INNSPUB

International Journal of Biosciences | IJB |
ISSN: 2220-6655 (Print), 2222-5234 (Online)
http://www.innspub.net
Vol. 20, No. 4, p. 1-8, 2022

RESEARCH PAPER OPEN ACCESS

Proximate composition of some commercially available fish and poultry feeds sold in the market of Bangladesh

Md. Sabbir Hasan, Mahci Al Bashera, Farhana Jahan, Amin Hossain, Md. Waliullah, Md. Badrul Islam*

Natural Products Research Division, Bangladesh Council of Scientific and Industrial Research, Rajshahi Laboratories, Rajshahi-6206, Bangladesh

Key words: Proximate analysis, Nutrient values, Fish feeds, poultry feeds, Feeds.

http://dx.doi.org/10.12692/ijb/20.4.1-8 Article published on April 17, 2022

Abstract

This study aimed at analyzing the proximate compositions (moisture, crude protein, crude lipid, ash content) and minerals (iron and phosphorous) of some commercial fish feeds (FF) and poultry feeds (PF) available in the local market of the Rajshahi City Corporation area of Bangladesh. In addition, results were compared with the company labeled nutrients values and Bangladesh guideline values. Three FF products and two PF products are collected, namely FF1, FF2, FF3 and PF1, PF2 respectively. The variation between the analyzed and the company declared values have no significant difference ($p \geq 0.05$), but the results of proximate parameters and mineral contents are significantly different at 0.05 level ($p < 0.05$). The highest percentage of moisture (11.02±1.52) and crude protein (32.98±0.45) was found in PF-1 and FF-2, respectively, while the highest percentage of ash content (10.81±0.05) and crude lipid (12.0±0.1) was found in FF-1. Furthermore, the iron and phosphorous contents of feed samples ranged from 0.28±0.05 to 1.2±0.05 and from 1.0±0.05 to 13.63±0.02, respectively, whereas FF-1 exhibited the highest values for both parameters. We compared the results of our analyses with those of the Bangladesh Standard Guideline values of feeds for fish and poultry. It is evident that maximum feed samples analyzed contain the required nutrients in the range of the regulatory guidelines, but feed samples of different feed manufacturers have differed between laboratory test results and labeled values, especially the protein and lipid content. The paper, thus, recommends that proper monitoring is required in the Fish and P feed industries in Bangladesh.

* **Corresponding Author:** Dr. Md. Badrul islam ✉ badol02@yahoo.com

Introduction

Nutrition is the most important consideration in any livestock enterprise and its survival is dependent on the availability of feedstuffs, which are the main component of human food. Bangladesh is an agrarian-based country and most of the people largely depend on agriculture (BER 2017).

Poultry and fish farming has been contributing to alleviating poverty through income and employment generation in one hand, on the other hand, it also contributes to ensuring nutritional security as these products are relatively a cheap source of protein which enable people to consume them at the lowest cost (Monirul Alam, Khatun, and Kamruzzaman 2012; Khanum *et al.* 2022).

(Hamid *et al.* 2017) reported that about 44% of the human daily intake comes from animal protein derived from the consumption of livestock products, of which the poultry sub-sector itself contributes about 22%to 27%.Thus, the development of such mixed farming, including crop, livestock, fisheries and poultry, can contribute to achieving the first goal of "no poverty" and second goal of "zero hunger" of the 17 Sustainable Development Goals (SDGs) by 2030 (Abraham and Pingali, 2020; Boto-Álvarez and García-Fernández, 2020).

The increasing demand for food fish influences the high production level of fishery in Bangladesh. For the growth of fish, the nutritive value of fish feed is required. It is essential to know the nutritional requirements, particularly for protein, lipid and energy of optimum growth of a fish species, as well as in formulating a balanced diet. According to Rahman *et al.*, dietary protein and energy levels are known to affect the growth and body composition of fish species (Lovell, 1989; Rahman, 2014). Some authors Islam, 2019; Ojabo and Wunduga, 2020 observed that improper protein, energy and other nutrient levels in feed increased fish production cost, especially the recurrent expenditure and deteriorated water quality. While insufficient energy in diets causes protein waste due to the increased proportion of dietary protein used for energy and the produced ammonia can pollute the water and make it unfit for fish culture (Lovell 1989). Bhuiyan *et al.* (2016) reported that excessive energy in diets could lead to increase body lipid deposition and growth reduction because of lack of necessary nutrients for growth. The use of feed is increasing with the expansion of aquaculture in Bangladesh. The production of commercial feeds has increased at an average rate of 32% per year over the period 2008–2012 and has reached an estimated total of almost 1.07 million tons in 2012 (Mamun-Ur-Rashid *et al.* 2013).

