# GROWTH PERFORMANCE OF *Clarias gariepinus* (BURCHELL, 1822) JUVENILES FED WITH WATERMELON SEED CAKE (*Citrullus lanatus*) DIETS AS A REPLACEMENT OF SOYBEAN MEAL

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**Abstract:** *Clarias gariepinus* juveniles of average weight of 50 g were stocked into a plastic tank of 20 x 15 x 1.2 m dimension with holding capacity of 360 litres and at a stocking density of 20 fingerlings in plastic tank and fed diets containing various inclusion levels of water melon cake meal as a partial/complete replacement of soy bean meal. The water melon seed cake meal was included at 0%, 25%, 50%, 75% and 100% levels inclusion representing 0%, 25%, 50%, 75% and 100% replacement of soy bean diets of the fish. Results showed that fish fed 25% level of inclusion of water melon replacement had significantly higher ($p<0.05$) final mean weight (250.40 g), protein intake (258.00 g), percentage weight gain (53.15%), specific growth rate (2.33 g), protein efficiency ratio (1.63) and nitrogen metabolism (2192) than the other experimental diets. However, fish fed water melon seed cake containing 50%, 75% and 100% inclusion levels of water melon diets had lower values compared with the 25% inclusion level. Feed Conversion Ratio (FCR) and Protein Efficiency Ratio (PER) in feed containing 50%, 75% and 100% water melon cake (1.28 g, 1.29 g and 1,78 g) and (1.65 g, 1.66 g and 1.67 g) had lower values compared with the commercial feed, 25% and 0% inclusion levels (1.10 g, 1.11g ) and 1.12 g) and (1.62 g, 1.63 g and 1.64 g), respectively. The physico-chemical water parameters showed no significant difference ($p>0.05$) in all the experimental treatments. The carcass composition indicated significant increase ($p<0.05$) in all the treatments compared to the initial composition of the carcass. The commercial fed compared significantly better ($p<0.05$) than all the experimental diets. It is therefore established in this study, that water melon cake can completely replace soy bean meal in the diet of *Clarias gariepinus* juveniles at 25% inclusion level.

**Keywords:** *Clarias gariepinus*, juveniles, watermelon seed cake, soybean meal, physico-chemical

## Introduction

Inadequate animal protein consumption among most Nigerians has been reported (Agboola, 2004; Collins, 2007). The animal protein intake is less than 10 g which is far below the Food and Agriculture Organization (FAO) recommended value of 35 g per day (FAO, 2014). The livestock industry alone has not been able to address this problem adequately due to increasing population of man and livestock. Consequently, attention is being geared to the plant protein sources to supplement animal protein sources (Robinson *et al.*, 2001; Magdy, 2006), though it has the problem of anti-nutritional factors which can be reduced or removed completely through processing methods.

Soybean meal is a good source of plant protein in fish feed, but is expensive due to high demand by man, livestock and industries. This calls for more research work on plant protein sources to serve as an alternative to soybean in fish feeds.

Fish nutrition experts world over have considered the use of alternative plant protein sources for inclusion in fish diet to partially or completely replace soybean meal. This is because Soybean meal is expensive, (Collins, 2007). Though legumes and oil seeds have economic potential of being used as plant protein sources, but little knowledge is available on their usage compared to animal protein sources in aquaculture practice.

Watermelon is an oil seed that is rich in protein up to 30.6 and there is less competition on the use of its seeds by man and industries. It is also cheap to buy and available in all geo-political areas of Nigeria and the tropics, which makes it a good candidate for fish feed production. Therefore, this study is aimed at evaluating the growth performance of *Clarias gariepinus* juveniles fed with water melon diets as a replacement of Soybean meal.

## Materials and Methods

### *Experimental site*

The experiment was carried out at the National Agricultural Extension and Research Liaison Services (NAERLS) Skill Acquisition Centre, Ahmadu Bello University, Zaria with latitude 11◦9'48"N, longitude 7◦38'2"E and altitude 630 m above sea level.

