Islam, M.S.; Kamal, M.A.H.M.; Mustafa, M.G.; Rashed-Un-Nabi, M. and Kamal, D. 2007. Usability of feed mill sweepings as a substitute to commercially formulated feed in gift tilapia culture. *Khulna University Studies*, 8(2): 261-267.

Khulna University Studies, 8(2): 261-267, 2007

RESEARCH ARTICLE **LIFE SCIENCE**

Copyright © Khulna University

USABILITY OF FEED MILL SWEEPINGS AS A SUBSTITUTE TO COMMERCIALLY FORMULATED FEED IN GIFT TILAPIA CULTURE

M. Shafiqul Islam[1], Md. A.H.M. Kamal[1], M. Golam Mustafa[1], Md. Rashed-Un-Nabi[1] and Dipak Kamal[2*]

[1] *Institute of Marine Sciences and Fisheries, University of Chittagong, Chittagong 4331, Bangladesh*
[2] *Fisheries and Marine Resources Technology, Khulna University, Khulna 9208, Bangladesh*

KUS 07/34-021007
Manuscript received: October 2, 2007; Accepted: December 9, 2007

Abstract: Feed mill sweepings (FMS) were used as the substitute of the commercially formulated feed (FF) for rearing GIFT Tilapia. The average moisture, crude protein, fiber and carbohydrate, fat and ash content of the FMS were 13.23%, 34.92%, 26.07%, 5.96% and 19.80% respectively. For FF these values were 14.83%, 28.49%, 31.57%, 8.71% and 16.41% respectively. No significant differences was observed in the proximate biochemical composition between FMS and FF. Average total weight gain in 60 days was observed to be 47.22 g and 53.45 g for FMS and FF respectively with no significant difference. The mean instantaneous growth rate per day was found 4.15±0.96% for FMS and 4.32±1.03% for FF respectively. The survival rate was 83% for FMS and 84% for FF respectively. A comparatively lower FCR that achieved with FMS (1.91) over the FF (1.97) suggested that feed mill sweepings can be used as a substitute to formulated feed in GIFT tilapia culture.

Key words: feed mill sweepings, formulated feed, GIFT tilapia, growth, FCR

Introduction

GIFT (Genetically Improved Farmed Tilapia), a Nile tilapia strain belongs to the genera *Oreochromis*, was invented by ICLARM (International Center for Living and Aquatic Resource Management) (Dey *et al*., 2000) through a neutral technology that requires small quantity of feed and fertilizer and returns maximum net benefits in comparison to normal strain (Acosta *et al*., 2001). It was brought from the Philippines to Bangladesh in 1994. It is a mouth breeder and easily cultivable in large or small ponds. Growth of GIFT tilapia is 50–60% higher than other tilapia (Mazid, 2002). It attains marketable size of 300-400 g within 3–4 months. It has become a high demand fish in Asian markets due to its superior quality i.e. better taste, higher growth rate, lower FCR (Feed Consumption Ratio and short culture period in comparison to other strains or species of tilapia (Acosta *et al*., 2001).

* Corresponding Author. E-mail: <dipak_kamal_ku@yahoo.com>; Cell: 01552-484122
DOI: https://doi.org/10.53808/KUS.2007.8.2.0734-L

Supplementary feeds provide additional nutrients to cultivable fish when natural productivity of pond water becomes insufficient for the desired growth. Therefore, use of supplemental feed is essential in commercial aquaculture to ensure net return (Diana, *et al.,* 1994). Feed constitute the largest single cost item in aquaculture which is usually about 40–60% to the total cost (Mitra *et al.,* 2005).

Formulated feed (FF) is the specially prescribed supplemented feed for a specific species of fish. Feed requirement varies by species, size, life stages and stocking density. On the basis of requirements, different nutrients like carbohydrate, protein, lipid, fat, vitamin, and minerals etc. are added in a certain ratio to meet nutritional requirement of the selected fish species.