The fisheries sector contributed 3.69% to national GDP and 22.60% to the agricultural GDP among the agro-based economy of Bangladesh earned more than 2% to foreign exchange by exporting fish and fish products in 2013-14 (DoF 2015). Fish provides 60% of animal protein consumption. More than 11% of the total population is directly or indirectly engaged in the fisheries sector, which accounts for 17.8 million (DoF 2015). The Ministry of Fisheries and Livestock of the Government of Bangladesh has formulated Fish feed rules in 2011 (MoFL 2011)and livestock feed rules in 2013(MoFL 2013) to maintain the quality of fish and poultry feeds in Bangladesh.

In Bangladesh, a variety of fish feed ingredients are available. There is a paucity of information on the nutrient content of fish feed produced by different feed industries (Ayuba and Iorkohol 2010). There is also no reliable published information on the chemical composition of commercial fish feed and feed ingredients in Bangladesh (Nasim Al Mahmud, Hossain, and Minar 2012). Bhuiyan *et al.* (2016) did a survey to identify potential feed ingredients based on their availability, price and primary nutritional value. The farmers hence depend only on the existing information about the feed composition and growth performance that is given by the feed industry (Ayuba and Iorkohol 2010). The government has no legal legislation and control over the feed components and feed quality (Saujanya Suman, Srirama Manyam 2021). Thus, there is a great possibility of deceiving the farmers both in terms of nutritive value and cost

of feed.

One of the most prominent protein sources in Bangladesh is poultry. Within the past decade, poultry has become an extremely popular and promising sector in the country (Netherlands Enterprise Agency 2020). The Bangladeshi population consumes a significant amount of poultry meat and eggs as their primary source of protein. In Bangladesh, there are a number of commercial producers of poultry feed, and raw materials used in the production of poultry feed come from a variety of sources (Netherlands Enterprise Agency, 2020; Ojabo and Wunduga, 2020).

Using different feeds yields different results in terms of growth and production of eggs; it is, therefore, important to balance the ratio of feeds to reach the optimal nutritional level. Because of the seasonal variations of local feed ingredients and metal pollution within the feed industry in Bangladesh, the situation of feed in that country is not good enough from a quality perspective. Furthermore, a lack of government control and analytical services has contributed to the current crisis. There is not enough information about the nutrition content of feeds consumed by poultry in the country. This is because there is the possibility that the feeds may contain contaminants in the form of nutritive elements. So far, no systematic work has been performed to give an insight into the proximate and mineral content in feed available in Bangladesh (Hasan *et al.*, 2021; Rahman, 2014).

Therefore, the present study was conducted to evaluate the nutritive composition of some commercial fish feeds and poultry feeds available in the Bangladeshi market and compares these values with those declared by the manufacturers.

Material and methods

Collection and preparation of feed samples for analysis

Feed samples for the present study were collected from Saheb Bazar, Rajshahi. The collected samples were finely ground by a grinding machine and kept in an airtight container for subsequent proximate analysis. The proximate analyses give the overall nutritional composition of the sample in question; this is briefly complemented by the ant nutrient and mineral composition of the sample. All reagents used in the study were of analytical grade from (Merck, Germany) and reagents were used without further purification.

Determination of moisture

Moisture content was determined by standard (AOAC, 2002). 2 gms of the sample were weighed in a porcelain crucible (which was previously cleaned, heated to 105℃ cooled and weighed). The crucible with the sample was heated in an electric oven for about six hours at 105℃. It was then cooled in desiccators and weighed again. The percentage moisture in the oil cakes was calculated from the formula:

$$\%\ Moisture = \frac{(W_1 - W_2)}{W_2} \times 100$$

Where W1 = Original weight of the sample before drying; W2 = weight of the sample after drying.

Determination of ash

Ash content in fish feed samples was determined as described by (AOAC, 2002). About 2 gms of fish feed samples were weighed in a porcelain crucible (which was previously cleaned, heated to about 100℃, cooled and weighed). The crucible with its content was placed in a muffle furnace for about four hours at about 600℃. It then cooled in a desecrator and weighed. To ensure completion of ashing, the crucible was again heated in the muffle furnace for half an hour, cooled and weighed again. This was repeated till two consecutive weights were the same and the ash was almost white in colour.

