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A Survey of the Nutrient Composition of Some Commercial Fish Feeds Available in Bangladesh

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Abstract

A study was undertaken to analyse and compare the nutrient content of some commercial fish feeds available in Bangladesh through chemical analysis. The commercial fish feeds collected from the markets were Quality Feeds Ltd. (QF), Aftab Feed Products Ltd. (AF), Saudi-Bangla Fish Feed Ltd. (SBF), Paragon Feeds Ltd. (PF) and AIT Feeds Ltd. (AIT). Proximate composition such as moisture, crude protein, crude lipid, ash, fibre and NFE (nitrogen free extract), and some of the macro minerals such as Ca, P, Na, K and S were analysed. In general, there was no large variation between analysed and company declared nutrient contents of different feeds except the protein and lipid content of some feeds. However, two pangas feeds such as Surovi (nursery and grower) of QF had much lower protein content (27.57% and 20.24%) compared to 32% and 25% protein value respectively declared by the company. Similarly, large (more than 5%) differences between the analysed and company declared protein content was observed in case of carp starter and grower feeds of QF. On the other hand, analysed protein content of all feeds of SBF was more than that declared by the company except for special shrimp feed which had slightly lower (1%) protein compared to the company declared value. Pangas feeds (grower I and II) of PF had about 3% lower protein than the company declared value. The analysed lipid contents of all feeds were higher than the company declared values except nursery feeds of QF which had about 1-2% less lipid content compared to the company declared value. Fibre contents of different feeds analysed were much higher (3-5%) than the company declared values. The analysed mineral contents in all the feeds were higher than the recommended mineral requirement for fishes. The

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results of the study showed that on the basis of nutrient content feeds from Saudi-Bangla Fish Feed Ltd. is better than other feeds.

Introduction

With the increasing demand for food fish and the decline in capture fisheries production, aquaculture in Bangladesh is heading towards intensification. This shift from low density to high density culture i.e. traditional to semi-intensive or intensive culture is consequently leading to an unprecedented rise in the demand for feeds more than that of fertilizers. Farmers shift gradually from no feed, through the use of farm-made feeds, to factory-made feeds. This demonstrates a real possibility of increasing production and reveals the potential importance of aquafeeds in Bangladesh. Now aquaculture feeds have been considered a major subsector of the feed milling industry. Nowadays, the production of fish feeds is the fastest growing feed market in Bangladesh. At present, there are about 25 commercial fish feed industries in Bangladesh. Most of them are producing both poultry and fish feeds. The well known industries that produce fish feeds are Saudi-Bangla Fish Feed Ltd., Aftab Feed Products Ltd., Quality Feeds Ltd., AIT Feed Ltd., Usha Fish Feed Ltd., Urbashi Fish Feed Ltd., Paragon Feed Ltd., Suny Feed Ltd., Oriental Feed Ltd. and Rupashi Feed Ltd. All these companies are local. However, CP (Thailand) shrimp feed is also available in the market. The annual production capacity of a feed industry varies from 10,000 to 30,000 MT. Among fish feeds, pangas feeds dominate the market since pangas culture has been spreading rapidly. At the same time, hundreds of small-scale non-commercial and on-farm feed manufacturers produce fish feed throughout the country for their own farm consumption.

The nutrient balance of feed influences feed utilization and growth of fish. It is very essential to know the nutritional requirements particularly for protein, lipid and energy for optimum growth of a fish species as well as in formulating a balanced diet. Dietary protein and energy levels are known to influence the growth and body composition of fish (Lovell 1989). Improper protein and energy levels in feed increases fish production cost and deteriorates water quality. Insufficient energy in diets causes protein waste due to the increase proportion of dietary protein used for energy and the produced ammonia can reduce the water quality (Phillips 1972, Prather and Lovell 1973, Shyong et al. 1998). On the contrary, excessive energy in diets can lead to increased body lipid deposition and growth reduction because of lack of necessary nutrient for growth (Daniels and Robinson 1986, Van der Meer et al. 1997). From the economic point of view, feed cost appears to be one of the major constraints against the greater expansion of aquaculture (Kaushik 1990).

