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Article

Study on proximate composition and nutritional quality of some farm made fish feed collected from Muktagacha, Trishal and Phulpur upazila in Mymensingh district

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Abstract: An experiment was conducted to evaluate the feed quality of farm made feed from three upazila of Mymensingh district for four months from July to October, 2015. Fish feed samples were collected from various farms at Muktagacha, Phulpur and Trishal upazila of Mymensingh district. Total 30 feed samples were analyzed to determine the proximate composition and quality of farm made feed. Only one feed sample (F- 27) contains less than 12% moisture found in Trishal upazila. Maximum moisture value (24.53%) was found in feed sample F-13 in Phulpur upazila which indicated that this feed is poor quality compared to others. These may due to lack of maintenance at processing and may be due to improper storage system. Only four feeds were found having more than 25% protein. The analyzed crude protein contents of fish feed varied from 10.85 to 27.30%. The highest protein content was observed in feed (F-20) (27.30%) and the lowest was found in 10.85% in feed (F-22). The mean crude lipid values of the analyzed fish feeds varied from 5.79 to 22.95%. Highest lipid content was observed in 22.95% in feed (F-19). The analyzed mean ash content of fish feeds varied from 8.41 to 20.99%. The fiber content was observed within 4.35-8.20%. Ash content of feed (F-22) was found higher (20.99%) than other feeds. The analyzed nitrogen free extract (soluble carbohydrate) content of farm made fish feeds varied from 18.62 to 43.25%. The highest nitrogen free extract containing feed (F-25) having 43.25% NFE. The findings of this study demonstrated that low quality feeds and ingredients were supplied to the fish farmers by majority of feed traders and the farms with few exceptions were bound to use those ingredients due to their manufacture constraints.

Keywords: inclusion; nitrogen free extract; quality; feed (f); production

1. Introduction

In the agro-based economy of Bangladesh, fisheries sector contributed 3.69% to national GDP and 22.60% to the agricultural GDP and more than 2% to foreign exchange earnings by exporting fish and fish products in 2013-14 (D_OF, 2015). Fish provides 60% of animal protein consumption. More than 11% of total population directly or indirectly engaged in the fisheries sector which accounts 17.8 million (D_OF, 2015). Bangladesh achieved a rank of 5th and 4th position in inland closed water fisheries production and inland open water fisheries collection, respectively among the top 20 aquaculture producing countries in the world (FAO, 2014) and accounting for 2.34% of the total global aquaculture production (BBS, 2010). It has been considered as the fastest growing food sector in the world.

Aquaculture has emerged as one of the most promising industries in the world with a considerable growth potential to improve human dietary standards by providing protein rich food and diversifying rural production and aquaculture potential (Dhawan *et al*., 1998). Carp polyculture is the most popular form of aquaculture practice in Mymensingh district. Water bodies of Bangladesh are known to be the habitat of 260 freshwater fishes, 475 marine fishes, 23 exotic fishes and a number of other vertebrates and invertebrates (Rahman, 2005).

Average fish production (2839 kg/ha) in aquaculture ponds and ditches of Bangladesh is still much lower than many other carp producing countries like China (4474 kg/ha) due to some constraints and problems in culture system (Dey *et al*., 2005; FRSS, 2009). To increase the production, we need to identify the existing constraints and problems first. But in Bangladesh, research on this issue is not satisfactory. It is essential that the feed should provide maximum production efficiency at a minimum cost. The growth rate and feed conversion efficiency will depend upon the quality of feed. The success of intensive and semi-intensive fish culture depends on a large extent to the application of suitable feeds. This demonstrates a real possibility of increasing production and reveals the potential importance of aqua feeds in Bangladesh. Therefore, aquaculture feeds have been considered a major sub-sector of the feed milling industry. There is no evaluation of the nutritive value of fish feed produced by different farms. The farmers have to depend only on the existing information about the raw ingredients composition and growth performance they observed.