Estimation of protein

Protein in the sample was determined by Micro-Kjeldahl distillation method (AOAC, 2002). The samples were digested by heating with concentrated sulphuric acid (H2SO4) in the presence of digestion

mixture, Potassium sulphate (K_2SO_4) and copper sulphate ($CuSO_4$). The mixture was then made alkaline with 40 % NaOH. Ammonium sulphate thus formed, released ammonia which was collected in 4% boric acid solution and titrated against standard HCl. The percent nitrogen content of the sample was calculated the formula given below. Total protein was calculated by multiplying the amount of percent nitrogen with an appropriate factor (6.25) (Rahman *et al*., 2019).

$$\% N = \frac{1.4 \times (mLHCl - mLblank) \times HClconcentration}{Weightofsample\ (g)}$$

$$\% Protein = \% N \times factor\ (6.25)$$

Estimation of lipid

Fat determination is one of the key analyses used for food labelling and quality control. Fat content in the fish feed samples was determined by petroleum ether extraction followed by Soxhlet apparatus (AOAC, 2002). For the present study, 5 g of finely ground sample was taken in a motor and anhydrous sodium sulphate of twice the weight of the sample was added into it. Then the mixture was ground until a free-flowing powder was obtained. Then the powder was transferred to a thimble and sealed the end. Extraction thimble with the sample was placed in the Soxhlet apparatus and fixed a previously dried and weighed round bottom flask. 200 mL of extracting solvent (petroleum ether) was added to the flask containing pumice chips. Then the flask and the condenser were connected to the Soxhelt extractor. Sample was allowed to reflux for about five hours. After the extraction, the flask was removed from the apparatus and kept in the water bath and then in the oven (Hasan *et al*. 2016). Then the flask was cooled and weight was taken. Percent crude fat was calculated using the following formula.

$$\% \text{ Crude fat} = \frac{(X-F)\times 100}{W}$$

Where, X – Weight of the flask with fat and chips, F – Weight of the flask and chips, W- Weight of the sample

Estimation of Iron and phosphorous

The dried samples of fish feed samples were put in a cleaned, dried mortar separately and were grounded to fine particles and then sieved using a sieve of particle size 0.02 mm. 0.5 g each of samples were measured into a clean dried beaker (100 mL), 5 mL of aqua regia HCl and HNO3 (3:1) was then added to the sample for digestion. The samples were allowed to be evenly distributed in the acid by stirring with a glass rod and then the beaker was placed on the heater.

The digested sample was filtered into a graduating cylinder and the filtrate was made up to 50 mL using distilled water. ThermoSpectronic20, USA, Spectro-photometer was used to analyse the concentration (mg/g) of Iron and P in the five different samples of fish feed samples.

Determination of Phosphorus of fish feed samples was carried out by following the method Vanado molybdate yellow colour method (AOAC, 2002). A 10 ml aliquot of previously digested fish feed samples was pipetted out into a 50 ml volumetric flask. Then 10ml vanado molybdate reagent was added, diluted to 50 ml with DW, mixed well and the intensity of the yellow colour was read at 470 nm on spectrometer. The amount of phosphorus was calculated from the standard graph of phosphorous.

Determination of Iron of fish feed samples was done by adopting the method FrederickáSmith, 1952. A 10 ml aliquot of digested fish feed samples was pipetted out into 50 ml volumetric flask.

Then 1ml hydroxylamine hydrochloride solution and 10 ml ammonium acetate buffer were added. To this mixture was added 4 ml 1,10-phenalthroline reagent, mixed thoroughly and allowed 10 minutes for color development and light red colour was read at 510 nm on the spectrometer. The amount of iron was calculated from the standard graph of iron.

Statistical analysis

With the use of OriginPro 2019b Software (2019), we conducted a one-way analysis of variance (ANOVA)

where significant effects of the studied parameters were observed.

Results and discussion

The major nutrient value of fish and poultry feeds that are considered when formulating diets are crude protein, moisture, crude fat and crude fibre. The results of proximate composition and mineral contents of fish feeds and poultry feeds analyzed are shown in Table 1 and 2, respectively.

The results were compared with manufacturers' labeled values and Bangladeshi standards for fish feeds and poultry feeds.

Table 1. Proximate compositions and mineral contents of fish feeds (dry wt. basis).

