

ASSESSMENT OF QUALITY OF POULTRY FEED MANUFACTURED IN REGISTERED AND UNREGISTERED FEED MILLS IN BANGLADESH

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ABSTRACT: The study evaluated poultry feed quality and health-hazardous elements from registered and unregistered feed mills in Savar, Kaliakoir, and Sreepur upazilas of Dhaka Division, Bangladesh. A total of 90 feed samples, including broiler starter, grower, and layer feeds, were randomly collected from five registered and five unregistered feed mills, considering three samples in each category. The feed samples were evaluated for physical attributes, including color, odor, particle size, and the presence of foreign materials, and were subsequently subjected to proximate analysis for the determination of moisture, crude protein (CP), ether extract (EE), and ash. The concentrations of two heavy metals, lead (Pb) and chromium (Cr), were determined in the feed samples. Both registered and unregistered feed samples showed acceptable physical quality, characterized by normal color and smell, particle size and absence of visible mold contamination or foreign materials. Proximate analysis showed the significant variation in terms of moisture, CP, EE, and ash within and between feed groups, indicating comparatively lower quality of feed obtained from unregistered group. In broiler feed (starter and grower), mean moisture, CP, EE, and ash contents ranged from 10.45–11.35%, 16.98–21.66%, 5.24–8.20%, and 6.13–7.20%, respectively, across registered and unregistered categories. In layer feed, the corresponding values in registered and unregistered categories were 11.05% and 10.81% moisture, 16.86% and 13.54% CP, 5.45% and 5.78% EE, and 11.77% and 8.16% ash, respectively. The concentrations of Cr and Pb were found to be below the detection level for all types of feed in both categories. The present study found that feed from unregistered mills, particularly in crude protein, was below standard, whereas registered-mill feed largely met nutritional standards. Based on the measured physicochemical parameters and Pb and Cr levels, no significant public health risk was evident.

Keywords: Chicken feed, Health hazard, Nutritional quality, Physical quality, Proximate analysis.

INTRODUCTION

The production of chicken feed is booming in Bangladesh due to the growing demand for poultry goods, particularly chicken eggs and meat (Hamid et al., 2016). According to the Feed Industry Association Bangladesh (FIAB), poultry uses the most feed because commercial poultry farming depends entirely on industrially produced feed. In Bangladesh, the annual feed demand is approximately 8.0 million metric tons, with commercial poultry farms being the largest consumers (Mamun et al., 2024). There are about 507 registered feed mills which are regulated and maintained by the government authorities (DLS Annual Report 2023-2024). A large number of unregistered feed mills are expanding in addition to registered mills in order to meet the growing demand for poultry feed (Nabihatul Afrooz, 2022). Since many of these feed producers do not hold an official license from the Department of Livestock Services (DLS), there is little control to guarantee that they adhere to quality standards. In the absence of oversight, they frequently disregard advised protocols. Nevertheless, unregistered feeds are commonly used, primarily due to their lower cost compared to feeds from registered feed mills (Nakkazi et al., 2015). They typically use lower quality raw materials to keep expenses down and draw in more customers, which boosts their profit margins (Mengesha and Mammo, 2012; Sigut et al., 2025).

The quality of chicken meat and eggs mostly depends on the quality of feed (Gautron et al., 2022; Maina et al., 2025). To evaluate the quality of poultry feed, several factors need to be considered. The quality of the ingredients used in poultry feed is crucial to its nutritional value (Demissie and Negash, 2020; Hossain et al., 2022). Poultry feed should be free from harmful contaminants, such as toxins, bacteria, and heavy metals (Alam et al., 2021; Islam et al., 2024; Mamun et al., 2024). The texture of the feed should be appropriate for the age and size of the birds (Tadesse et al., 2017). Proper packaging of poultry feed is essential to protect it from moisture, pests, and other contaminants (You et al., 2024). Low quality feed can also enhance the high mortality of chicken (Sultana et al., 2017). Numerous reports have emerged regarding adulterated, poor-quality feed produced by unregistered feed mills, resulting in serious health issues in birds, significant drops in production, and posing a potential risk to public health (Islam et al., 2024; Mamun et al., 2024). In most cases, farmers typically prioritize treating disease or low productivity with antibiotics over enhancing feed quality.

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Additionally, a significant barrier to the sustainable growth of the industry is the insufficient quantity and quality of chicken feed (Sigut et al., 2025).