From the economic point of view, feed cost appears to be one of the major constraints against the greater expansion of aquaculture (Kaushik, 1990). Maintaining the good health of farmed fishes is very important to get the expected yield from the unit culture area. So an extra care should be paid during the feed formulation for the cultured fish species as it determine the quality of the final crop of a farm. The importance of fish feed is increasing with the intensification of aquaculture. However, commercial fish production fully depends on quality feed. Feed costs generally constitute the highest single operation cost of semi-intensive or intensive grow-out farming operation (Shang and Costa-pierce, 1983). It is therefore of great importance to the fish farmers to utilize their investments in feed as optimal as possible. Different farmers formulate fish feed without proper knowledge on feed formulation. Government has a legal legislation but still has very less or no control over feed formulation; there is a great possibility of deceiving the farmers both in terms of nutritive value and feed cost.

2. Materials and Methods

The present investigation was conducted for a period of 4 months from July, 2015 to October, 2015 to find out the farm made feed quality of three upazila of Mymensingh district namely Muktagacha, Phulpur and Trishal (Figure 1) in Bangladesh. The farmers cultured different species of fish. Farmers of the area used both the farm made and commercial fish feed in their farms.

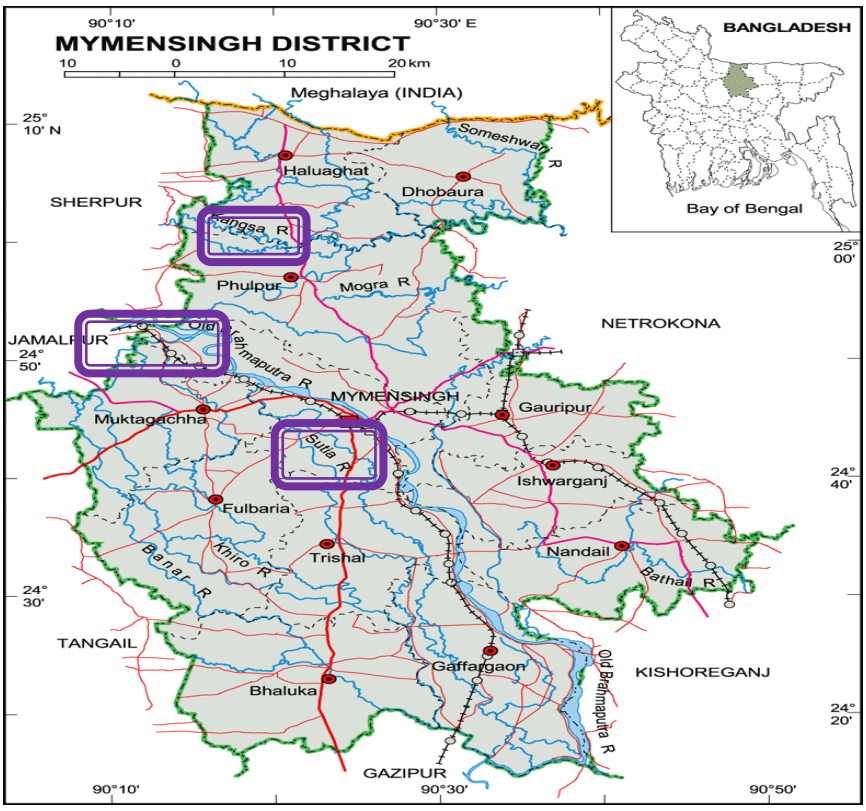

Figure 1. Study area of the interest.

2.1. Collection and storage of samples

Different farm made fish feed samples were analyzed in Fish Nutrition Laboratory of the Faculty of Fisheries, BAU, Mymensingh. For the present study a total of 30 farms information and feed samples 10 from farmers of Muktagacha upazila, 10 farm feed samples from farmers of Phulpur upazila and another 10 from Trishal upazila of Mymensingh district were brought into the fish nutrition laboratory, Faculty of Fisheries, Bangladesh Agriculture University, Mymensingh.

