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GROWTH PERFORMANCE OF *HETEROBRANCHUS BIDORSALIS* FINGERLINGS FED SOYBEAN SEED MEAL SUBSTITUTED WITH WATERMELON SEED MEAL

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Abstract

The study on growth performance of Heterobranchus bidorsalis fingerlings, fed watermelon seed meal as substitute for soybean seed meal was conducted. Five diets were formulated to substitute soybean seed meal at (0%)$T_{0,}$ (25%), T_1, (50%) T2, (75%) T_3 and (100%) $T_{4\ inclusion}$. T_0 (control) had no watermelon seed meal. Growth and feed utilization of 150 fingerlings of mean weight 2.95±0.04g were investigated. Ten (10) fingerlings were randomly stocked in plastic containers with 25 litres water each in five treatments in three replicates which were carefully sorted out to reduce experimental errors and were acclimatized for two weeks. Feeding was done at 9.00am and 5.00pm daily at 3% body weight per day for 70 days, adjusted bi-weekly by virtue of weight gained. Water quality parameters such as Temperature, Dissolved Oxygen, pH and Ammonia were monitored and maintained at acceptable level. Mean weight gained8.77 ±0.13g,percentage mean weight gain 299.04± 5.81%, specific growth rate 1.98±0.02and protein efficiency ratio0.008±.01 were significantly higher in fish fed T_1(25%), while T_4(100%) had lowest weight gain 6.8351g.. The feed conversion ratio 0.96±0.03 of treatment T_1 is significantly better than other treatments in the study. Survival rate 93.33±5.77and condition factor 1.67±0.01 were significantly higher in T_1 (25%) inclusion of water melon seed meal. The use of watermelon seed meal as supplementary feed for Heterobranchus bidorsalis fingerlings is highly recommended at 25% inclusion.

Keywords: Watermelon meal, H. bidorsalis, growth, feed utilization

Introduction

Heterobranchus bidorsalis belongs to the family *Clariidae*, the air breathing catfishes. It is one of the commonly cultured fish species in North Central of States of Nigeria. The *H. bidorsalis* is a highly economic species that perform better than other species in the family *Clariidae*. It performs well in captivity by attaining maturity in 10-12 months of domestication but 2 - 3 years in the wild (Adebayo and Fagbenro, 2004). Intensive aquaculture is limited due to constraints in getting its seed from natural waters that are uneconomical and unrealistic (Adebayo and Olanrewaju, 2000; Adebayo and Fagbenro, 2004). The species has limited availability as well as breeding constraints of longer time sexual maturity and short breeding period, which is at the peak of rainy season. The species does not breed in ponds but fingerlings are sourced at the bank of large rivers (Adebayo and Olanrewaju, 2000; Adebayo and Fagbenro, 2004).Also, high cost of feeds has been identified as the major challenge catfish farming business face in Nigeria (Odinaka 2016). Conventional ingredients used in fish feed are in high demand for human consumption and their yield are currently being affected by climate change. The implications in food security as well as water and land use, urgent need local materials especially agricultural by-products of lower price to replace instead costly feed materials. Agricultural by-products in the tropics are abundant as there are wide arrays of plants and fruits. Today, more emphasis is being placed on substitution possibility of some of these by-products whose nutritive values has been ascertained. By-products of banana had already been successfully tested in animal production (Ogunsipe *et al.,* 2010; Ekwe *et al*., 2011). 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). There are locally available ingredients that are not consumed by man in Nigeria (Ibiyo and Olowosegun, 2004). Watermelon (*Citrulluslanatus*) seed meal is one of such agricultural by-product which is not consumed by man and whose nutritive potential has not been effectively utilized in animal nutrition. Watermelon is a creeping annual cash crop which belongs to the family curcurbitaceae. Watermelon seed is rich in minerals, protein, vitamins, carbohydrate and fibre (Tarek and Khaled, 2001). After consumption of its fibre, the seeds of watermelon are usually dumped as waste materials. Therefore, the work was aimed at substituting Soya bean, seed meal in diet of *H.bidorsalis* with watermelon seed meal.

Materials and Methods

Study Area

The study was conducted at laboratory II of Zoology Department, Nasarawa State University, Keffi.

