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# Effect of various supplementary feedings on growth of Nile Tilapia (*Oreochromis niloticus)* in concrete ponds

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**Abstract:** The study was conducted to evaluate the effect different supplementary feeding of wheat flour, noug cake and maize flour on the growth performance of *Oreochromis niloticus* in concrete ponds at Zeway fisheries resources research center. The feeding trial was conducted in three ponds of having a surface area of 35m$^2$ each for seven months between July 2012 and January 2013. All the experimental and control group were run in triplicate with stocking density of 3fish/m$^2$. The supplemental feeds were agreed at 5% of the fish body weight with respective test feeds and the control group was without any supplemental feed. The initial weight (33.3gm) and length (12.5cm) of *O. niloticus*, in all treatments was not noted as statically different. The results of study indicated that, the final weights were significantly different among the treatments. Generally, fish fed with supplementary feeds grew significantly higher than the unfed (Control group) group (ANOVA, $P<0.001$). Similarly, growth of the fish fed with wheat flour + noug cake (WF+NC) showed significantly higher growth performance than the fish fed with maize flour + noug cake (MF+NC) (ANOVA, $P<0.05$). Fish rose in WF+NC (0.35 g/day) demonstrated better growth rate than MF+NC (0.15g/day). Variation in growth rate between fed treatments and unfed treatment as well as among fed treatments might be attributed to both direct and indirect effects of supplementary feeds given to the fish. Direct intake of feeds by the fish provides more nutrients resulting in better growth and production. Moreover, addition of supplementary feeds can elevate the level of organic nutrients that favor the growth

of flagellate phytoplankton which are good quality food for the fish. We therefore concluded that all supplementary feeds nearly doubled the growth of *O. niloticus* in ponds.

**Keywords:** Feed effect, *Oreochromis niloticus,* Growth performance, Pond experiment

## INTRODUCTION

Fish farming is the industry of producing fish through husbandry or culture for food, recreation and other purposes, which dates back to ancient Egypt and China. There are over 100 species of fish that are farmed in the world. There has been documented that, over 20 species of Tilapia and genus sarotherodon are known to be cultured either at subsistence or commercial scale. Among those species, *Oreochromis niloticus* is the most important species of fish in tropical and sub-tropical aquaculture[1] ,due to their biological, social and physical reasons, biologically *Oreochromis niloticus;* grow fast, show high food conversion efficiency , readily accept artificial feeds, easily breed in captivity, disease resistant, have high fecundity rate; socially: have good table food quality, good market price; and physically: tolerant to a wide range of environmental conditions[2,3]. Additionally it provides one of the major sources of animal protein and income throughout the world. It is currently ranked second only to carps in global production and is likely to be the most important cultured fish in the 21$^{st}$ century[2].

*Oreochromis niloticus* can efficiently utilize wide variety of food under natural condition, including phytoplanktons, aquatic invertebrates and detritus[4,5] . However, one of the major challenges facing the fish farming venture has been the problem of low-cost fish feeds which acquire 30-60% of the total cost of production depending on the intensity of the production[6]. One of the approaches to tackle this problem has been to experimentally test the use of locally available feed ingredients to grow fish in ponds[7,8].

Developing an alternative low-cost feeds for small-scale fish farmers has become a priority in many developing countries, including Ethiopia. Locally available feeds like noug cake, wheat flour and maize flour are known to be important sources of carbohydrate, lipids and protein for somatic growth of fish in semi-intensive cultures[3,8] . This experiment was therefore, conducted to evaluate the effect of different locally available feeds; wheat flour, maize flour, and noug cake on the growth performance of *O. niloticus* in concrete experimental ponds.

## MATERIALS AND METHODS

The study was carried out on station at Zeway Fisheries Resources Research Center (ZFRRC), which is sited in Oromia Regional State in East Shoa Zone at 160 km distance from Addis Ababa (capital city of Ethiopia). It is located at 7.9$^0$N & 37.7$^0$E and elevation of 1638m above sea level. The mean annual temperature of the area is about 26°C. The whole experimental period lasted in seven months between July 2012 and January 2013.

***Experimental units*:** A total of 12 compartments separated by happa net in three different concrete ponds each having a surface of 35m$^2$ and with water depth 1m were used.

***The experimental diets:*** The experiment was designed in randomized way included three treatments and three replications each. Treatment one was fed with 51% of wheat flour and 49% noug cake (WF+NC), treatment two was fed with 43 % of maize flour and 57 % of noug cake (MF+NC) and control was without any supplemental feed. Diet in the fed treatments had 21% of crude protein. The

daily ration was given twice a day manually, in the morning (10:00 am) and in the afternoon (3:00 pm). The daily ration was calculated and adjusted regularly according to the weight gain of the fish every month. Fish were fed with supplementary diets at 5% of their total body weight, so that the feed adjustment was done every month[3,8,9] .