### *Purchase and processing of water melon*

Water melon seed was purchased at Bara market in Bauchi State, Nigeria and was certified by the Institute of Agriculture Research (IAR), Ahmadu Bello University, Zaria. Thereafter, 1 kg was toasted in aluminum frying pan for 20 min at 80$^{o}$C. It was allowed to cool under shade before it was ground using GASA Q-Link Laboratory blender Model -18L40 and later sieved using 0.2 mm mesh size sieve to remove the seeds coat. A sample of 100 g was used for bio-chemical analysis of proximate composition. The remaining was made into water melon seed cake after extrusion of the oil. The water melon cake was toasted in an aluminum pan for 20 min. After cooling, the water melon cake was ground based on the quantity for the replacement of soybean meal. Other ingredients, such as maize, soybean cake, g/nut, fish meal, oil, methionine/cysteine, and premix were weighed based on the Pearson's square method of feed formulation. Starch was added to serve as binder and the entire ingredients was thoroughly mixed to form thick slurry. The feed was then made into pellets using locally fabricated pelletizer, pellet size was 3mm in diameter and 6mm long. The dietary treatment were made up of the five treatments which contained 42% Crude Protein (CP) of Water Melon Cake (WMC) meal which was used to replace Soy bean meal (SBM) at isonitrogenous inclusion levels of 0%, 25%, 50%, 75% and 100% asT2, $T_3$, $T_4$, $T_5$ and $T_6$, respectively; while $T_1$ was commercial feed (coppens) to compare the

efficacy of the WMC diets. 360 juveniles of *Clarias gariepinus* with mean weight of 50 g were purchased at Bagauda Farms in Kano State, Nigeria. The fish were harvested and kept overnight and was package in jerry can and transported early in the morning. The fish were acclimatized before they were randomly assigned to the five dietary treatments of three replicates and the commercial feed tanks. The fish were fed ad-libitum at 5% body weight and at an interval of 3 h, that is, 8.00-9.00am, 12.00-1.00pm and 4.00-5.00pm daily for 60 days. The water medium was changed bi-weekly with clean water and uneaten food/ feaces were siphoned out early in the morning before feeding begins to prevent accumulation of metabolites. Additional oxygen was provided in the plastic tanks using aquarium aerators connected to an electric socket. The experiment was carried out in a 20 x 15 x 1.2 m plastic tanks capacity of 360 litres and was covered with $^1/_2$" mesh sized polyethylene netting material to prevent fish from leaping out and predators from eating the fish. The source of water used in the experiment was de-chlorinated bore hole tap water, pump into 10,000 litres capacity overhead tank, allowed to cool over night before filling the experimental tanks through the tap. Growth parameters and nutrient utilization was determined according to the method of (Sotolu and Faturoti, 2008) as follows:

Mean Weight Gain (MWG) = $W_2$–$W_1$

**Where** $W_2$= Final mean weight

$W_1$=Initial mean weight

Percentage weight gain= MWG (g) x 100 ÷ 1MW (g)

Specific growth rate (SGR) = Loge Final weight – Loge initial weight x 100 ÷Culture Period

Daily growth rate (DGR) =Mean increase in weight per day (g) ÷ Mean weight of fish

Feed conversion ratio (FCR) =Weight of dry feed fed (g) ÷ Mean weight gain (g)

Protein intake= Feed intake (g) x % Crude protein ÷100

Protein efficiency ratio (PER) =Mean weight gain (g) ÷Protein consumed (g)

Nitrogen metabolism =0.54 (b-a)h ÷ 2

**Where:** a= initial weight of fish

b= final weight of fish

h= Experimental period in days

0.54= Experimental constant

Condition factor = K=100 ÷ L3

***Analytical technique***

Proximate composition of the water melon seed cake and soybean (Table 1) and experimental diets (Table 2) were analyzed using the methods of AOAC (2000). The gross energy was computed using the equation of Pauzenga (1985). The physico-chemical parameters of the water temperature, pH, dissolved oxygen and ammonia were monitored weekly during the experiment using combined pH and temperature pen meter model pH – 009 (111) to determined pH and temperature, while D. O was determined using pH, conductivity and oxygen meter model EC- 900 and ammonia was determined using the method of Stephen (2009).

***Data collection and analysis***

During the experiment, the entire fish population, that is, 20 in each tank were scooped out and weighed bi-weekly using digital scale weighing model LD-5k02. Growth parameters were also calculated. All experimental data obtained were subjected to one way analysis of variance. Where statistical significant difference were obtained, mean separation was carried out using Duncan's Multiple Range Test (DMRT) at P<0.05% probability level. SAS, 2004 General Linear Model (GLM) was used to computerize the data. Correlation analysis was used to determine the relationship between the different variables.

