EFFECTS OF MASH FEED, SINKING FEED AND FLOATING FEED ON GROWTH PERFORMANCE, FEED UTILIZATION AND HEMATOLOGY OF NILE TILAPIA (*Oreochromis niloticus*)

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Abstract:

The present study was conducted to evaluate the effects of mash feed, sinking feed and floating feed on growth performance, feed utilization and hematology of Nile tilapia (*O. niloticus*). The study was assigned in Completely Randomized Design (CRD) with three treatments and four replicates. Fish with average weight 13.30± 0.85 g. (means ± SD) were fed three experimental diets mash feed, sinking feed and floating feeds that had same feed formula and proximate composition. The fish were fed experimental diets at the rate of 3.0-5.0 % of their body weight per day, twice daily for four weeks. At the end of the experiment, there were no significant (P>0.05) differences between the treatments in weight gain (WG), average daily gain (ADG), feed conversion ratio (FCR). Specific Growth rate (SGR) was significantly (P< 0.05) different among the treatments. The high SGR was found in fish fed floating feed, followed by fish fed sinking feed, whereas lower value was found in mash feed. Fish fed floating and sinking feed exhibited a significant (p<0.05) higher level of serum protein. In this case, the level of serum protein was lower in mash feed. However, no significant differences (P>0.05) were observed for red blood cell (RBC) count, hemoglobin (Hb) concentration, hematocrit (Ht) percentage and immunoglobin (IgM) level. Results from this study demonstrated that fish fed floating and sinking feed both had better growth performance (p<0.05) than fish fed mash feed.

Keywords: Feed type; Growth performance; Hematology; Nile tilapia

Introduction

The Nile tilapia, *Oreochromis niloticus* is considered as one of the most important species of fish in tropical and sub-tropical aquaculture (FAO, 2012). Today, tilapia has become the shining star of aquaculture and also popularly known as ‘aquatic chicken’ and the rate of consumption has increased across the globe (Fitzsimmons, 2005). Regardless of the profits and advancement of aquaculture, this industry faces a number of problems, including high feed cost, disease and environmental pollution due to excessive uses of fish feed (FAO, 2009). The feed used in most of the commercial tilapia culture operations in Bangladesh and Thailand are floating, sinking and mash type feed. Those countries culture tilapia by purchase or production of sinking, floating and mash feeds on farms. Floating diets are usually more expensive than sinking or mash feed because of extrusion process during feed production, needs high temperature, high pressure then the extra cost add. On the other hand, sinking and mash feeds rather less expensive to produce than the floating feeds. So farmers need less investment in fish farming. There are some observations on field level that some farmers prefer floating diets for feeding tilapia because it provides opportunity to observe satiation level of the fish. But sometimes due to higher turbidity of water body which hinder water visibility that makes impossible for farmers to observe satiation level of tilapia, as a result excluding the need for relying on floating feed. Previous studies in halibut, *Hippoglossus hippoglossus* have demonstrated that growth, nutrient utilization and production are affected by the form of the diets used (Suontama *et al*., 2007). Limbu **(**2015**)** found inconsistence results in *Clarias gariepinus* when floating and sinking feeds are compared on their effect on growth, nutrient utilization and yield, found similarity in mean weight gain and daily feed intake for fed on floating and sinking feeds. Good quality feeds help farmers to culture fishes for high growth and high profits (FAO, 2015). Good quality floating, sinking and mash feeds are crucial to the development and success of a tilapia farming industry. Floating feeds are high cost than sinking and mash feed but farmers may be convenient by feed management or by others means that floating feed more favorite for tilapia culture. But many farmers are still doubtful about the effectiveness of floating feed. Most of the research are conducted in consideration of the culture techniques of *O. niloticus* but few studies have been run to explore the feeding habit of tilapia in order to recommend the convenient feed for this species culture among floating, sinking and mash diets. For this reason famers do not know which feed to choose for *O.niloticus* culture due to scarcity of published scientific information on growth performance, nutrient utilization when this species of fish is fed on floating, sinking and mash feeds. This has been costly to Nile tilapia farmers since they tend to use the costly floating feeds. So it is mandatory to search a suitable and profitable type of feed that will meet up the Tilapia farmer's demand which ultimately go in line with food security. In order to estimate the available nutrients derived from the feed to maximize the fish culture potential, it is essential to quantify the output from feed input to the cultured fish. Hence the present study was undertaken to study the effects of mash feed, sinking feed and floating feed of Nile Tilapia in order to recommend the appropriate feed types.