Experimental Fish

One hundred and fifty fingerlings of *Heterobranchus bidorsalis* of mean weight 2.95± 0.04 g were obtained from a reputable farm in Abuja. The experimental 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 growth trial.

Experimental Design

The experiment which lasted 70 days was carried out in plastic containers measuring 52 x 33.5 x 21.cm with 25 litres of water. The fingerlings were randomly distributed at a stocking density of 10 fish per container in triplicate per treatment, and each treatment and their replicates assigned to a particular diet for 10 weeks. Experimental diets contained watermelon seed meals as a replacement of soybean at T_0 (0%), T_1 (25%), T_2 (50%), T_3 (75%) and T_4 (100) respectively. The T_0 (0%) diet served as control.

Experimental Procedure

After 14 day of acclimatization, the fish were introduced to experimental diets and fed at 3% of their body weight twice daily at 9.00am and 5:00pm (Madu and Aliko 2001). The fingerlings were weighed bi-weekly with Digital Scale so as to adjust the feed by virtue of weight gained. Water quality parameters such as Dissolved Oxygen, Hydrogen ion concentration, Water temperature and ammonia were monitored throughout the 70 days of feeding trials

Collection of feed ingredients and formulation of Experimental Diets

The feed ingredients used in the feed formulation include fish meal, maize meal, groundnut cake meal, lysine, bone meal, cassava flour, salt, vitamin premix and methionine. These were purchased from reputable feed mill at Karu L.G.A, Nasarawa State. Watermelon and soybean seeds were purchased from Orange Market Mararaba. The feed ingredients were processed and milled. Winfeed method of feed formulation was adopted. All the ingredients used in the formulation were constant except watermelon seed meal that was made to substitute soybean seed meal at percentage basis as shown Table 1. After the formulation, the processed fish feed ingredients were thoroughly mixed with addition of water (75cl) until a dough-like consistency was formed. The dough was immediately pelletized using a hand operated pelleting machine with a mat mince diameter of 2mm to produce strands of feed. The pellets were sun-dried, kept in polythene bags and properly labelled. Moisture contents, crude fibre, lipids, crude protein and ash of each diet (Table 2) were determined using the method described by AOAC (2016).

Table 1: Gross composition of the experimental diets

Ingredients	**T_0 (0%)**	**T_1 (25%)**	**T_2(50%**	**T_3 (75%)**	**T_4(100%)**
Fish Meal	16.33	16.33	16.33	16.33	16.33
Lysine	1	1	1	1	1
Methionine	1	1	1	1	1
Maize Floor	7	7	7	7	7
Groundnut Cake Meal	37	37	37	37	37
Soybean Seed Meal	30	22.5	15	7.5	0
Watermelon Seed Meal	0	7.5	15	22.5	30
Cassava Floor	6.5	6.5	6.5	6.5	6.5
Salt	0.333	0.333	0.333	0.333	0.333
Vitamin Premise	0.167	0.167	0.167	0.167	0.167
Bone Meal	0.67	0.67	0.67	0.67	0.67
Total	100	100	100	100	100

Analysis of Growth and Feed Utilization

Weight gain was calculated as the difference between the initial and final body weight of fish.
Percentage mean weight gain was determined as described according to Wannigama *et al.*(1985).
% mean weight gain = (W2 – W1/W1) x100
Where W1= initial weight, W2 = final weight of experimental fish
Specific growth rate was determined as described by brown (1957)

$$SGR = \frac{\text{Log wf} - \log w_i}{T} \times 100$$

Where Wf = Final Mean Weight
W_i = Initial Mean Weight
T = Culture Period
Feed intake was determined by the difference between the feed supplied and left over.

$F_1 = W_0 - W_1$

Where W_0 = weight of feed supplied
W_1 = the left over feed

Feed Conversion Ratio: The Feed Conversion Ratio (FCR) is the amount of unit weight of food that the fish were able to convert into a unit muscle or grams of feed consumed per gram of body weight gain.

$$FCR = \frac{\text{Feed intake (g)}}{\text{Total weight gain (g)}}$$ according to (Utne, 1979)

Feed Efficiency (F.E)
This is simply the reciprocal of the feed conversion ratio (FCR)

$$\text{Feed efficiency} = \frac{1}{FCR} \times 100$$

Condition Factor (k): This is the state of well-being of the fish. It was determined as described by larger, (1956), Fulton, (1902).