The collected farm made fish feed samples from farms of Muktagacha upazila were numbered as (F-1 to F-10), (F-11 to F-20) for Phulpur and (F-21 to F-30) for Trishal upazila to make easier of the present study. Data of proximate composition of feed samples which were analyzed from July to October, 2015 were recorded and get used to know the quality of feed which was the purpose of the present work. The collected feed samples were kept at refrigeration temperature till the end of the study. The samples were taken from the refrigerator and kept to the room temperature for few hours. Then the required amounts of samples were finely ground by a small mortar and kept it airtight container for subsequent chemical analysis.

2.2. Analytical methods

The analysis of feed was carried out in the Fish Nutrition Laboratory of the Department of Aquaculture, Faculty of Fisheries, Bangladesh Agricultural University (BAU), Mymensingh for the determination of proximate composition *viz.* moisture, crude protein, crude lipid, ash and crude fiber. The proximate composition of different farm made fish feeds were analyzed in triplicate according to standard procedure given in Association of Official Analytical Chemists (AOAC, 2000).

2.3. Determination of moisture

Moisture content was determined by placing an accurately weighed amount ground sample in a pre-weighed porcelain crucible in a thermostat oven (Gallenkamp, HOTBOX, Model OVB-306) at 105° C for about 24 hours until and reporting the loss weight, the loss weight is the moisture.

2.4. Determination crude protein

Crude protein was determined indirectly by measuring total nitrogen content by standard Kjeldahl method known quantities of sample (approximately 0.5g), catalyst mixture (1.0g) and concentrated H_2SO_4 (10 ml) was taken in a Kjeldahl flask. Then the digestion tubes were set in digestion chamber fixing at 420^0C for 45 minutes ensuring water supply, easier gas outlets etc. and digested in digestion unit (Digestor, Model-2020) to obtain a clear solution. After digestion the tubes were allowed to cool and the digest was then distilled in distillation unit (Kjeldahl system, Distilling unit, Model 1026) using 33% sodium thiosulphate ($Na_2S_2O_3$), 40% NaoH and 4% boric acid solution and was titrated with standard HCl. The nitrogen values obtained was converted into percentage of crude protein by multiplying with a factor of 6.25 (for animal source) or 5.87 (for plant source) assuming that protein contains 16% nitrogen or 17% nitrogen, respectively.

2.5. Determination of ash content

Accurately weighed samples (about 2-3g) were taken in pre-weighing porcelain crucibles and placed in a muffle furnace (Philip Harris Ltd, England), at 550^0C for 6 hours. The crucibles were then taken out to cool in desiccators and weighed in a sensitive electric balance.

2.6. Determination of crude lipid

Crude lipid was determined by extracting a weighed quantity (2-3 g) of samples with analytical grade acetone in Ground Joint Soxhlet Apparatus. Extraction was allowed to continue by heating in the electric heater at 70°C temperature until clear acetone (without oil) was seen in siphon, which took about 3 hours. Then the round bottom flask of the apparatus was separated and the extract was transferred to a pre-weighed beaker and left for evaporation of acetone. After the evaporation of acetone, only the lipid was left in the beaker which was later calculated in percentage.

2.7. Crude fiber content in the feeds

A small amount of finely ground sample (1-2 g) was taken in to a filter crucible and was inserted into the hot extractor unit (Hot Extractor, Model-1017). 150m1 of preheated 0.128M H_2SO_4 was added into the reagent heating system and 2-3 drops of N-octanol were added through the valves. The mixture was digested for 30 minutes. Acid was then removed from it by filtering and washing with warm distilled water (3times). The residue in the flask was boiled with required 150m1 of 0 0.223M KOH for 30 minutes and then filtered with subsequent washed in warm distilled water (3times) and acetone. The residual content was then dried in hot air

oven at 105°C for an over-night and then weighed and placed in to the muffle furnace at 500°C for 3 hours and again weighed. The loss of weight represented the crude fiber.

2.8. Estimation of nitrogen free extracts (soluble carbohydrate)

Nitrogen free extracts (NFE) which is a soluble carbohydrates was calculated by subtracting the sum of the percentage contents of moisture, lipid, ash, protein, and crude fiber from 100.

