



EFFECT OF BAKER'S YEAST (*Saccharomyces cerevisiae*) ON REARING OF *Heterobranchus longifilis*: GROWTH AND SURVIVAL IN OUTDOOR CONCRETE TANKS

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ABSTRACT

Heterobranchus longifilis juveniles (117.68 ± 21.34 g) used for this study were product of an indoor experiment in glass aquaria transferred to outdoor tanks. This study is therefore, a continuation of the indoor study using the same feed for the fish outdoors for 230 days. They were stocked in ten concrete tanks, of sizes 2 m x 2 m x 1 m. The fish were stocked according to the number harvested from the indoor experiment for each treatment. The experimental diets were prepared with fish meal, soybean, groundnut cake, wheat offal, yeast, premix, starch, vitamin C and vitamin B-complex to meet the requirement of *H. longifilis*. The analysed crude protein in each diet is 42.56, 43.32, 43.69, 43.86 and 43.98. There was significant variation ($P < 0.05$) in the Mean Final Weight (MFW), Mean Weight Gain (MWG), Protein Efficiency Ratio (PER), Specific Growth Rate (SGR) and Percentage Survival (PS). The survival of the fish was highest with the fish fed 2 g yeast/100 g of diet and however this was not significantly different from fish fed 1g yeast/ 100g diet. The cost of production of one kilogram of fish using varying levels of *S. cerevisiae* in diets varied significantly ($P < 0.05$).

Keywords: dietary supplement, growth studies, probiotic

INTRODUCTION

Yeast (*Saccharomyces cerevisiae*) is a cheap dietary supplement and is easily produced on an industrial level from carbon-rich substrate by-products (Lee and Kim, 2001). Dry matter intake and nutrient digestibility improved when *S. cerevisiae* was incorporated in animal diets (Dann *et al.*, 2000; Lehloenya *et al.*, 2008). They serve as supplement in animal feed to make up for amino acid and vitamin deficiencies of cereals.

Dietary live yeast (*S. cerevisiae*) has been used as fermenting agent in baking, distilling, and brewing industries. In animal feed it is also used as a probiotic (Saegusa *et al.*, 2004), growth promoter (Nilson *et al.*, 2004).

Yeast cell wall contains chitin, mannan and glucan that have been known as immunostimulant (Li and Gatlin, 2003; Oliva-Teles and Goncalves, 2001; Rodriguez *et al.*, 2003). The proximate composition of *S. cerevisiae* is as follows: 45% protein, 8% fat, 13% ash, 10% water and 23% fibre and carbohydrate. It has an amino acid profile that shows the protein quality is high except that it is deficient in methionine (FAO 1980). It contains B-complex vitamins and it is a rich source of protein (Ebrahim and Abou-seif, 2008). The crude protein content of *S. cerevisiae* is 44.4% (Ebrahim and Abou-seif, 2008).

In supplementing fish feed with yeast several results have been reported, it improves digestion (Dann *et al.*, 2000, Erasmus *et al.*, 2005) and fish growth (Oliva-Teles and Goncalves, 2001). Nile Tilapia demonstrated improved growth and feed efficiency when 0.1 % brewer's yeast was supplemented in its diet (Lara- Flores *et al.*, 2003).

This study was carried out to evaluate the effect of various levels of *S. cerevisiae* in non-extruded floating feed on the growth, production and survival of table sized *H. longifilis*.

MATERIALS AND METHODS

Experimental Fish

The *H. longifilis* juveniles (117.68 ± 21.34 g) were product of the indoor experiment in glass aquaria. This is a continuous study using the same feed for the fish outdoors. They were stocked in 2 m x 2 m x 1 m concrete tanks according to the number harvested from the indoor experiment.