There is a paucity of information on the nutrient content of fish feed produced by different feed industries in Bangladesh. There are also no reliable published information on chemical composition of commercial fish feed and feed ingredients in Bangladesh (Hossain 1996). The only report available is by Bhuiyan et al. (1989) who made a survey to identify potential feed ingredients based on their availability, price and primary nutritional value. The farmers have to depend only on the existing information about the feed composition and growth performance that is given by the feed industry. The government has no legal legislation and control over the feed components and feed quality. Also there are no guidelines for the establishment of a new feed industry. So, there is a great possibility that the farmers will be deceived by the feed manufacturer. There is no monitoring by the government on the quality and nutrient content of the feeds produced by different feed manufacturers, even if there is a possibility to use unauthorized feed ingredients. So far, there has been no attempt hitherto to evaluate the nutrient content of feeds produced by commercial industries. Therefore, the present study investigates the nutrient composition of commercial fish feeds available in the greater Mymensingh region of Bangladesh and compares these values with those declared by the manufacturers.

Materials and Methods

Collection and preparation of samples for analysis

Samples of commercially available feeds were collected from Quality Feeds Ltd. (QF), Aftab Feed Products Ltd. (AF), Saudi-Bangla Fish Feed Ltd. (SBF), Paragon Feeds Ltd. (PF) and AIT Feeds Ltd. (AIT). Besides poultry feed, the above feed manufacturers produce pangas, carp and shrimp/prawn feeds. Wherever possible, samples of nursery, starter and grower/finisher diets were collected for each of the fish species. After collection of feed samples, the samples were kept in a refrigerator before chemical analysis. The samples were taken from the refrigerator and kept in room temperature for one hour. Then the required amount of samples were finely ground by a mortar and kept in an airtight container for subsequent chemical analysis.

Analytical methods

The proximate composition of different commercial fish feeds were analyzed according to standard procedures given in Association of Official Analytical Chemists (AOAC 1980). Triplicate samples of each

commercial feed types were used to determine the following chemical compositions.

Moisture

Moisture was determined by keeping feed samples in a thermostat oven at 105ºC for 24 hours.

Crude protein

Samples (0.5 g) were digested in digestion unit (Digestor, model 2020) for 45 minutes. The digesta was then distilled in distillation unit (Kjeltec System, Distilling unit, model 1026). Finally it was titrated with 0.2 N HCL and crude protein was obtained by multiplying the total nitrogen by a conversion factor of 6.25.

Crude lipid

Crude lipid was determined by extracting a weighed quantity of sample with acetone in Soxhtec Extraction Unit (model 1045).

Ash

Ash content was determined by igniting feed samples in a muffle furnace at 450 ºC overnight.

Crude fibre

Samples (1-2 g) were digested with 0.128 M H_2SO_4 with a few drops of octanol in digestion unit (Hot Extractor, Model-1017) for 30 minutes. Filtering and washing with boiling water removed acid. Residue was boiled with 0.223 M KOH for 30 minutes, then washed in boiling water and acetone. The residue was dried in an oven at 130ºC for 2 hours and ignited in muffle furnace at 500^0C for 3 hours. The loss of weight represented the crude fibre.

Nitrogen free extract (NFE)

NFE was calculated by subtracting the sum of moisture, crude protein, crude lipid, ash and crude fibre from 100 (Castell and Tiews 1980).

Calcium (Ca), Sodium (Na) and Potassium (K)

Finely ground sample (0.5 g) was placed in a digestion flask and 10 ml of diacid mixture (HNO_3: $HClO_4$ in a ratio 2:1) was added into the

flask and kept for sometime (about 15-20 minutes). Then flask was heated at a temperature gradually to 200°C. The content of the flask was boiled until they became clear and colourless. After cooling, the digest was transferred into a 50 ml volumetric flask and the volume was made up to the mark with distilled water. A Jenway Model PFP 7 flame photometer was used in accordance with the manufacturer's specifications for the determination of Ca, Na and K within the digested filtrates.

Phosphorus (P) and Sulphur (S)

For P and S determination, samples were assayed by using a spectrophotometer (Jenway 6300). Ammonium molybdate and stannous chloride was used for P determination and barium chloride and acid seed solution (6 N HCl containing 20ppm S as K_2SO_4) was used for S determination.

Results

The results of proximate composition and mineral contents of different feeds analysed are shown in tables 1 and 2 respectively.