Feed mill sweepings (FMS) are the residue or feed mill dust produced during the production of formulated feed (FF) in factories. It contains ingredients (e.g. trash fish, soybean meal, oil seed, oil cake etc.) more or less similar to that of FF. During the production of FF a bulk of FMS is also produced as by product. Considering it as a powdery waste, it is usually dumped without any consideration of its proper utilization. It is expected that FMS contains reasonable amount of proteins, carbohydrates, ashes with low amount of moisture, fat and vitamin. Therefore, FMS may give a growth rate similar to that of FF.

Aquaculture in Bangladesh has increased many folds over the last two decades to meet the protein requirement of her growing population. Fish farming has become one of the most profitable businesses across the country. Therefore, the demand for supplemental fish feed has increased significantly. In order to meet the growing demand, a number of fish and shrimp feed industries have been established in the country over the last decade. However, due to high price of the FF the majority of the small and marginal fish farmers can not provide it in their ponds. In this context, FMS would be a good alternative to poor fish farmer who can collect it free or at a very low cost. Keeping this view in mind, the present study was carried out with the following objectives – (i) to compare the biochemical composition of FF and FMS, and (ii) to compare the growth performance of GIFT tilapia using the FF and FMS.

Materials and Methods

The experiment was conducted over a period of nine months from September 2003 to May 2004 in 6 earthen ponds test the performance of FMS as replacement of FF on the weight gain, growth rate and FCR of GIFT tilapia in two treatments with 3 replications. The selected ponds were dewatered and dried for 7 days. After liming at a rate of 250 kg ha^{-1} (Uddin, 2007) ponds were filled with rain water. One meter water level in the experimental ponds was maintained through a control inlet and outlet system.

Prior to stocking fry in the ponds the pH, DO and temperature of pond water were recorded following the standard methods of APHA (Anon, 1976; Bardach *et al.,* 1972). The same parameters were recorded at each sampling date after stocking at 15 days interval up to 60 days of experimental periods.

Immediately after collection of the GIFT fry, initial average weight of the individual fry was measured nearest to 0.01 g with an electronic single pan balance. Fries were acclimatized for two

hours prior to stock in the experimental ponds at a density of 7 individuals m^{-2} and reared for two successive months. Total weight gain, growth rate and FCR of the experimental fish with 2 feeds were measured at every 15 days after stocking. FMS was used as test feed (T_1) and a commercial FF was used as control (T_2). Both the FMS and FF were collected from the same fish feed industry.

Experimental design

Parameters	Description
Test species:	GIFT tilapia.
Test feeds:	Treatment 1 (T_1): Feed mill sweepings (FMS). Treatment 2 (T_2): Formulated feed (FF).
No. of ponds used:	Treatment 1 (T_1): 3 ponds (P_1 – P_3); Treatment 2 (T_2): 3 ponds (P_4 – P_6).
Pond size and depth:	30 m^2 and 1 m respectively.
Stocking density:	7 Individual m^{-2}.
Feeding rate:	12% of fish biomass day^{-1} in 2 rations.
Feeding time:	Morning (8 am; 6%); Afternoon (4 pm; 6%).
Fish parameter tested:	Weight gain, growth rate and FCR.
Culture period:	60 days.
Sampling period:	2 weeks interval from stocking date.

* Results were compared at 5% level of significance.

The proximate biochemical composition (protein, fiber and carbohydrate, fat, moisture and ash) was estimated for both the FMS and FF following Nabi *et al.* (2001).

Both the feed were given every day in the morning and afternoon at a rate of 12% biomass of the test fish throughout the rearing period. Feed was given through spreading on the surface water of the ponds.

The growth performance was monitored by measuring the weight of sixty (60) individual randomly for each pond. Specific growth rate was calculated using the following formula (Alam, 1990):

$SGR = \frac{\ln W_2 - \ln W_1}{T_2 - T_1} \times 100$ Where W_1 & W_2 are the body weight in gram at time T_1 and T_2 respectively and were expressed as percentage per 15 days.

