	0.694615
total length (cm)	100.8	107	115	121.66	128.1	137.9	139.9	142	152.2	161.4	167.4	175	185.1	1833.39	141.03
mean length (cm)	7.75	8.23	8.84	9.35	9.85	10.6	11.65	11.82	12.68	13.44	13.95	14.58	15.42	148.16	11.39692
length gain (cm)	0	0.48	0.61	0.51	0.5	0.75	1.05	0.17	0.86	0.76	0.51	0.63	0.84	7.67	0.59
feeding rate (g)	7.02	7.61	8.45	9.05	9.57	10.01	9.51	9.73	10.27	7.22	7.53	7.82	8.32	112.11	8.623846
specific growth rate (cm)	0	0.51	0.33	0.14	0.09	0.05	0.02	0.04	0.04	0.04	0.04	0.02	0.03	1.35	0.103846
mean growth rate (cm)	0	0.02	1.22	4.84	2.75	1.72	8.53	6.95	1.16	9.67	6.44	5.22	7.42	55.94	4.303077
Food conv. Efficiency (%)	0	9.32	11.83	7.85	6.37	5.19	14.3	3.08	7.3	10.94	8.49	7.92	12.25	104.84	8.064615
survival rate (%)	100	100	100	100	100	90	90	90	90	90	90	90	90	1220	93.84615

Table 4. Physiochemical parameters for treatment B.

Parameters	WK 0	WK 1	WK 2	WK 3	WK 4	WK 5	WK 6	WK 7	WK 8	WK9	WK10	WK11	WK12
Temprature (°C)	26	27	28	27.5	26	27	28	26	26	27	26.5	28	27
Dissolved O2 (mg/l)	5.96	6.12	6.83	6.24	6	5.9	6.3	6.12	5.8	6.13	5.9	6	6.12
pH	6	7	7.5	6.5	7.5	7	8	7	7	7.5	7.5	6.5	7
Ammonia (mg/l)	0.01	0.34	0.4	0.38	0.5	0.62	0.65	0.68	1	0.7	0.6	0.62	0.58
Nitrite (mg/l)	0.01	0.01	0.02	0.01	0.03	0.03	0.02	0.01	0.03	0.02	0.01	0.02	0.02

Table 5. Production parameters for treatment C.

Parameters	Wk0	Wk1	wk2	Wk3	wk4	Wk5	Wk6	wk 7	wk 8	wk 9	wk10	Wk11	wk 12	total	mean
total weight (g)	106	111.3	117.21	122.92	129.76	137.8	144.87	149.32	156.37	164.4	171.5	186.59	196.32	1894.3	145.717
mean weight (g)	8.15	8.56	9.01	9.45	9.98	10.6	12.07	13.57	14.21	14.94	15.59	16.96	17.84	160.93	12.3792
weight gain (g)	0	0.41	0.45	0.44	0.53	0.62	1.47	1.5	0.64	0.73	0.65	1.37	0.88	9.69	0.74538
total length (cm)	98.25	103.3	109.42	115.97	122.95	130.9	135.5	139.65	146.1	152.25	158.8	169.5	178.9	1761.4	135.493
mean length (cm)	7.55	7.94	8.41	8.92	9.45	10.06	11.29	12.69	13.28	13.86	14.43	15.4	16.26	149.54	11.5031
length gain (cm)	0	0.39	0.47	0.51	0.53	0.61	1.23	1.4	0.59	0.58	0.57	0.97	0.86	8.71	0.67
feeding rate (g)	6.89	7.23	7.61	7.99	8.43	8.95	8.64	8.21	8.6	6.57	6.86	7.46	7.86	101.3	7.79231
specific growth rate (cm)	0	0.43	0.82	0.09	0.08	0.07	0.06	2.04	0.04	0.03	0.03	0.04	0.02	3.75	0.28846
mean growth rate (cm)	0	0.12	6.48	3.79	3.04	2.57	1.68	8.39	1.07	9.91	7.14	1.22	6.32	51.73	3.97923
Food conv. Efficiency (%)	0	5.67	5.91	5.5	6.28	6.92	17.01	18.27	7.44	11.11	9.47	18.36	11.19	123.13	9.47154
survival rate (%)	100	100	100	100	100	100	90	80	80	80	80	80	80	1170	90

Table 6. Physiochemical parameters for treatment C.