2.9. Statistical analysis

After data entry, the collected data were analyzed and graphically presented with the help of Microsoft Office Excel 2010 software and SPSS version 20.0.

3. Results

The moisture content of farm made fish feeds varied from 11.11% to 24.53%. The highest mean moisture containing feed was F-13 having 24.53%. The lowest mean moisture containing feed was F-27 having 11.11%. The laboratory analyzed moisture values of different farm made samples are shown (Table 1 and Figure 2).

The analyzed mean crude protein content of farm made fish feeds varied from 10.85 to 27.30% (Table 1). The lowest mean crude protein containing feed was F-22 feed having 10.85% protein. The highest mean crude protein containing feed was F-20 feed having 27.30% protein. The laboratory analyzed crude proteins content of different farm made feed samples are shown in Figure 2.

The lipid content varied between 5.79 and 22.95%. The highest lipid value was found in F-19 (22.95%). Lowest value of crude lipid (5.79%) was found in F-16 feed. The laboratory analyzed Crude lipids content of different farm made feeds are shown (Table 1 and Figure 2). The analyzed ash contents of fish feed varied from 8.41 to 20.99% (Figure 1). Lowest value of ash (8.41%) was found in F-3 feed. The highest mean ash containing feed was F-22 feed having 20.99% ash.

Fiber content varied among different feeds from 4.35 to 8.20%. The highest (8.20%) fiber content was in the F-13 feed. The lowest (4.35%) fiber was measured from F-28 feed. Crude fibers content of the farm made feeds are shown (Table 1) graphically in Figure 1.

Table 1. Nutritional component of farm made fish feeds of Muktagacha, Phulpur and Trishal upazila.

Upazila	No. Farm	Proximate Composition and Nutritional Factors					
		Moisture (%)	Protein (%)	Lipid (%)	Ash (%)	Fiber (%)	NFE (%)
Muktagacha	F-1	15.45±0.32	20.13±0.37	16.84±0.40	11.90±0.86	7.60±0.36	28.08±1.03
	F-2	15.94±0.12	21.35±0.36	13.22±0.46	12.99±0.64	6.35±0.48	30.15±0.82
	F-3	18.54±0.09	14.09±0.26	21.53±0.37	8.41±0.82	6.70±0.50	30.73±0.90
	F-4	16.01±0.26	22.05±0.37	14.73±0.34	9.60±0.48	6.20±0.65	37.61±1.48
	F-5	13.67±0.78	19.95±0.67	17.65±0.44	8.80±0.26	7.10±0.40	39.93±1.93
	F-6	18.09±0.16	21.87±0.44	21.59±0.38	9.14±0.39	6.80±0.39	29.31±0.58
	F-7	20.29±0.56	21.87±0.34	15.33±0.86	11.06±0.38	6.40±0.48	31.45±0.97
	F-8	12.13±0.41	23.63±0.65	15.20±0.46	16.97±0.84	5.80±0.58	32.07±0.62
	F-9	18.84±0.06	21.53±0.86	15.84±0.56	10.39±0.67	6.20±0.60	33.40±0.33
	F-10	15.51±0.71	20.3±0.56	13.29±0.76	11.59±0.93	7.56±0.38	39.31±1.30
Phulpur	F-11	14.66±0.10	22.93±0.67	15.54±0.28	13.17±0.67	6.50±0.43	33.70±0.78
	F-12	19.22±0.52	15.75±0.56	12.83±0.78	10.24±0.87	7.80±0.54	41.98±0.35
	F-13	24.53±0.73	17.32±0.67	14.63±0.67	10.78±0.38	8.20±0.56	32.74±0.76
	F-14	16.07±0.99	21.87±0.49	14.80±0.83	11.91±0.27	6.75±0.60	35.53±2.01
	F-15	16.73±0.61	26.42±0.46	19.41±0.60	11.21±0.28	5.40±0.78	26.23±0.65
	F-16	19.48±0.80	23.80±0.65	5.79±0.82	15.58±0.84	6.45±0.68	28.90±1.62
	F-17	19.57±0.89	18.90±0.44	19.30±0.45	9.13±0.78	5.20±0.65	33.10±0.98
	F-18	20.40±0.37	20.65±0.65	17.25±0.57	9.39±0.29	6.80±0.71	25.51±0.76
	F-19	15.08±0.35	26.25±0.66	22.95±0.76	12.70±0.78	4.40±0.56	18.62±1.06
	F-20	17.49±0.27	27.30±0.56	15.48±0.78	12.17±0.44	4.60±0.46	22.96±1.25
	F-21	14.45±0.89	17.85±0.76	12.92±0.47	17.97±0.56	7.10±0.43	29.98±0.73
	F-22	16.05±0.73	10.85±0.64	6.67±0.59	20.99±0.78	7.35±0.32	38.09±0.38
Trishal	F-23	13.93±0.34	24.15±0.72	18.54±0.81	11.48±0.76	5.60±0.68	26.40±0.62
	F-24	14.46±0.32	19.25±0.49	12.46±0.44	14.870.67	6.25±0.38	32.71±0.48
	F-25	14.53±0.84	16.45±0.28	10.23±0.50	15.540.38	6.95±0.45	43.25±0.65
	F-26	17.73±0.95	24.50±0.38	17.72±0.38	12.65±0.45	6.05±0.36	21.35±0.45
	F-27	11.11±0.91	11.90±0.36	9.54±0.43	17.56±0.56	6.95±0.76	42.94±0.55
	F-28	15.44±0.65	26.05±0.64	22.93±0.28	12.45±0.64	4.35±0.87	18.78±0.44
	F-29	19.32±0.21	18.70±0.59	19.20±0.57	8.96±0.89	5.21±0.37	28.61±0.36
	F-30	14.65±0.28	18.37±0.65	12.21±0.40	14.54±0.56	6.25±0.64	33.98±0.98