Feed conversion ratio (FCR) i.e. the efficiency of each feed was determined by measuring the amount of feed used to produce a unit of fish following the formula:

$F.C.R = \frac{Dry\ wt.\ of\ feed\ used}{Wet\ wt.\ gain\ (fish)}$ (New, 1987)

The survival rate was calculated using the following formula:

$Survival\ Rate = \frac{total\ number\ of\ species\ harvested\ at\ the\ end}{total\ number\ of\ species\ stocked\ at\ the\ begining} \times 100\%$

Statistical analysis: To compare proximate biochemical composition of two feeds student's 't' test was applied (Gupta, 1997). Similar statistical test was performed to test significant difference between FMS and FF in terms of absolute weight gain, growth rate and FCR in GIFT tilapia.

Results

Among the water quality parameters in six experimental ponds, DO varied from 7.02±0.92 to 7.23±0.89 mg l^{-1}, water temperature varied from 25.75±1.92 to 29.25±1.95 °C and pH varied from 6.37±0.21 to 6.75±0.43 during the rearing period. Water quality parameters between the two treatments did not show any significant difference (Table 1).

Table 1. Water quality parameters in different treatments.

Values	DO		pH		Temperature °C	
	T_1	T_2	T_1	T_2	T_1	T_2
Min	5.9	6.3	6	6	23	27
Max	8.3	8.5	6.5	7	28	32
Mean	7.02	7.23	6.37	6.75	25.75	29.25
SD	±0.92	±0.89	±0.21	±0.43	±01.92	±01.95

The moisture, crude protein, fiber plus carbohydrate, fat and ash content of FMS were found to be 13.23%, 34.92%, 26.07%, 5.96% and 19.80% respectively. While in FF these values were 14.83%, 28.49%, 31.57%, 8.71% and 16.41% respectively. The crude protein and ash content were higher in FMS (Fig. 1). However, no significant differences in the proximate composition were observed between FMS and FF.

Results of feeding trials with FMS (T_1) and FF (T_2) are shown in Table 2. The initial average weight of the fingerlings in T_1 and T_2 was recorded at 1.5±0.23 g and 1.5±0.29 g respectively. After 60 days of experiment, mean final weight of the GIFT tilapia was 18.14±0.17 g and 20.08±0.55 g in T_1 and T_2 respectively. Final total weight of the biomass of each pond was found to be 3011±55.61 g in T_1 and 3372±41.62 g in T_2 (Table 2). The FCR in T_1 and T_2 were found to be 1.91 and 1.97 respectively (Table 3).

Table 2. Results of feeding trials with formulated feed T_2 and feed will sweepings T_1*.

Days	15		30		45		60		Mean ± SD
Treatment	T1	T2	T1	T2	T1	T2	T1	T2	
Average individual weight (g)	2.28 ±0.04	2.42 ±0.23	4.63 ±0.18	5.58 ±0.15	10.32 ±0.32	11.93 ±0.25	18.14 ±0.17	20.08 ±0.55	8.84 ±7.06
Individual weight gain (g)	0.78 ±0.04	0.92 ±0.23	2.34 ±0.23	3.16 ±0.37	5.7 ±0.39	6.36 ±0.39	7.82 ±0.49	8.14 ±0.79	10 ±7.8
Total weight gain (g)	146 ±5.31	168 ±43.65	410 ±39.62	562 ±61.24	981 ±85.55	1110 ±60.36	1297 ±73.26	1367 ±113.08	47.22 ±35
Total biomass weight (g)	424 ±3.81	443 ±46.34	809 ±37.48	992 ±17.32	1776 ±90.69	2084 ±53.63	3011 ±55.61	3372 ±41.62	53.45 ±35.97
Total weight gain per day (g)	9.70 ±0.35	11.21 ±2.91	27.31 ±2.64	4.70 ±0.39	65.37 ±5.7	74 ±4.02	86.49 ±4.88	91.12 ±7.54	4.15 ±0.96
Instantaneous growth rate (%)	2.80 ±0.13	3.16 ±0.64	37.46 ±4.08	5.59 ±0.81	5.35 ±0.36	5.07 ±0.31	3.76 ±0.27	3.47 ±0.32	4.32 ±1.03

*During stocking initial average weight per species was 1.5±0.23 g and 1.5±0.29 g in T_1 and T_2 respectively.