Parameters	WK 0	WK 1	WK 2	WK 3	WK4	WK 5	WK 6	WK 7	WK8	WK 9	WK 10	WK11	WK12
Temprature (°C)	26	27	28	27	26	26.5	27.5	27	28	27	27	28	27
Dissolved O2 (mg/l)	5.5	5.8	6	6.2	5.3	5.5	5.8	6	5.9		6	6.1	5.7
pH	6	6.5	7.5	7	7	8	7	7.5	7	6.5	7	7.5	7
Ammonia (mg/l)	0.01	0.02	0.38	0.42	0.62	0.72	0.92	1	0.95		0.9	1	0.5
Nitrite (mg/l)	0.01	0.02	0.02	0.01	0.03	0.04	0.02	0.02	0.03	0.02	0.01	0.04	0.02

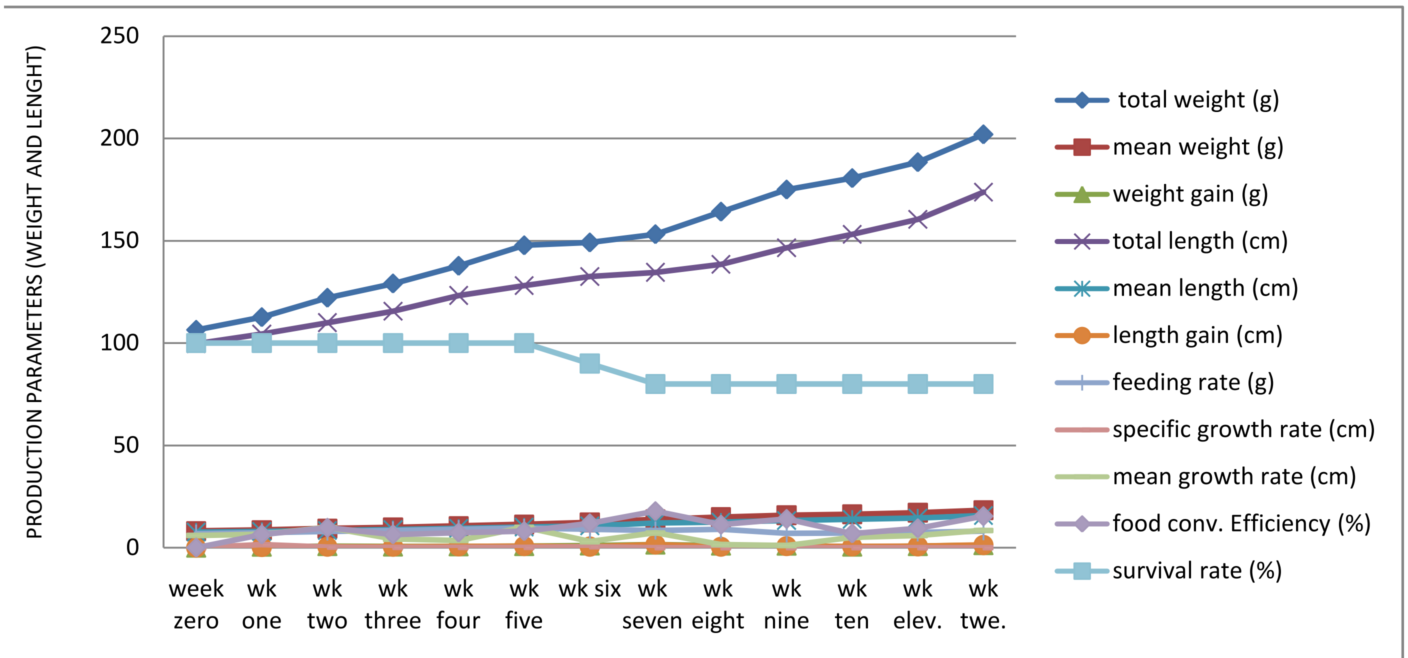

Figure 1. Production parameters for treatment A

from the study agree with Boyd and Lichtokoppler, (1979). The highest survival rate was found in treatment B at 93.8% followed closely by treatment A and C at 90% (Figures 1 to 6).

