*ARC International Journal of Agribusiness and Agricultural Research*
*ISSN: 2360-9987, Volume 4, Issue 1, (March, 2017) pages 01 – 10*
*www.africaresearchcorps.com*

# Effects of Water Melon (*Citrullus Lanatus*) on Growth Performance of *Oreochromis Niloticus* Fingerlings as a Replacement for Soybean Meal

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***Abstract:*** *This study was designed to evaluate the growth performance of O. niloticus fingerlings fed watermelon seed meal as substitute for soybean meal. Four iso-nitrogenous diets (35% crude protein) were formulated with watermelon seed meal replacing soybeans at 0%, (T1), 50% (T2), 75% (T3), 100% (T4). The 0% diet served as control diet,. Ten fingerlings were randomly allocated treatment and their replicates and fed the experimental diets at 5% body weigh daily for 56days. The mean weight gain and specific growth rate differed significantly between the control diets and test diets. The highest weight gain (15.62g) was recorded in T3 (3.39g and the lowest values were recorded in T4 (12.79g) respectively. Other parameters such as feed intake, condition factor, survival rate were not significantly (P>0.05) different but increased level of WSM in the feed. Nutrient utilization indices with regard to FCR and PER though not significant (>0.05) these parameters showed decreasing trend to level of WSM in the diets. This scenario has been attributed to higher fibre and antinutrient contents of WSM which might have interfered with digestibility of nutrients. No effects was recorded on water quality parameters such as Temperature, Dissolved oxygen and pH. WSM can be included up to 75% in O. niloticus diets so as to reduce high cost soyabean in fish feed production.*

***Keywords****: O. niloticus, Water melon seed, Growth, Soy bean meal*

## INTRODUCTION

Tilapia (O. niloticus) belongs to the family Cichlidea, it is one of the commonly cultured fish species in this part of Nigeria, second to the African catfish (*C. gariepinus*). Its popularity makes it a common name given to anybody involved in Fish Farming around the study area. One of the major factors for the increased popularity is the dwindling catch from the wild and or capture fisheries with each passing day (Gabriel *et a*l., 2007). However, increased cost of feed has continued to be a major setback to this important aspect of Agriculture. Jamiu and Ayinla (2003) stated that feed management determines the viability of aquaculture as it accounts for at least 60 percent of the cost of fish production. Therefore, the establishment of economically viable fish culture ventures requires the incorporation of agricultural wastes or by-products as feed ingredients or direct feed (Shang and Costa-Pierce 1983) to replace conventional feed stuffs whose dwindling supply has resulted into arbitrary hike in prices. Conventional ingredients used in fish feed are in high demand for human consumption and their yield are currently being affected by climate change, hence out of concern for and the implications for food security as well as water and land use, there is urgent need to get local materials especially agricultural by-products of lower price to replace these costly feed materials (Tiamiyu *et al.*, 2014). Agricultural by-products in the tropics are as abundant as there are wide arrays of plants and fruits. Today, more emphasis is been placed on substitution possibility of some of these byproducts whose nutritive values have been ascertained. By-products of banana (Ogunsipe *et al*., 2010; Ekwe *et* *al*., 2011); cashew (Omosulis et al., 2011); Neem seed cake (Hassan et al., 2015) and Cassava leaf meal ( Hassan *et al*., 2017) had already been successfully tested in animal husbandry and fish culture. Cocoa pod husk meal has been shown to replace maize in the diet of cichlid, *O. niloticus* and catfish *Clarias isheriensis* (Fagbenro, 1992). Likewise, plantain peel meal has been shown to replace up to 25% of maize in the diet of *C. gariepinus* without adversely affecting the growth (Falaye and Oloruntuyi, 1998). These are locally available and are not consumed by man in most cases (Ibiyo and Olowosegun, 2004).

