Journal of Science of Agriculture, Food Technology and the Environment Vol. 21 No. 1, 2023 & 2024 *108-116*
Available online: jsafeacademicjournal.com

LENGTH-WEIGHT RELATIONSHIP (LWR) AND CONDITION FACTOR (K) OF *Clarias gariepinus* (BURCHELL, 1822) JUVENILES FED CASHEW NUT WASTE DIETS

Okpani Joseph Agha and Ude Emmanuel Fame
Department of FisheriesandAquaculture, Faculty of Agriculture and Natural resources Management, Ebonyi State University, P.M.B. 53, Abakaliki, Nigeria. Email: emmanel.ude@ebsu.edu.ng

ABSTRACT

The present study investigated the length-weight relationship (LWR) and condition factor (K) of African catfish *Clarias gariepinus* Juveniles fed cashew nut waste diets for fourteen weeks. A total of Four hundred and eight (408) Juveniles of mean length 10.87±0.32cm and mean weight 14.10±0.06g were randomly distributed into four treatment in triplicate of 34 fish per replicate in a completely Randomized Design to assess their growth pattern and physical condition. The Length-Weight Relationship and condition factor were calculated by the use of recommended formula and procedure. The length-weight relationship regression analysis showed that the values of 'b' obtained in the control and other three treatments were 2.1877, 3.1387, 3.3046 and 3.0875 respectively with corresponding coefficient of determination (r^2) values of 0.3991, 0.6692, 0.6027 and 0.6889. Treatments 1,2 and 3 exhibited positive allometric growth pattern while the control diet revealed a negative allometric growth pattern, showing the fish were not in a stable condition.

Keywords: *Length-Weight Relationship, Condition Factor, Cashew Nut, Clarias gariepinus.*

INTRODUCTION

A useful biological tool to look into the growth, age, maturity, reproduction, mortality and condition of fish are Length-Weight relationship (Sigh and Serajuddin, 2017 and Fafioye *et al.*, 2018). It also portrays the mathematical relationship between two variables (Length and weight). The known variable is used to calculated the unknown variable. Proper knowledge of length-weight relationship and condition factor are important for fish farmers to manage fish species as to know the weight in relation to its length and variation difference of fish of the same species (Getso *et al.*, 2017). Palatability and nutritional values of fish has given rise to its demand globally which has given rise in fish farming venture (Afolabi, 2020). Globally, African catfish (*C. gariepinus*) has become a major economic important aquaculture species. It is an indigenous species to Africa and spread widely from African natural habitat to Middle East and other part of the world (Froese and Pauly, 2017 and Sadauki *et al.*, 2022). African catfish is graded high in warm water aquaculture, and accepted by many fish farmers, because of certain attributes which include fast growth, large

size, low bone content; adaptation to any environmental conditions and high market value (Dan-Kishiya, 2013, Ude, 2011). Catfish is omnivorous fish that feed on anything and convert it very well for growth (Afolabi, 2020). Cashew *Anacardium occidentale* belongs to the family Anacardiaceae. It is native to Brazil and grown in other places such as West Indies, India, Vietnam, and Africa. Cashew is supple plant that grows well on poor sandy soils under different climate condition. It can tolerate draught and soil that lack nutrients. Cashew is ranked high as one of edible nuts in the world with soaring nutrient value. It is a famous plantation crops in the world and marketed because of their nutritional value (John *et al.,* 2017). The plants of cashew produces cashew nut affixed at the bottom of a cashew apple, with only one cashew nut, attached to each apple, and enclosed in a stiff shell. It is a good source of plant protein, mineral, vitamin and amino acids (Ogueji *et al.,* 2020). John *et al.* (2017) reported that African countries produce about 100,000 metric tons of cashews yearly, despite their huge production, they gain little from the products because they export the cashew nuts without processing them to the developing countries.

MATERIALS AND METHODS

Study Area:

The research was carried out in outdoor concrete thanks in the Department of Fisheries and Aquaculture, Ebonyi state University, Abakaliki Ebonyi State, Nigeria which lies between Longitude 08º 07.692" East and Latitude 06º 19.370" North with mean minimum and maximum temperatures of 25ºC and 34ºC.