**Results and Discussion**

Proximate composition of water melon cake and soybean cake is presented in Table 1. The crude protein composition, ether extract and fibre were 41.53%, 7.12% and 5.48% in water melon cake, while those of soybean were 48.23%, 6.13% and 5.46%, respectively. Diet formulation and the bio-chemical analysis of the dried ingredients for the five (5) diets formulated for feeding trial are presented in Table 2. Values for crude protein content ranged between 41.51 to 41.56%, while lipid ranged from 6.60 to 7.29% and crude fibre ranged from 4.36 to 5.32%. The physico-chemical water parameter is given in Table 3.

**Table 1: Proximate composition of water melon seed cake and soybean cake**

| Parameter % | Water melon cake | Soybean cake |
|---|---|---|
| Dry matter | 93.26 | 94.12 |
| Crude protein | 4.53 | 48.23 |
| Lipid | 7.12 | 6.13 |
| Crude fibre | 5.48 | 5.46 |
| Ash | 4.86 | 4.35 |
| Nitrogen Free Extract | 23.14 | 21.64 |
| GE (kcal/kg) | 1089 | 2675 |

GE=Gross energy

**Table 2: Feed ingredients used at different percentage of soybean replacement at 42% for juveniles of *Clarias gariepinus***

| Ingredients | WMC 0% | WMC 25% | WMC 50% | WMC 75% | WMC 100% |
|---|---|---|---|---|---|
| Maize | 31 | 31 | 31 | 31 | 31 |
| Water melon | – | 5 | 10 | 15 | 20 |
| G/nut cake | 23.40 | 23.40 | 23.40 | 23.40 | 23.40 |
| S/bean cake | 21 | 15.75 | 10.50 | 5.25 | – |
| Fish meal | 20 | 20 | 20 | 20 | 20 |
| Oil | 2 | 2 | 2 | 2 | 2 |
| Salt | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 |
| Meth./Cyst. | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 |
| Vit, premix | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| Total | 100 | 100 | 100 | 100 | 100 |

**Table 3: Chemical analysis of formulated 42% water melon cake for *Clarias gariepinus* juveniles**

| Ingredients | WMC 0% | WMC 25% | WMC 50% | WMC 75% | WMC 100% |
|---|---|---|---|---|---|
| Crude protein | 41.56 | 41.53 | 41.51 | 41.50 | 41.51 |
| Lipid | 7.29 | 7.12 | 6.98 | 6.62 | 6.60 |
| Crude fibre | 4.46 | 4.36 | 4.56 | 5.30 | 5.32 |
| Calcium | 1.34 | 1.32 | 1.31 | 2.92 | 2.90 |
| Lysine | 6.72 | 6.87 | 6.87 | 6.89 | 6.88 |
| Meth./Cyst. | 1.61 | 1.67 | 1.69 | 1.69 | 1.69 |
| GE(kcal/kg) | 1934 | 1932 | 1894 | 1796 | 1791 |

GE= Gross energy

There was no significant difference (P>0.05) in temperature of the experimental tanks which ranged from 27.30±0.02 to 8.01±0.02. Similarly, there was no significant difference (P>0.05) in the dissolved oxygen which ranged from 6.70±0.02 to 6.80±0.02, pH values which ranged from 7.60±0.03 to 8.50±0.03 and ammonia values of 0.04±0.06 to 0.05±0.06, respectively. Growth protein efficiency ratio and protein utilization is given in Table 5. From the results, mean final weight (260.20 g), mean weight gain (137.70 g), mean feed intake (374.00 g), mean protein intake (156.47 g), ADWG (2.31 g), percentage weight gain (53.31%), specific growth rate

(2.36 g), feed conversion ratio (1.10 g), protein efficiency ratio (1.62 g), nitrogen metabolism (2284) and condition factor (0.12) of fish fed with commercial feed gave the highest growth Protein Efficiency Ratio and nutrient utilization than all the experimental diets with significant difference (P<0.05). However, growth performance of fish fed with the experimental diet shows that, 25% inclusion level is better than all the other diets with mean weight of (133.10 g), percentage weight gain (53.15%), SGR (2.33 g), FCR (1.12 g) and PER (1.63 g). Statistical analysis shows significant difference (P<0.05) of 25% inclusion level to all the others. Progressive decrease of growth performance and nutrient utilization were obtained with increase of the water melon cake meals. At 25% inclusions, mean weight gain (138.70 g), 50% (89.30 g), 75% (166.00 g) and 100% (140.70 g). The same trend were recorded in FCR and PER, respectively. On the other hand, 100% inclusion level gave the worst growth performance and nutrient utilization. Statistical test shows significant difference (P<0.05) between the 100%, 75%, 50%, 25% and 0% growth and nutrient utilization performances.

