THE EFFECTS OF VARYING LEVELS OF YEAST (*Saccharomyces cerevisiae*) ON THE GROWTH AND BODY COMPOSITION OF *Heterobranchus longifilis* FINGERLINGS

OVIE, S.O.,* IBIYO, L.M.O., BABALOLA, T.O.O. and **EZE, S.S.**
National Institute for Freshwater Fisheries Research, P. M. B. 6006
New Bussa, Niger State, Nigeria

*Corresponding author: *stella_ovie@yahoo.com*

Abstract

This study investigated the effects of yeast on the growth and body composition of *Heterobranchus longifilis*. Fingerlings of *Heterobrachus longifilis* (mean weight 31.89 ± 0.4 g) were stocked ten fish in 35L of water in 54L capacity aquaria and fed varying levels of yeast in floating diets for 56 days. Four treatments having 1.0 g, 2.0 g, 3.0 g and 4.0 g yeast/100 g respectively with a control diet, were investigated in triplicates. The diets had 42.56 %, 43.32 %, 43.69 %, 43.86 % and 43.98% crude protein. The fish fed 4 g yeast /100g and 16.99 g wheat offal/100 g diet showed the best growth. All growth parameters varied significantly ($p < 0.05$). The carcass composition of the fish showed that the protein and the lipid content were highest with the fish fed the control diet. The survival of the fish was high and it varied significantly ($p < 0.05$).

Keywords: fish growth, yeast, *Heterobranchus longifilis.*

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Introduction

Feed is one of the most important inputs in any fish farming industry. Davies *et al* (2006) reported that 30 to 70 % of total operating cost of aquaculture enterprise represents diet cost while over feeding leads to economic waste and adverse water quality. Aquaculture production therefore, would be greatly dependent on the provision of cheap feed that meets the requirement of commercial fish species.

In animal feed *Saccharomyces cerevisiae* is incorporated as a Single Cell Protein (SCP) to complement other protein sources. Yeast is produced at industrial level from carbon-rich substrate by-products and is cheaper as additives (Lee and Kim, 2001). Yeast cell wall contains chitin, mannan and immunostimulante (Oliva-Teles and Goncalves, 2001; Li and Gatlin, 2003); Rodriguez *et al* 2003). *S. cerevisae* contains 45 % protein, 8 % fat, 13 % ash, 10 % water and 23 % fibre and carbohydrate (FAO 1980). It has an excellent amino acid profile being deficient only in methionine (FAO 1980).

The supplementation of yeast-based diets was shown to have beneficial effect on nutrient 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 fed a diet with 40% protein and 0.1 % supplement of brewer's yeast (Lara-Flores *et al* 2003). Omar *et al* (1989) observed that active yeast (*S. cerevisiae*) caused Tilapia and Carp to have significant growth over inactive yeast. For hybrid catfish 2% dry yeast inclusion produced significant growth (National Institute of Oceanography

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and Fisheries Research, 2011). Chiu-Hsia *et al* (2010) observed 211.6 % weight gain and 1.2 feeding efficiency for *Epinephelus coioides* when it was fed yeast added as probiotic.

The frequency of feeding in any aquaculture system could contribute immensely to the effective utilization of the feed. However, various frequencies have been adopted for different species to minimize wastage such as, once every two days for estuarine grouper (Chua and Teng, 1978), three times a day for common carp (Charles *et al* 1984) and twice a day for sunshine bass (Webster *et al* 2001) are the various practises. Therefore, this study sets out to investigate the effect of varying levels of yeast in the growth and body composition of *H. longifilis* fingerlings.

Materials and methods

Ten *H. longifilis* fingerlings of mean weight 31.89 ± 0.4 g were stocked in glass aquaria of 54L capacity containing 35L of water. The experimental design was a complete randomised system consisting of five treatments (0, 1.0 g, 2.0 g, 3.0 g and 4.0 g yeast/ 100 g diet respectively). Each treatment was replicated thrice. The experimental fish was acclimatised for a week while being fed the control diet (0 % yeast/100 g diet).

The experimental diets were formulated with fish meal, soybean, groundnut cake, wheat offal, yeast, premix, starch and vitamins to meet the requirement, 42.5 % c.p. (Eyo, 1995) and 45.36 % c. p. (Ovie *et al* 2006) for *Heterobranchus longifilis*. The analyzed crude protein levels for the control and four experimental diets are 42.56%, 43.32%, 43.69%, 43.86% and 43.98%. Tables 1 and 2 show the percentage composition and the proximate composition of the control and four experimental diets respectively.