$K = \frac{W}{L^3} \times 100$ where: K = Condition Factor
W = Body weight in gram
L= Total length in centimetres

Survival Rate (%) $= \frac{Ni}{N0} \times 100$ according to (Alatise and Otubusin, 2006)
Where: N_0 = Total number of fish stocked at the beginning of the experiment
Ni = Total number of fish alive at the end of the experiment

Protein Efficiency Ratio (PER) is mean weight gain (g) per average protein fed, where average protein fed = feed intake x% crude protein of feed (Agbebi *et. al.,* 2012).

Data obtained were statistically analysed by employing the analysis of variance (ANOVA) at 5% level of significance.

Results and Discussion

The physicochemical parameters of water were monitored and maintained within suitable range for culture of tropical fish like *H. bidorsalis*. The mean values of physico-chemical parameters of water are present in Table 2. The highest mean temperature was recorded in T_2(27.60°C) and the least recorded in T_1(27.30°C). The highest mean of dissolved oxygen was recorded in T_1(6.75mg/l) while the least was T_4(5.90mg/l). Also, the highest mean value of PH was recorded in T_1(7.25%), while the least was recorded in T_4(6.85). The highest mean value of ammonia was recorded in T_3(0.12mg/l) and T_4(0.12mg/l) while the least was recorded in T_2(0.10mg/l).

Table 2: Mean Values of Water Quality Parameters Recorded during the Feeding Trial

Parameters	Temperature (^{0}c)	Dissolved Oxygen (Mg/l)	pH	Ammonia (Mg/l)
T_0	27.50±0.70	6.20±0.30	7.10±0.0^{bc}	0.11±0.01
T_1	27.30±0.80	6.75±0.25	7.25±0.02^{d}	0.09±0.01
T_2	27.60±0.50	6.50±0.50	7.15±0.02^{cd}	0.10±0.00
T_3	27.50±0.50	6.25±0.25	6.95±0.02^{ab}	0.12±0.00
T_4	27.40±0.80	5.90±0.20	6.85±0.02^{a}	0.12±0.10

Value with the same superscripts across the column are not significantly different (P>0.05)
The figures in parenthesis are the standard errors.

Fish fed T_1 (25% watermelon seed meal inclusion) had the highest mean weight gain of 8.77 ±0.13gfollowed by fish fed T_2 (50% inclusion) with 7.83 ±0.50g. The lowest mean weight gain of 6.84 ±0.15g was recorded in T_4(100% inclusion).Percentage mean weight gain(%) of *Heterobranchus bidorsalis* fingerlings fed watermelon seed meal revealed that the highest percentage mean weight gain 299.04±5.81g was obtained in fish fed T1 (25% inclusion), followed by T2 50% inclusion and T_0 252.31±3.90g while the lowest percentage mean weight gain 230.38±1.97g was obtained in fish fed T4 (100% inclusion), the result showed that there was significant difference (P<0.05) in percentage mean weight gain among the treatments.

Specific growth rate (SGR%) of *Heterobranchus bidorsalis* fingerlings fed watermelon seed meal is shown in (Table 4). The highest specific growth rate 1.98± 0.02 was recorded in T1 and it was significantly different (P<0.05) from other treatments. T_0 and T_3 (0% and 75%) were not significantly different (P>0.05) from each other. Results on the condition factor of

Heterobranchus bidorsalis fingerlings fed watermelon seed meal is shown in (Table 4). The result showed that the treatments were significantly different ($P<0.05$) from each other. T_1 had the best condition factor 1.66± 0.01 and it is significantly different ($P<0.05$) from other treatments followed by T_3 with 1.56± 0.0244 and T_2 1.53± 0.02). The least condition factor 1.41± 0.0457 was obtained in T_0.Percentage survival rate of *Heterobranchus bidorsalis* fingerlings fed watermelon seed meal is shown in table 4. Result from ANOVA showed that the treatments were not significantly different from each other. T_1, T_2, T_3 with 93.33± 5.77, 93.33± 5.77, and 93.33± 5.77 respectively had the highest survival rates followed by T_0 with 90.00± 10.00 and T_4, 90.00 ± 10.00% as the lowest. The proximate composition of experimental diets indicated that all the diets met the targeted crude protein requirement for *H. bidorsalis fingerlings* (Table 3). The highest moisture content was recorded in T_0(7.35%) and the least was recorded in T_2(7.25%). The highest crude protein was recorded in T_1 (42.34%) and the least was recorded in T_0(40.56%). The highest lipids contents were recorded in T_3(25.35%) and the least was recorded in T_2(0.97%) and the least was recorded in T_0(0.85%). The highest Ash content was recorded in T_3(22.05%) and the least was recorded in T_2(21.58%). The highest NFE was recorded in T_2(8.98%) and the least recorded in T_3(0.61%).There was significant difference ($p<0.05$) in the values of ash, moisture, fat, crude protein and crude fibre content of the five diets.