**Table 4: Physico-chemical parameters in experimental plastic tanks of *Clarias gariepinus* juveniles**

| Parameters | CF | WMC 0% | WMC 25% | WMC 50% | WMC 75% | WMC 100% | SEM |
|---|---|---|---|---|---|---|---|
| Tem protein efficiency ratioature | 28.30±0.03 | 28.40±0.03 | 27.40±0.03 | 27.55±0.03 | 27.30±0.03 | 27.40±0.03 | ±0.23 |
| D.O. | 6.40±0.24 | 6.36±0.24 | 6.38±0.24 | 6.28±0.24 | 6.26±0.24 | 7.30±0.24 | ±0.21 |
| pH | 7.50±0.10 | 7.42±0.10 | 7.40±0.10 | 7.50±0.10 | 7.36±0.10 | 7.30±0.10 | ±0.03 |
| Ammonia | 0.04±0.20 | 0.04±0.20 | 0.04±0.20 | 0.05±0.20 | 0.04±0.20 | 0.05±0.20 | ±0.01 |

Means with same superscripts along the same row were significantly different (p<0.05); CF= commercial feed

**Table 5: Growth protein efficiency ratioformance of *Clarias gariepinus* juveniles**

| Indices | CF | WMC 0% | WMC 25% | WMC 50% | WMC 75% | WMC 100% | SEM |
|---|---|---|---|---|---|---|---|
| MIW(g) | 50 | 50 | 50 | 50 | 50 | 50 | ±0.00 |
| MFW(g) | $260.12^{a}$ | $240.10^{ac}$ | $250.40^{ab}$ | $189.30^{d}$ | $166.00^{e}$ | $140.70^{f}$ | ±20.15 |
| MWG(g) | $210.12^{a}$ | $190.10^{c}$ | $200.40^{ab}$ | $149.30^{d}$ | $116.00^{e}$ | $140.70^{f}$ | ±15.36 |
| MFI(g) | $274.00^{a}$ | $244.00^{c}$ | $258.00^{b}$ | $172.00^{d}$ | $140.00^{e}$ | $100.00^{f}$ | ±28.94 |
| MPI(g) | $115.10^{a}$ | 102.50c | 108.40b | $72.24^{d}$ | $59.00^{e}$ | $38.18^{f}$ | ±12.58 |
| ADWG(g) | $2.31.^{a}$ | $2.20^{ac}$ | $2.22^{ab}$ | $1.50^{d}$ | $1.45^{e}$ | $1.40^{f}$ | ±0.18 |
| PWG (%) | $53.31^{a}$ | $52.10^{ac}$ | $54.10^{ab}$ | $47.20^{d}$ | $42.00^{e}$ | $38.00^{f}$ | ±2.30 |
| DGR(g) | $0.04^{a}$ | $0.03^{b}$ | $0.04^{a}$ | $0.02^{c}$ | $0.02^{c}$ | $0.01^{d}$ | ±0.01 |
| FCR(g) | $1.10^{f}$ | $1.12^{d}$ | $1.11^{e}$ | $1.28^{c}$ | $1.19^{b}$ | $1.78^{a}$ | ±0.11 |
| SGR | $2.36^{a}$ | 2.30c | 2.33b | 2.13d | 2.03e | 1.19f | ±0.19 |
| PER | $1.67^{a}$ | $1.65^{c}$ | $1.66^{b}$ | $1.65^{d}$ | $1.64^{e}$ | $1.63^{f}$ | ±0.01 |
| NM | $2284^{a}$ | $2138^{c}$ | $2192^{b}$ | $1471^{d}$ | $1433^{e}$ | $1366^{f}$ | ±176 |
| CF | $0.12^{a}$ | $0.09^{c}$ | $0.10^{b}$ | $0.08^{d}$ | $0.07^{e}$ | $0.05^{f}$ | ±0.01 |

Means with the same superscripts along the same row were significantly different (p<0.05); MIW= mean initial weight, MFW = mean final weight, MWG =mean weight gain, MFI= mean feed intake, MPI = mean protein intake, ADWG= average daily weight gain, PWG= Percentage weight gain, DGR= daily growth rate, FCR= feed conversion ratio, PER= protein efficiency ratio, NM= nitrogen metabolism, CF= condition factor and CF= commercial feed.