Feeding was done once a day at 17.00 hours at 3% body weight for 56 days. Remnants of feed were siphoned out daily and water replaced to the level of 35 litres of the aquaria. Sampling was carried out fortnightly by bulk weighing the fish in each aquarium. On sampling days total exchange of water was done and the quantity of feed was adjusted to the new weight of the fish by calculating (Feeding Rate = Body Weight x 3 %).

Proximate analysis of the feed and fish were carried out according to AOAC (2000). Statistical analysis was

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

Ingredients	Control (Diet I)	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
Ground Nut 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 Premix	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

Table 2: Proximate composition of non-extruded floating diets fed to *H. longifilis*.

	Control Diet	Diet II	Diet III	Diet IV	Diet V
% Moisture	8.50	6.50	9.20	8.15	8.60
% 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

done using One-Way ANOVA in the computer package *SPSS* Version 13, while the difference in the means was assessed using Duncan (1955) and Tukey (*SPSS* Version 13) significant tests.

Water quality parameters such as temperature, dissolved oxygen, pH and conductivity were measured throughout the experimental period using A.P.H.A methods (1989).

The biological parameters were calculated as follows:

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

Food Conversion Ratio (FCR) = Food Eaten (g)/Time (Days) (Halver, 1972)

Specific Growth Rate = 100 x

$$\frac{\ln \text{Mean Final Weight (g)} - \ln \text{Mean Initial Weight (g)}}{\text{Time (Days)}}$$

(Brown, 1957)

Protein Efficiency Ratio (PER) = Weight Gain (g) x 100/Protein eaten x 6.25 (Osborne *et al* 1919, Halver, 1972)

Percentage Survival (PS) = 100 x No of fish available/ No. of fish stocked

Results

The water quality parameters recorded showed that the study was carried out at conducive levels throughout the 56 days experimental period, temperature was 30.1- 30.6°C, Dissolved Oxygen 1-12 mg/l, pH 6-7.5 and 140- 420 µ ohm conductivity. Table 3 shows the summary of results of growth of *H. longifilis* fed varying levels of yeast in non-extruded floating diets.

The growth parameters FCR, SGR and PER varied significantly ($p < 0.05$) and all showed that the best growth was in the fish fed 4 g yeast/100 g diet. The fish fed 2 g yeast/100 g diet had the poorest growth. The percentage survival was high in all treatment, it ranged from 80% in the control diet to 100% in the fish fed the diet containing 3 g yeast/100 g diet. Figure 1 shows the growth of *H. longifilis* using varying levels of yeast in non-extruded floating diets.

Table 4 shows the proximate composition of carcass of initial fish stocked and fish at harvest. Carcass composition shows that moisture was lowest in the control diet and highest in the fish fed 3 g yeast/100 g diet. The ash and crude protein content was highest in fish fed 1 g yeast/100 g diet and lowest in the fish fed 3 g yeast/100 g diet. The crude fibre content was highest in the fish fed 3 g and 4 g yeast/100 g diet and lowest in fish fed 2 g yeast and the control diets. The crude fat content of the carcass shows that the fish fed the control diet had the highest while fish fed 2 g yeast/ 100 g diet had the lowest.

Table 3: Growth of *Heterobranchus longifilis* fed non-extruded floating diets containing varying levels of yeast.

	Mean Initial Weight	Mean Final Weight	Mean Weight Gain	Food Conversion Ratio	Specific Growth Rate	Protein Efficiency Ratio	Percentage Survival
control (Diet I)	31.96± 0.42^{a}	104.19± 18.99^{ab}	72.22± 19.36^{ab}	1.33±0.29b^{c}	2.09± 0.34^{ab}	28.48± 9.57^{ab}	80.00± 10.00^{a}
Diet II	32.56± 1.29^{a}	144.17± 14.16^{ab}	84.94± 16.55^{bc}	1.06±0.17^{abc}	2.23± 0.21^{ab}	31.92± 6.22^{ab}	93.33±5.8^{ab}
Diet III	31.63± 0.43^{a}	93.42± 0.22^{a}	61.79± 0.21^{a}	1.36±0.00^{c}	1.93± 0.02^{c}	23.23± 0.08^{a}	96.67±5.8^{ab}
Diet IV	31.67± 0.16^{a}	129.03± 4.02^{bc}	97.50± 3.99^{cd}	0.95±0.05^{ab}	2.52± 0.05^{bc}	36.64± 1.5^{bc}	100.00±0.0^{b}
Diet V	31.63± 0.18^{a}	147.77± 4.61^{c}	116.14± 4.55^{d}	0.88±0.05^{a}	2.75± 0.05^{c}	43.65± 1.71^{c}	96.67±5.8^{ab}