Moisture

The analysed moisture contents varied between 8.83 to 14.29% in QF, 9.59 to 10.53% in AF, 9.40 to 10.47% in SBF, 9.90 to 11.08% in PF and 14.28% in AIT fish feeds. Most of the collected feed samples contained lower moisture than the company declared moisture content. But, only two pangas feeds such as Rupali (starter) of Quality Feeds Ltd. and grower-I of AIT Feeds Ltd. had much higher moisture contents (16.31% and 14.28% respectively) compared to 12% and 11% moisture declared by the company.

Crude protein

The analysed crude protein contents of QF, AF, SBF, PF and AIT fish feeds varied between 19.27 to 32.98%; 27.07 to 30.82%; 25.24 to 32.47%; 25.20 to 26.30% and 29.79%, respectively (Table 1). The highest crude protein content (32.98%) was found in Sonali Grower (pangas feed) of QF and the lowest (19.27%) was found in Starter feed (carp) of QF. Two pangas feeds such as Surovi nursery and grower of QF had much lower protein content (27.57% and 20.24% respectively) compared to 32% and 25% protein value declared by the company. Similarly large differences between the analysed and company declared protein value was

Table 1. Analyzed proximate composition (±SD) of different commercial fish feeds available in Bangladesh (% dry matter basis)