Multiple studies (Shamim et al., 2024; Islam et al., 2024; Islam et al., 2024; Ochieng et al., 2021) have reported alterations in feed quality and the presence of potential pollutants in poultry feeds in developing countries. However, comparative data on the physical quality, proximate composition, and heavy metal contamination of feeds produced by registered and unregistered feed mills in Bangladesh remain limited, particularly in the Dhaka division. Therefore, the present study was designed to evaluate and compare the physical characteristics, proximate composition, and selected heavy metals (lead and chromium) in poultry feeds collected from registered and unregistered feed mills in the Dhaka division of Bangladesh. The importance of feed quality in sustainable poultry production is emphasized in this study, which also calls on farmers, consumers, and legislators to collaborate in order to preserve uniform feed standards.

MATERIALS AND METHODS

Location

The study was conducted under the Laboratory of Department of Animal Production & Management, Sher-e-Bangla Agricultural University, Dhaka 1207

Collection of feed samples

Broiler starter, broiler grower, and layer feed were collected randomly from 5 registered feed mills of three selected areas, namely at Savar, Kaliakoir, and Sreepur Upazila of Dhaka Division. The same categories of feed samples were also collected from the 5 unregistered feed mills in the same areas as well. A total of 90 feed samples of poultry feeds were collected from the farms, considering three samples in each feed mill, and kept in a zip lock poly bag.

Evaluation of physical properties

Feed samples were evaluated for physical characteristics including color, odor (with no rancid or abnormal smell), the presence of visible foreign materials based on visual inspection and feed form (mash, crumble, and pellet). Feed particle size was evaluated based on the protocol as described previously (Wilcox et al., 1970).

Determination of chemical properties

The feed samples were subjected to proximate analysis by standardized method according to (AOAC, 1990) for the determination of moisture, crude protein (CP), ether extract (EE) & ash. Selected individual feed sample was mixed thoroughly, dried, ground by grinding machine at the size of 0.5mm. Triplicate samples of each commercial feed types were used to determine the following chemical compositions.

The moisture content determination was carried out by keeping feed samples in a thermostat oven at 105°C for 24 hours. This was done by the difference between the net weight and the weight after drying to a constant weight. The final weight determined after cooling in a desiccator for about 35 minutes AOAC (1990). Crude protein was measured using the Kjeldahl method, a typical laboratory procedure for finding total nitrogen content in feed samples. About 1g of each sample was subjected to acid digestion using condensed sulfuric acid (H_2SO_4) and a mixed catalyst. The digested solution was then distilled into a 2% boric acid solution and consequently titrated with 0.1N hydrochloric acid (HCl). The nitrogen content obtained was transformed to crude protein by applying a conversion factor of 6.25 ($N \times 6.25$) according to AOAC (1990). For measuring ether extract, 3g sample was wrapped in filter paper and placed in an extraction thimble with cotton wool on top. It was then set up for Soxhlet extraction using 300 cm³ of 60–80 °C petroleum ether in a pre-weighed flask. The extraction ran for 3 hours with a constant water flow through the condenser. Afterward, the sample was air-dried and oven-dried at 80 °C until a constant weight was achieved. The crude fat content was calculated as a percentage of extractable fat.

During ash determination of feed according to AOAC (1990) method, a 2g sample is placed in a crucible and incinerated in a muffle furnace at 550°C. After approximately 6 hours, the weight stabilizes, indicating complete ashing. The final residue, representing the mineral content, is weighed after cooling in a desiccator. The weights were measured and the weights of the ashes obtained by difference.

Determination of heavy metals

Heavy metal analysis was performed following a wet-acid digestion procedure adapted from standard methods for trace metal determination. Briefly, 2 g of homogenized poultry feed sample was transferred into a digestion flask and treated with 10 mL concentrated nitric acid (65% HNO_3) and 4 mL hydrogen peroxide (30% H_2O_2). The mixture was heated gradually on a hot plate until complete digestion was achieved, as indicated by the formation of a clear solution. After cooling, the digest was filtered through Whatman No. 14 filter paper and diluted to a known volume with distilled water. The resulting solutions were analyzed for heavy metals using an Analytik Jena novAA 400P Atomic Absorption Spectrophotometer (AAS) (United States Environmental Protection Agency. 1996. *Method 3050B: Acid Digestion of Sediments, Sludges, and Soils*. Washington, DC, USA.)

Statistical analysis

All collected data were checked for completeness and entered into Microsoft Excel for data organization and tabulation. Statistical analyses were performed using Statistix 10 software (Analytical Software, Tallahassee, FL, USA). Analysis of variance (ANOVA) was used to evaluate differences among the measured parameters. Results are presented as mean $\pm$ standard deviation (SD). Statistical significance was declared at $P < 0.05$.