Name of feeds	FF-1		FF-2		FF-3		BSV
	TR	LV	TR	LV	TR	LV	
Moisture (%)	4.12 ± 0.46	4.91	4.05±1.30	3.98	9.0±0.38	9.52	≤12
Ash (%)	10.81±0.05	11.13	7.41±0.05	7.52	9.43±0.02	9.88	≤21
Crude protein (%)	28.31±0.41	25.16	32.98±0.45	34.35	23.59±0.69	26.33	≥22
Crude lipid (%)	12.0±0.1	9.24	2.57±0.02	1.19	2.68±0.03	1.09	≥5
Iron (mg/g)	1.2±0.05	1.4	0.45±0.01	0.72	0.64±.005	0.88	-
Phosphorous(mg/g)	13.63±0.02	12.35	11.35±0.05	11.69	11.01±0.01	11.33	≥6

All data are presented in Table 1 as mean ± standard deviation. FF- Fish Feed, PF-Poultry Feed, BSV- Bangladesh Standard Value, TR- Test Results, LV-Labeled Values. * The results are significantly different at 0.05 level (p<0.05).

Moisture

In general, the moisture content depicts the amount of moisture content in feeds. Results obtained from the analysis showed that moisture contents in fish feeds varied between 4.05±1.30 to 9.0±0.38% (table 1). On the other hand, for poultry feed, PF1 showed slightly increased moisture content (table 2). The more moisture is present in feeds, the greater the chance that fungi and other microorganisms will contaminate the feeds.

Ash

The ash content of feeds relates to the inorganic mineral content. As the label indicates, the percentage of ash represents the mineral content of the feed, which typically contains minerals such as calcium, phosphorus, potassium, and magnesium. Results of analyzed ash contents of the collected commercial fish samples were in the ranges of 7.41±0.05 to 10.81±0.05 %, as shown in Table 1. All the feed samples showed ash content in the range of Bangladesh standard values.

Crude protein

Crude protein is one of the most important nutrients to quantify in a prospective feed because it is one of the most costly to supply and a deficiency of protein has a drastic effect on growth and production. Protein is usually the first nutrient to be considered, and the level of energy in the diet is adjusted to provide an optimal ratio. Protein must be balanced with essential amino acids. The protein content is used by manufacturers to determine the amount of carbohydrates in food. Measuring crude protein levels is a common practice in the fields of animal husbandry and food science. Fish and poultry are mainly composed of protein. Animal sources contain more protein than plant sources. Various diets are commonly utilized, depending on the fish and poultry's production stage. Results of analyzed crude protein contents in fish feed were highest in FF2 (32.98±0.45%) sample and lowest in FF3 (23.59±0.69%). Whereas, for poultry feed, crude protein contents in PF1 and PF2 are 14.04±0.03% and 13.89±0.46% respectively even though there were remarkable differences between the analyzed and company declared protein values. In addition, all the fish feed samples showed crude proteins within the Bangladesh standard range, but the poultry feeds showed proteins below the Bangladesh standard

values. The crude protein content is very vital for animal growth. In feeds, high crude protein concentrations are crucial for the many types of livestock (fish, poultry) that feed on them. When the crude protein percentage is low, the digestive bacteria are not able to maintain adequate levels to digest the feeds.

Crude lipid

Considering that lipids contain concentrated energy, their inclusion in a diet is known to affect growth rate and feed efficiency, but they are also known to affect diet palatability, feed dustiness, and pellet quality. Various fish feeds had different crude lipid contents analyzed. Among fish feed samples, FF1 had a very high crude lipid content (12.0±0.1%) while FF2 and FF3 had crude lipid contents below Bangladesh's standard. Furthermore, poultry feed samples were also found to have a lipid content below the Bangladesh standard value. In contrast to the company-declared crude lipid value, the analyzed crude lipid value was different.

Table 2. Proximate compositions and mineral contents of poultry feeds (dry wt. basis).

Name of feeds	PF-1		PF-2		BSV
	TR	LV	TR	LV	
Moisture (%)	11.02±1.52	12.33	6.13±0.28	6.59	≤10
Ash (%)	8.81±0.03	8.56	8.97±0.05	8.66	-
Crude protein (%)	14.04±0.03	18.47	13.89±0.46	18.88	≥18.70
Crude lipid (%)	1.99±0.02	0.88	2.89±0.02	1.18	5 - 7
Iron (mg/g)	0.50±0.01	0.61	0.28±0.05	0.45	0.035 - 0.06
Phosphorous(mg/g)	7.89±0.05	7.41	1.0±0.05	2.18	≥6.5

All data are presented in Table 2 as mean ± standard deviation. FF- Fish Feed, PF-Poultry Feed, BSV- Bangladesh Standard Value, TR- Test Results, LV-Labeled Values. *The results are significantly different at 0.05 level (p<0.05).