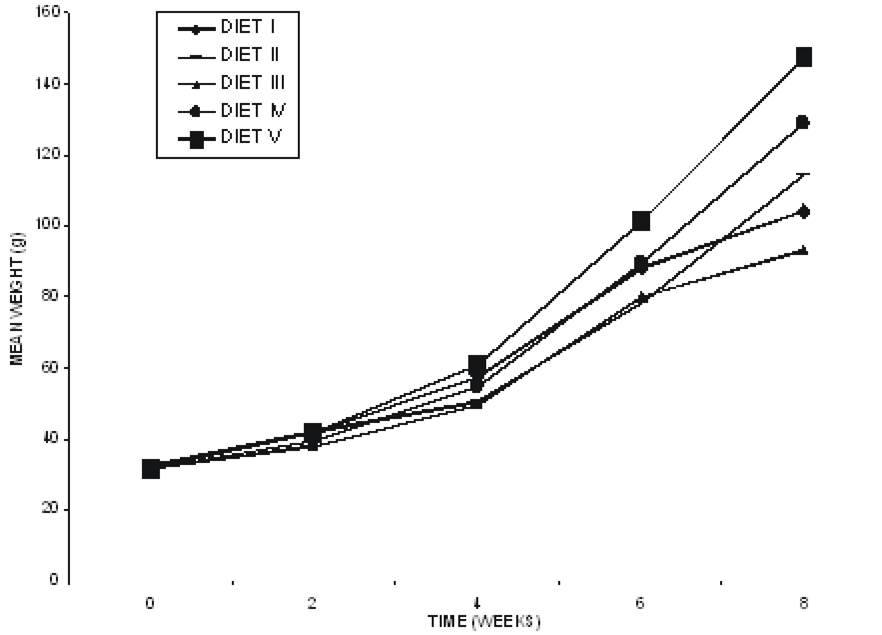

Figure 1: Growth of *Heterobranchus longifilis* with varying levels of yeast in floating diets.

Table 4. Proximate composition of carcass of initial fish stocked and fish at harvest.

	INITIAL	CONTROL (DIET I)	DIET II	DIET III	DIET IV	DIET V
% Moisture	78.30	66.30	74.05	77.99	78.21	77.17
% Protein	11.70	24.17	16.88	15.05	14.23	14.96
% Lipid	3.25	7.00	6.34	4.58	4.77	5.00
% Ash	2.79	2.15	2.25	2.05	2.00	2.20
% Fibre	6.00	0.25	0.30	0.25	0.35	0.35
% NFE	NIL	0.13	0.18	0.08	0.44	0.32

Discussion

The survival rate of the fish fed with varying levels of yeast as additive in diets was high and they varied significantly ($p < 0.05$). This compares well with Lara-Flores (2003) and Ebrahim and Abou-Seif (2008) in replacing fish meal with yeast for *O. niloticus* and Chiu-Hsia *et al* (2010) in the inclusion of *S. cerevisiae* as a probiotic for *Epinephelus coioides.* In considering the trend of the survival observed in this study, being lowest in the control (0 % yeast) while other diets containing yeast were higher, the availability of yeast may have caused the improvement (Table 3). The higher surviving fish were those that had good response to the diets indicating that the diet supports good metabolism, high yield and profitability.