The result showed that the highest mean weight was observed in tank A (18.33 g) which surpassed that of tank B and C (De Silva and Davy,1992; De Silva and Anderson,1995). The highest mean length (16.26 cm) and the highest specific growth (3.75 cm) were observed in tank C. It could therefore be concluded that a mixture

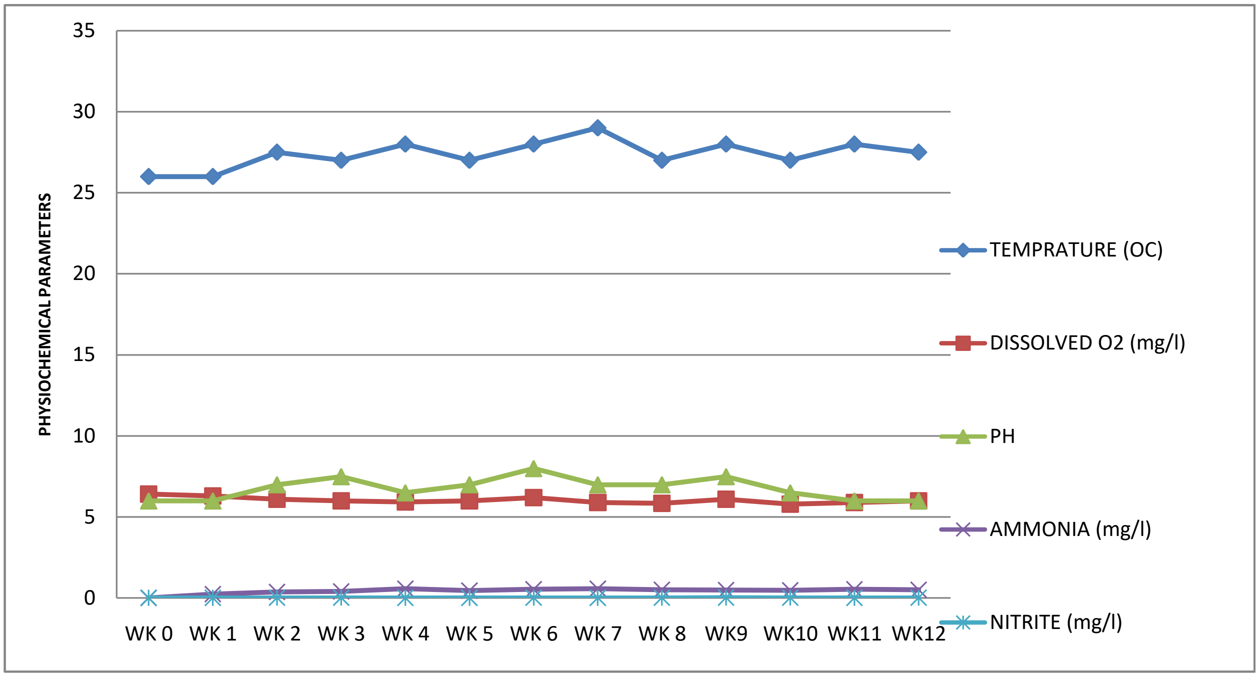

Figure 2. Physiochemical parameters for treatment A.