Collection of Research Materials

Cashew nut wastes

The Cashew nut waste (*Anacardium occidentale*) was collected from Embik Cashew Nut Processing Industry at Umuori Urata, Imo State, South East Nigeria. Other ingredients (Wheat, Yellow Corn, fishmeal, Soybean, vitamin premix, lysine, metthionine, vitamin C, iodized salt, oil and cornstarch) were bought from International Market, Abakaliki, Ebonyi State Nigeria. The soybean was toasted until the color changed to brown to remove or reduce anti-nutritional factors. All the ingredients were ground separately to fine powders in a Hammer Mill R175A made in China machine. The feed was homogenously mixed and pelleted, then sundried and packaged well in air tight containers.

Fish and Experimental Set-up

Four hundred and eight (408) African catfish (*Clarias gariepinus* Burchell 1822) Juveniles of similar size were purchased from Mercynuel fish Farm in Abakaliki, Ebonyi State, Nigeria. They were acclimated for fourteen days and randomly distributed into twelve outdoor concrete tanks in three replicates of 1m x 1m x 0.9m. Each replicate contained 34 fish per tank in a completely randomized design. The fish were denied food a day before the commencement of the feeding trial to empty their gastro-intestinal tract and prepare them for the experimental diets.

Formulation of Experimental Diets.

Four iso-nitrogenous 40% Crude protein were formulated to have varying levels of 0%, 25%, 50%, and 75% of the diets containing 0.00g100 g^{-1}, 13.0g100 g^{-1}, 25.0g100 g^{-1} and 37.0g100g^{-1} of the cashew nut waste. The quantities of the ingredients were weighed according to treatment with Electronic Digital Kitchen Scale CAMYR EK5505E Ohaus Corporation NJ, USA. The cashew nut wastes ground to a fine powder; was thoroughly mixed together with other ground ingredients like soybean, maize, fishmeal, wheat; and vitamin premix, methionine, lysine, vitamin C, iodized salt (NaCl) and oil. Cornstarch was used as a binder to form a homogenous mesh. The respective ingredients that were thoroughly mixed together was pressed and extruded through a 2mm dice attached to a Viking Exclusive Jancod pelletizing machine. The resultant pellets were sun-dried for two days. Analysis for proximate composition was carried out to determine percentage crude protein, crude fibre, crude lipids, moisture, ash and nitrogen free extract, according to AOAC (2012). The fish, were stocked in triplicates for each dietary treatment and fed with assigned experimental diet at 5% of the body weight twice daily at 9.30am in the morning and 5.30pm in the evening for a period of 98 days.

Measurement of Length-Weight Relationship and Condition Factor

Measuring of the total length of each fish in the control and the other three treatments was done with a meter rule and recorded in centimeter. The total length of each fish was measured from the tip of the snout of the fish to the posterior end of the caudal fin. The standard length was measured from the tip of the snout of the flexure point of the caudal fin. while the weight was measured with Electronic Digital Kitchen weighing balance CAMRY EK5505E model. The total length, standard length and weight of each fish was done separately and recorded. The determined total length was used in conjunction with the determined weight to estimate Length-Weight relationship and computed from the formula as described by LeCren (1951). Thus W

$= aL^b$. Where W = Body weight of the fish (g). L = Length of the fish (cm). and b = Exponent or regression intercept. Since the weight of the body of the fish increased more than the total length, 'a' and 'b' were evaluated logarithmically. Thus W = Log a + b Log L. Where W = weight of fish in grams. 'a' = the intercept (proportional constant at Y and X). 'b' = allometric growth coefficient (slope) and L = total length in centimeter. r^2 which is the significant level of coefficient was calculated and the parameters of 'b' of each treatments was tested by Fisher's LSD to confirm if r^2 significantly varied either isometric growth pattern if b = 3, or allometric if $b \neq 3$; positive allometric if b>3 and negative alometric if b<3. The condition factor (K) was used to assess the relative well-being of the fish and was calculated using the formula $K= 100*W/L^3$ (LeCren, 1951). Where: K = Condition factor. W = Observed weight of the fish (g) and L = Observed total length (cm).

Length-weight Relationship of Fish Fed Cashew Nut Waste Meal

Mean weight gain (MWG): This was calculated as the final mean weight of the fish (g) minus the initial mean weight (g). MWG = $W_2 – W_1$ (g)

Where W_2 is final weight and W_1 is initial weight.

Mean length gain (MLG): Calculated by deducting the initial mean length from the final mean length. MLG = $L_2 – L_1$ (cm). Where: L_2 is the mean final length at the end of the experiment, and L_1 mean initial length at the beginning of the experiment.

