



## **Growth and Survival of Nile Tilapia (*Oreochromis niloticus*, Linnaeus 1758) Fry Fed at Different Inclusion Levels of Wonderful Kola (*Buchholzia coriacea*) Seed Meal (BSM)**

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### **Authors' contributions**

*This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.*

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### **ABSTRACT**

The effect of different inclusion levels of wonderful kola (*Buchholzia coriacea*) seed meal (BSM) on growth performance and survival rate of *Oreochromis niloticus* fry was investigated. Five days old mixed sex of *O. niloticus* (0.1– 0.2 g weight and 0.45 mm length) were subjected to powdered *B. coriacea* seeds meal (BSM) at 0, 2, 4, 6, 8 and 10 g/kg twice daily for 1 month from April-May, 2015. It was conducted in an indoor experimental plastic basin of capacity 50 cm in diameter and 30 cm deep. 60 fry per duplicates with a total of 720 fry, six isonitrogenous treatments and 2 duplicates per each treatment. A complete randomized design and 30% Crude Protein were used. The highest mean length, mean weight, specific growth rate and weight gain observed are 0.488 mm, 4.68 g, 0.85 and 4.65 g respectively. The highest of survival rate (100%) was recorded in fish fed with 6 g/ kg BSM. Treatment 1 having 0% BSM (control) had the lowest weight gain. In conclusion, the addition of 4 g/ kg of BSM in a fish diet, has no negative effect on the growth performance and survival of *O. niloticus*.

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**Keywords:** *Buchholzia coriacea*; *O. niloticus*; growth; survival.

## 1. INTRODUCTION

Tilapia is a common name used for a variety of Cichlid fish of the genera *Oreochromis*, *Sarotherodon*, and *Tilapia* [1]. Nile tilapia (*Oreochromis niloticus*) is an important tropical food fish that readily takes prepared feeds from the fry stage to adult size. Food quantity and quality have been identified as critical factors for larval fish growth performance [2]. Regardless to the food quantity, there are several feeding strategies commonly applied in fish larval growth trails. It is recommended that fry be fed *ad libitum* or to apparent satiation, so that all fish have adequate access to feed [3]. These feeding techniques are widely used for rearing tilapia fry during the first month of exogenous feeding, which represent the culture time when hormonal sex-reversal treatment is applied [4,5].

*Oreochromis niloticus* tilapia culture is the second largest aquaculture system in use worldwide and is mostly done using semi-intensive systems in developing countries [6]. Several characteristics distinguish the above genera, but possibly the most critical relates to reproductive behavior [7]. All tilapia species are nest builders; fertilized eggs are guarded in the nest by the parents [8]. As in most fish culture systems, balanced feed is one of the most significant inputs in tilapia culture, and accounts for 30 to 60% of production costs [9,10]. Tilapia are also among the easiest and profitable fish being farmed, this is because they exhibit some desirable qualities of cultured fish species such as high fecundity rate, tolerance to a wide variety of water conditions even marine conditions [11]. Once introduced into that habitat, they generally establish themselves very quickly. They have tolerance to high stocking densities along with high growth rate [11].

*Buchholzia coriacea* (which is known also as "wonderful kola") belongs to the Capparaceae family and it has been used for decades by many traditions for medicinal purposes [12]. *B. coriacea* was named after R. W Buchholz who collected plants in Cameroon in the late 19th century [13]. Locally, its common names includes 'essenbossi' (Central Africa), 'uke' (Igbo), 'owi' (Edo) and 'uworo' (Yoruba). *B. coriacea* plant parts (e.g. leaves, roots, seeds and stem) are used traditionally in the form of concoctions for the treatment of various ailments caused by pathogenic microorganisms including fever,

malaria, menstrual and gastrointestinal infections and also known to increase sex hormone of male. These seed gave it its common name (wonderful kola) because of its usage in traditional medicine. Phytochemical, antispasmodic and antidiarrhoeal properties of the methanolic extract of the leaves of *B. coriacea* has been reported by Anowi et al. [14].