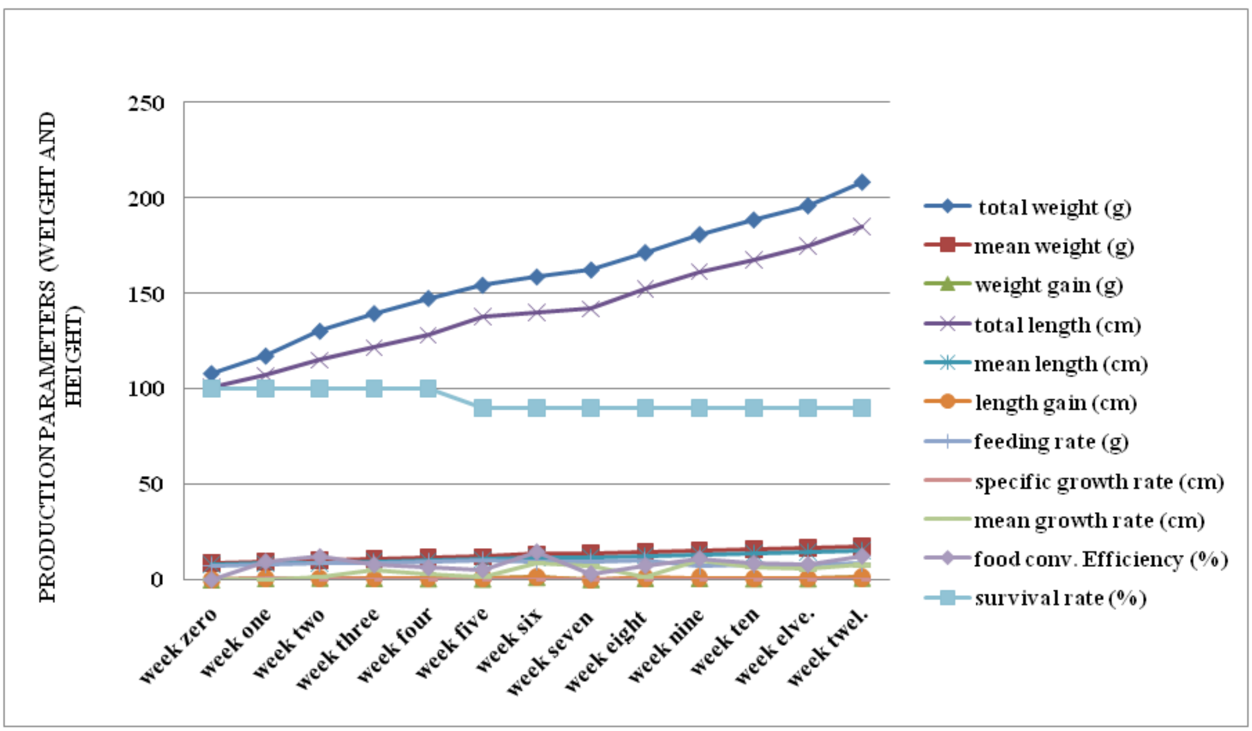

Figure 3. Production parameters for treatment B.

of vital chicken feed and fishmeal can replace Coppens. Fish farmers can therefore explore the use of vital chicken feed mixed with fishmeal as an alternative to Coppens (commercial fish feed) in the diet of *Clarias gariepinus* to reduce cost. The result of the study is in agreement with Bascinar et al., 2007.