Watermelon (*Citrullus lanatus*) seed meal is one of such agricultural by-product whose nutritive potential has not been effectively taped in animal nutrition. Watermelon a creeping annual cash crop which belongs to the family Curcurbitaceae. It grows successfully in the tropics and sub tropics (Mohr, 1989). Watermelon seed is rich in minerals, protein, vitamins, carbohydrate and fibre (khaled, 2001). Watermelon seeds are rich in oil and protein (Mustafa et al., 1972 and Alkhalifa, 1996). Watermelon seed oil proved to be good source of high quality edible oil characterized by low free fatty acid content (Mustafa *et al*., 1972). The experience with watermelon seed cake or meal in rations for animals showed that it is a good source of digestible protein comparable to other oil seed cakes like cottonseed, linseed (Tiamiyu *et al.,* 2014). In this part of Nigeria water melon production is very popular and produced both in rainy and dry season. After, consumption the seeds are usually dumped as waste material. In view of the increasing demand for fish and high cost of conventional feed ingredients and availability of these of the test seed in the study, this experimented was conducted.

## MATERIALS AND METHODS

### Study area

The study was conducted at the research and Teaching Farm of the Department of Fisheries University of Maiduguri, Borno State, Nigerira.

### Experimental fish

The fingerlings of *O. niloticus* for this study were obtained from the Fish hatchery complex of the Fisheries Department, University of Maiduguri. The experiment fish were sorted carefully to obtain homogenous set of fingerlings with a view to reduce experimental errors associated with variation in initial weight of fish before commencement of any growth trial.

### Experimental design

The experiment which lasted for 56 days was carried out in plastic containers measuring 52 x 33.5 x 21 cm (25L). The fingerlings were randomly distributed at a stocking density of 10fish/Tank and each group of fish and their replications were assigned to a particular diet for 56 days. Experimental diets were formulated to contain water melon seed meals as a replacement of Soybean at 0% (T1), 50% (T2), 75% (T3), and 100% (T4) respectively. The o% diet served as control.

### Experimental procedure

After 14 days of acclimatization, the fish were introduced to the experimental diets and by hand at 5% of the cumulative body weight of each container. Daily ration was divided into two feedings per day (08:00 and 16:00) and the fingerlings were weight fortnightly so as to adjust the feed by virtue of weight gained. An electronic digital scale was used to measure weights of fingerlings

**Collection of Feed Ingredients and Formulation of Experimental Diets**;

The feed ingredients used in the feed formulation includes Fish meal, Soybean meal, Maize meal, Vitamin and Mineral premixes were purchased from the Maiduguri Monday market, they were then processed and groud into meal for storage. Water melon seeds were procured from an open market in Maiduguri. The feed ingredients were processed and milled according to method described by Tiamiyu *et al*. (2014). Pearson Square method of feed formulation was adopted to obtain 35% crude protein diet. After the formulation the processed meals were thoroughly mixed with addition of water (500ml/kg) until a dough-like consistency was formed. The dough was immediately pelletized using a hand operated pelleting machine. The pellets were sun dried and kept in an air-tight polythene bags and properly labeled.

**Growth Parameters Determination**

The following indices of growth and nutrient utilization were determined from the data obtained:

- **Specific growth rate (SGR)** were calculated using the formula

$$SGR\% = \left(\frac{lnWf - lnWi}{T}\right) \times 100$$

- **Feed Conversion Ratio (FCR)**
  The Feed Conversion Ratio (FCR) is the amount of food required to produce a unit of fish, or is the grams of feed consumed per gram of body weight gain. FCR was calculated using the formula;
  Feed conversion ratio (FCR) = total feed intake (g)/total wet weight gain (g).
- **The feed conversion efficiency (FCE %)** is the grams of weight gained per gram of feed consumed. It was calculated using the formula
  Feed conversion efficiency (FCE %) = (weight gain by fish (g)/ diet fed (g)) X 100
- **Protein Efficiency Ratio (PER)** is the grams of weight gained per gram of protein consumed. Calculated with the formula below
  Protein Efficiency Ratio (PER) = wet weight gain (g)/total protein fed.
  Where protein fed = [(% protein in diet x total diet consumed) / 100]

- **Relative growth rate (RGR %);**

$$RGR\% = \left(\frac{Wf - Wi}{Wi}\right) \times 100$$

- **Weight gain (WG)** is the final weight of the fish minus the initial weight of the fish, calculated as follows

$$WG = Wf - Wi$$

Where *Wf* refers to the mean final weight,
*Wi* is the mean initial weight of fish and
*T* is the feeding trial period in days.