Materials and Methods

Animals

A total of 120 fingerling Nile Tilapia (*Oreochromis niloticus*) with average weight of 13.30 ± 0.85 g were obtained from Private Hatchery, NakornPathom, Thailand. After transportation, fishes were acclimated in 1,000 L fiber tank for 7-10 days with mash feed prior to the initiation of the experiment.

Experimental diets

In this experiment, one feed formula was used to form three types of feed, mash feed, sinking feed and floating feed. The floating feed was nursery feed, commercial fed, size 2-3 mm. from Betagro feedmill, Samutprakarn, Thailand. Sinking feed was produced by grinding the floating pellet to fine ground then re-pelleted by mincer to form sinking feed and dry by hot air oven at 80 ^{o}C for 12 hr. The mash feed was produced by grinding the floating pellet to fine ground then add water to form the dough before use. Proximate compositions of the experimental diets base on dry matter were the same that was 0% moisture, 47.48 % crude protein, 11.18 % crude lipid, 12.90 % ash, 3.09 % fiber, 25.35 % NFE as starch and sugar, 2.60 % calcium, 1.50 % phosphorus.

Experimental design

The trial was assigned in completely randomize design (CRD) of three treatments and four replicates, T1 Mash feed, T2 Sinking feed, T3 Floating feed.

Experimental condition

A total of 120 fingerling of Nile Tilapia (*Oreochromis niloticus*) were randomly distributed 10 fish to each of 12 glass aquarium of 120 L. All experimental units were supplied with filtered water and continuous uniform aeration was given through the air-diffuser stones. Throughout the trial water in each aquarium (about 80%) was exchanged every two days. Water was exchanged just before feeding in morning and 1 h after feeding in evening. Each experimental feed was fed to fish at 3-5% body weight at the same amount for each treatment and each replicate. The amount of feeds required for each day was divided into two parts and feed twice per day for four weeks. After 30 minutes of feeding unconsumed feeds were siphoned out and dried to determine the exact feed consumption. Total weight of fish in each aquarium was estimated every week and the amount of feed fed to fish was adjusted accordingly.

Data collection

Growth performance

At the end of the four weeks of feeding trial, fish were starved for 24 hours, after that they were then counted and weighed to determine the weight gain (WG), average daily gain (ADG), specific growth rate (SGR), feed conversion ratio (FCR) and survival rate. The following indices were calculated as the follows:

Survival rate (%) = (final no. of fish /initial no. of fish) x 100

Weight gains (WG, g / fish) = final live weight of fish – initial live weight of fish

Average Daily Growth (ADG, g/day) = net weight gain/rearing period

Specific growth rate (SGR, % body weight/day) = [ln final fish weight - ln initial fish weight] x 100/ culture period

Feed intake/feed given (FI, g/fish) = Dried feed given weight per aquarium/number of fish in aquarium

Feed intake per day(FIPD, g/fish/day) = Dried feed given weight per aquarium/(number of fish in aquariumXrearing period)

Feed Conversion Ratio (FCR) = dry feed consumed / wet weight gain

At end of the experiment, three fishes were randomly chosen from each tank and were anaesthetized using clove oil. About 1.0 ml of blood was drawn from the caudal vein, using a 2.0 ml syringe with 26-G needle (Hawk *et al*. 1965). Three fish from each replicate were anesthetized with clove oil and blood was collected from the caudal vein using a syringe with EDTA as an anticoagulant. For serum, another three fish from each replicate were anesthetized and blood was collected without anticoagulant and left to clot. Then the clotted blood was centrifuged at 4000 × g for 10 min to separate the serum. The blood samples were used to analyzed red blood cells (RBC), hemoglobin (Hb) and hematocrit. RBC were counted with a hemocytometer under the light microscope. The estimation of hemoglobin was done according to the method of Drabkin & Austin (1935). Hematocrit was measured using hematocrit capillary tubes spun in Gemmy model KHT-410E Hematocrit Centrifuge. Total serum protein and immunoglobin were measured following the method of Lowry *et al.* (1951) using BSA as the standard protein.

The feeding trial and all analysis were conducted at Nutrition and Aquafeed Laboratory, Department of Aquaculture, Kasetsart University, Bangkok, Thailand.

Statistical Analysis

All mean value data were analyzed using one-way analysis of variance (ANOVA) to compare significant differences between treatments. Duncan multiple range tests was used to compare the means of the treatment. The treatment effects were considered to be significant at $p<0.05$. The standard deviation of each parameter and treatment was determined and expressed as the Mean ± SD. All statistical analysis performed using statically software.