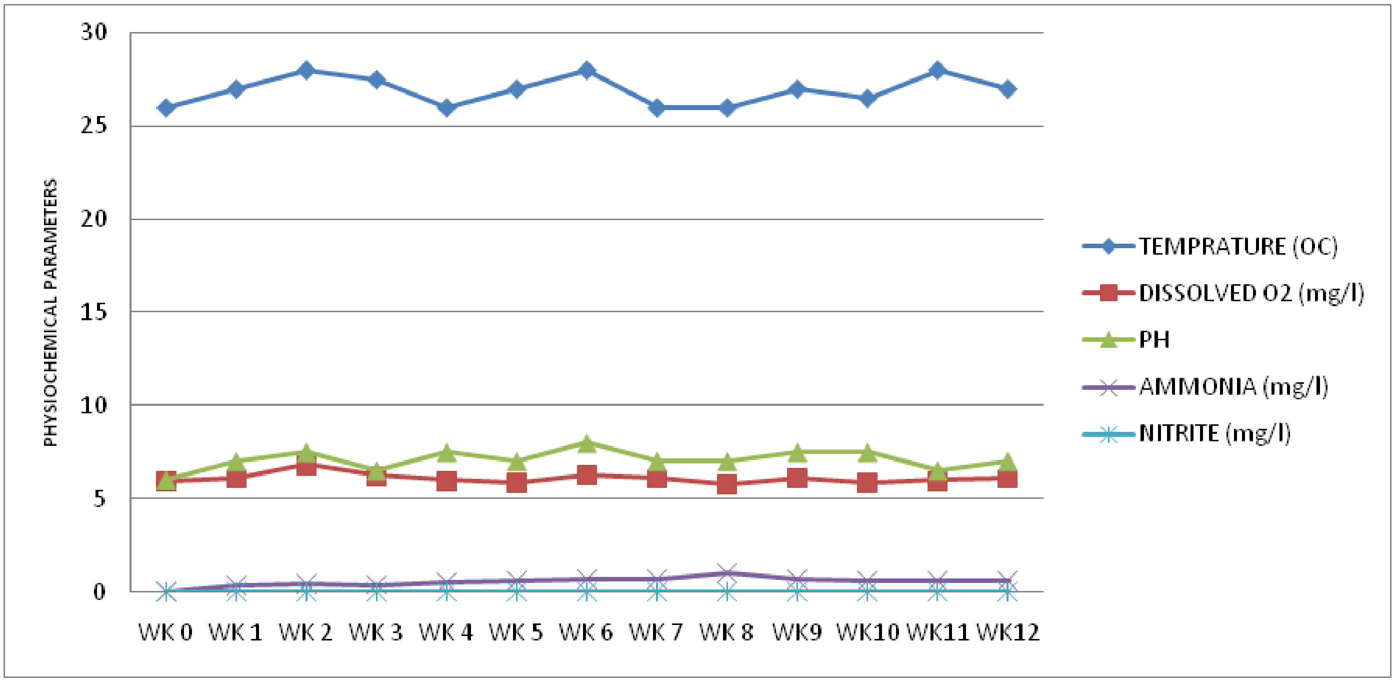

Figure 4. Physiochemical parameters for treatment B.