In the experiment a total of 30 farms made feed samples were analyzed to know the actual carbohydrate content in the feeds. The analyzed carbohydrate content of fish feeds varied from 18.62% to 43.25% (Table 1). The highest (43.25%) carbohydrate content was in the F-25 feed. The lowest (18.62%) carbohydrate was measured from F-19 feed. Most of the feeds contain carbohydrates between the range 25% to 35%. Carbohydrate content of the farm made feeds is shown (Table 1) graphically in Figure 2.

Table 2. Comparative study of proximate composition of three upazila (by ANOVA test).

Treatment	Moisture (%)	Crude Protein (%)	Crude Lipid (%)	Ash (%)	Crude Fiber (%)	NFE (%)
Muktagacha	16.45±2.49[ab]	20.68±2.56	16.52±2.99	11.09±2.54[b]	6.67±0.60	33.20±4.26
Phulpur	18.32±2.96[a]	22.12±3.97	15.80±4.59	11.63±1.93[b]	6.21±1.28	29.93±6.83
Trishal	15.17±2.22[b]	18.81±5.07	14.24±5.11	14.70±3.52[a]	6.21±0.95	31.61±8.31
Significance level	0.04	0.20	0.50	0.01	0.49	0.56

Table 2 shows that the moisture and ash content of the feed samples varied significantly (at 5% level) varied among upazila to upazila under Mymensingh district.

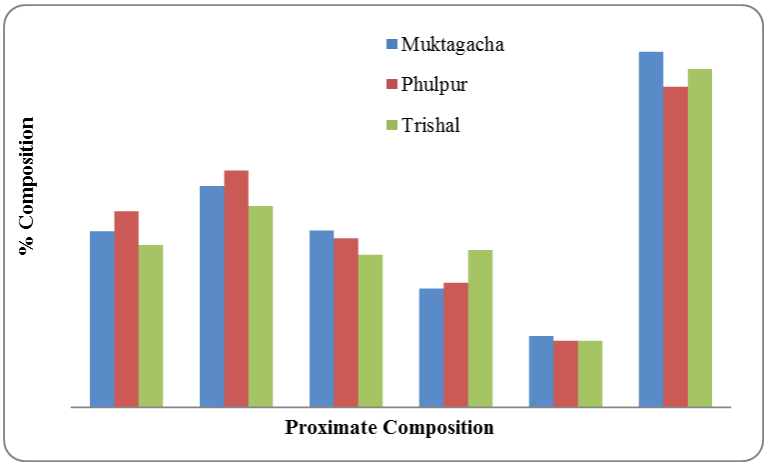

Figure 2. Comparative study of proximate composition of three upazilas.