RESULTS AND DISCUSSION

Physical quality characteristics of feed samples

Feed form has reported to control feed intake in poultry, with pelleted diets generally improving feed consumption compared with mash diets; however, the magnitude of this effect may vary depending on diet composition, particle size, bird age, and management conditions (Shabani et al., 2015). Both the feed particle size and nutrient density play an important role on feed intake and bird performance (Svihus et al., 2024). The results demonstrated in Table 1 that the color of the feed exhibited slight variations among the samples. The feeds were observed in shades of yellow, dark yellow, dark brown, and light brown. All samples maintained a normal flavor profile, with no foreign particles or molds detected. No significant variation has been observed in particle size between registered and unregistered feed mills (Figure 1). The form of feed presentation and particle size significantly influence broiler performance within the poultry sector (Lv et al., 2015). Particle size has been shown to influence feed intake and the development of the gastrointestinal tract (Naeem et al., 2024). Particle size distribution of the poultry feed samples was determined by sieve analysis and expressed as the percentage of feed particles retained in each sieve-size fraction. The sieve fractions were classified as >4 mm, 3–4 mm, 2–3 mm, 1–2 mm, and 0.5–1 mm. The results showed that particle size distribution varied among starter, grower, and layer feeds. In broiler starter feed, most particles were retained in the 2–3 mm and 1–2 mm fractions. In broiler grower feed, the highest proportion of particles was retained in the 2–3 mm fraction, representing 89.12% in registered feed and 87.86% in unregistered feed. Layer feed showed a wider particle size distribution, with particles distributed across all sieve-size fractions. Overall, the results indicate that grower feed had a more uniform particle size distribution, while layer feed showed greater variation in particle size. Providing broilers with a pelleted diet enhances both weight gain and feed intake (Svihus et al., 2024; Stojkov et al., 2025). In the feed industry, feed formulations, conditioning, and grinding are regarded as critical factors affecting pellet quality. Enhancements in pellet quality can be achieved by refining feed production processes, particularly in grinding and conditioning (Lilly et al., 2011; Rueda et al., 2022; Svihus et al., 2024). It is widely accepted that grinding raw materials to a finer particle size may lead to improved pellet quality (Shabani et al., 2015). A comparative physical analysis of the feeds revealed color variations among different feeds from registered and unregistered companies. Additionally, some unregistered feeds contained foreign particles. While most feed companies produced feeds with a similar aroma, certain unregistered feeds were noted to be hard.

Table 1 - Comparative analysis of physical properties between registered and unregistered feed mill.

Parameter	Feed company	Broiler starter	Broiler Grower	Layer (Layer feed)
Feed form	Registered Unregistered	Crumble Crumble	Pellet Pellet	Mash Mash
Color	Registered Unregistered	Dark brown / Light brown Brown / Dark brown	Light brown / Dark yellow Dark yellow	Yellow/Dark yellow Yellow
Smell	Registered Unregistered	Normal Normal	Normal Normal	Normal Normal
Foreign particles	Registered Unregistered	Absent Absent	Absent Absent	Absent Absent/Present