Specific growth rate (SGR): This is the percentage of rate of difference between the natural logarithm of the final weight and initial weight of the fish sample with time. (Days)

SGR = (Log_e W_2 – Loge W1)/Cultural period X 100

Where: Log_e = natural logarithm, W_1 = initial mean weight at the beginning of the research, W_2 – final weight at the end of the research, T = experimental period in days.

Feed conversion ratio (FCR): is calculated by dividing the total feed given to the fish bb the mean body weight of the fish in grams.

FCR = Quantity of feed consumed (g)/Weight gain of fish (g)

Protein Efficiency Ratio (PER) = Fish weight gain (g)/Protein intake

Survival rate (%) = Number of survived fish at the end/Number stocked at the beginning X 100 (Brown, 1975)

Statistical Analysis

Data collected was subjected to one-way analysis of variance (ANOVA) compiled with Microsoft Excel to calculate the condition factor and create a scatter plot showing the length-weight relationship of the fish in each treatment group using Tukey's post-hoc to test the significant difference ($p<0.05$).

Table 1: Diet formulation and Proximate Composition of Cashew Nut Waste Based Diets

Parameter	CONTROL	T1 (25%)	T2 (50%)	T3 (75%)
Soy bean meal	25.00	18.00	12.00	6.00
Cashew nut reject meal	0.00	13.00	25.00	37.00
Fishmeal	40.00	34.00	28.00	22.00
Yellow corn meal	12.11	12.11	12.11	12.11
Wheat meal	11.89	11.89	11.89	11.89
Vitamin premix*	02.75	02.75	02.75	02.75
Methionine	02.25	02.25	02.25	02.25
Lysine	01.85	01.85	01.85	01.85
Corn starch	02.15	02.15	02.15	02.15
Oil	01.00	01.00	01.00	01.00
Vitamin C	00.50	00.50	00.50	00.50
Iodized salt	00.50	00.50	00.50	00.50
CP	40.84 ± 0.04^{a}	39.13 ± 0.01^{b}	38.44 ± 0.01^{c}	40.62 ± 0.01^{a}
C Fat	17.96 ± 0.01^{a}	18.22 ± 0.01^{a}	16.82 ± 1.02^{b}	19.44 ± 2.07^{a}
C Fibre	2.52 ± 0.33^{b}	2.67 ± 0.02^{a}	2.63 ± 0.21^{a}	2.54 ± 0.01^{b}
Ash	6.55 ± 1.03^{b}	6.71 ± 1.21^{a}	6.64 ± 1.00^{a}	6.49 ± 1.33^{b}
Moisture	7.85 ± 1.05^{b}	8.10 ± 0.00^{a}	8.03 ± 1.06^{a}	7.83 ± 0.03^{b}
NFE	24.25 ± 1.02^{c}	25.17 ± 1.04^{b}	27.48 ± 1.13^{a}	23.06 ± 1.40^{c}
DM	92.15 ± 2.71^{a}	91.90 ± 2.51^{b}	91.97 ± 2.42^{b}	92.17 ± 2.34^{a}

*Vitamin premix. Vitalyte-extra containing the following per kg of feed. Vitamin A 15,000,000IU, Vitamin D3 4,400,000IU, Vitamin A 2,500IU, Vitamin K 4,350mg, Vitamin B2 4,350mg, Vitamin B6 2,350mg, Vit. B12 11,350mg, Vitamin C 1,000mg, Nicotinamide 16,700mg, Calcium pantothenate 5,350mg, Potassium chloride 87,000mg, Sodium Sulphate 212,000mg, Sodium Chloride 50,000mg.

Means with different letters (a, b, c, d) within the same row differ significantly ($p<0.05$)

*NFE = Nitrogen Free Extract 100 – (crude protein + crude fat + crude fibre + ash content + moisture content)

** DM = Dry Matter 100 – Moisture content.

RESULTS

The physico-chemical parameter of water monitored were Temperature, Dissolved Oxygen (DO), pH, total hardness and Conductivity Table 2. They were assessed using APHA Standard procedure APHA (2012). Good water quality is ideal for successful fish farming. If the water quality is bad due to disparity in one or more parameters, fish health and growth will be affected (Reid *et al.,* 2019). The water temperature was measured with Mercury-in-Glass Thermometer and recorded in ºC. Dissolved oxygen and total hardness were monitored with Multi- Analyzer water parameter kit model EZ-9909-SP. pH was measured with Multi-Parameter Analyzer Model COM-600. HACH Conductivity Meter 16300 Model was used to measure the Conductivity of the water in the treatment tanks. Water was collected bi-weekly at 8.30am in the morning with a 2–1 Van Dorn bottle for the examination. using APHA (1912) method.