Total weight gain per day (g) per phase using two types of feed has been shown in Table 2 (Fig. 2). The mean of the total weight gain per day in T_1 and T_2 were found to be 47.22±35.00 g and 53.45±35.97 g respectively (Table 2). No significant difference was observed ($p>0.05$) in the mean of the total weight gain per day per phase between two treatments.

No significant difference was observed in average body weight between the two feed treatments (Fig. 3). Similar result was also noticed for the specific growth rate using two feed treatments in experimental fish (Table 2; Fig. 4).

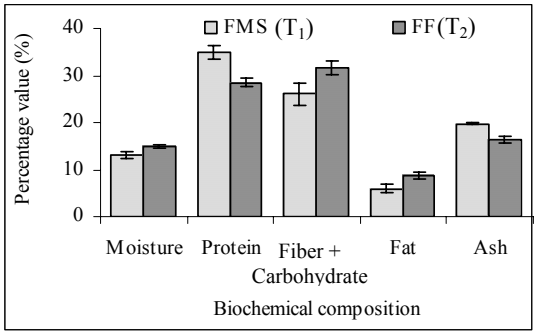

Fig. 1. Biochemical composition of FMS and FF used in two treatments in rearing of GIFT tilapia in earthen ponds.

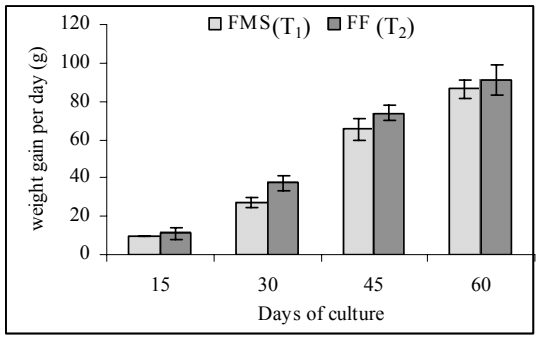

Fig. 2. Total weight gain per day over 60 days of culture of GIFT tilapia in FMS and FF.

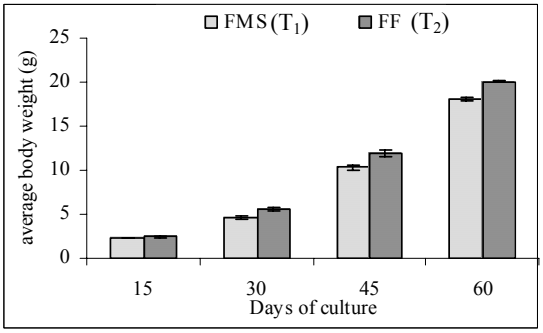

Fig. 3. Average body weight over 60 days of culture of GIFT tilapia in FMS and FF.

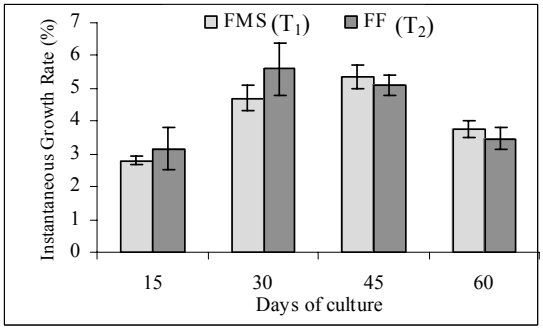

Fig. 4. Instantaneous growth rate over 60 days of culture of GIFT tilapia in two treatments.

Table 4. Feed conversion ratio in FMS and FF.for rearing GIFT tilapia in 60 days.