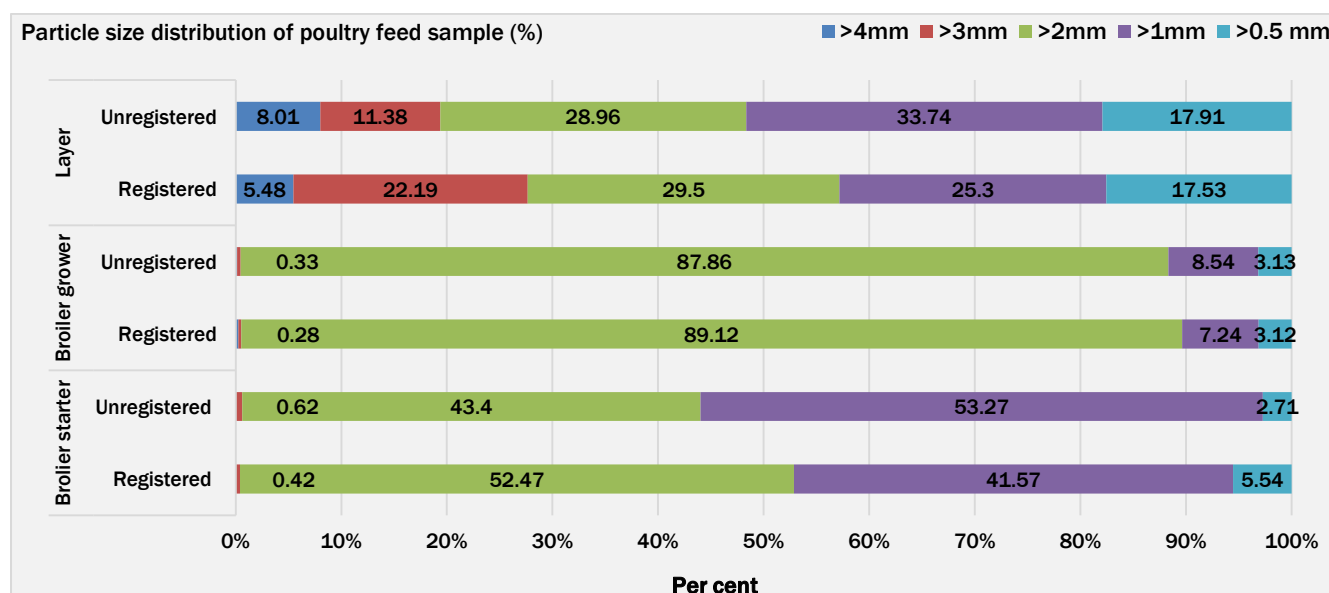


Figure 1 - Particle size distribution of poultry feed samples

Chemical properties of feed

Moisture percentage

Moisture or water contents of feeds are often overlooked. Present study indicates the moisture content ranging 9.09% to 12.11% in different types of chicken feed (Figure 2). The results indicate minor differences in the moisture of chicken feed from various sources. Moisture per cent in chicken feed ranges between 8-12% indicating the good quality feed with longer shelf life, which means that those feeds may store well and resist fungal attack. Moisture content of feed may sometimes be lower or higher than the manufacturers declared. The type of ingredients or the timing of ingredient collection determines the moisture content of feed. Moreover, high moisture percentage may support the growth of fungi in the feed when stored for longer period (Vieira, 2003). Corns are the major ingredients poultry feeds in Bangladesh, which possess more than 20% at the time of harvesting (Saiful et al., 2015).

Crude protein percentage

Typically, starter rations contain higher protein levels compared to grower and finisher rations for both broilers and layers. The crude protein content ranged from 17.71% to 22.03% in broiler starter rations, 15.62% to 21.50% in broiler grower rations, and 11.97% to 17.64% in layer rations were investigated this study (Figure 3). However, according to standard commercial industry standards, the commonly recommended crude protein levels of 20–22% for broiler starter, 18–20% for broiler grower, and 16–18% for layer rations. Based on this comparison, some starter and grower feed samples were below the recommended crude protein range, while some grower samples exceeded the recommended range. Layer rations also showed lower crude protein values in some samples, indicating variation in protein adequacy among the analyzed feed samples. In this study, significantly lower CP value was found in all types of unregistered feed compared to registered feed. This might be because protein feed ingredients for ration formulation are expensive, and some feed producers might employ less expensive protein sources to increase their profits. It is evident that crude protein constitutes a significant and costly element of animal feed (Alhotan et al., 2014). When low-quality protein contains insufficient and unbalanced amino acids, adding more dietary protein to the ration may not have an impact on growth, feed efficiency, or carcass characteristics; instead, it may result in increased mortality (Delezie et al., 2007).

Ether extract percentage

Figure 4 illustrates clear differences in Ether extract percentage among poultry feeds from registered and unregistered feed mills. Registered feeds, particularly for broiler growers, generally contain higher and more consistent fat levels, which are indispensable for supplying energy to poultry (Swamy and Upendra, 2013). However, feeds from unregistered sources are more inconsistent and frequently have lower fat values, particularly in the diets of broiler growers. Significant variations in the nutritional quality of broiler starter and layer feeds were observed.

Ash percentage

Mineral elements are abundant in the bodies of animals, and in a chicken's body, which is around 4%. Minerals are critical nutrients required in specific amounts in the poultry diets needed for muscle contraction, egg shell formation, stronger bones, blood clotting, and enzyme activation (Orban et al., 1993). This study reported the various ranges of ash content in different feed sample (Figure 5). However, it was reported that low ash content in feed causes diseases and poor eggshell formation in birds (Delezie et al., 2015).