Table 3: Proximate composition of experimental diets

Parameters	**T_0(0%)**	**T_1(25%)**	**T_2(50%**	**T_3(75%)**	**T_4(100%)**
Moisture	7.35	7.30	7.25	7.30	7.26
Crude Protein	40.56	42.34	42.26	42.22	41.39
Lipids	21.30	16.85	16.70	25.35	23.35
Crude Fibre	0.85	0.95	0.97	0.96	0.90
Ash	22.00	21.70	21.58	22.05	21.90
NFE (Nitrogen Free Extract)	2.41	7.89	8.98	0.61	0.65

NFE = 100 – (Protein + Lipids + Fibre + Ash)

Table 4: Growth performance of *Heterobranchus bidorsalis* fingerlings fed differently processed watermelon seed meal based-diet.

Growth Parameters	**T_0(0%)**	**T_1(25%)**	**T_2(50%)**	**T_3(75%)**	**T_4(100%)**
Mean Initial Weight (g)	2.95 ± 0.05^{a}	2.93 ± 0.02^{a}	2.93 ± 0.04^{a}	2.96 ± 0.05^{a}	2.97 ± 0.04^{a}
Mean final weight (g)	$10.41\pm0.2.0^{b}$	11.70 ± 0.10^{a}	10.77 ± 0.52^{b}	10.26 ± 0.21^{bc}	9.80 ± 86^{c}
Weight gain (g)	7.45 ± 0.16^{bc}	8.77 ± 0.13^{a}	7.83 ± 0.50^{b}	7.31 ± 0.17^{cd}	6.8 ± 0.15^{d}
Percentage mean weight	252.31 ± 3.90^{c}	299.04 ± 15.8^{a}	267.04 ± 15.49^{b}	247.07 ± 3.00^{c}	230.38 ± 1.97^{d}
gain (%)	90.00 ± 10.00^{a}	93.33 ± 5.77^{a}.		93.33 ± 5.77^{a}	90.00 ± 10.00^{a}
Survival rate (%)			$93.33\pm^{a}5.77$		
Initial Mean Total	5.66 ± 0.05^{a})	6.47 ± 0.14^{a}		5.68 ± 0.0^{5a}	5.62 ± 0.07^{a}
Length(cm)			5.6733 ± 0.10^{a}		
Final Mean Total	9.04 ± 0.15^{a}	8.90 ± 0.03^{ab}		8.69 ± 0.08^{c}	8.77 ± 0.09^{b}
Length (cm)			8.90 ± 0.14^{ab}		
Percentage Increase in	59.68 ± 2.07^{a}	57.63 ± 3.42^{ab}		52.88 ± 0.45^{b}	56.13 ± 3.58^{a}
Length (%)	1.41 ± 0.05^{c}	1.67 ± 0.01^{a}	56.90 ± 4.27^{ab}	1.56 ± 0.02^{b}	1.46 ± 0.01^{c}
Condition Factor (K)	1.80 ± 0.02^{c}	1.98 ± 0.02^{a}	1.53 ± 0.02^{b}	1.78 ± 0.01^{d}	$1.71\pm.01^{e}$

Specific growth rate	1.86 ± 0.06^{b}

Value with the same superscripts across the rows are not significantly different (>0.05)
The figures in parenthesis are the standard errors.