**Condition factor (Fulton) (*K*)** for all individuals of the fish was calculated using the following formula:

$$K = (W/TL^3) \times 100$$

Where**:**
K – Condition factor (Fulton),
W **–** Body weight in grams,
TL **–** Total length in centimetres.

- **Mortality Rate (%)**

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

- **Survival Rate (%)**

$$S\% = (\frac{Ni}{No}) \times 100$$

Where;

No **–** Total number of fish stocked at the beginning of the experiment

Ni – Total number of fingerlings alive at the end of the experiment

**Proximate Analysis**

Proximate compositions of water melon seed meal, other dietary ingredients, formulated diets, initial and final carcass of fish were determined according to standard methods of AOAC (2000).

**Data Analysis**

The data obtained were analyzed using one way analysis of variance (ANOVA). Duncan's Multiple Range Test was used to rank the mean differences. All analysis was computed using SPSS package version 20.

Table 1: Gross and proximate composition of experimental diets

| | **T1(100:0)** | **T2(50:50)** | **T3(25:75)** | **T4(0:100)** |
|---|---|---|---|---|
| **Fish meal** | 10.00 | 10.00 | 10.00 | 10.00 |
| **Soybean meal** | 65.10 | 32.55 | 16.28 | 0 |
| **Watermelon seed** | 0 | 32.55 | 48.83 | 65.10 |
| **Maize** | 11.70 | 11.70 | 11.70 | 11.70 |
| **Rice bran** | 11.70 | 11.70 | 11.70 | 11.70 |
| **Min/Vit premix** | 1.00 | 1.00 | 1.00 | 1.00 |

| | | | | |
|---|---|---|---|---|
| **Salt** | 0.50 | 0.50 | 0.50 | 0.50 |
| | | **Proximate composition of diet** | | |
| **Moisture** | 8.52 ± 0.01$^{b}$ | 8.37 ± 0.00$^{c}$ | 8.69 ± 0.01$^{a}$ | 8.39 ± 0.02$^{c}$ |
| **Protein** | 35.37 ± 0.00 | 35.75± 0.01 | 34.69 ± 0.01 | 34.73 ± 0.01 |
| **Lipid** | 7.15 ± 0.00$^{c}$ | 8.62 ± 0.02$^{a}$ | 8.64 ± 0.01$^{a}$ | 8.39 ± 0.02$^{b}$ |
| **Ash** | 8.19 ± 0.02$^{b}$ | 7.52 ± 0.01$^{d}$ | 7.92 ± 0.01$^{c}$ | 8.28 ± 0.01$^{a}$ |
| **Fibre** | 4. 19 ± 0.01$^{c}$ | 5.26 ± 0.01$^{a}$ | 5.20 ± 0.01$^{b}$ | 5.10 ± 0.01$^{c}$ |
| **NFE** | 36.17 ± 0.03$^{c}$ | 34.48 ± 0.03$^{b}$ | 34.86 ± 0.00$^{e}$ | 35.11 ± 0.02$^{d}$ |

Mean in the same row with different superscripts differ significantly (P< 0.05)

**KEYS:**

T1 – 100% soybean meal: 0% water melon seed T2 – 75% soybean meal: 25% water melon seed

T3 – 50% soybean meal: 50% water melon seed T4 – 25% soybean meal: 75% water melon seed

## RESULTS AND DISCUSSION

Growth performance and nutrient utilization parameters are presented in Table2. The initial weight of the *O. niloticus* ranged from 2.67-2.78g which did not significantly (P>0.05) differ between experimental treatments and the control. Mean weight gain differed significantly (P<0.05) between treatments and the control diets. The control diet recorded the lowest value (12.79 ± 0.24g) and the highest weight gain (18.48 ± 0.01)was obtained by fish fed 75% Water melon seed meal (wsm) based diet but decreased to 14.± 0.15 at 100% WSM based diet. These may be due to the ability of *O. niloticus* to survive and thrive well in low protein diet probably because it is herbivorous specie. Similar trend was observed for Specific growth rate, Relative growth rate (RGR), Total feed intake, feed utilization efficiency and survival rate. But these parameters were not significantly (P>0.05) between the control and test diets.