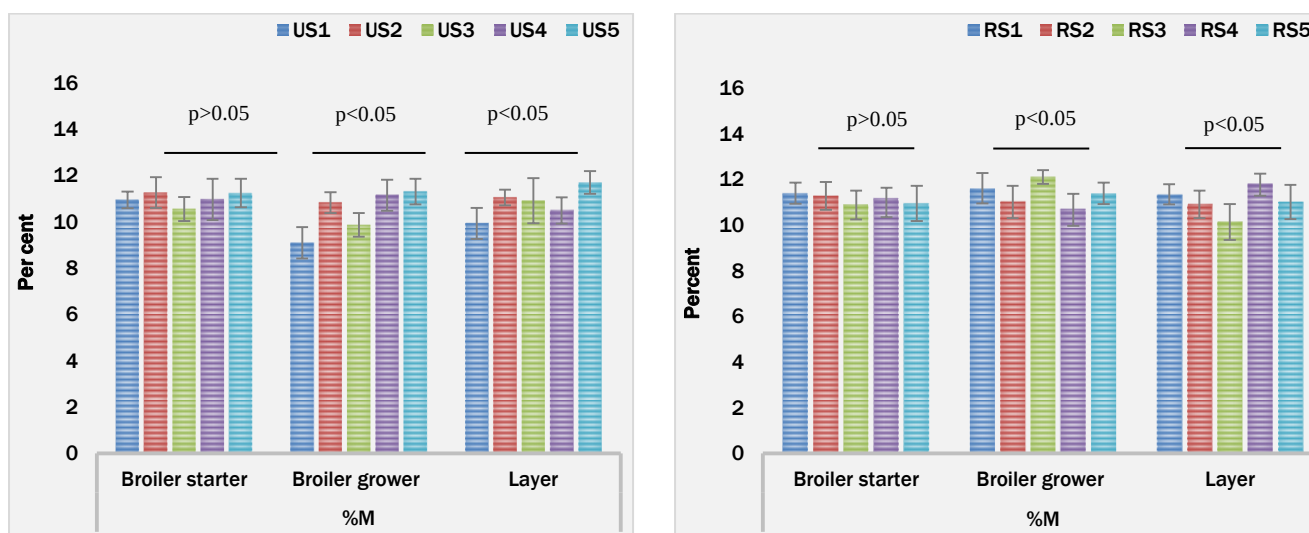


Figure 2 - Moisture percentages of registered (left) and unregistered (right) feed mill samples. RS= Registered feed mill samples; US=Unregistered feed mill samples, M= Moisture.

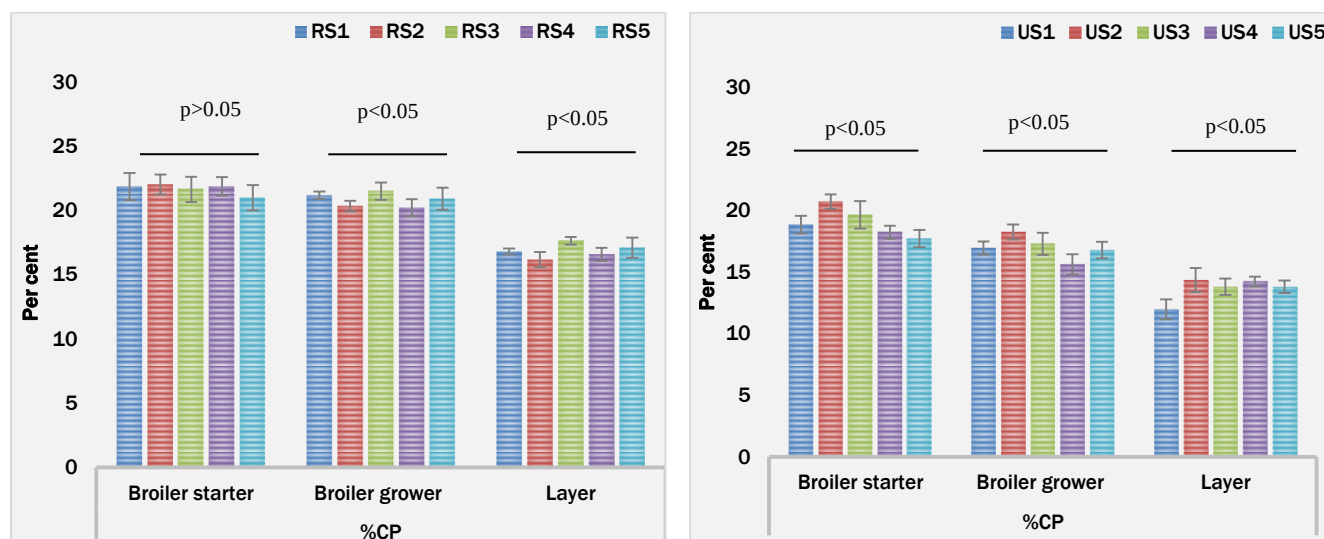


Figure 3 - Crude protein percentage of registered (left) and unregistered (right) feed mill samples. RS= Registered feed mill samples; US=Unregistered feed mill samples, CP= Crude protein.