The rapid increase in high cost of protein based fish feed ingredients in the market is of great concern to fish farmers. Fish farmers are not aware of the protein content (12.04%) of *B. coriacea* for utilization as fish feed ingredient [14]. *B. coriacea* as a source of additional protein in fish feed will help poor farmers to cut down high cost of dietary protein sources by incorporating it as a protein source in fish feed. There is the need therefore, to explore the use of non-conventional feed source that have the capacity to yield the same output as conventional feedstuffs and perhaps at a cheaper cost. The limited studies on the effects and usage of the plant seeds as feed ingredient are breakthroughs towards investigation of its possibilities and viability as a feed source. The essential nutrient contents of *B. coriacea* seed such as Vitamin A & B-vitamins, calcium, iron, copper, sulfur and protein and its ability to absorb and neutralize toxic elements in food could justify its significance in developing the plant as one of the major local feed stuffs by Anowi et al. [14]. This study is therefore to assess the efficacy of *B. coriacea* Seed Meal (BSM) on growth and survival of *O. niloticus*.

## 2. MATERIALS AND METHODS

### 2.1 Study Area

The study was carried out in fish nutrition complex of the Department of Fisheries, University of Maiduguri, Nigeria. Which is located at latitudes 10° 43'N and 10° 14'N, Longitude 10° 15'E and 13° 17'E. It occupies a total landmass of 50,778sq km [15].

### 2.2 Ingredient Collection and Preparation

Ingredients includes; *B. coriacea* seeds, soya beans, wheat bran, fish meal were procured alongside with minerals and vitamins from a local market in Maiduguri. The feedstuffs were separately milled except *B. coriacea* seeds which

**Table 1. Feed composition of the experimental diet**

Ingredients (%)	<i>B. coriacea</i> inclusion level (g/kg) (Treatments)					
	0	2	4	6	8	10
Wheat Bran	45.36	45.36	45.36	45.36	45.36	45.36
Fish Meal	21.67	21.67	21.67	21.67	21.67	21.67
Soya Bean	21.67	21.67	21.67	21.67	21.67	21.67
Premix	0.3	0.3	0.3	0.3	0.3	0.3
Vitamin C	0.05	0.05	0.05	0.05	0.05	0.05
Salt	0.3	0.3	0.3	0.3	0.3	0.3
Methionine	0.35	0.35	0.35	0.35	0.35	0.35
Lysine	0.3	0.3	0.3	0.3	0.3	0.3
Starch	10	8	6	4	2	0
<i>B. coriacea</i>	0	2	4	6	8	10
Total	100	100	100	100	100	100

were soaked in water for 24hours to remove contaminants, the seeds were then air dried, milled and store in a cold dry place until required and soyabeans was toasted before milling. 30% CP diet was formulated using the pearson square method. The milled *B. coriacea* seeds were included at doses 0 g (treatment 1), 2 g (treatment 2), 4 g (treatment 3), 6 g (treatment 4), 8 g (treatment 5), 10 g (treatment 6) per 1000 g local fish feed. Nutrient in-balance caused by the addition of (BSM) was corrected by adding 10,8,6,4,2 and 0 g/kg of starch (non-nutritive ingredient) to all the treatments as a binder sequentially from 0 to 10 g/kg.

### 2.3 Experimental Fish

Seven hundred and twenty (720) 5 days old *O. niloticus* fry were procured from a local fish farmer in Maiduguri, Nigeria.

### 2.4 Experimental Design

Sixty (60),5 days old fry (0.1 – 0.3 g and 4-5 mm length) were stocked in 30 litres capacity trough in duplicates with a total of 6 treatments in a complete randomized design. The fry were fed with *B. coriacea* included at 0 g (Treatment 1), 2 g (Treatment 2), 4 g (Treatment 3), 6 g (Treatment 4), 8 g (Treatment 5), 10 g (Treatment 6) per kg fish feed for 1 month indoor, they were fed twice per day *ad-libitum*. Uneaten feed were siphoned every morning before feeding and the water temperature level was maintained. Sampling of the cultured fish was carried out bi-weekly for a period of 30 days for the collection of data to determine the variation among the treatments. Throughout the entire culture, period different water quality parameters like temperature, dissolved oxygen and pH were regularly monitored.

### 2.5 Proximate Analysis of Diets

Triplicate sample of each experimental diet was analyzed for proximate composition using the AOAC [15] standard.

### 2.6 Statistics Analysis

Data obtained from the experiment were subjected to one way analysis of variance (ANOVA). Means between the treatments were determined using the least significance difference (LSD) with the aid of statistics 8.0.