Iron and Phosphorous

Minerals within animals function as structural components of organs and tissues, as cofactors or activators in enzyme and hormone systems, as components of body fluids and tissues (where they maintain osmotic pressure, acid-base balance, membrane permeability, and tissue irritability), and as cell regulators. The analyzed Fe (III) mg/g and P mg/g contents of the different fish and poultry feeds are shown in table 1 and table 2 respectively. We found that iron and phosphorous in fish feeds ranged from 0.45±0.01 to 1.2±0.05 mg/g and 11.01±0.01 to 13.63±0.02 mg/g respectively and were within the standard range. For poultry feeds, PF1 had good iron and phosphorous contents, but PF2 had values that were lower than Bangladesh's standard values.

The nutrient balance of feed influences feeds utilization and growth of fish (Lall and Tibbetts 2009). It is essential to know the nutritional requirements, particularly for protein, lipid and energy of optimum growth of a fish species, as well as in formulating a balanced diet (Murai 1991). There is no reliable published information on the chemical composition of commercial fish feed and feed ingredients in Bangladesh (Kader, Hossain, and Hasan 2005). Protein is the major growth-promoting factor in feed. The protein requirement of fish is influenced by various factors such as fish water temperature, feeding care, availability and quality of natural foods.

This study showed that different fish meals were found to have different percentages of chemical composition, which does not look similar to the labeled on manufacturer's proximate composition of feeds and the results found in this study was nearly similar to Bangladesh's national fish feed ingredients standards (MoFL 2011) and animal feed ingredients standards (MoFL 2013).

In respect of fish producers of Bangladesh, good quality and low-cost fish feed is the most important demand of farmers to reduce production costs. So, a lack of knowledge and information makes them uncertain about the application of these feeds. The present study attempted to collect this information. The existing information about the composition and nutritive value of the poultry feed permits the poultry farmers to select the better choice of feed and its ratio for the better growth and health of the poultry based on cost, palatability and energy.

Conclusion

The growth, health, and reproduction of fish and poultry are very dependent on the availability of adequate nutrients, both in quality and quantity, regardless of the culture system in which they are raised. Feeds of different feed manufacturers have varied between analytical and manufacturer values of different nutritional compositions.

There were significant variations among the various means of the feed samples at $P<0.05$. This study revealed that most of the feed samples differed from the mean recommended values by the Bangladesh standard values.

The enforcement of standards and frequent monitoring of feeds by the appropriate government regulatory agencies are recommended for ensuring the quality and standardization of feeds that meet the nutritional requirements of fish and poultry.

Acknowledgments

The authors wish to thank Director, BCSIR Rajshahi Laboratories, for providing the research facilities.

Competing Interests

Authors have declared that no competing interests exist.

Authors' Contributions

This work was carried out in collaboration between all authors. All authors read and approved the final manuscript.

References

AOAC. 2002. Official Methods of Analysis. Washington DC: 17th Edition Association of Official and Analytical Chemists.

Abraham, Mathew, Prabhu Pingali. 2020. "Transforming Smallholder Agriculture to Achieve the SDGs." In The Role of Smallholder Farms in Food and Nutrition Security 173–209. Springer, Cham.

Ayuba VO, Iorkohol EK. 2010. Proximate Composition of Some Commercial Fish Feeds Sold in Nigeria.

BER. 2017. Bangladesh Economic Review 2017 Chapter **7,** 97–112.

Bhuiyan Rezaya Rabbi, Simul Bhuyan, Tahmina Sharif Anika. 2016. **4(3),** 695–99.

Boto-Álvarez, Alejandra, Roberto García-Fernández. 2020. "Implementation of the 2030 Agenda Sustainable Development Goals in Spain. Sustainability **12(6),** 2546.

Do F. 2015. Ministry of Fisheries and Livestock.

FrederickáSmith G. 1952. The Colorimetric Determination of Iron in Raw and Treated Municipal Water Supplies by Use of 4: 7-Diphenyl-1: 10-Phenanthroline. Analyst **77(917),** 418–22.