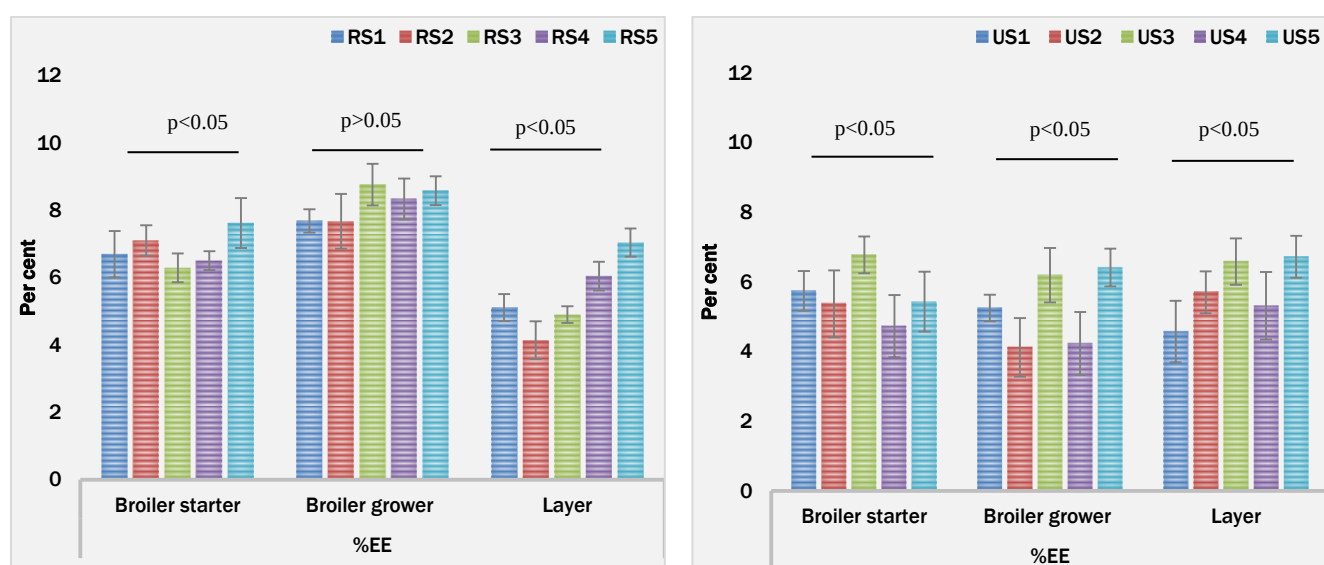


Figure 4 - Ether extract percentage of registered (left) and unregistered (right) feed mill samples. RS= Registered feed mill samples; US=Unregistered feed mill samples, EE=Ether extract.