## 3. RESULTS

### 3.1 Growth and Survival Performances of *O. niloticus* Fry Fed with Different Levels of *Buchholzia coriacea*

Table 2 shows the effect of *B. coriacea* seeds based meal on growth performance of *O. niloticus*. The highest final weight ( $4.68 \pm 0.7$  g) was obtained in fry fed with 4 g/kg *B. coriacea* seed meal (BSM), followed by fry fed with 10, 8, 6, 2, 0 g/ kg BSM having a final weight of 4.00, 3.60, 3.60, 3.41 and 3.20 g respectively. There were significance differences ( $P < .05$ ) between the weight gain values of fish fed at 4 g/kg compared to the entire treatments. The highest weight gained ( $4.65 \pm 0.77$  g) was recorded in fry fed with 4 g/ kg BSM, fry fed with 6, 8, and 10 had the same weight gained value and the lowest value ( $3.24 \pm 0.56$  g) was recorded on the control. The final mean length (0.48 mm) was recorded in fry fed with 4 g/ kg BSM followed by 0.46mm mean length obtained in fry fed with 10 g/ kg BSM. The lowest (0.38 mm) was obtained in fry fed with 2 g/ kg BSM. There was no significance difference ( $P > .05$ ) in final mean length among the entire treatments (Table 2).

Survival rate was observed to be higher (100%) in fry fed with 0 g/ kg, 2 g/ kg and 6 g/kg BSM. The lowest survival rates (95.83%, 94.16% and 94.16%) was observed in fry fed with 8, 4, 10 g/kg BSM respectively. There was no significance difference ( $P>0.05$ ) in survival rate among the entire treatments (Table 2).

The highest specific growth rate(0.85 g) was observed in fry fed with 4 g/ kg BSM and the lowest specific growth rate (0.62 g) was observed in the control (0 g/ kg BSM). There were significance difference ( $P<0.05$ ) in mean weight gain among the entire treatments (as shown in Table 2).

### 3.2 Proximate Composition of the Six Diets Formulated with Different Levels of *B. coriacea* for *O. niloticus* Fry

The proximate composition of the six diets formulated is presented in Table 3. Slight variation occurred in the crude protein and this may be due to the differences in the by- product composition. The crude protein content of the diet ranged between 21-27%, fat ranged between 8.5-9.5%, crude fibre ranged between 12-16%, moisture content ranged from 2-6%, ash content is 2% for the entire treatments.

## 4. DISCUSSION

Feed supply influences the growth of fish [16], but it turns more critical for the early larval

stages since its metabolic requirements vary rapidly with time. BSM have been successfully used in this experiment to rear *O. niloticus* fry. As a part of a general tilapia culture project, the use of BSM as dietary complement of *O. niloticus* larvae during the first month of exogenous feeding, demonstrated that the inclusion of at least 4 g of *B. coriacea* seeds meal in 1kg feed, improved the growth performance of the fish. There was increase in growth among all the fish that fed with BSM compared to the control.

Garcia-Ulloa and Hernández-Garciabada [17] observed that after the first 30 culture days, growth of *O. niloticus* larvae fed with decapsulated artemia cysts increased. They obtained mean weight values that fluctuated from 0.06 to 0.38 g. This is however lower than 3.41 to 4.68 g obtained from this study. In another experiment [18], fed *O. mossambicus* fry at an initial rate from day 1 to day 21. After the first month of feeding with prepared peninsula, mean weight value was below 0.5 g. Belal and Al-Jasser [19] worked with *O. mossambicus* larvae (18.5 mg initial weight) fed them at 30% of total biomass/d in the first culture week, thereafter, it was gradually reduced from 20 to 10% BW/d in the following 5 weeks. In that case, the final individual weight was 0.958 g after 42 culture days. The above results are lower than that obtained from this study. Variation might be due to variation in species and diets.

**Table 2. Mean ( $\pm$ SEM) growth and survival of *O. niloticus* treated with *B. coriacea* seeds based meal reared for 30 days indoor**