Name of the Feed Industry	Type of the Feed	Moisture (%)	Protein (%)	Lipid (%)	Ash (%)	Fibre (%)	NFE* (%)
Quality Feeds Limited	Sonali (N)	10.77±0.29 (Max. 1)**	32.15±0.53 (Min. 32)	7.06 (Min. 8)	15.1±0.34 -	10.84 (Max. 6)	31.09
	Sonali (S)	10.57±0.09 (Max. 12)	32.59±1.23 (Min. 30)	6.34 (Min. 6)	14.2±0.2 -	10.33 (Max. 6)	32.66
	Sonali (G)	10.26±0.08 (Max. 12)	32.98±0.08 (Min. 30)	5.91 (Min. 6)	15.61±0.29 -	10.14 (Max. 6)	31.73
	Rupali (N)	11.29±0.53 (Max. 11)	31.96±2.48 (Min. 32)	6.06 (Min. 8)	13.2±0.29 -	11.06 (Max. 6)	33.47
	Rupali (S)	14.31±0.14 (Max. 12)	27.21±0.49 (Min. 27)	6.61 (Min. 5)	14.81±0.38 -	10.37 (Max. 6)	32.05
	Rupali G)	10.5±0.08 (Max. 12)	27.98±1.04 (Min. 27)	6.28 (Min. 5)	14.07±0.64 -	11.01 (Max. 6)	36.39
	Surovi (N)	11.01±0.29 (Max. 11)	27.57±0.16 (Min. 32)	6.95 (Min. 8)	14.62±0.14 -	11.58 (Max. 6)	34.96
	Surovi (S)	9.27±0.19 (Max. 12)	24.91±2.67 (Min. 25)	7.51 (Min. 5)	16.8±0.04 -	11.32 (Max. 7)	35.81
	Surovi (G)	9.56±0.18 (Max. 12)	20.24±1.52 (Min. 25)	7.90 (Min. 5)	16.75±0.16 -	10.19 (Max. 7)	40.64
	Shrimp (Sundari G.)	11.24±0.23 (Max. 12)	23.59±1.38 (Min. 23)	7.03 (Min. 4)	14.79±0.24	9.86 (Max. 7)	39.70
	Shrimp (Special G.)	10.2±0.16 (Max. 12)	26.37±0.00 (Min. 26)	7.94 (Min. 4)	12.49±0.25	10.73 (Max. 6)	38.14
Quality Feeds Limited	Carp (S)	8.83±0.02 (Max. 11)	19.27±0.24 (Min. 32)	8.89 (Min. 5)	17.35±0.38 -	8.24 (Max. 6)	42.16
	Carp(G)	9.78±.13 (Max. 12)	20.63±0.06 (Min. 25)	8.86 (Min. 8)	16.89±0.36 -	10.22 (Max. 6)	39.92
Aftab Feed Products	S	9.59±0.10 (Max. 11)	30.82±0.50 (Min. 32)	9.97 (Min. 5)	11.27±0.29 (Max. 17)	9.61 (Max.5.5)	34.65
	G	10.53±0.24 (Max. 11)	27.91±0.80 (Min. 29)	9.92 (Min. 5)	11.27±0.04 (Max. 17)	9.45 (Max. 5.5)	37.08
	F	9.68±0.17 (Max. 11)	27.07±0.51 (Min. 27)	9.98 (Min. 5)	11.99±0.34 (Max. 17)	8.54 (Max. 5.5)	38.31
Saudi-Bangla Fish Feed Ltd.	N	10.19±0.14 (Max. 11)	32.06±0.74 (Min. 32)	7.72 (Min. 5)	18.12±0.08 (Max. 16)	10.15 (Min. 6)	28.69
	S-I	9.94±0.28 (Max. 11)	31.53±0.04 (Min. 32)	7.06 (Min. 5)	18.84±0.70 (Max. 16)	9.86 (Min. 6)	29.46
	S-II	9.78±0.02 (Max. 11)	32.47±0.09 (Min. 30)	7.90 (Min. 6)	18.42±0.19 (Max. 17)	10.28 (Min. 6)	27.90
	S-III	10.47±0.07 (Max. 11)	28.97±0.38 (Min. 28)	7.11 (Min. 5)	17.29±0.28 (Max. 18)	9.24 (Min. 6)	33.47
	G-I	10.01±0.07 (Max. 11)	28.38±0.28 (Min. 28)	7.83 (Min. 3)	18.37±0.06 (Max. 18)	9.55 (Min. 6)	32.27
	G-II	9.4±0.20 (Max. 11)	25.24±0.56 (Min. 28)	6.14 (Min. 3)	16.54±0.07 (Max. 18)	10.58 (Min. 6)	37.59
	Fish Feed G	10.1±1.17 (Max. 12)	28.78±2.18 (Min. 24)	8.19 (Min. 4)	16.94±0.05 (Max. 18)	9.64 (Max. 6.5)	32.77
	Galda N	9.94±0.03 (Max. 11)	31.44±0.57 (Min. 30)	8.38 (Min. 5)	18.09±0.20 (Max. 16)	11.88 (Max. 6)	27.21
	Galda S-I	10.03±0.09 (Max. 11)	31.26±0.27 (Min. 30)	7.69 (Min. 5)	18.32±0.10 (Max. 16)	10.21 (Max. 6)	29.26
	Galda S-II	9.84±0.03 (Max. 11)	31.76±0.04 (Min. 25)	7.54 (Min. 4)	18.62±0.07 (Max. 17)	9.86 (Max. 6)	29.06
	Special Shrimp	9.71±0.19 (Max. 11)	29.15±0.22 (Min. 30)	7.31 (Min. 4)	18.82±0.06 (Max. 17)	9.91 (Max. 6)	31.43
Paragon Feeds Ltd.	G-I	9.9±0.04 (Max. 11)	25.20±2.40 (Min. 28)	6.31 (Min. 4)	23.4±1.05 (Max. 18)	9.86 (Max. 6)	31.75
	G-II	11.08±0.10 (Max. 11)	26.30±0.56 (Min. 28)	6.24 (Min. 4)	26.32±0.69 (Max. 18)	9.52 (Max. 6)	28.11
AIT Feeds Ltd.	G-I	14.28±3.15 (Max. 11)	29.79±0.29 (Min. 30)	7.06 (Min. 6)	15.7±2.5 (Max. 16)	11.36 (Max. 6)	30.93

*Nitrogen free extract (NFE) calculated as: NFE = 100- %(moisture + crude protein + crude lipid + ash + crude fibre).
**Figures in the parentheses indicate the proximate composition (% dry matter basis) declared by the company.
N - nursery; S - starter; G - grower; F - finisher

Table 2. Analyzed mineral contents of different commercial fish feeds available in Bangladesh (% dry matter basis)