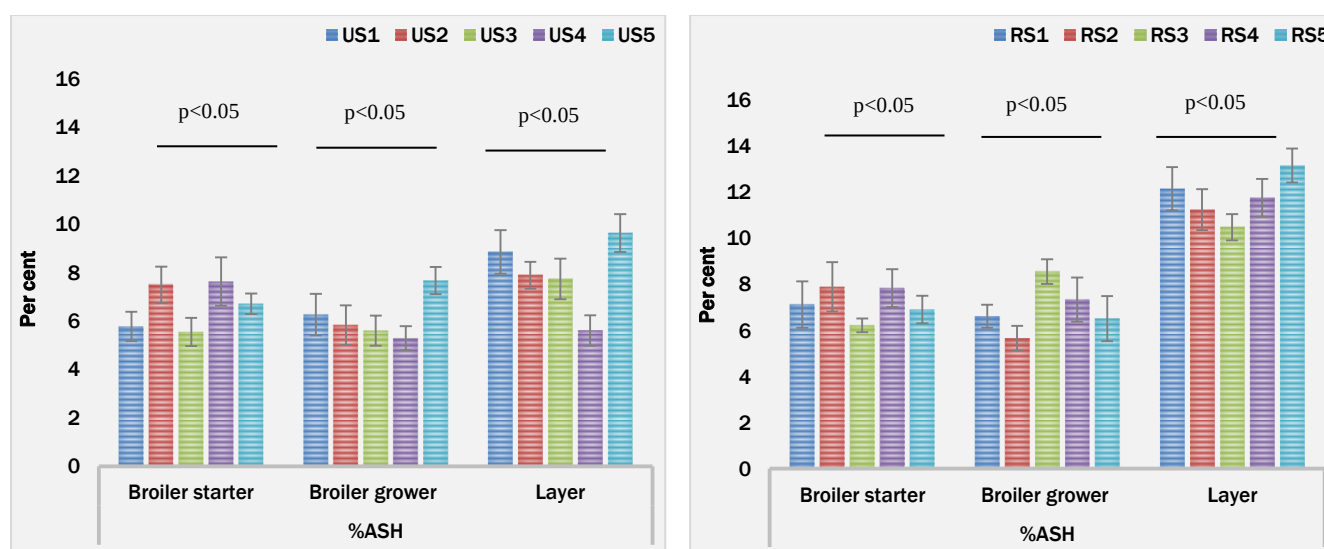


Figure 5 - Ash percentage of registered (left) and unregistered (right) feed mill samples. RS= Registered feed mill samples; US=Unregistered feed mill samples.

Comparative analysis between registered and unregistered feed mill samples

Figure 6 compares the quality of poultry feed across starter, grower, and layer feeds from registered and unregistered feed mills, focusing on important components like moisture, fat, protein, and minerals. All things considered, feed from registered mills appears to be more consistent and balanced overall, particularly in terms of protein and minerals, which are essential for healthy growth, especially in the early stages of chicken (Dutta et al., 2020). Feed from unregistered feed mills, on the other hand, frequently lacks these vital nutrients and varies significantly (Hasan et al., 2022). While the two groups moisture levels are generally comparable, the unregistered group exhibits greater variability. Additionally, some of the unregistered samples had a slightly higher fat content. These results imply that feed quality is not substantially maintained by unregistered feed mills (Dutta et al., 2020).