Proximate composition for percentage Moisture, Protein, Fat, Fibre, Ash, Nitrogen Free Extract (NFE) and Dry Matter (DM) contents were done in duplicates and assessed by using the standard procedure of AOAC (2012). Percentage Moisture content was determined by drying the samples in the oven for four hours in a temperature range of 105ºC to a constant weight. The crude protein content was determined by the use of Kjeldahl method by multiplying a constant factor 6.25 by Nitrogen content. Crude Fat was determined through petroleum ether extraction using Soxhlet method. Crude Fibre was determined by acid digestion method; this was followed by combusting the samples in a muffle furnace for 6 hours at a temperature of 550ºC to obtain the ash content. Dry Matter was determined by oven drying the samples at 105ºC for 24 hours. NFE was determined by subtracting the sum of the values of Crude Protein, Crude fat, Crude Fibre, Ash, and Moisture from 100.

The results of bi-weekly growth parameters for *Clarias gariepinus* fed graded levels of Cashew nut waste diets are shown in table 3. The result revealed a significant increase in the final feed intake of *Clarias gariepinus* in the treatments and the control. However, best feed intake was observed in the 50%-fed group at 289.80±1.32g and lowest in the 25%-fed group at 132.35±1.32g. In relation to Length-Weight, a significant increase at ($p<0.05$) feed intake was observed in treatment T3 and was significantly higher than other treatments (T1, T2) and the

control. The results of the study showed that there were no significant differences ($p>0.05$) in the initial total length final total length, initial standard length, and total standard length. of *Clarias gariepinus* fed the cashew nut waste diets at different inclusion levels and the control.

The results of the length-weight relationship regression analysis and condition factor of *C. gariepinus* fed cashew nut waste diets is shown in Table 4. The initial mean length and weight of the fish were 10.87±0,32cm and 14.10±0.06g respectively. the 'b' values of the *C. gariepinus* recorded were 2.1677, 3.1387, 3.3046 and 3.0875 with the corresponding coefficient of determination (r^2) as 0.3991, 0.6692, 0.6027 and 0.6889 for the control, T1, T2 and T3 respectively (Table 4). The results showed that the control demonstrated negative allometric growth pattern. 'b' is less than 3, Fisher's LSD $p>0.05$. While T1, T2 and T3 showed positive growth pattern. 'B' values are more than 3, Fisher's LSD test $p<0.05$.

Table 2: Water Quality Parameters

Parameter	CONTROL	T1 (25%)	T2 (50%)	T3 (75%)
Temperature ºC	27.72±2.00[a]	28.05±2.11[a]	27.72±2.114[a]	28.02±1.03[a]
DO mg/L	5.04±0.06[a]	5.00±0.02[a]	5.10±0.02[a]	5.02±0.06[a]
Total hardness ppm	33.01±2.32[a]	32.36±2.01[a]	33.41±2.02[a]	33.44±2.22[a]
pH	6.65±0.22[b]	6.04±0.43[b]	6.85±0.36[b]	7.35±0.78[a]
Conductivity µ/cm	120,60±3,0[a]	122.13±3.0[a]	121.23±3.2[a]	120.01±3.0[a]

Note: DO = Dissolved Oxygen. Values represent mean standard error of mean (SEM) of 12 replicates of the feeding trial. Different letters (a, b) in each row signifies significant difference ($p<0.05$)

Table 3: Growth Parameters of *Clarias gariepinus* fed Cashew Nut Waste Diets.

Parameter	Treatment	Initial	Final
Feed Intake (g)	Control	37.88±1.04[b]	149.42±1.06[b]
	T1	38.42±1,00[b]	132.35±1.35[c]
	T2	32.59±1.3[c]	289.80±1.32[a]
	T3	39.12±0.05[a]	186.24±1.41[a]

	Control	15.68±0.08[a]	165.35±2.15[b]
Weight (g)	T1	14.63±0.	138.64±2.08[c]
	T2	12.78±0.04[c]	180.14±2.43[a]
	T3	13.31±0.04[b]	145.35±2.16[b]
	Control	14.26±0.01[a]	34.48±1.00[a]
Total Length (g)	T1	13.66±0.01[a]	33.14±1.21[a]
	T2	13.43±0.11[a]	35.42±1.06[a]
	T3	13.80±0.22[a]	34.46±1.24[a]
	Control	12.80±1.41[a]	28.42±0.22[a]
Standard Length (g)	T1	10.04±1.02[a]	29.34±0.04[a]
	T2	11.27±1.00[a]	31.34±0.33[a]
	T3	10.23±1.04[a]	29.44±0.13[a]