4. Discussion

Due to dramatic development in aquaculture throughout the world the need for ready-made fish feed has also increased. In Bangladesh at present semi intensive and improved extensive culture method is being practiced. Growth, health and reproduction of fish and other aquatic animals are primarily dependent upon an adequate supply of nutrient, both in terms of quantity and quality, irrespective of the culture system in which they are grown. Therefore, supply of inputs (feeds, fertilizers etc.) has to be ensured so that the nutrients and energy requirements of the species under cultivation are met and the production goals of the system are achieved (Hassan, 2001).

In the following study feed manufacturer used a number of raw feed ingredients for their farm made feed formulation. A wide variety of raw feed stuffs are rice bran, wheat bran, wheat flour, broken rice, fish meal, meat bone, mustard oil cake, soybean oil cake etc. Many of them also used to mix maize, biscuit, calcium and salt. Some variation was observed among different types of feeds in case of moisture content.

The mean moisture value of Muktagacha, Phulpur and Trishal upazila was 16.45%, 18.32% and 15.17%, respectively. Moisture range in fish feed 8-12% indicates good quality. But in majority of feeds the actual moisture content was more than 12%. A good percentage of moisture containing feeds were F-27 (11.11%), F-23 (13.93%), F-5 (13.67), F-8 (12.13).Where majority feed contained more than 18 % moisture. The analyzed mean moisture content of fish feed varied from 11.11 to 24.53%. Seenapa and Devaraj (1991) found that a diet containing 9.9% moisture was optimum for the growth of catla fry. Dry feeds contain 8-10% moisture while the water content of moist feed ranges from 17 to 40% or more (Lall, 1991). Roy (2002) reported that a diet containing 9.8% moisture appears to be more suitable for GIFT tilapia. Therefore, variation of moisture content in aqua feed among different farms was found due to lack of knowledge about moisture content. Protein is the major growth promoting factor in feed. The protein requirement of fish is influenced by various factors such as

fish size, water temperature, feeding rate, availability and quality of natural foods, and overall digestible energy content of diet (Satoh, 2000; Wilson, 2000). The highest crude protein containing feeds were F-20 (27.30%), F-15 (26.42%), F-19 (26.25%) and F-28 (26.05%).The analyzed crude protein content of fish feeds varied from 10.85% to 27.30%. Lowest crude protein containing feeds were F-22 (10.85%), F-27 (11.9%) and F-03 (14.09%). This might be due to using low graded inputs as protein sources. The major source of protein is fish meal, but high price and un-availability of fish meal compels feed manufacturers to use alternate sources of protein. Hepher (1990) found that most fishes required 35-50% protein in their diets. Lall (1991) found that protein requirements of common carp, grass carp and tilapia were 31-38, 41-43 and 30-40%, respectively. Patra (1993) reported that maximum feed intake obtained when pelleted feed having 35% crude proteins in Thai koi feed. Wilson (2000) reported that most of the commercial catfish feeds contain 32% crude protein. Roy (2002) reported that a diet containing 27.87% protein appears to be more suitable for GIFT Tilapia. Hoq *et al.* (2003) reported that a protein level of 30% in formulated feed for feeding Tilapia fry in rearing hapas and nursery ponds is suitable. Mollah and Hossain (1990) reported that 39.5% protein appeared suitable for rearing of *C. batrachus*. Das *et al.* (1991) found that the diet containing 38% protein appears to be more suitable for *Labeo rohita* fingerlings.