Day	15		30		45		60	
Treatment	T1	T2	T1	T2	T1	T2	T1	T2
Number of harvested fish pond^{-1*}	186	183	175	178	172	175	166	168
Mean individual weight (g) ±SD	1.50 ±0.23	1.50 ±0.29	2.28 ±0.04	2.42 ±0.23	4.63 ±0.18	5.58 ±0.15	10.32 ±0.32	11.95 ±0.55
Feed applied day^{-1} individual^{-1}	0.18	0.18	0.27	0.29	0.56	0.67	1.24	1.43
Total feed required day^{-1} pond^{-1} (g)	33.48	32.94	47.97	51.64	95.47	117.11	205.60	240.91
Total feed required per 15 days (g)	502.20	494.10	719.60	774.66	1432.07	1756.65	3083.95	3613.68

* Initial stocking of fish was 200 individuals pond^{-1}.

Higher survival rate was observed in case of FF (84%) when compared to the survival rate using FMS (83%) (Table 5). The FCR values for FMS and FF were found to be 1.91 and 1.97 respectively which showed a better FCR for FMS in comparison to FF (Table 5).

Table 5. Final survival and FCR in FMS and FF.for rearing GIFT tilapia in 60 days.

Parameter	FMS	FF
Total of the applied feed for 60 days (g)	5738	6639
Total weight of the harvested fish (g)	3011	3372
Survival rate (%)	83	84
FCR	1.91	1.97

Discussion

There was no significant difference between the proximate biochemical compositions of FMS and FF used in this experiment. Halver (1989) proposed that, in general, a fish feed must contains a proximate composition at– moisture between 11% and 13%, protein between 28% and 32% and ash between 15 % and 18%. The biochemical compositions for both types of the feeds used in the present study were found within the suggested range (Halver, 1989). However, the ash content in the FMS (19.79%) was a bit higher than that of required level. This may be due to the presence of considerable amount of other dust particle in the FMS.

Hysmith *et al.* (1972) suggested that feeds containing either 'low protein-high energy' or 'high protein-low energy' gave better growth rate. Both types of feed used were in the category of 'high protein-low energy' diet and thus a better growth rate was observed with both types of feeds in the present study.

Fish growth achieved with both the FMS and FF was found satisfactory in the present study. After 60 days the individual average weight of Tilapia fish in FMS and FF was found to be 18.02±3.0 g and 20.15±4.05 g respectively. Wane (2001) reported an average weight of 21.92 g in 58 days with standard formulated fish feed in GIFT tilapia. This result is similar to that of present investigation. An increased trend in growth rate confirms that both the feeds were nutritionally suitable for the GIFT tilapia. Statistical analysis of growth in terms of average weight increase and specific rate of growth between two feed treatments showed no significant difference.

According to Halver (1989) good quality feed gives an overall FCR value at ≤2 for common cultivable fish species. In the present study, the FCR for FMS was 1.91 while the value for FF was 1.97. Both the values found in the present study were very near to the values suggested by Halver (1989). On the other hand, present FCR values (1.91-1.97) were higher than the FCR value (1.27) for the same strain (GIFT tilapia) cultured in an intensive system (Ridha, 2006). However, during the present study FMS showed comparatively good FCR (1.91) than that of FF (1.97). On the other hand, the survival rate using FF was a bit higher compared to FMS which may be due to the high ash content in the feed mill sweepings.

Conclusion

FMS (feed mill sweepings) can be used as a diet of GIFT tilapia in replacement of high value FF (formulated feed) as they (FMS vs. FF) produced insignificant variation in mean biomass, growth rate and FCR. However, further investigation is needed with 120 days trial using both larvae and juvenile fish to establish the feed mill sweepings as a standard diet for GIFT tilapia. Thus, it may be concluded that apart from developing different feeding strategies, replacement of high value fish feed with low cost diet like FMS can lead to a significant savings in feed cost especially for the poor fish farmers of rural Bangladesh.

Islam, M.S.; Kamal, M.A.H.M.; Mustafa, M.G.; Rashed-Un-Nabi, M. and Kamal, D. 2007. Usability of feed mill sweepings as a substitute to commercially formulated feed in gift tilapia culture. *Khulna University Studies*, 8(2): 261-267.