Name of the Feed Industry	Type of the Feed	Calcium (%)	Phosphorus (%)	Sodium (%)	Potassium (%)	Sulphur (%)
Quality	Sonali (N)	0.86	0.66	2.21	1.12	1.19
Feeds	Sonali (S)	0.54	0.65	1.89	1.02	1.19
Ltd.	Sonali (G)	1.40	0.62	1.36	1.07	1.26
	Rupali (N)	0.76	0.63	2.22	1.11	1.40
	Rupali (S)	0.64	0.51	2.18	1.03	1.24
	Rupali (G)	0.43	0.35	1.62	0.97	1.19
	Surovi (N)	1.30	0.39	2.29	1.04	1.13
	Surovi (S)	0.84	0.34	1.91	0.76	1.30
	Surovi (G)	0.85	0.55	1.92	0.78	1.57
	Shrimp (Sundari G)	0.44	0.68	2.24	0.82	1.47
	Shrimp (Special G)	0.43	0.49	1.75	0.74	1.45
	Carp (S)	1.06	0.55	1.79	0.72	1.37
	Carp (G)	0.85	0.42	1.29	0.73	1.11
Aftab Feed	S	0.32	0.27	1.10	0.96	1.05
Products	G	0.32	0.22	1.00	1.05	1.12
Ltd.	F	0.32	0.22	0.84	1.07	0.92
Saudi-Bangla	N	0.97	0.51	1.23	1.30	1.19
Fish Feed	S-I	1.18	0.40	1.23	1.29	1.25
Ltd.	S-II	0.75	0.84	1.42	1.35	1.51
	S-III	1.40	0.78	1.24	1.37	1.66
	G-I	0.86	0.82	1.23	1.42	1.32
	G-II	0.21	0.88	1.29	1.35	1.25
	Fish Feed G	0.32	0.29	1.36	1.44	1.71
	Galda N	1.29	0.24	1.36	1.34	1.19
	Galda S-I	0.54	0.22	1.36	1.37	1.05
	Galda S-II	0.64	0.31	1.23	1.41	0.99
	Special Shrimp	0.64	0.27	1.23	1.26	0.99
Paragon	G-I	0.43	0.39	0.97	0.96	1.12
Feeds Ltd.	G-II	0.43	0.28	1.04	0.94	1.19
AIT Feeds Ltd.	G-I	0.56	0.50	0.95	0.93	1.11

N - nursery; S - starter; G - grower; F - finisher

observed in the case of Carp starter and grower (more than 5%) feeds of QF. On the other hand, the analysed protein content in all feeds of SBF was higher than that declared by the company except for special shrimp feed which had slightly lower (1%) protein than the mentioned value (Table 1). Pangas feeds (grower I and II) of PF had about 3% lower protein content than the company declared value.

Crude lipid

The analysed crude lipid contents of different fish feeds varied considerably among the feed manufacturers. The mean range of crude lipid was recorded as 5.91 to 8.89% in QF, 9.92 to 9.98% in AF, 6.14 to 8.38% in SBF, 6.24 to 6.31% in PF and 7.06% in AIT fish feed (Table 1). Except for nursery feeds, all other feeds of QF had higher lipid content than the minimum content declared by the company. However, the nursery feeds had about 1-2% less lipid content compared to the company

declared values. The lipid contents of all feeds of Aftab feed had much higher (about 5%) lipid than the company's minimum declared value. Similarly, all feeds of Saudi-Bangla had about 2-4% higher lipid content compared to the company declared values. PF and AIT feeds had also 1-2% higher lipid content than the company mentioned values.

Ash

The analysed ash contents of the collected commercial fish feed samples were in the range of 12.49 to 17.35% in QF, 14.31 to 15.24% in AF, 16.54 to 18.84% in SBF, 17.40 to 19.32% in PF and 15.70% in AIT Fish feed (Table 1).

Crude fibre

The analysed crude fibre contents of QF, AF, SBF, PF and AIT feeds varied between 8.24 to 11.58%; 8.54 to 9.61%; 9.24 to 11.88%; 9.86 to 9.52% and 11.36%, respectively (Table 1). Fibre contents of different feeds from all companies under study were higher (3-5%) than the company declared maximum values.

Minerals

The analysed mineral contents (%) of QF, AF, SBF, PF and AIT feeds are shown in table 2. There was wide variation in the mineral contents in feed from different companies (Table 2). The ranges of mineral contents were: calcium 0.21 to 1.40%, phosphorous 0.22 to 0.88%, sodium 0.84 to 2.29%, potassium 0.72 to 1.44% and sulphur 0.92 to 1.71%. However, the feed companies did not provide upper or lower limits for mineral contents in feeds.