***Experimental fish*:** A fingerlings of Nile tilapia (*O.niloticus*) having an average length of 8-11cm and an average weight 25-30g were collected from wild (Lake Hora) using beach seine . The fingerlings were transported at the early morning in plastic bag filled with water and oxygen. After arrival to the experimental station fish were acclimatized in the ponds for about one month prior to the start of the experiment. Thereafter, fish were chosen randomly into three groups each one represented in three replicate and stocked at a rate of 3fish /$m^2$.

**Data collection and Analysis:** During the experimental period, water quality parameters like pH, dissolved oxygen, seechi depth and temperature were measured monthly using digital pH meter, ox meter, conductivity meter and thermometer respectively. About 40% of fishes in each treatment were sampled randomly by using beach seine monthly. Growth performance of *O. niloticus,* monthly weight and length gain of the experimental fish were weighed and measured. Mortality of experimental fish was monitored regularly; dead fish were recorded and removed from the ponds. At the end of the experiment, the fishes were harvested; all fish were weighted, measured and counted. The growth performance of *O. niloticus* like specific growth rate (SGR), Daily growth rate (DGR) and survival rate (SR) were calculated as follows described in Hardy[10] and Ridha[2]:

*SGR (% day-$^1$) = [(ln final weight – ln initial weight) / time (days)] X 100*

*DGR (g day-$^1$) = (mean final weight (g) – mean initial weight (g) / days)*

*Weight gain (g) =final weight – initial weight*

*Survival rate (%) = (number of fish harvested / number of fish stocked) X 100*

***Statistical Analysis*:** A one-way ANOVA was used to test the effect of locally available feeds on the growth performance of experimental fish. Means were compared by Duncan's new multiple range test[11] . The data were expressed in terms of mean ± standard error. The statistical work was performed using SPSS 20.0 version statistical software. The level of significance was defined as $P<0.05$.

## RESULTS

The initial weight and length of *O. niloticus,* in all treatments was not statically different however, the final weight and length was significantly different from each other (table 1). Generally, fish fed with supplementary feeds showed significantly higher growth performance than the control group (ANOVA, $P<0.001$). Similarly, growth of the fish fed with WF+NC was significantly higher than the fish fed with MF+NC (ANOVA, $P<0.05$). Following the expectation the control group showed the lowest mean body weight compared with the treatment groups.

**Table-1:** The effect of different supplementary feeds on the body weight, length, daily growth rate and specific growth rate in *O.nilouticus (*mean± SE, n=31).

| Parameters | WF+NC group | Control group | MF+NC group |
|---|---|---|---|
| Initial weight (g) | 33.3±1.6[a] | 33.6±1.8[a] | 32.9±1.4[a] |
| Final weight(g) | 108.65±1.20[a] | 43.9±1.9[b] | 64±2.3[c] |
| Initial length(cm) | 12.26±0.19[a] | 12.56±0.22[a] | 12.5±0.18[a] |
| Final length(cm) | 18.4±0.37[a] | 12.9±0.21[b] | 15.7±0.30[c] |
| Weight gain (g) | 75,35±0.31[a] | 10,6±0.53[b] | 31.1±0.27[c] |
| Daily growth rate(g $d^{-1}$) | 0.35±001[a] | 0.05±0.012[b] | 0.15±0.04[c] |
| Specific growth rate (%$d^{-1}$) | 0.56±0.2[a] | 0.14±0.03[b] | 0.31±0.01[c] |
| Survival rate % | 80±0.3[a] | 83±0.21[a] | 91±.03[a] |

***Note: Mean values in the same row having the same letters are not significantly different (P > 0.05) whereas mean values in the same row having different letters are significantly different (P<0.05). WF- wheat flour, NC- noug cake and MF- maize flour.***

Growth trends of *O. niloticus* supplied with different supplemental diets and the reference group are shown in (Figure 1). The rate of growth of fish appears to vary between months. Fish grew slower in the first three months (July, August and September) compared to the rest of the months (October-January).