The result of feed utilization analysis of *Heterpbranchus bidorsalis* fed experimental diet are presented in Table 5.T_1(25%watermelon seed meal) had the lowest 0.96 ± 0.01 feed conversion that shows better conversion and it is significantly different ($P<0.05$) from the other treatments. T_0, had the highest figures in feed conversion ratio 1.12 which showed poor conversion. mean feed intake as presented in the table showed that average feed intake among the treatments were significantly different ($P<0.05$). Highest feed intake value 8.38 ± 0.08 was obtained in fish fed T1 (25%) and 8.38 ± 0.07 in T2 (50%) watermelon seed meal inclusion followed 8.36 ± 0.13 in fish fed T0 (0% inclusion) while the least average feed intake value of 7.23 ± 0.05) was obtained in T_4 100% inclusion of watermelon seed meal. Protein efficiency ratio of *Heterobranchus bidorsalis* fingerlings fed watermelon seed meal is shown in (Table 5). Result from the ANOVA table showed that the treatments were significantly different ($P<0.05$) from each other. T1 had the highest protein efficiency ratio 0.0083 ± 0.00 and it is significantly different ($P<0.05$) from other treatments followed by $\mathbf{T_0}$ with 0.0075 ± 0.00 and T2 with 0.0073 ± 0.00. The lowest protein efficiency ratio 0.0068 (0.0001) was obtained in T_4. Feed efficiency ratio of *Heterobranchus bidorsalis* fingerlings fed watermelon seed meal is shown in (Table 5). The result showed that the treatments were significantly different ($P<0.05$) from each other. T_1 had the highest efficiency ratio 98.71±2.54. This is significantly different ($P<0.05$) from other treatment followed by T_3 with 96.26±2.20. Result of mean protein fed showed that the treatment was significantly different ($P<0.05$) from each other. T_2 had the highest mean protein fed with 362.46± 2.85 and it is significantly different ($P<0.05$) from each other treatments followed by T_1 357.93± 3.45 and T_3 341.52± 1.48. The lowest was T_0 with 335.28± 5.05.

Table 5: Feed utilization of *Heterobranchus bidorsalis* fingerlings fed differently inclusion level of watermelon seed meal based-diet.

Growth Parameters	T_0(0%)	T_1(25%)	T_2(50%)	T_3(75%)	T_4(100%)
Average Feed Intake	8.3610 ± 0.13^{a}	8.38 ± 0.08^{a})	8.38 ± 0.06^{a}	7.59 ± 0.033^{b}	7.23 ± 0.04^{d}
Crude Protein in Diet (%)	40.56 ± 0.04^{c}	42.34 ± 0.08^{a}	42.26 ± 0.08^{a}	42.22 ± 0.06^{a}	41.39 ± 0.02^{b}
Average Protein Fed	335.28 ± 5.05^{c}	357.93 ± 3.45^{a}	362.46 ± 2.85^{a}	341.52 ± 1.48^{b}	336.93 ± 2.00^{c}
Feed Conversion Ratio	1.12 ± 0.02^{a}	0.96 ± 0.03^{c}	1.07 ± 0.06^{ab}	1.0393 ± 0.02^{b}	1.06 ± 0.02^{b}
Protein Efficiency Ratio	0.007 ± 0.01^{d}	$0.008\pm.01^{a}$	0.007 ± 0.01^{b}	0.0007 ± 0.01^{b}	0.006 ± 0.01^{c}
Feed Efficiency	89.13 ± 1.61^{c}	98.71 ± 2.54^{a}	93.47 ± 5.71^{bc}	96.26 ± 2.20^{b}	94.53 ± 1.83^{bc}

Value with the same superscripts across the rows are not significantly different ($P>0.05$) and the figures in parenthesis are the standard errors.