Growth indices	<i>B. coriacea</i> inclusion level (g/kg)					
	0	2	4	6	8	10
Initial mean length (mm)	0.045 $\pm$ 0.29	0.045 $\pm$ 0.29	0.045 $\pm$ 0.29	0.043 $\pm$ 0.027	0.043 $\pm$ 0.27	0.045 $\pm$ 0.3
Final mean length (mm)	0.39 $\pm$ 0.28 <sup>a</sup>	0.38 $\pm$ 0.27 <sup>a</sup>	0.48 $\pm$ 0.27 <sup>a</sup>	0.35 $\pm$ 0.85 <sup>a</sup>	0.34 $\pm$ 0.85 <sup>a</sup>	0.46 $\pm$ 0.60 <sup>a</sup>
Initial mean weight (g)	0.15 $\pm$ 0.05 <sup>a</sup>	0.20 $\pm$ 0.10 <sup>a</sup>	0.15 $\pm$ 0.80 <sup>a</sup>	0.19 $\pm$ 0.50 <sup>a</sup>	0.20 $\pm$ 0.00 <sup>a</sup>	0.15 $\pm$ 0.05 <sup>a</sup>
Final mean weight (g)	3.20 $\pm$ 0.56 <sup>ab</sup>	3.41 $\pm$ 0.37 <sup>ab</sup>	4.68 $\pm$ 0.76 <sup>a</sup>	3.60 $\pm$ 0.76 <sup>b</sup>	3.60 $\pm$ 0.4 <sup>ab</sup>	4.00 $\pm$ 0.4 <sup>ab</sup>
Specific growth rate (%/day)	0.62 $\pm$ 0.40 <sup>a</sup>	0.80 $\pm$ 0.33 <sup>a</sup>	0.85 $\pm$ 0.14 <sup>a</sup>	0.75 $\pm$ 0.14 <sup>a</sup>	0.75 $\pm$ 0.05 <sup>a</sup>	0.70 $\pm$ 0.35 <sup>a</sup>
Weight gain (g)	3.24 $\pm$ 0.56 <sup>ab</sup>	3.37 $\pm$ 0.39 <sup>ab</sup>	4.65 $\pm$ 0.77 <sup>a</sup>	3.75 $\pm$ 0.77 <sup>b</sup>	3.75 $\pm$ 0.2 <sup>ab</sup>	3.75 $\pm$ 0.2 <sup>ab</sup>
Survival rate (%)	100 $\pm$ 0.00 <sup>a</sup>	100 $\pm$ 0.00 <sup>a</sup>	94.16 $\pm$ 2.50 <sup>a</sup>	100 $\pm$ 0.00 <sup>a</sup>	95.83 $\pm$ 4.17 <sup>a</sup>	95.83 $\pm$ 4.17 <sup>a</sup>

\*means with the same superscript are not significantly different ( $P>0.05$ )

**Table 3. Proximate composition of the experimental diet**

Proximate composition (%)	<i>B. coriacea</i> inclusion level (g/kg)					
	0	2	4	6	8	10
Moisture	2.0 $\pm$ 0.00	3.5 $\pm$ 2.50	6.0 $\pm$ 1.00	2.50 $\pm$ 0.05	2.00 $\pm$ 1.00	1.50 $\pm$ 0.70
Crude protein	21.00 $\pm$ 1.00	23.98 $\pm$ 0.87	27.04 $\pm$ 0.43	25.39 $\pm$ 1.39	23.00 $\pm$ 1.00	25.12 $\pm$ 0.79
Fat	8.50 $\pm$ 0.50	8.50 $\pm$ 0.50	8.50 $\pm$ 0.50	8.50 $\pm$ 0.50	9.0 $\pm$ 1.00	9.50 $\pm$ 0.5
Fibre	16.00 $\pm$ 1.0	15.00 $\pm$ 1.0	12.00 $\pm$ 1.0	14.00 $\pm$ 1.00	14.50 $\pm$ 1.50	12.00 $\pm$ 1.00
Ash	2.00 $\pm$ 0.00	2.00 $\pm$ 0.00	2.00 $\pm$ 0.00	2.00 $\pm$ 0.00	2.00 $\pm$ 0.00	2.00 $\pm$ 0.00

Commonly, mean commercial weight of tilapia fry after the first 30 days of exogenous feeding, including and hormone treatment in the diet, vary from 0.2 to 1.0 g [20-24]. Working with blue tilapia (*O. aureus*, Steindachner) fry, this result does not agree with [25] who reported that the survival rate of *O. niloticus* varied from 60 to 80%. But the result in this present study is also higher (94 – 100%) than the research findings of Kohinoor et al. [26] who observed that the survival rate of monosex tilapia varied from 79 – 92%.

There are few reports rearing tilapia fry with high quality dietary items [27,28,29]. But again, due to differences in diets, culture conditions, culture techniques, species and fish age at the beginning of the studies, our results might not be properly compared with the above mentioned works.

## 5. CONCLUSION

Wonderful kola (*Buchholzia coriacea*) seed meal (BSM) is a proteinous plant. There is a significant difference between fry fed with BSM meal and the control. More studies should be conducted on the efficacy of BSM from fingerlings stage to adult stage to ascertain the accurate utilization of BSM in aquaculture.

## ETHICAL APPROVAL

As per international standard or university standard written ethical permission has been collected and preserved by the authors.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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