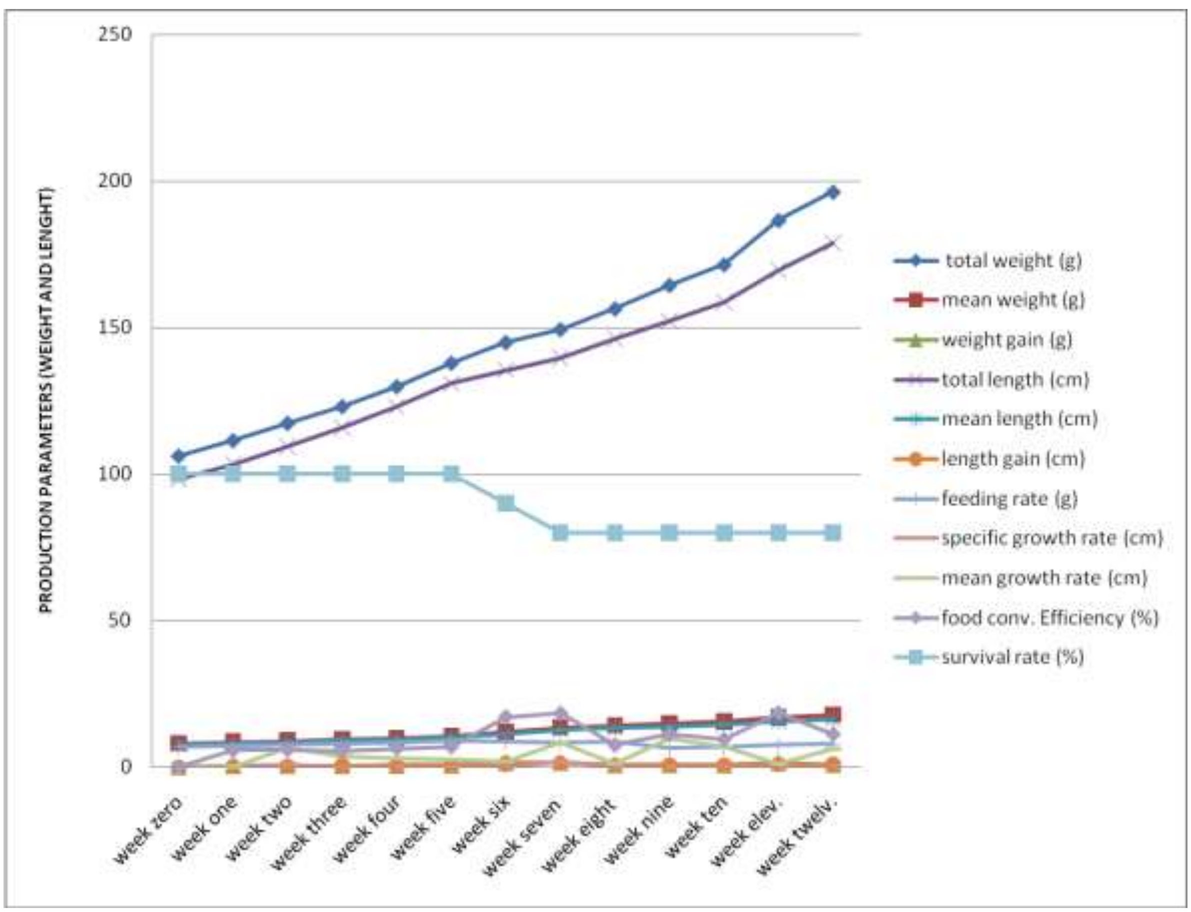

Figure 5. Production parameters for treatment C.

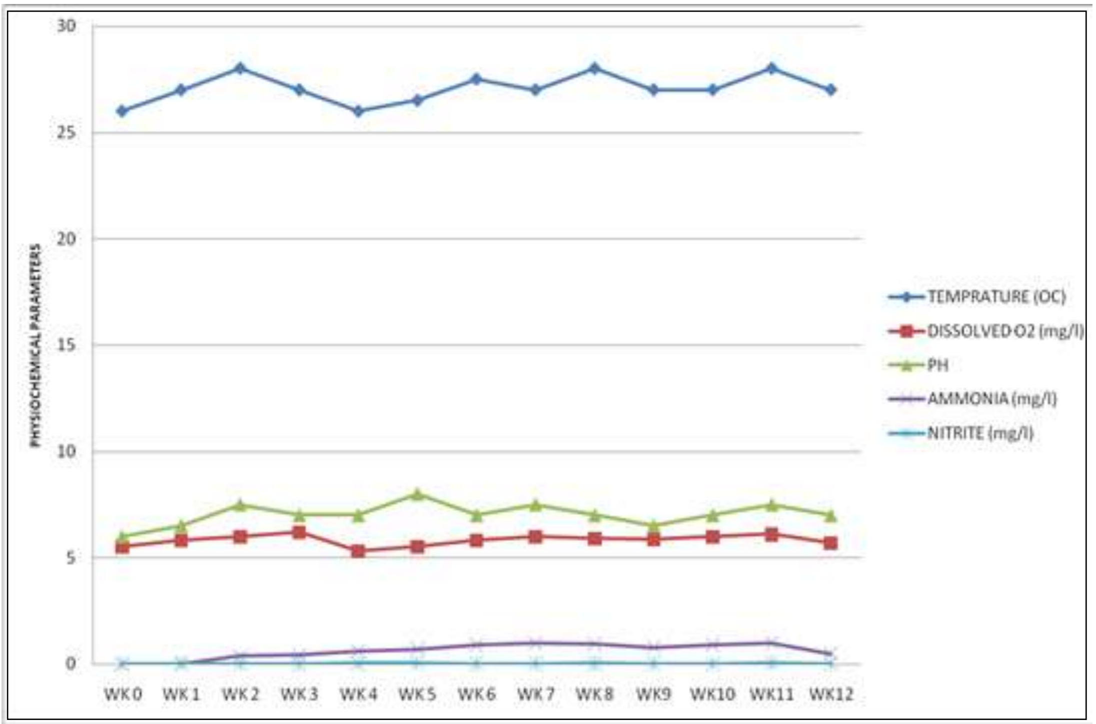

Figure 6. Physiochemical parameters for treatment C.

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