Table 4 : Length-Weight Relationship and of *Clarias gariepinus* fed Cashew Nut Waste Diets

Parameter	Obs.	K	Intercept of 'a'	Std Dev of 'a'	Cl of Intercept	Slope 'b'	Std Dev of 'b'	Cl of grade	Corr Coef r	r^2	Cl of r
Control	90	0.3809	94.1928	8.7719	32.3510 77.000	2.1677	0.2862	1.6268 2.7486	0.3617	0.3991	0.4885 0.7418
T1 (25%)	80	0.4033	39.1228	7.5620	24.6895 54.5952	3.1387	0.2499	2.6424 3.6285	0.8180	0.6692	0.7297 0.8797
T2 (50%)	98	0.4054	68.5172	9.1280	50.6264 86.4080	3.3046	0.2738	2.7679 3.8413	0.7763	0.6027	0.6027 0.8447
T3 (75%)	72	0.3259	40.9250	8.0610	25.1254 56.7245	3.0875	0.2480	2.6015 3.3735	0.8300	0.6889	0.7408 0.8905

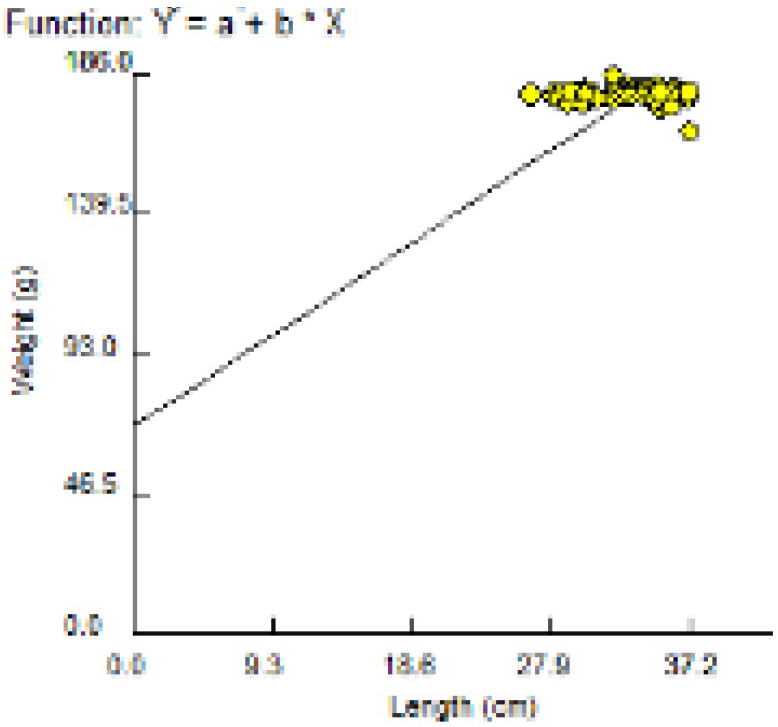

Figure 1: Length-weight Rlationship of *Clarias gariepinus* fed control diet

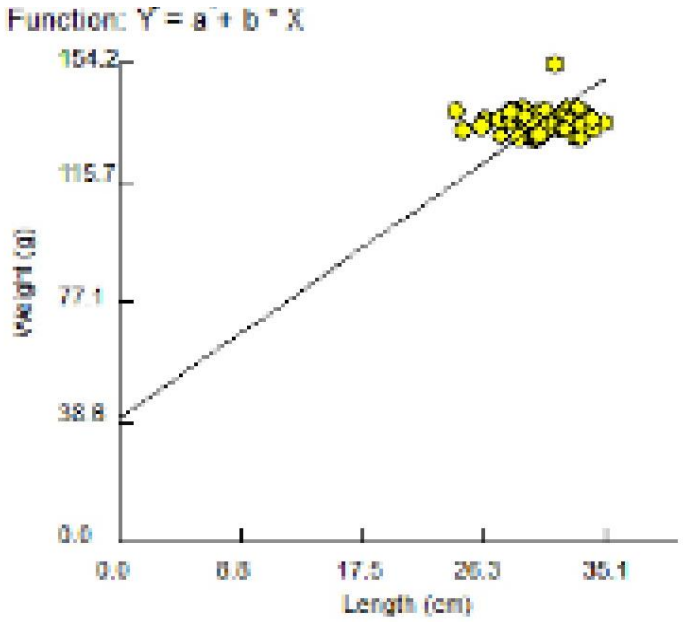

Figure 2: Length-weight Rlationship of *Clarias gariepinus* fed treatment 1

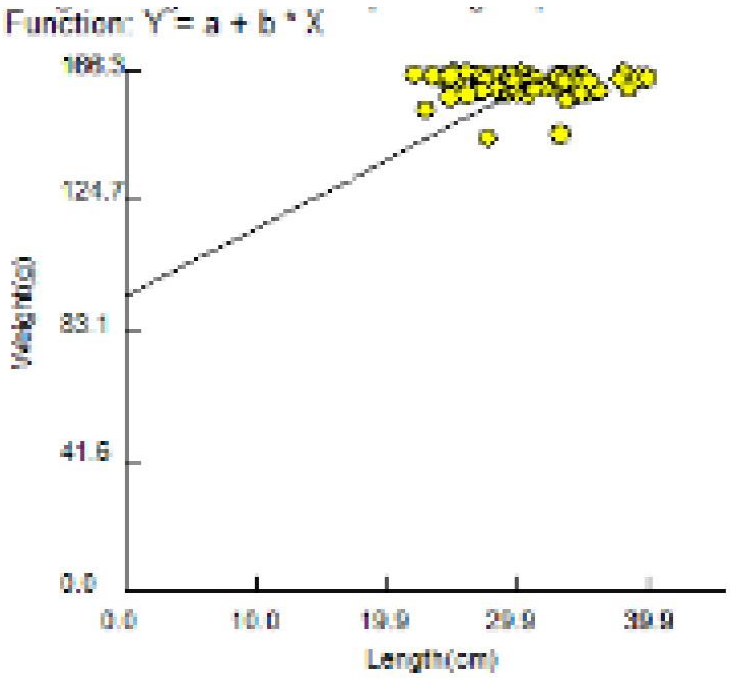

Figure 3: Length-weight Rlationship of *Clarias gariepinus* fed treatment 2 diet

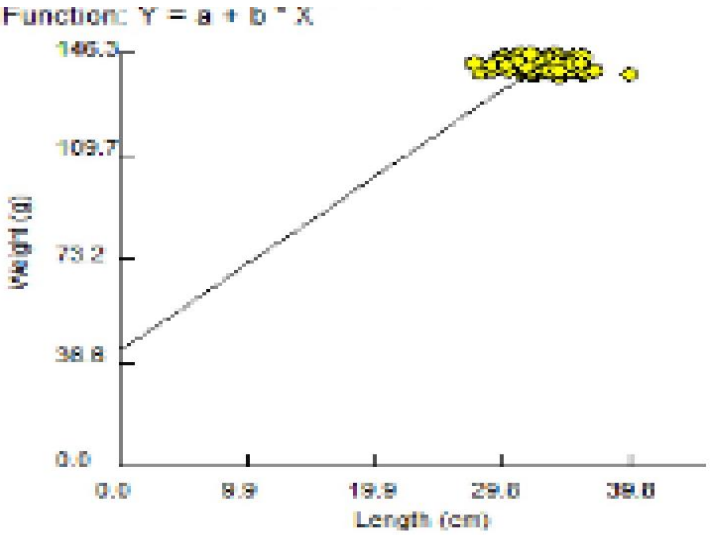

Figure 4: Length-weight Rlationship of *Clarias gariepinus* fed treatment 3 diet

DISCUSSION

The result of analysis of the proximate composition of the diets revealed that the values of crude protein recorded was in line with the maximum protein requirements of 40-45% for catfish culture reported by Bake *et al.* (2021), The values were comparable to the values reported by Anyanwu *et al.* (2021)

after feeding *C. gariepinus with Enterococcus faecicieum* and Iheanacho *et al.* (2019) who fed *C. gariepinus* with Cashew nut reject meal. However, the mean percentage crude protein recorded was in contrast to the 39% recorded by Pailboon and Kriangsak (2015) after feeding trial with *C. gariepinus.* The percentage crude fibre recorded were similar to the values obtained by (Bake *et al.,* (2021), but differ from what was obtained by Iheanacho *et al.,* (2019) after feeding *C. gariepinus* with cashew nut reject meal. The Nitrogen free extract (NFE) obtained from this research was lower than the results obtained by Ibrahim *et al.* (2021).