Discussion

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 (Hasan 2001). Nowadays, commercial fish feeds are widely used to get more aquacultural production. The present study was undertaken to know the actual nutrient content and compare the nutrient content of different

commercial fish feeds available in Bangladesh. From the chemical analysis, it was observed that in SBF Feed, more or less all the nutrients (protein, lipid, minerals etc) were similar to or above the range declared by the company. The values were also within the recommended nutrient levels for fish (NRC 1983).

Protein is the major growth promoting factor in feed. The protein requirement of fish are 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). Most of the analysed data on crude protein are more or less similar to the company declared values. The crude protein content of most of the feeds of different commercial feed industries analysed are within the acceptable range recommended for fish (NRC 1983). However, two pangas feeds and two carp feeds of QF and pangas feeds of PF had lower protein content compared to the company declared values. Wilson (2000) reported that most of the commercial channel catfish feeds contain 32% crude protein. Boonyaratpalin (1988) estimated the protein requirement for tropical catfish to be 35-40%, 25-35% and 28-32% for fry, grow-out and broodstock, respectively. Watanabe et al. (1990) observed that catfish production was increased through the use of high amounts of protein (35% or more) in their diet and phase feeding may be more profitable. All the feeds of Saudi-Bangla Fish Feed Ltd. had optimum dietary crude protein for the fish mentioned by the company (Garling and Wilson 1976, Stanley and Moore 1983, Chuapoehuk and Pothisoong 1985, Satoh 2000, Wilson 2000).

Lipids are primarily included in formulated diet to maximize their protein sparing effect (Hasan 2001) by being a source of energy. The analysed crude lipid content of different commercial fish feeds ranged from 5.91 to 9.98% which matched with the company declared crude lipid content. This lipid values are lower than 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. On the other hand, Wilson (2000) reported that lipid level in catfish feeds should be 5 to 6%. Luquet (2000) also stated that dietary lipid levels of 5 to 6% are often used in tilapia diet.

All plant ingredients contain a certain amount of fibre. Fibre provides physical bulk to the feeds. A certain amount of fibre in feed permits better binding and moderates the passage of feed through the alimentary canal. However, it is not desirable to have a fibre content exceeding 8-12% in diets for fish, as the increase in fibre content would consequently result in the decrease of the quality of an unusable nutrient in the diet (De Silva and Anderson 1995). When the fibre content is excessive, it results to lower digestibility of nutrients. The analysed crude fibre content

of all the diets under study were within the safe dietary limit for fish. So, the fibre content may not have any negative effects on fish. In the present study, the fibre content of all the feeds were 3-5% higher values compared to the company declared maximum value.

Minerals have a great diversity of uses within the animal body. Essential minerals for body functions in fish are calcium, phosphorus, sodium, molybdenum, chlorine, magnesium, iron, selenium, iodine, manganese, cobalt and zinc (Chow and Schell 1980). Minerals are the constituents of bones and teeth and components of blood pigments, enzymes and organic compounds in tissues. In commercially available fish feeds in Bangladesh, independent of target species or age, the concentrations of minerals are extremely variable. This variability is due to a number of factors- i) differences in the basic raw ingredients used in diet formulation, ii) differences due to addition of specific macro or trace mineral premixes and iii) differences arising from contaminants present in conventional and unconventional feed ingredients. The calcium and phosphorus in different commercial feeds tested were above the levels recommended as dietary requirement for commercial species of fishes (NRC 1983, Satoh 2000, Wilson 2000). Sodium, potassium and sulphur content (Table 2) of different feeds were even higher than the recommended inclusion levels (Gatlin and Wilson 1982, Satoh 2000, Wilson 2000). Although most elements are found in concentrations above the suggested required levels, the total concentration with the finished feed does not represent a measure of its bioavailability to the fish.

The data showed that large differences exist in the chemical composition (nutrient content) within and between various commercial fish feeds. However, considering the analysed proximate composition and mineral content of the feeds under study, the feeds from Saudi-Bangla Fish Feed Ltd. is better than other feeds.

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