The FCR, SGR, PER and MWG varied significantly ($p < 0.05$). The FCR for all diets indicated effective utilization and conversion to flesh. This is a similar trend observed when *S. cerevisae* was used to replace fish meal up to 30 % in *Cyprinus carpio* feed (Ahmet and Gui, 2011). The FCR of Diets IV and V in this study were below 1 an indication of high protein digestibility and utilization. These two diets, when used in commercial catfish farming would increase profitability and further boost catfish farming. This result compares well with Chiu-Hsia *et al* (2010) in the feeding of *E. coioides* with *Saccharomyces cerevisiae* and reported 211.6 % weight gain while the growth rate of 4.72 g/fish/d was reported for *C. gariepinus* (National Institute of Oceanography and Fisheries Research, 2011). Figure 1 shows there was exponential growth in *H. longifilis* for all diets fed, although, the fish fed control (Diet I) and III had a slight drop in the sixth week. This drop was diet-related as water quality showed that, Dissolved Oxygen was 5-6 mg/litre and pH 6.5-6.9, also other fish fed with different diets and having the same number of fish had better growth.

The adoption of once daily feeding in this study was due to the behaviour of the fish to an early morning feeding and this favoured the feeding, acceptance and utilization of the diets while minimizing waste. This was also the practise for channel catfish (Webster *et al* 1992a). There was also good digestibility and hence utilization of feed as observed in *C. carpio* when partial replacement of fish meal with yeast was carried out (Ahmet and Gui, 2011). In *Sparus aurata* the replacement of fish meal reported by Semih *et al* (2009) also resulted in excellent utilization of diets as in this study. Although, Davies *et al* (2006) and Ovie and Ovie (2007) suggested twice daily feeding for *H. longifilis,* it was not suitable with this experimental fish as it constituted wastage in the first two days of the experiment.

The body protein deposition was highest with the control diets (0 g yeast/100 g diet). All the fish fed experimental diets had higher protein deposition, over the initial fish stocked being highest in the fish fed 1.0 g yeast/100 g diet and lowest in the fish fed 3 g yeast/100 g diet.

In conclusion, this study has shown that in the development of floating feed for *H. longifilis*, 4 g yeast/100 g diet is recommended because all the growth parameters were superior in the fish fed this diet. The success of catfish farming in Nigeria and the sub-Saharan Africa would be based on continuous studies on value addition on diets supplied to them.

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References

Ahmet, S.K. and Gul, C.C. 2011. Effects of partial Replacement of fishmeal by dried Baker's Yeast (*Saccharomyces cerevisiae*) on growth performance, feed utilization and digestibility in Koi Carp (*Cyprinus carpio* L. 1758) *Journal of Animal and Veterinary Advances*. *10 (3)* 346-351.

AOAC. 2000. *Official Methods of Analysis* (17TH) Association of Official Analytical Chemists. Arlington VA.

American Public Health Association (APHA). 1989. American Water Works Association and Water Pollution Control Federation (1989). *Standard Method for Examination of Water Waste Water. 17th Edn.,* APHA, New York U. S. A., pp. 1268.

Brown, M.E. 1957. Metabolism. In: W. S. Hoar, D. J. Randall (Eds.). *Physiology of Fishes*. New York Acad. Press 1: 447pp.

Charles, P.M., Sebastain, S.M., Raj, M.C.V. and Marian, M.P. 1984. Effect of feeding frequency on growth and food conversion of *Cyprinus carpio* fry. *Aquaculture 40:* 293-300.

Chiu-Hsia, C., Chih, H.C., Wen-Ren, G., Yuan-Kuang, G.and Winton, C. 2010. Dietary administration of the probiotic, *Saccharomyces cerevisiae* P13 , enhanced the growth, innate immune responses and disease resistance of the grouper, *Epinephelus coioides*. *29 (9)* Elsevier 1053-1059.

Chua, T.E. and Teng, S.K. 1978. Effect of feeding requirement on the growth of young estuary grouper, *Epinephelus tauvina* (Forsskal) cultured in floating net cages. *Aquaculture 14:* 37-47.

Dann, H.M., Drackley, J.K., McCoy, G.C., Huyjens, M.F. and Garrett, J.E. 2000. Effects of yeast culture (*Saccharomyces cerevisiae*) on prepartum intake and postpartum intake and milk production of Jersey cows. *Journal of Dairy Science 83:* 123-127.

Duncan, D.B. 1955. Multiple range and multiple *F*-tests. *Biometrics, 11:* 1- 42.

Davies O.A., Inko-Tariah, M.B. and Amachree, D. 2006. Growth response and survival of *Heterobranchus longifilis* fingerlings fed at different feeding frequencies. *African Journal of Biotechnology. 5 (9)* 778-780.