Discussion

Growth performance of *Heterobranchus bidorsalis* fingerlings fed differently inclusion level of watermelon seed meal based-diet. The result of this study indicated that there was no weight loss in the present study compared to the weight at initial stage. Observation on growth and nutrient utilization revealed that growth significantly reduce as watermelon is increased in the diet. The growth performance of fish fed with experimental diet showed that 25% inclusion level was better than all the other diets with mean weight gain of 8.77. On the other hand, 100% inclusion level clearly gave the worst performance and average feed intake. The fingerlings consumed all the diets but feed intake was higher in the treatments that received lowest levels 0%, 25% and 50%, this could be due to the presence of low molecular weight metabolites such as free amino acids (FAA) which acts as feed attractants in fish rations. The lower feed intake in the treatment fed 75% and 100% may be due to poor palatability resulting from residual and anti-nutritional compounds such as tannin, saponin, and non-starch polysaccharides that have been reported to have adverse effect on the growth performance of young fish according to (Leenhouwer *et al.,* 2009, Alegbeleye, 2011). The 25 % inclusion has the highest mean weight gain 8.77± 0.13g which is significantly superior to 0%, 50% and 75%. This work is in line with the work of Ernesto *et al.,* (2000); Amisah *et al., (*2009) where broiler had the best growth performance at 25% Cassava Root meal inclusion level. It is also similar to the works of Orisasona *et al.*(2014) who reported 25% in boiled lima bean substitution of soybean in diet of *C. gariepinus*.

Many other authors similarly reported varied replacement level such as 20%by Faturotiand Akinbote (1986) in cassava peel fed to *Tilapia zilli.* 50% inclusion by Babatunde *et al*. (2001), Falaye*et al.* (1999) of waste and by-products with conventional one. It can be correctly inferred then that replacement of conventional feed by alternate sources of plants and animal origin, depends on the inclusion levels and anti-nutritional factor of feed ingredient. Moreover, in the study, the lowest feed conservation ratio (FCR) value in T_1(25%) (0.96) indicated better feed utilization by the fish, which may have accounted for better growth performance of *Heterobranchus bidorsalis* fed 25% (watermelon seed meal (WMSM**)**amongst other diets. Adikwu (2003), reported that the lower the FCR the better the feed utilization by the fish. Despite the significant effect observed in growth, survival of the fish fed the different diets were not affected, the percentage survival rate was good throughout the experimental period. This could be as a result of good water quality management, good handling and the suitability of WMSM as ingredient in *H. bidorsalis* diet. 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. Survival likely depends strongly on tolerance level of different fish species to the nature and level of anti-nutritional factor in the feedstuff.

The feed efficiency ratio obtained showed T_1(104.71) (1.54) was significantly difference from others with T_0 (control) having the lowest efficiency ratio of 89.13 (1.61). Protein efficiency ratio (PER) values increased among the experimental fish with respect to the quantity of total feed intake. The highest PER value was obtained at the 25% WMSM treatments indicating maximum utilization of nutrients in the diets in comparison with higher inclusion level of WMSM. Adejumo (2005), reported higher PER value at 20% inclusion level of replacing maize with millet. De Silva and Anderson (1995), reported that protein efficiency ratio is a measurement of how well the protein sources in a diet could provide the essential amino acids requirement of the fish feed. The specific growth rate in this study was between 1.71 - 1.98.Olukunle and Falaye (1998) reported specific growth rate of 0.39 - 1.36 for *Clarias gariepinus* fed sesame seed cake as a partial and total replacement of fish meal. Kasi *et al.*(2011) reported a range of 1.0 – 1.42 for cobia (*Kachycentron Canada*).The high specific growth rate, high feed efficiency, high protein efficiency and low feed conversion of fish in T1 (25%) watermelon seed meal confers it with better advantages for growth and efficiency of feed utilization over the rest of the experimental diet. This result agrees with the assertion of Olaniyi

(2009) who stated that the higher the specific growth rate and the smaller the field conversion ratio, the better the feed quality.

Conclusion and Recommendations

In conclusion the study showed that feeds were consumed by the experimental fish, *Heterobranchus bidorsalis* fingerlings which brought an increased in weight. The lower growth response by fish fed diets T_3(75%) and T_4(100%) inclusion was probably caused by reduced palatability of the diet which causes reduction in feed intake. Watermelon seed-based diet improve growth and survival rate of *Heterobranchus bidorsalis* fingerlings without negative effects on survival rate. The T_1(25%) inclusion had the highest food efficiency, protein efficiency and food conversion ratio. This indicated that watermelon seed meal which replaced soybean seed meal at 25% inclusion gave the best growth in the fish. Based on the results of this study, there is the need to investigate the decreasing trend recorded at 75% and 100% replacement. Different inclusion levels, their effects on nutrient composition and growth performance of *H. bidorsalis* should be carried out.

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