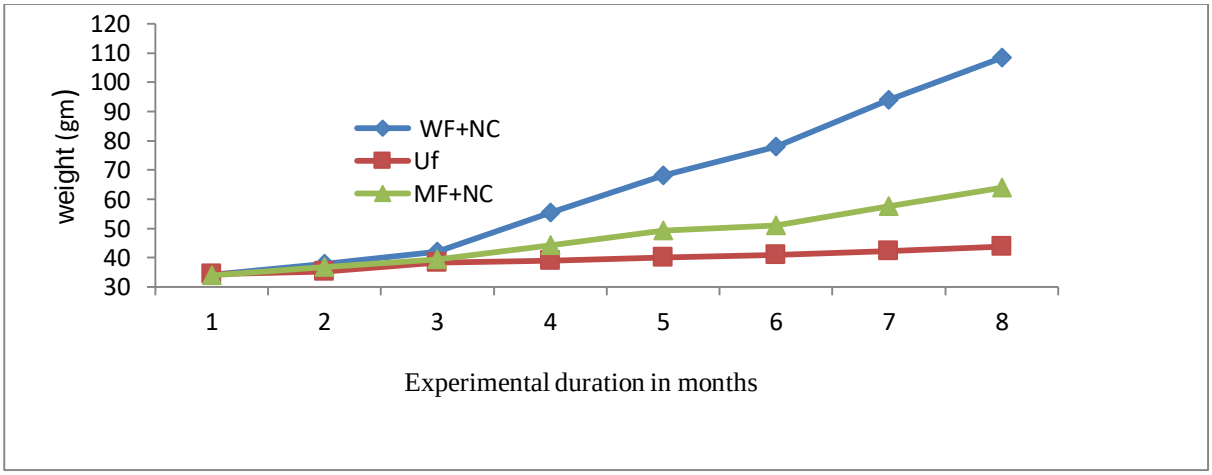


**Fig. 1:** Growth in total weight of *O. niloticus* fed with different locally available feeds in concrete ponds. (Control group, WF- wheat flour, MF- maize flour and NC- noug cake).

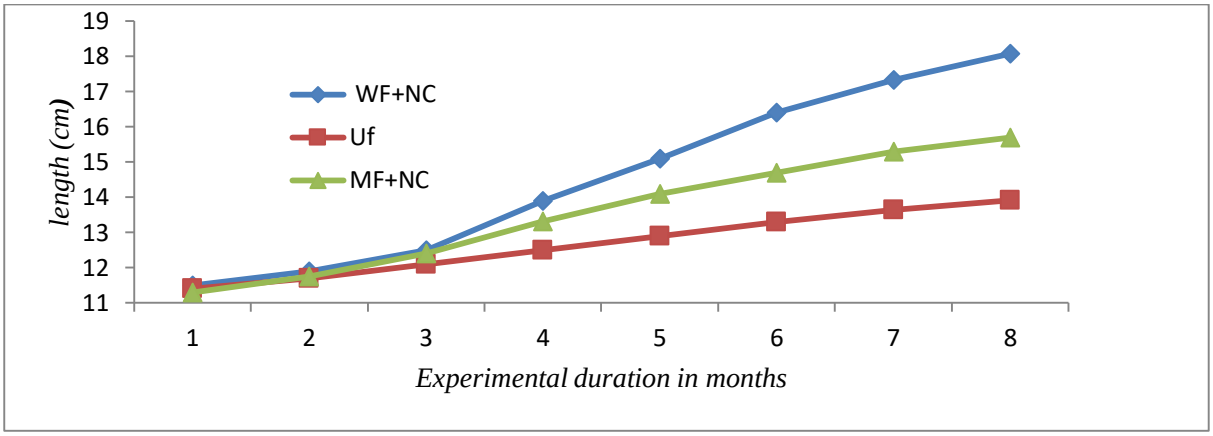


**Fig. 2:** Growth in total length of *O. niloticus* fed with different locally available feeds in concrete ponds. (Control group, WF- wheat flour, MF- maize flour and NC- noug cake).

During the experimental period, certain water quality parameters like dissolved oxygen (D.O), pH, temperature and turbidity were checked on a regular basis and the mean values were presented blow (Table 2). The mean values of D.O and pH showed slightly the same, however, the mean value of Seechi depth of a reference group showed higher (25cm) than the treatment groups (14-15cm). Moreover, the water temperature was varied from 18-26°C, which was related to seasonal variation. For instance the value of the water temperature was below 21°C in the month of July to September.

**Table- 2:** The mean value of some water quality parameters measured during the experiment

| *Treatments* | *D.O (%)* | *pH* | *Temperature (°C)* | *Seechi depth (cm)* |
|---|---|---|---|---|
| *WF+NC* | *7.8* | *7.73* | *18-26* | *14* |
| *Control group* | *8.2* | *7.91* | *18-26* | *25* |
| *MF+NC* | *7.6* | *7.86* | *18-26* | *14.8* |

***WF- wheat flour, NC- noug cake,and MF- maize flour***

## DISCUSSION

*Oreochromis niloticus* fed with WF+NC and MF+NC showed remarkable variation on growth performance between the test groups and the reference group (Tablae1 and Fig. 1). Fish supplied with supplementary feed grew significantly better than the reference group, which was left without any supplementary feed (ANOVA, $P<0.001$). Similarly, a significant difference between the test groups was resulted. Among the experimental groups, fish fed with WF+NC grew significantly better than fish fed with MF+NC (ANOVA, $P<0.05$).