Hamid MA, Rahman MA, Ahmed S, Hossain KM. 2017. "Status of Poultry Industry in Bangladesh and the Role of Private Sector for Its Development. Asian Journal of Poultry Science **11(1),** 1–13.

Hasan, Md. Sabbir, Mahci Al Bashera, Shyama Prosad Moulick, Fatema Tuz, Jahidul Islam, Mst Sarmina Yeasmin, Badrul Islam. 2021. "Antimicrobial Activities and GC-MS Chemical Profiling of Methanol Extracts of Different Parts of Morus Alba (Tut) in Bangladesh. International Journal of Biosciences **18(5),** 156–66.

Hasan, Md Sabbir, Rownok Jahan, Md Alam, Mst Khatun, Sharif Al-Reza. 2016. Study on Physicochemical Properties of Edible Oils Available in

Bangladeshi Local Market. Archives of Current Research International **6(1),** 1–6. https://doi.org/10.9734/ACRI/2016/29464.

Islam, Md Monirul. 2019. "Nutritional Compositions and Sensitivity Analysis of Poultry Feed Mills in Bangladesh through Experimental Economics Approach." Agricultural Research & Technology: Open Access Journal **21(2).** https://doi.org/10.19080/artoaj.2019.21.556159.

Kader MA, Hossain MA, Hasan MR. 2005. A Survey of the Nutrient Composition of Some Commercial Fish Feeds Available in Bangladesh. Asian Fisheries Science **18(1/2),** 59.

Khanum, Romaza, Petra Schneider, Al Mahadi, Muhammad Salim, Mohammad Mojibul Hoque Mozumder, Md Shamsuzzaman. 2022. Does Fish Farming Improve Household Nutritional Status? Evidence from Bangladesh." International Journal of Environmental Research and Public Health **19(2),** 967.

Lall Santosh P, Sean Tibbetts M. 2009. Nutrition, Feeding, and Behavior of Fish. Veterinary Clinics of North America: Exotic Animal Practice **12 (2),** 361–72.

Lovell Tom. 1989. Nutrition and Feeding of Fish. 260. Springer.

Mamun-Ur-Rashid M, Belton B, Phillips M, Kurt Rosentrater A. 2013. Improving Aquaculture Feed in Bangladesh: From Feed Ingredients to Farmer Profit to Safe Consumption. WorldFish.

Mo FL. 2011. Fish Feed Rules 2011. Ministry of Fisheries and Livestock. **3.**

Mo FL. 2013. Livestock Feed Rules 2013. Ministry of Fisheries and Livestock.

Monirul Alam GM, Nilufa Khatun M, Kamruzzaman M. 2012. Factors Affecting Poultry Production: Empirical Insights from Rural Areas of Bangladesh.

Murai T. 1991. Principles of Fish Nutrition. Aquaculture **92(5003),** 291–92. https://doi.org/10.1016/0044-8486(91)90032-3.

Nasim Al Mahmud, M D, M Belal Hossain, Maruf Hossain Minar. 2012. Proximate Composition of Fish Feed Ingredients Available in Lakshmipur Region, Bangladesh. American Journal of Agricultural Economics Science **12,** 556–60.

Netherlands Enterprise Agency. 2020. Poultry Sector Study Bangladesh, no. March: 1–76.

Ojabo LD, Wunduga M. 2020. Proximate Analysis of Selected Commercial Broiler Feeds in Makurdi Metropolis, North-Central Nigeria." Merit Research Journal of Agricultural Science and Soil Sciences **8(2),** 21–24. https://zenodo.org/record/3674002.

Rahman, Md. Lutfor, Nurul Absar, Md. Jahidul Islam, Shyama Prosad Moulick, Sabbir Ahmed, Mandira Saha, Md. Sabbir Hasan, Khokan Chandra Modak. 2019. A Comparative Assessment of Quality Features and Physicochemical Characteristics of Rice Bran Supplemented Breads with Local Breads. European Journal of Nutrition & Food Safety **11(3),** 108–13. https://doi.org/10.9734/ejnfs/2019/v11i330148.

Rahman, Mohammad Arifur. 2014. Assessment of the Quality of the Poultry Feed and Its Effect In. Journal of Bangladesh Chemical Society **27(1 & 2),** 1–9.

Saujanya Suman, Srirama Manyam KV, Satyanarayana K, Vijayaraghavan. 2021. Food Safety System in Bangladesh : Current Status of Food Safety. Feed The Future Innovation Lab For Food Safety (Fsil), E United States Agency For International Development (USAID).