The importance of water to fish is numerous. Fish use water for their biological functions, such as respiration, feeding, reproduction, movements, growth, and osmoregulation. Any defect in water quality will have adverse effect on fish. There was no harmful effect on the water quality because of the cashew nut waste meal. The values of all the water quality parameters measured were within the ranges recommended by (Boyd, 2017; Solomon *et al.,* 2013. The finding agrees with what Boyd (2017), and Bhatnagar *et al.* (2013) recorded. Feed intake of the test fish was observed to remarkably increased in T2 which significantly differed ($p<0.05$) from other treatment and the control.

The Length-Weight parameters 'a' and 'b' and the condition factor (K) of the fish are affected by many factors such as age, stage of maturity, sex, muscular development, etc as reported by Gupta and Bamerjee (2015) Fafioye *et al.* (2018) and Oladunjoye *et al.* (2020). The linear regression slope 'b' reveals that the fish had a negative allometric growth pattern in T1, T2 and T3. This implies that the increase in the length of the fish is not equal compared to the weight under specific gravity. The results of this study agrees with the findings of Olapedi and Conteh (2019) who recorded the values of five treatments to be 3.3, 3,03, 3.0, 2.9 and 2.7. The reason for the negative allometric growth pattern may be attributed to increase intake of water, or food, the day of sampling the fish, habitat, age, sex, season and geographical location, which have been reported to have impact on fish weight.

The low down of fish condition factor (K) observed in this study may be attributed to adverse condition of the environment and inadequacy of the fish nutrients which is in agreement with the finding of Qazi *et al.* (2010). values The values of condition factor

obtained in this research is lower than the recommended 2.9 and 4.8 mature freshwater fish by Bagenal and Tesch (1978)

CONCLUSION

the study of the length-weight relationship and condition factor provided a useful information on the well-being of the fish in the treatments. The results revealed that the trial fish exhibited negative allometric growth pattern in the control diet, This shows that the condition of the water was not good for the fish growth and development. this implies that there may be need for thorough analysis of the water parameters in Ebonyi State University, Abakaliki. However, fish in T1, T2, and T3 showed that the fish were in good condition.

Disclosure statement

No potential conflict of interest was reported by the Author(s)

Funding

Authors received no external funding for this research.

REFERENCES

Afolabi, J.O; Oladele, O.O. and Olususi, C.F. (2020): Assessment of bacterial loads of *Clarias and Applied Zoology 81:* 32

Anyanwu, C.N; Osuigwe, D.I; Adaka, G.S; Anyanwu, D.C; and Chukwuotito, P.C. (2021): Evaluation of growth and Body composition of *Clarias gariepinus* fingerlings fed graded levels of *Enterococcus faecium. Nigeria Journal of Fisheeries 18(1):* 2166-2169

AOAC (2012): Official methods of Analysis. (18th Edition) Washington DC, USA. Association of Officiating Analytical Chemists method 9335.14 and 992.24.

APHA (1912): American Public Health Association. American Water Works Association. Water Pollution Control Federation Standard Methods for the examination of water and wastewater. American Public Health Association. Washington DC, USA

Bake, G.G; Ajibode, D.O; Gana, A.B; Yakubu, F.B; Samaila, J; Abdulkarim, I.A; Igili, G.M; Sadiku, S.O.E. and Gatlin, D.M. (2021): Growth performance, body composition and apperant nutrients digestibility of hybrid *Clarias gariepinus* fingerlings fed with blended insect meal. *Nigerian Journal of Fisheries 18(1):* 2118-2128

Bhatnagar, A. and Devi, P. (3013): Water quality guidelines for the management of pond fish culture. *International Journal of Envinmental Science 3(6):* 1980-2009

Boyd, C.E. (2017): Water management for ponds fish culture.*In: Developmen t of Aquaculture and Fisheries Sciences (9):* Elsevier Scientific Publications. Amrmsterdam. 1-231pp.

Dan-Kishiya, A.S.(2013): Length-Weight relationship and condition factor of five fish species from a tropical water supply reservoir in Abja, Nigeria.