Feed and Feeding

The experimental diets were prepared by using the following ingredients: fish meal, soybean, groundnut cake, wheat offal, yeast, premix, starch, vitamin C and Vitamin B-complex to meet the requirement of *H. longifilis*. The analyzed crude protein in each diet was 42.56%, 43.32%, 43.69%, 43.86% and 43.98%. The proximate analysis of the

feed was carried out according to AOAC (2000). Feeding was done 17hrs at 3% body weight for 230 days. The quantity of feed was adjusted to the new weight of the fish after every sampling day. The total quantity of feed consumed in each treatment was calculated and costs estimated.

Sampling, Water Exchange/Quality

Fish were sampled by bulk weighing fortnightly. The water in the tanks was topped weekly and on sampling days total replacement was done. Water quality parameters such as temperature, dissolved oxygen, pH and conductivity were measured using standard methods (APHA 1989).

Statistical Analysis and Biological Parameters

Statistical analysis was done using One-Way ANOVA in the computer package SPSS version 13. The difference in means of treatments was assessed using Duncan (1955) significant test.

Biological parameters were calculated as follows:

Mean Gain Weight (MGW) = Mean Final Weight – Mean Initial Weight

Food Conversion Ratio (FCR) = Food Eat/Weight Gain (Halver, 1972)

Specific Growth Rate (SGR) = $\frac{\ln \text{ Mean Final Weight} - \ln \text{ Mean Initial Weight}}{\text{Time}} \times 100$ (Brown, 1957)

Protein Efficiency Ratio (PER) = $\frac{\text{Weight Gain}}{\text{Protein Eaten}} \times 6.25$ (Osborne *et al.*, 1919, Halver 1972)

Percentage Survival = $\frac{\text{Number of Fish Harvested}}{\text{Number of Fish Stocked}} \times 100$

Total Cost of Feed = $\frac{\text{Cost of Feed Eaten}}{\text{Kg of Fish at Harvest}}$

RESULTS

Table 1 shows the percentage composition of the ingredients combined to compound the control and four experimental diets namely diet II, III, IV and V. The diets were compounded with various ingredients including fish meal, soybean meal, wheat offal, oil, starch, and premixes. Yeast was added to all diets except the control diet. Table 2 shows the proximate composition of the control and four experimental non-extruded floating diets. The crude protein content of the control and four non-extruded floating diets are 42.56%, 43.32%, 43.69%, 43.86% and 43.98%.

Table 1: Percentage composition of five non-extruded floating experimental diets

INGREDIENTS	CONTROL	DIET II	DIET III	DIET IV	DIET V
Fish meal	42.00	42.00	42.00	42.00	42.00
Soybean meal	5.00	5.00	5.00	5.00	5.00
Groundnut cake	25.00	25.00	25.00	25.00	25.00
Wheat offal	20.99	19.99	18.99	17.99	16.99
Yeast	0.00	1.00	2.00	3.00	4.00
Oil	4.00	4.00	4.00	4.00	4.00
Methionine	0.20	0.20	0.20	0.20	0.20
Aqua biomix premix¹	0.50	0.50	0.50	0.50	0.50
Starch	2.00	2.00	2.00	2.00	2.00
Salt	0.25	0.25	0.25	0.25	0.25
Vitamin c	0.03	0.03	0.03	0.03	0.03
Vitamin b.co	0.03	0.03	0.03	0.03	0.03

¹Aqua Biomix Fish Premix

Vitamin A i.u	20,000,000	Vitamin B2 mg	30,000	Folic acid mg	4,000
Vitamin D3 i.u	2,000,000	Niacin mg	150,000	Biotin mg	800
Vitamin E mg	200,000				
Vitamin C mg	500,000	Pantothenic acid mg	50,000	Choline chloride mg	600,000
Vitamin K3 mg	8,000	Vitamin B6 mg	12,000	Cobalt mg	2,000
Vitamin B1 mg	20,000	Vitamin B12 mg	50	Copper mg	4,000
Iodine mg	5,000	Selenium mg	200	Antioxidant mg	100,000
Inositol mg	200,000	Zinc mg	40,000	Lysine mg	100,000
Iron mg	40,000	Manganese mg	30,000	Methionine mg	100,000