Table 2: Mean (± SE) Growth Performance and Nutrient of *O. niloticus* fed with varying replacement level of Soyabean meal with water melon

| **Parameters** | **Inclusions level of water melon seed meal (%)** | | | |
|---|---|---|---|---|
| | **0** | **50** | **75** | **100** |
| **Initial Weight (g)** | 2.78 ± 0.13$^{a}$ | 2.67 ± 0.10$^{a}$ | 2.77 ± 0.05$^{a}$ | 2.75 ± 0.07$^{a}$ |
| **Final Weight (g)** | 15.57 ± 0.13$^{b}$ | 15.54 ± 0.34$^{b}$ | 18.48 ± 0.01$^{a}$ | 17.31± 0.22$^{ab}$ |

| | | | | |
|---|---|---|---|---|
| **Weight gain (g)** | 12.79 ± 0.24 $^{b}$ | 12.87±0.29 $^{b}$ | 15.62 ± 0.06$^{a}$ | 14.± 0.15$^{ab}$ |
| **Initial length (cm)** | 3.00 ± 0.05$^{a}$ | 3.00 ± 0.17$^{a}$ | 3.60 ± 0.10$^{a}$ | 3.06 ± 0.33$^{a}$ |
| **Final length (cm)** | 5.83 ± 0.49 $^{a}$ | 6.50 ± 0.05 $^{a}$ | 6.90 ± 0.23$^{a}$ | 5.76 ± 0.24 $^{a}$ |
| **Length gain (cm)** | 2.83 ± 0.43 $^{a}$ | 2.50 ± 0.20 $^{a}$ | 3.30 ± 0.32$^{a}$ | 2.70 ± 0.25 $^{a}$ |
| **Total feed consumed** | 2.55 ± 0.17$^{ab}$ | 2.26 ± 0.19$^{b}$ | 2.96 ± 0.08$^{a}$ | 2.77 ± 0.05$^{a}$ |
| **Specific Growth Rate (%)** | 2.23 ± 0.23$^{b}$ | 2.32 ± 0.18 $^{b}$ | 2.85 ± 0.07$^{a}$ | 2.65 ± 0.04$^{ab}$ |
| **Feed Conversion Ratio** | 1.14 ± 0.18$^{a}$ | 1.92 ± 0.03$^{a}$ | 1.87 ± 0.03$^{a}$ | 1.92 ± 0.04$^{a}$ |
| **Feed Conversion Efficiency (%)** | 92.26±14.99$^{a}$ | 108.66±4.38$^{a}$ | 114.60±4.61$^{a}$ | 109.80±5.15$^{a}$ |
| **Protein Efficiency Ratio** | 2.10 ± 0.43$^{a}$ | 2.09 ± 0.47$^{a}$ | 1.27 ± 0.01$^{a}$ | 1.24 ± 0.01$^{a}$ |
| **ANPU** | 0.47 ± 0.00$^{b}$ | 0.32 ± 0.00$^{c}$ | 0.28 ± 0.00$^{d}$ | 0.17 ± 0.00$^{e}$ |
| **Condition Factor (K)** | 0.56 ± 0.09$^{a}$ | 0.60 ± 0.04$^{a}$ | 0.64 ± 0.04$^{a}$ | 0.67 ± 0.09$^{a}$ |
| **Survival Rate (%)** | 93.33±3.33$^{a}$ | 93.33±3.33$^{a}$ | 100.00±0.00$^{a}$ | 93.33±3.33$^{a}$ |

* Values in each row allocated common superscripts or without superscripts are not significantly different from each other (P > 0.05).