Results and Discussion

Growth performance of Nile tilapia fed different experimental diets for four weeks was shown in Table 1 and Figure 1. The different feed types had no significant ($p>0.05$) effects on the final weights, weight gain (WG), average daily gain (ADG) and food conversion ratio (FCR) but had significant ($p<0.05$) effects on the specific growth rate (SGR) where floating and sinking feed were significantly higher ($p<0.05$) than the group of mash feed. The present experiment clearly demonstrated the beneficial effects of floating and sinking feeds on the performance of Nile tilapia although feed contain the same nutrient concentration and fed the same amount. In this experiment, though, there were no significant differences in the growth parameters in term of WG, ADG, FCR among the type of feed but every numerical value of these parameters tended to be higher ($p=0.07$-0.09) than those group of fish fed mash feed. In laboratory condition of small aquarium and shallow water depth, it is easy for the fish to go to consume feed that sinking or lay on the bottom then feed intake was not big different. Fish got the same amount of feed and nutrients for promote their growth. Tilapia are able to consume floating and sinking pellets very effectively. According to a study, sinking pellets were better utilized than unpelletized feeds like mash feed (Allison *et al.*, 1979). David *et al.* (2017) reported that floating feed is better for the growth performance of African catfish fingerlings. Similarly *et al.* (2006) demonstrated that extruded pellets are better than paste diet for the growth performance and water quality management in juvenile olive flounder aquaculture. In the present study, all growth parameters in fish fed mash feed lower than the other groups due to low water stability of mash feed and high nutrient leaching of it before fish consume the feed. This results was in accordance with the study of Kim & Sin (2006) in juvenile olive Flounder.

Table 1: Growth performance and nutrient utilization of tilapia fed mash, sinking and floating feed over the experimental period

Parameters	T1: Mash feed	T2: Sinking feed	T3: Floating feed	P-value
Initial weight (g/fish)	13.68±0.87	13.05±0.68	13.17±1.07	0.584
Final weight (g/fish)	28.90±0.20	31.41±2.21	31.99±4.10	0.276
Weight gain at final (g/fish)	15.22±0.72	18.36±1.86	18.82±3.32	0.096
Average daily gain (g/fish/d)	0.54±0.03	0.66±0.07	0.67±0.12	0.090
Specific growth rate (% /day)	2.68±0.21[b]	3.13±0.20 [a]	3.16±0.29 [a]	0.032
Feed intake/ feed given (g/ fish)	21±00	21±00	21±00	1.000
Feed intake per day/ feed given per day (FIPD) (g/fish/day)	0.75±00	0.75±00	0.75±00	1.000
Feed conversion ratio	1.38±0.06	1.15±0.10	1.14±0.18	0.074
Survival rate (%)	100±00	100±00	100±00	1.000

Note :Different superscript letters a, b in the same row indicate significant difference (P<0.05).

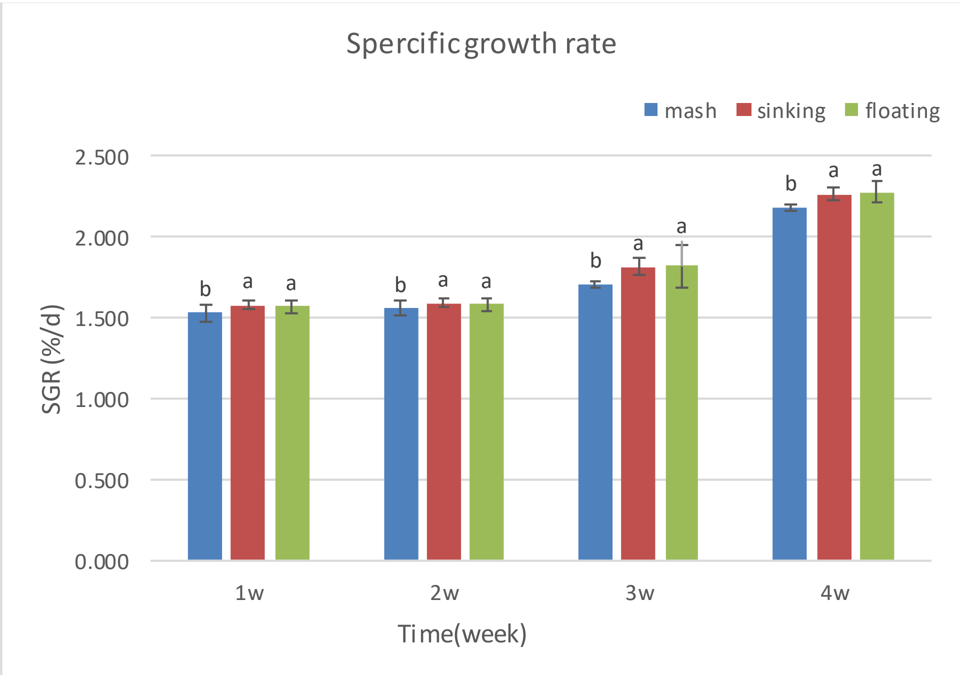

Figure 1: Specific Growth Rate of Tilapia over the experimental period.