References

Acosta, B.O.; Gupta, M.V.; Dunham, R. and Gardiner, P.R. 2001. Fish genetics research at ICLARM – The Worldfish Centre. pp. 97-102. In: Gupta, M.V. and Acosta, B.O. (eds.), *Fish Genetics Research in Member Countries and Institutions of the International Network on Genetics in Aquaculture*. ICLARM Conference Proceedings 64, Manila, The Philippines.

Alam, R. 1990. Formulation and analysis of two cheaper feeds for prawn and a comparative study on their effect on growth. MSc. Thesis, Institute of Marine Sciences, University of Chittagong, Bangladesh.

Anon. 1976. Standard Methods for Examination of Water and Wastewater. American Public Health Association, Washington DC.

Bardach, T.E.; Ryther, J.H. and MacLarney, W.O. 1972. *Aquaculture: the Farming and Husbandry of Freshwater and Marine Organisms*. John Wiley & Sons, New York, 867pp.

Dey, M.M.; Eknath, A.E.; Li, S.; Hussain, M.G.; Thien, T.M.; Hao, N.V., and Pongthana, N. 2000. Performance and nature of genetically improved farmed tilapia: a bioeconomic analysis. *Aquaculture Economics and Management,* 4(1/2): 85-108.

Diana, J.S.; Lin, C.K. and Jaiyen, K. 1994. Supplemental feeding of tilapia in fertilized ponds. *Journal of the World Aquaculture Society,* 25: 497-506.

Gupta, S.P. 1997. *Advanced Practical Statistics*. S. Chand and Company Ltd., New Delhi, India, 573pp.

Halver, J.E. 1989. *Fish Nutrition*. Academic Press, London. 798 pp.

Hysmith, B.T.; Booth, J.R.; Cook, H.L. and Mies, W.L. 1972. A study of the effect of feeding synthetic diets to Brown shrimp *Penaeus aztecus*. *Proceedings of the World Merciculture Society,* 3: 365-388.

Mazid, M.A. 2002. *Development of Fisheries in Bangladesh: Plan and Strategies for Income Generation and Poverty Alleviation*. Nasima Mazid Publisher, Dhaka, 176 pp.

Michael, R.G. 1969. Seasonal trend in physiochemical factors and plankton of fresh water fish pond and their role in fish culture. *Hydrobiologia*, 33: 144-160.

Mitra, G.; Mukhopadhyay, P.K. and Chattopadhyoy, D.N. 2005. Nutrition and feeding in fresh water prawn (*Macrobrachium rosenbergii*) farming. *Aqua Feeds: Formulation and Beyond*, 2 (1): 17-19.

Nabi, M.R.; Kader, M.A. and Hakim, M.A. 2001. Variations in the biochemical composition of *Polynemus paradiseus* Lin. at different stages of maturity. *Chittagong University Journal of Science*, 25(2): 55-60.

New, M.B. 1987. Feed and feeding of fish and shrimp–a manual of the preparation and presentation of compound feeds for fish and shrimp in Aquaculture. ADCP/REP/26, 275p.

Ridha, M.T. 2006. Evaluation of growth performance of non-improved and improved strains of the Nile tilapia (L.), *Oreochromis niloticus*. *Journal of the World Aquaculture Society,* 37(2): 218-223.

Uddin, M.S., 2007. Mixed culture of tilapia (*Oreochromis niloticus*) and freshwater prawn (*Macrobrachium rosenbergii*) in periphyton-based ponds. PhD Thesis, Wageningen University, The Netherlands, 209pp.

Wane, S.A. 2001. Evaluation of certain substances as growth promoting agents for fish and shrimp culture. *Indian Journal of Fisheries,* 33: 95-105.

Islam, M.S.; Kamal, M.A.H.M.; Mustafa, M.G.; Rashed-Un-Nabi, M. and Kamal, D. 2007. Usability of feed mill sweepings as a substitute to commercially formulated feed in gift tilapia culture. *Khulna University Studies*, 8(2): 261-267.