However, FCR, PER and NPU decreased with increasing level of WSM in the diets. But no significant differences were computed in these parameters as presented in Table 1 above. Since there was no significant differences in the protein content of the diet, differences in performance of experimental fish may be linked to superiority of protein quality of watermelon which increased as level of replacement increases up to 75% and decreased thereafter at 100% level of replacement. The Characteristic feed utilization efficiencies and consequent growth rates has earlier been reported and attributed to dietary protein quality by Cai *et al.* (2004), Sotolu & Faturoti, (2008), Antinutritional factors in watermelon seed may also be implicated as possible cause of reduction in growth in 100% replacement diet.. Olubamiwa *et al*. (2000) had earlier stated that watermelon seeds possess chemical compounds such as alkaloids, lectins and phenolic compounds such as lactones, tannins and flavonoids which probably function in the protection of seeds from microbial degradation until conditions are favourable for germination (Cai *et al*., 2004; Komutarin *et al*., 2004). These compounds might have led to prevention of digestion in the gut of the fish at level of replacement. Previous authors (Tuleun *et al.* 2009) stated that the wide use of legume as feedstuff alternatives have been largely limited by the presence of antinutritional factor like trypsin inhibitors tannins and cyanide. Fakunle *et al* (2013) also reported that that toxic component or anti-nutritional factors in most agricultural by-products may cause irritation of digestive tract which is capable of decreasing feed intake and growth. Hence inclusion beyond the tolerable level of the fish leads to adverse growth consequences.

Many other authors have similarly reported varied replacement level of about 50% (Babatunde *et al*. 2001, Falaye *et al.* 1999), 60% (Olubamiwa *et al*. 2000) and 100% (Tiamiyu *et al*., 2014) of waste and by-products with conventional once, with commendable successes. It can be correctly inferred then that replacement of convention feeds by alternate sources of plant and animal origin, depends on the nature and composition of the unconventional feedstuffs, inclusion levels, anti-nutritional factor of feed ingredients, method of processing and the tolerance levels of the experimental fish species.

Another possible reason for the reduced growth, feed intake, protein efficiency ratio and increased feed conversion ratio may be due high fibre content of WSM which could affects digestibility of nutrient in the elementary system. This in line with the views of Falaye *et al*. (1999) who reported a lower digestibility coefficient with increased cocoa husk in the diets and linked observations to elevated crude fibre resulting from the complex polysaccharides of the husk. Similarly, Fagbenro (1992) associated the digestibility in *C. Isheriensis* fed cocoa husk rations with cellulose activity in the fish gut. Gatlin (2010) indicated that cellulose and other fibrous carbohydrate are found in the structural component of plant and are indigestible to monogastric animals including fish. Oladunjoye *et al.* (2005) furthermore stated that high fibre content could be responsible for growth depression. However the result of the present study show that *Clarias gariepinus* cannot tolerate inclusion levels beyond 75% and fiber content beyond 5% as negate the recommendations of Sawaya *et al*. (1986) who stated that watermelon seed should not be included at levels higher than 20%, because these levels brings up the fiber content of the ration over 10%, which reduce feed intake.

Despite the significant effect observed in growth, survival of the fish fed the different diet were not affected, Basavarajah and Anthony (1997) had reported a survival rate of 98% for common carp fry fed conventional feed and 100% for fry fed supplementary feed for a 35 days feeding trial. Similarly Singh and Goswami (1996) pointed out that 100% survival rate of carp can be achieved under very minimal stress and well fed condition, survival likely depend strongly on tolerance level of different fish species to the nature and level of anti-nutritional factor in the feedstuff. Carcass composition of the fish fed the experimental diets were higher in values than the those recorded in the start of the study, protein retention was higher for the control and T2 suggesting that the protein to energy ratio used in the feed was at the right level and as a result, there was no sparing of protein for energy. The lipid content increase in this study is likely due to the fact that both soybeans and watermelon seeds are oil seeds (Mustafa *et al*., 1972), Abbas (2007) and Manjappa *et al*, (2011) opined that better nutrients utilization in fish carcass fed high lipids diets is related to both the dietary protein level and availability of non-protein energy sources.

## CONCLUSIONS

In conclusion the Superiority of protein in soybean as well as anti-nutritional factor present in the raw watermelon seed meal and high fiber contents of diet are envisaged as reasons for better performance of diet with no or lesser water melon meal inclusion. Lesser water melon inclusion is sufficient for effective growth and nutrient utilization under the experimental condition carried out in this study. It is therefore, means that there is further room for fish farming to become even more productive without compromising the environmental or welfare standards.

**RECOMMENDATION**

Based on results of this study, there is need investigate the decreasing trend recorded at 100% level of replacement. This is to establish optimum replacement levels of WSM FOR SBM at levels above 70% levels of replacement. Different processing methods and their effect on nutrient composition and growth performance of *O. niloticus* should be carried out.

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