Table 2: Proximate composition of five non- extruded experimental floating diets

	Control (Diet I)	Diet II	Diet III	Diet IV	Diet V
%	8.50	6.50	9.20	8.15	8.60
MOISTURE					
% PROTEIN	42.56	43.69	43.32	43.86	43.98
% LIPID	11.70	10.00	11.73	14.60	11.45
% ASH	9.50	10.00	9.65	9.00	9.25
% FIBRE	3.10	2.79	3.34	3.10	3.60
% NFE	34.64	27.02	22.76	21.29	23.12

Table 3 shows ranges of some of the water quality parameters measured weekly during the study. They were found to be at conducive levels for rearing of *H. longifilis*.

Table 4 shows the growth, survival and cost of broodstock *H. longifilis* reared with non- extruded floating diets. There was significant variation ($P < 0.05$) in the MFW, MWG, PER, SGR and PS. The fish fed 4 g yeast/100 g diet had the best weight gain while the fish fed 3 g yeast/ 100 g diet had the least. The FCR and PER showed that the fish fed 1 g yeast/100 g diet converted the feed best while the fish

fed 3 g yeast/ 100 g diet had the least for FCR and the fish fed the control diet was least in terms of PER. The FCR of the fish fed 1 g yeast/100 g diet did not vary significantly ($P > 0.05$) with the fish fed the control diet. In terms of PER the fish fed 4 g yeast/ 100 g diet had the least. The SGR and PS was best with fish fed 2 g yeast/ 100 g diet and least with the fish fed 3 g yeast/100 g diet.

The cost of production of 1 kg of fish with the varying diets varied significantly ($P < 0.05$). The costs of feeding fish to table size with control, II, III and IV diets did not vary significantly ($P > 0.05$).

Table 3: Some water quality parameters of the experimental tanks

Parameters	Temperature	Ph	Dissolved oxygen	Conductivity
Ranges	25 -27 °C	6.7 – 7.5	3.5 – 6.5 mg/l	120 µOhm

Table 4: Growth, survival and cost of *Heterobranchus longifilis* reared with non-extruded floating feed

	Mean Initial Weight Indoor	Mean Initial Weight outdoor	Mean Final Weight (g)	Mean Weight Gain (g)	Food Conversion Ratio	Specific Growth Rate	Protein Efficiency Ratio	Percent Survival (g)	Cost of Fish =N=/kg
Control (Diet I)	31.96 ± 0.42 ^a	104 ± 18.99 ^a	4233.33 ± 57.74 ^c	4129.15 ± 67.18 ^c	2.43 ± 0.4 ^a	1.62 ± 0.08 ^{cd}	0.40 ± 0.03 ^a	60.61 ± 10.5 ^b	2988.64 ^{ab}
Diet II	32.56 ± 1.29 ^a	114.17 ± 14.16 ^{ab}	4000 ± 0.0 ^b	3885.83 ± 14.16 ^b	2.42 ± 0.21 ^a	1.55 ± 0.05 ^{bc}	0.64 ± 0.02 ^{cd}	77.47 ± 0.95 ^c	2835.40 ^{ab}
Diet III	31.63 ± 0.43 ^a	93.42 ± 0.22 ^a	4250 ± 0.0 ^c	4156.58 ± 0.23 ^c	2.52 ± 0.01 ^{ab}	1.66 ± 0.0 ^d	0.54 ± 0.12 ^{bc}	82.60 ± 3.49 ^c	3238.80 ^b
Diet IV	31.67 ± 0.16 ^a	129.03 ± 4.02 ^{bc}	2933.33 ± 57.74 ^a	2804.3 ± 58.85 ^a	2.88 ± 0.01 ^a	1.36 ± 0.02 ^d	0.50 ± 0.12 ^b	28.57 ± 0.0 ^a	2553.99 ^a
Diet V	31.63 ± 0.18 ^a	147.77 ± 4.61 ^c	4833.33 57.74 ^d	4685.57 ± 53.21 ^d	2.68 ± 0.09 ^{ab}	1.52 ± 0.01 ^b	0.60 ± 0.01 ^c	59.52 ± 4.13 ^b	4041.68 ^c