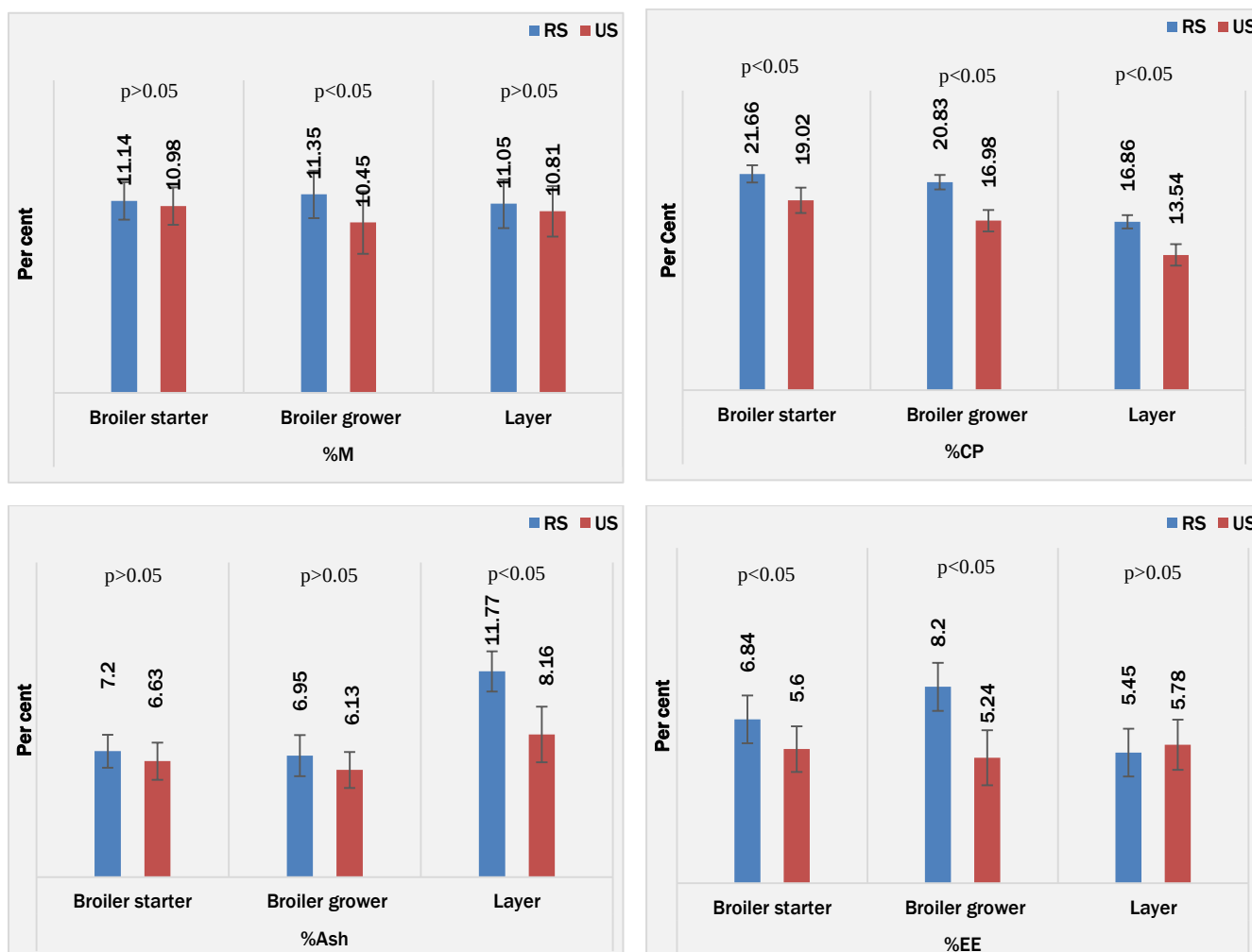


Figure 6 - Comparative nutrient composition between registered and unregistered feed mill samples. RS= Registered feed mill samples; US=Unregistered feed mill samples, M= Moisture, CP=Crude protein, EE=Ether extract.

Heavy metals in feed

Poisonous metals lead and chromium in broiler feed might exhibit toxicity and carcinogenic effects at low concentrations on public health by consumption of poultry products day by day. According to the United States Environmental Protection Agency, metals such as Chromium (Cr), Arsenic (As), Cadmium (Cd), and Lead (Pb) are regarded as some of the most environmentally hazardous elements (Hossain et al., 2022). The concentrations of both lead and chromium were found to be below the detection limit (BDL) in this study (Table 2), indicating the feed is generally considered not hazardous. Therefore, periodic analyses of these toxic metals in poultry feed are necessary for ensuring feed quality and consumer safety as well. However, many works have been carried out regarding the analysis of these metals in different types of poultry feed and found below the detection level (Islam et al., 2024).

Table 2 - Comparative heavy metal composition between registered and unregistered feed

Elements	Feed company	Broiler starter	Broiler Grower	Layer (Layer feed)
Cr	Registered	BDL	BDL	BDL
	Unregistered	BDL	BDL	BDL
Pb	Registered	BDL	BDL	BDL
	Unregistered	BDL	BDL	BDL

BDL=Below detection limit. Values that were below 0.021 ppm and 0.074 ppm were identified as BDL for Cr & Pb respectively.

CONCLUSION

The research included testing broiler feeds by measuring their physical structure, chemical content, concentration of heavy metals and their quality against food safety standards. The study showed that feed from registered feed mills in the Dhaka Division was of a much higher quality than that from unregistered feed mills. Unregistered feed millers are using low-quality ingredients to increase profits, as they are not inspected by the government authority. Because of these factors, the government and involved stakeholders ought to take action to ensure the availability of nutritious and safe animal feed, which contributes to the production of safe protein for human consumption. Further research should include more feed mills and samples from diverse regions to validate quality variability and monitor nutritional consistency, adulteration, and other contaminants, particularly in unregistered feed mills.

DECLARATIONS

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Data availability

The datasets used and/or analysed during the current study available from the corresponding author on reasonable request.

Authors' contribution

The first four authors contributed equally and were considered as first author. M. S. Islam planned, designed the research, managed the fund, prepared original draft and reviewed the manuscript. J. He designed the research and reviewed the manuscript. M. S. Uddin collected data, samples and conducted laboratory analysis. M. A. Hossain prepared manuscript, analyzed and visualized data. Z. Naim reviewed the manuscript. M. Akter reviewed and approved the final version of the manuscript. R.N. Ramim reviewed the manuscript. All authors read and approved the submitted version of the manuscript.

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Competing Interests

The authors declare no competing interests in this research and publication.

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