American Journal of Research Communicatioin 1(9): 175-187

Fafioye, O; Asiru, R.A. and Oladunjoye, R,Y, (2018): Length-Weight relationship, abundance and sex ratio of giant River Prawn *Macrobranchium vallenhovenii* (Herklots 1867) from River Osun Southwestern Nigeria. *Journal of Aquaculture Research and Development 9(10):* 1-5

Froese, R., and Pauly, D. (2017): Fish Base: World wide web electronic publication. Available at: http://www.fishbase,org

Getso, B.U., Abdullahi, J.M. and Yola, I.A. (2017): Length-Weight Relationship and Condition Factor of *Clarias gariepinus* and *Oreochoromis niloticus* of Wudil River, Kano, Nigeria. *Agro-Science journal of Tropical Agriculture, Food, Environment and Extension 16(1):* 1-4

Gupta, S and Banerjee, S. (2015): Length-Weight relationship of *Mystus tengara* (Ham-Buch 1822), a freshwater catfish of Indian subcontinent. *International Journl of Aquatic Biology, 3(2):* 114-118

Ibrahim, B.U; Sale, M.M; Abdullahi, H.C and Usman, A. (2021): Evaluation of sweet potato (*Ipomoea batatas*) peel mea;l diets on growth performance of *Clarias gariepinus. Nigeria Journal of Fish 18(1):* 2221-2226

Iheanacho, S.C; Ogueji, E.O; Igberi, C; Avwemoya, F; Amadi-Eke, A; Yaji, A. and Mbah, C. (2019): Sustability of discarded cashew nut (*Anacardium occidentale*) meal as repl;aacement of soybean meal (*Glycine max*) in the diet of juvenile African catfish *Clarias gariepinus. Indian Journal of Fisheeries 66(3)* 78-86

John, O.O; Gabriel, I; Peter,Y; and Felicia, O. (2017): Comparative studies of the phytochemical, antioxide and antimicrobial properties of cashew leaf, bark and fruit extract. *American Journal of Food Nutrition 5(4):* 93-101

LeCren, C.D. (1951): The length-weight relationship and seasonal Cycle in Gonad weight and condition in Perch, *Perca fluviantilis. Journal of Animal Ecology. 20:* 201-219

Ogueji, E.O., Iheanacho, S.C., Mbah, C.E., Yaji, A.G. and Ezemagu, U. (2020): Effect of partial and complete replacement of soybean with discarded cashew nut (*Anacardium occidetale* L) on liver and stomach histology of *C. gariepinus* (Burchell 1822). *Aquaculture Fish 5:* 86-91

Olapade, O. and Conteh, K.U. (2019): Growth performance. length-weight relationship and condition factors of *Clarias gariepinus* fed *Anisophyllea laurina* seed meal substitute. *Journal of Applied Sciences and Environmental Management 23:* 505

Oludunijoye, R.Y., Odusolu, A.A., Asiru, RA. and Fafioye, O.O. (2020): Prevalence and diversitty of Heliminthes Fauna in Fishes of Ogun River, Nigeria. *Tropical Journal of Natural/Products Research 4(8):* 397-400

Qazi, J., Shakir, H., Hussain, A. and Ali, S. (2010): Growth coefficent and condition factor of three carp species reared under semi intensive culture.

Punjab University Journal of Zoology 25: 13-20

Reid, G.K; Gurney-Smith, H.J; Flaherty, M; Garber, A.F; Forster, I; Brewer-Dalton, K; Knowler, D; Marcogliese, D.J; Chopin, T; Moccia, R.D; Smith, C.T. and De Silva, S. (2019): Climate change and Aquaculture. Considering adaptation potential. *Aquculture Environment Interactions 11:* 603-624

Sadauki, M.A; Bawa, S.B; and Nababa, A.S. (2022): Gastro-Intestinal helminth funa of *Clarias gariepinus* (Burchell 1822) in Jibia reservoir, Katsina State, Nigeria. FUDMA *Journal of Sciences* (FIS)ISSN online: 2616-1370ISSN print: 2615 – 2944Vol. 6 no.1March 2022, pp107 – 111DOI:https://doi.org/10.33003/fjs-2022-0601-883

Singh, M. and Serajuddin, M. (2017): Length-weight relationship and condition factor of *Channa punctatus* collected from three different rivers of India. *Journal of Entomology and Zoology Studies 5:* 191-197

Solomon, S.G; Ataguba, G.A. and Imbur, I. (2012): Growth performance of juvenile *C. gariepinus* fed different dietary lipid sources. *International journal of Research in Aquaculture 2(4):* 52-55

Ude, E.F. (2011): Evaluation of seasonal occurrence of catfish families in Ebonyi River, Nigeria. *Journal of Fisheries 8(1):* 208-214