DISCUSSION

The Mean Final Weight and Mean Weight Gain followed the same trend such that the fish fed 1 g yeast/ 100 g diet and 3 g yeast/ 100 g diet had lower growth than the control diet and varied significantly ($P < 0.05$). This lower growth observed may not be attributed to the quantity of yeast because the diet containing the larger quantity of yeast (Diet V) had a superior MWG. Fish fed diets containing 2 g yeast/ 100 g diet had higher growth, although, the fish fed the control diet did not vary significantly ($P = 0.05$) while the fish fed diet V varied significantly ($P < 0.05$) with the control diet.

The Food Conversion Ratio of fish fed 2 g, 3 g and 4 g yeast/100 g diet did not vary significantly ($P > 0.05$). This is an indication that the level of yeast inclusion in this study as additive was converted to flesh at the same level in all treatment. In terms of conversion ratio, therefore, the lower level of 2 g yeast/ 100 g diet could be selected and adopted as the level of inclusion suitable for the growth of the fish. More so, the cost of this feed did not vary significantly with the cost of the control diet. The Food Conversion Ratios obtained in this study were higher than that reported by El-Saidy and Gaber (2002), Belal and Al-Owafeir (2004) and Bob – Manuel and Alfred-Ockiya (2011) in replacing fishmeal with yeast in *O. niloticus* diet.

The specific growth rate of fish fed the varying diets showed that the fish fed 2 g yeast/ 100 g diet had the best growth. This result compares well with that which recorded the highest growth rate in the inclusion of yeast in *C. gariepinus* diet (National Institute of Oceanography and fisheries Research 2011). The good response of the fish to yeast in the feed is as a result of the excellent amino acid profile in *S. cerevisiae* (FAO 1980; Ebrahim and Abou-seif, 2008). It could also be as a result of the ability of yeast to improve nutrient digestion (Dann *et al.*, 2000, Erasmus *et al.*, 2005 and Lehloenya *et al.*, 2008).

The PER showed that yeast in the diets improved the growth of the fish such that all diets containing yeast were superior in growth to the control diet. This is similar to the observation for *O. niloticus* fingerlings (Ebrahim and Abou-Seif (2008).

The survival of the fish was highest with the fish fed 2 g yeast/ 100 g of diet and this was not significantly different from fish fed 1 g yeast/ 100 g diet. Since the percentage survival did not follow any particular trend the yeast component of the feed may not have affected survival.

The cost of production of one kilogram of fish using varying levels of *S. cerevisiae* in diets varied significantly ($P < 0.05$), although, the fish with the

least cost ₦2553.99K containing 3 g yeast/100 g diet did not vary significantly ($P > 0.05$) with the Fish fed the control diet. The difference in cost of ₦434.97K is high when production is in tonnes. The fact that the Food Conversion Ratio did not vary significantly ($P > 0.05$) indicates that the four experimental feed are suitable for the production of table size *H. longifilis*. It was observed that the fastest growing fish was produced at the highest cost of ₦4041.68K/kg. In aquaculture production, when the fish has grown to a mean weight of 500 g to 700 g food fish should be dispensed of through sales to avoid unnecessary cost. In growing fish to brood stock the gain for such production would be in the fingerling production which will eventually offset whatever extra cost was expended in raising the fish to brood stock.

CONCLUSION

In conclusion, 2 g yeast/100 g diet is recommended as additive for the growing of *Heterobranchus longifilis* to table size.

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