Ebrahim, M.S.M. and Abou-Seif, R.A. 2008. Fish meal replacement by yeast protein (*S. cerevisiae*) supplemented with biogenic L-carintine as a source of methionine plus lysine mixture in feed for Nile Tilapia (*Oreochromis niloticus*) fingerlings. *8th International Symposium on Tilapia in Aquaculture,* 999-1009.

Erasmus, L.J., Robinson, P.H., Ahmadib, A., Hinders, R. and Garrett, J.E. 2005. Influence of prepartum and postpartum supplementation of yeast culture and monensin, or both on ruminal fermentation and performance of multiparous dairy cows. *Anim. Feed Sci. Technol. 122,* 219-239.

Eyo, A.A. 1995. Dietary protein requirement of *Heterobranchus longifilis*. National Institute for Freshwater Fisheries Research (NIFFR) *Annual Report* 118-125p.

FAO. 1980. Aquaculture development and co-ordination programme. Fish Feed Technology. Lecture presented at the FAO/UNDP Training Course in Fish Feed Technology, Seatle, Washington. p. 400. http://www.fao.org/docrep/X5738/X5738EOO.htm

Halver, J.E. 1972. *Fish Nutrition*. Acad. Press New York. 718pp.

Lara-Flores, M., Olvera-Novoa M.A., Cruzman M.B.E. and Lopez-Madrid W. 2003. Use of bacteria *Streptococcus feacium* and *Lactobacillus acidophilus*, and the yeast Saccharomyces cerevisiae as growth promoters in Nile Tilapia (*Oreochromis niloticus*). *Aquaculture 216:*193-201.

Lee, B.K. and Kim J.K. 2001. Production of *Candida utilis* on molasses in different culture types. *Aquaculture Engineering 25:* 111-124.

Li, P. and Gatlin, D.M. 2003. Evaluation of brewer's yeast (*Saccharomyces cerevisiae*) as a feed supplement for hybrid Bass (*Morone chrysops* X *M. saxatilis*). *Aquaculture*, *219:* 681-692.

National Institute of Oceanography and Fisheries Research 2011. Yeast in catfish feeds. allaboutfeed.acc. blueskies.nl/ news/research-yeast-in-catfish-feeds-12144.html

Oliva-Teles, A. and Goncalves, P. 2001. Partial replacement of fishmeal by brewer's yeast (*Saccharomyces cerevisiae*) in diets for sea bass (*Centrarchus labrax*) juveniles. *Aquaculture 202:* 269-278.

Omar, E.A., Nour, A.M., and Abou Akkada A.R. 1989. *J. Agric; Sci.* Mansoura Univ. *14:* 1469-1478.

Osborne, T.B., Mendel, L.B. and Ferry, E.L. 1919. A method of expressing numerically the growth promoting value of protein. *J. Biol chem*. *37:* 223-224.

Ovie, S.O., Sadiku S.O.E. Ovie, S.I. 2006. Dietary protein requirement of the African mudfish *Heterobranchus longifilis*. *Journal of Sustainable Tropical Agricul-tural Research 17:* 146 -153.

Ovie, S.O., and Ovie, S.I. 2007. Feeding frequencies of *Heterobranchus longifilis* fry and fingerlings in static aerated rearing system. *The Zoologist 5:*24-32.

Rodriguez, A., Cuesta, A., Ortuno, J., Esteban, M.A., and Meseguer, J. 2003. Immunostimulant properties of a cell wall-modified whole *Saccharomyces cerevisiae* strain administered by diet to sea bream (*Sparus aurata* L.). *Veterinary Immunology and Immunopathology. 96:* 183-192.

Semih, S., Nejde,t G. and Belgin, H. 2009. Replacement of fish meal by yeast (*S. cerevisiae*): Effect on digestibility and Blood parameters for gilt head Sea Bream (*Sparus aurata*). *Journal of Animal and Veterinary Advances.*

Webster, C.D., Thompson, K.R., Morgan M., Grisby, E.J. and Dasgupta**,** S. 2001. Feeding frequency affect growth not fillet composition of juvenile sunshine Bass Morone, *Chrysops Morone Saxatilis* grown in cages. *Journal of World Aquaculture Society 323:* 79-88.

Webster, C.D., Tiawell, J.H. and Yaucey, D.H. 1992a. Effects of protein level and feeding frequency on growth and body composition containing 34% and 38% protein at two feeding frequencies of channels catfish. *Journal of Applied Aquaculture 1 (3)* 67-80.

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