Lipids are primarily included in formulated diet to maximize their protein sparing effect (Hassan *et al.*, 1991) being a source of energy. The observed lipid values were in line with that of Cowey and Sargent (1979) who reported that in general, 10-20% of lipid in most freshwater fish diets gives optimal growth rates without producing an excessively fatty carcass. Wilson (2000) reported that lipid level in catfish feeds should be 5% to 6%. Singh (1991) reported that the optimum lipid requirements of Indian major carp and common carp were determined to be 4- 6%. Roy (2002) reported that a diet containing 9.48% lipid appears to be more suitable for GIFT tilapia. Bhuiyan (2002) found that the diet containing 9.94% lipid appears to be more suitable for carp polyculture. The lipid content varied between 5.79 and 22.95%. The high lipid value of F-19, F-28, and F-06 feed contained 22.95, 22.93, and 21.59% lipid, respectively. Lowest value of cr ude lipid (5.79%) was found in F-16 feed. Usually in a balanced diet there have an invert relationship between lipid and protein on their inclusion level. But in the current experiment this relationship was not found. Feeds containing high protein also contain high lipid. An excess of lipid have harmful consequences for fish. Luquet (2000) stated that dietary lipid levels of 5 to 6% are often used in tilapia diet. Akand *et al*. (1991) found that SGR, and weight gain (%) were significantly high ($P<0.05$) in *H. fossilis* fed 10% lipid diet but at highest SGR and weight gain (%) were obtained with the diet containing 5% lipid.

The mean nitrogen free extract (soluble carbohydrate) value of Muktagacha, Phulpur and Trishal upazila was 33.20%, 29.93% and 31.61%, respectively. The highest (43.25%) carbohydrate content was in the F-25 feed. The lowest (18.62%) carbohydrate was measured from F-19 feed. Ali *et al.* (2008) reported that the diet containing 13% carbohydrates were more suitable for Nile tilapia. Pillay (1996) found that successful fish feeds contain 20 and 30% carbohydrates for cold-water and warm-water fish feeds, respectively. Roy (2002) reported that a diet containing 29.18% carbohydrates appears to be more suitable for GIFT tilapia. Carbohydrate content of the feed used by different farmers of Muktagacha, Phulpur and Trishal upazila seems to be a bit higher. Fiber content varied among different feeds from 4.35to 8.20%. The highest (8.20%) fiber content was in the F-13 Feed. The lowest (4.35%) fiber was measured from F-28 Feed. Bhuiyan (2002) found that the diet containing 13.31% crude fiber appears to be more suitable for carp polyculture. A certain amount of fiber in feed permits better binding and moderates the passage of feed through alimentary canal. However, it is not desirable to have a fiber content exceeding 10-12% in diets for fish, as the increase in fiber content would consequently results in the decrease of the quality of an unusable nutrient in the diet (De Silva and Anderson, 1995).

The mean Ash value of Muktagacha, Phulpur and Trishal upazila was 11.09, 11.63, 14.70%, respectively. The analyzed ash contents of fish feed varied from 8.41 to 20.99%. Lowest value of ash (8.41%) was found in F-3 feed. Seenapa and Devaraj (1991) found that a diet containing 12.25% ash to Catla fry at 10% body weight would be optimal. Bhuiyan (2002) found that the diet containing 11.02% Ash were more suitable for Carp polyculture. Roy (2002) reported that a diet containing 12.92% ash were more suitable for GIFT tilapia. Ali *et al*. (2008) found that the diet containing 18% ash were more suitable for Nile tilapia.

5. Conclusions

This study showed that the proximate composition of fish feed varied from one farm to another. Majority of fish farms are producing low quality feeds using lower graded raw materials. To earn extra profit farmers wish to buy cheap raw feed stuffs and are using some alternative sources of protein rather than fish meal which are sometimes detrimental for fish health. Storage lifetime of most fish feeds are very short and feed quality denatures shortly after formulation. So fish farmers can't store feeds for long time. Sometimes feeds become

toxic which results in mass destruction of farmed fish. Due to lack of supply of fish meal throughout the world the price of this item is very high. For that reason manufacturers are compelled to use low graded raw materials for feed formulation. Government should strictly implement the feed laws and should formulate new policies regarding fish feed manufacturing marketing and application.

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Conflict of interest
None to declare.

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