Obviously, feed is one of the main factors that determine the growth of fish. Growth depends on a number of various factors amongst which food ration and the weight of the fish are of special importance. As described by Balfour[12], in control group sufficient feed both for maintenance (respiration, blood circulation, excretion, osmoregulation, digestion and movement) and growths inhibits or entirely cease the growth of the fish. Therefore, it is not surprising that in the present study, fed fish showed significantly better growth performance compared to unfed fish (Table 1). This result in agreement with the study reported on growth performance of *O. niloticus* in cage culture system in Lake Kuriftu by Ashagrie Gibtan[3], Lake Elen by Abebe Tadesse[13] ; Lake Babogaya by Belsti Fetene[14] and Solomon Hailu[15]. However R.Moav *et al.*[16], reported that there was no significant difference in

growth of cultured fish with and without supplemental feeding, which was probably due to lower densities of stocked fish[17]. Furthermore, in the present study direct intake of feeds by the fish provides more nutrients resulting in better growth and production. Moreover, addition of supplementary feeds can elevate the level of organic nutrients that favor the growth of flagellate phytoplankton which are good quality food for the fish.

Growth trends of *O. niloticus* supplied with different supplemental diets and the reference group were presented in Fig.1. The rate of growth of fish appears to vary between months. This might be related difference in water temperature seasonally. The growth performance of the fish varied between months in all groups. Fish showed relatively slow growth rate between July and September and inclined after October. This difference may be attributed to change in season. The air temperature is relatively colder during the wet season between June and September and warmer in the dry season mainly starting from October. The difference in temperature will affect the feeding rate of fish and hence the growth rate. This has been reported in a study conducted under controlled system in aquaria[13] [1]. Similarly, lower growth rate of *O. niloticus* fingerlings were observed during cold months in natural lakes in the Ethiopian Rift Valley[3,18].

Even though, the present study resulted in significantly difference on the growth performance of *O. niloticus* among the test and reference groups, the overall fish performance was poor. The poor growth of the fish resulted was probably affected by different factors, low crude protein content of the test feed which was about 21%, this level of crude protein even not control group sufficient for the maintenance of the fish[11], noted that feeds for fry and fingerlings frequently greater than 35% crude protein while maintenance diets may contain as little as 20-30%.

***Environmental conditions:*** In the present study, the water temperature of the experimental ponds was ranged from 18°C to 26°C. These values were partially in the preferred range of temperature recorded for Nile tilapia. These results are in agreement with those of A.F.M. El-Sayed[19] ; who noted that optimal water temperature for optimum growth Nile Tilapia is 21-28°C except the values recorded in July – September (below 21°C) . However, values of water temperature were not in agreement with A.Saber *et al.*[20] found that the optimal temperature for growth of Nile Tilapia was 26-34°C. Changes in pH values of water during the experimental period indicated that the minimum pH value was 7.73 and the maximum pH was 7.91 (Table.2). This range was in the optimum values of pH recorded for Nile tilapia[20] . Table 2 further shows that the minimal and maximal values of dissolved oxygen were ranged from 7.6 to 8.1 mg $L^{-1}$. This range was suitable for Nile tilapia feeding and growth, which was in agreement with[20], showed that Nile tilapia produced the best growth rate when DO ranged from 7 to 8.3 mg $L^{-1}$**.**

The pond water transparency of the experimental ponds was measured, higher seechi depth in the reference pond than the treatment ponds was resulted (Table 2). Supporting the seechi depth result, treatment ponds look greenish while the control group remained transparent (personal observation) indicating that uneaten fish feed initiated the growth of phytoplankton in the treatment ponds and no feed was given to the control group which was resulted less phytoplankton growth.

## CONCLUSIONS

In the present study, supplementation of locally available feed like wheat flour, nuag cake, and maize flour were resulted in better growth performance of *O. niloticus* in concrete ponds compared to the unfed group. However, the growth rate and the final body weight of the fish in experimental duration were generally lower than similar studies reported previously in Ethiopia. The poor growth of fish might be attributed to a combination of factors including low water temperature, low crude protein level content of the test feed and social behavior of the fish. Hence, more detailed studies need to be

conducted in order to investigate these aspects under different agro-ecologies and pond management in the future.

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