The hematological parameters of Tilapia fed three types of feed was presented in Table 2 and Figure 2. Hematological parameters can be used as an index of health status of fish (Blaxhall, 1972). Routine examination of blood parameters has been used in earlier studies to assess fish health status and circumstantial stress (Hesser, 1960; Blaxhall, 1972; Blaxhall & Daisley, 1973; Casillas & Smith, 1977). The results of this study showed that the different feed types had no significant (p>0.05) effects on Tilapia health when focusing on hematological parameters in term of the RBC count, Hb concentration, Hct percentage and IgM level but had significant ($p<0.05$) effect on the serum protein level where mash feed was significantly lower than those groups of sinking and floating feed. The present study has been indicated that serum protein level in the group of fish fed mash feed was significantly lower than those group of sinking and floating feed because fish might be always in stressful condition due to feed competition. Mash feed had lower water stability in water so feed mater and nutrient dissolved in water before fish consumption then caused poor water quality and induced fish stress (Kim & Sin, 2006). Lee *et al.* (2016) investigated on the effects of extruded pellets and dough Type Diets and reported that fish fed dough diet indicating that extruded diet was probably pollution free and environmentally friendly. In this instance, sinking and floating feeds could be the right choice to increase total fish production, minimize production cost including promote fish health.

Table 2: Hematology studies of tilapia fed mash, sinking and floating feed over the experimental period.

Parameters	T1:Mash feed	T2:Sinking feed	T3: Floating feed	p-value
Red Blood cell count ($x10^5$ cell/mL)	1.41±0.43	1.90±0.92	2.04±1.14	0.593
Haematocrit (%)	24.00±2.58	27.00±4.69	28.00±7.07	0.540
Hemoglobin (g/dL)	23.90±4.65	26.84±6.91	27.01±2.86	0.637
Serum Protein (g/dL)	1.66±0.93 ^{b}	3.72±0.94 ^{a}	5.02±0.78 ^{a}	0.001
Immunoglobin (IgM; g/L)	0.19±0.07	0.08±0.06	0.06±00	0.093

Note :Different superscript letters a, b in the same row indicate significant difference ($P<0.05$).

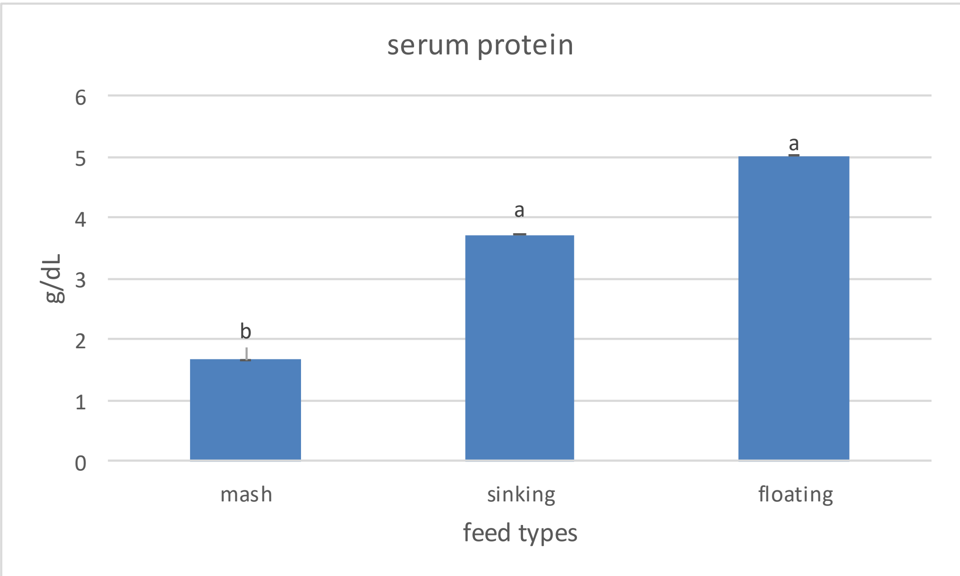

Figure 2: Serum protein of Tilapia over the experimental period

Conclusion

In conclusion, results from the present study, showed the beneficial effects of sinking and floating feeds over commonly used mash feed in enhancing growth performance of Nile tilapia and fish health.

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