**Table 6: Carcass composition of *Clarias gariepinus* juveniles**

| Parameters | Ref. Value | CF | WMC 0% | WMC 25% | WMC 50% | WMC 75% | WMC 100% | SEM |
|---|---|---|---|---|---|---|---|---|
| Dry matter | 12.14 | 14.67f | 14.70d | 14.97e | 15.75c | 15.88b | 16.45a | ±0.21 |
| CP | 28.20 | 44.92a | 44.89c | 44.90b | 43.68d | 42.42e | 41.72f | ±2.25 |
| Lipid | 3.40 | 5.56a | 5.35c | 4.47b | 4.29d | 3.26e | 3.26f | ±0.37 |
| Ash | 3.86 | 6.73a | 6.32c | 6.70b | $5.53^{d}$ | 5.52e | 5.53f | ±0.34 |
| Fibre | 2.34 | 2.60f | 2.76d | 2.66e | 2.84c | 2.90b | 2.98a | ±0.08 |
| Moisture | 4.25 | 6.25f | 6.32e | 6.28d | 6.78c | 6.82b | 6.85a | ±0.34 |
| NFE | 8.48 | 11.56a | 11.47c | 11.53b | 11.34d | 10.57e | 10.48f | ±0.42 |

Means with different superscripts along the same row were significantly different (p<0.05); Reference values = FAO/WHO 1990 CP = Crude protein

Growth performance and feed utilization by fish fed at 25% inclusion level decreased steadily as water melon cake meal inclusion increases in the diets. This finding could be due to high fibre content and imbalance of ammonia acids in the diets which could reduced feed intake and consequently retard fish growth as reported by Babalola (2006) on the use of bambara nut meal. Similarly, the results on ADWG, PWG and PER could also be attributed to differences in the WMC meal inclusion which decreased at the increasing level of WMC meal in the diets. The consumption of anti-nutrient factors such as tannins, alkaloid, cyanide, saponins contained in the WMC meal are responsible for slow growth ability of the fish as reported by Abu *et al*. (2010) replacement of maize with cassava root meal. PER, FCR and NM was highest in 100%, 75% and 50%, but did not differ statistically (P<0.05) from values of 0%, 25% and commercial feed. These results seem to have direct link with feed intake. The importance of feed intake by fish as a determinant of growth performance has been emphasized by Amisah *et al*. (2009), Akande (2010) on the link of feed intake to growth performance.

Results of physico-chemical water quality parameter (Table 4) revealed that D.O, pH, temperature and ammonia were within the recommended ranges of Poikilothermic fishes, such as *Clariides* and *Chichlids* as recorded by Stephens (2009) on fish and water quality. The body moisture content in this study (Table 6) is closely related to the weight gain and inversely related to the percentage of body fat content. Fish fed the highest WMC meal of 100%, 75% and 50% inclusions recorded the lowest weight gain, fat, protein, ash and nitrogen metabolism. This showed that, the feed were poorly digested due to imbalance amino acids, such as methionine, cysteine and lysine which boost growth. Similar finding was reported by Barros (2000) on the use of cotton seed meal on the growth performance of channel cat fish.

Generally, fish fed WMC meal at higher inclusion levels had higher fiber, low lipid, moisture and ash content. The increase could be due to poor feed intake which resulted in starvation and in turn led to mobilization of body lipid reserves to meet energy needed for vital body functions. Adewolu (2008) reported a similar result when Tilapia zilli was fed potato leaf meal.

**Conclusion**

The utilization of water melon seed cake for fish feeding gave better growth than soy bean meal hence; it should be encouraged to reduce over dependence on the expensive soy bean meal. This study was carried out with *Clarias gariepinus*, trials using other species will allow for the comparison of result findings.

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