PROXIMATE AND MINERAL COMPOSITION OF POULTRY BY-PRODUCT MEAL, HATCHERY BY-PODUCT MEAL, FISH MEAL, AND FEATHER MEAL

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Abstract
The Study was designed to evaluate the proximate and mineral composition of Poultry by-product meal, Hatchery by-product meal, Fish offal meal, and Feather meal. Poultry by-products, hatchery by-products, fish offals and chicken feathers were subjected to different processing techniques involving washing, cooking (for about 1 hour, 30 minutes, 1 hour, and 40 minutes respectively, at 100^{o}C), Oven drying for 5 hours at about 184^{o}C. The processed sample meals were analyzed for proximate composition and mineral profile at the biochemistry Laboratory. The result showed that Poultry by-product meal, hatchery by-product meal, fish offal meal and feather meal had dry matter values 92.16, 88.67, 86.90 and 96.55% respectively; Crude Protein content ranging 22.12 - 49.31%; Crude fibre 0.04 - 14.79%; Oil content 0.74 - 8.78%; and Ash 5.47 - 16.35%. Calcium content 0.30 - 1.36%, Phosphorus 0.34 - 1.52%, Potassium 0.11 - 0.27%, Iron 0.75 - 2.21%, Magnesium 0.57 - 0.62%, and Copper 0.09 - 0.21%, all within the minimum and satisfactory levels as recommended for animal products. It was concluded that these unconventional feedstuffs are a good source of animal proteins as they all contain CP values above 20%, and hence can be a replacement for plant protein in livestock diet.
Key Words: Chemical Composition, Feather Meal, Fish Meal, Poultry by-Product meal and proximate analysis.

Introduction

The cost of feed ingredients has over the years increased due to their shortage in supply. It accounts for up to 70 - 80% of poultry and other livestock production. Among feed ingredients, protein and energy-rich ingredients of animal feeds is the most expensive (Gandi, *et al*., 2020), since they constitute the macro ingredients. Shortage in animal protein, particularly in developing countries, has necessitated investigations into several novel alternative feeding materials for possible incorporation into animal feeds (Fasuyi and Aletor, 2005). Protein is supplied both from vegetable and animal sources, such as oilseed meals, legumes, abattoir waste, poultry by-product meal (PBPM), fish etc. Plants are still the main source of different poultry feed nutrients, but the increasing rate of livestock growth cannot be maintained at the current crop production volume worldwide. As such, the use of unconventional animal feed sources may be a solution (Gandi, *et al.*, 2020).

The need to maximize the economic and environmental disposal of slaughterhouse by-products also stimulated a renewed interest in the investigation of slaughterhouse by-products for possible use as protein feedstuff in livestock feeds (Fasuyi and Aletor, 2005). Hatchery by-product meal contains variable amounts of shells, eggs, embryos and culled chicks, and this variability is reflected in its composition and nutritive value. It contains protein and minerals and can be processed through different methods such as cooking, drying and grinding into a meal (hatchery by-product meal) suitable to feed livestock (Göhl, 1970). Feather meal results from the processing of the feathers obtained after poultry dressing. Feather meal is used as a source of protein for farm animals and as a fertilizer. It is primarily a protein source and it represents 3-7% weight of the live bird, therefore producing a considerable mass of protein (Soni *et al*., 2017). Feather meal is a protein source of poor quality because it is deficient in amino acids that are essential in many livestock species, notably lysine, methionine, histidine and tryptophan (Crawshaw, 2019).

According to Meeker *et al*. (2006), poultry by-product meal is one of the most important sources of animal protein used to feed domestic animals, along with other sources such as meat and bone meal, fish meal, feather meal etc., and it is obtained from the combination of by-products coming from poultry slaughterhouses or poultry processing plants. The composition of poultry by-products depends on processing conditions and on the source of materials (Johnson *et al.*, 1998).

Huge quantities of animal by-products such as hatchery waste, fish offal, feathers and broiler chicken head and shank are produced and disposed, and this contributes to environmental pollution

problem. Conversion of these materials into feedstuffs suitable for farm animals would not only mitigate the environmental pollution, but also make new sources of animal protein available to be incorporated into animal feed.

Materials and Methods

Location for the study

The Study was conducted at the Teaching and Research Farm, Department of Animal Science, Kaduna State University (KASU), Kafanchan Campus. Kafanchan is located at latitude 9° 59'N, longitude 8° 29'E and it is situated at an elevation of 733m above sea level (Ovimaps, 2022).

Sources of materials and sample preparation

Some of the animal by-products (i.e. broiler chicken head and shank, Fish offals and feathers) were sourced from various locations within Kaduna metropolis, while the Hatchery by-product was sourced from a Hatchery in Jos, Plateau State. Each Sample was collected and refrigerated before processing, except for the feathers sample that was cleaned and dried under room temperature.

Processing of animal by-product samples

Hatchery by-product meal sample (4.8kg) was added into boiling water at 100^0C, and was allowed to cook for 30 minutes. This was done as recommended by Abiola and Onunkwor (2004). The solid part of the hatchery by-product meal sample was drained and separated from the liquid. The sample was resized using mortar and pestle, and was oven dried on trays for 5 hours at 75°C. The refrigerated sample of poultry trimmings (Head and shank), was placed in a bowl of water at room temperature, and allowed to defrost. The sample (4kg) was boiled in a steel pot of boiling water (6 litres) for 1 hour, at 100^0C. The liquid content of the cooked sample was properly drained using a sieve, while the solid content was allowed to cool for about 30 minutes at room temperature, after which it was resized (mashed) into smaller particles using a mortar and pestle. The fish meal was sieved to separate the solid content from the liquid. It was drained properly, sprayed on trays and oven dried in an electric oven for 5 hours at 75°C. The Feather samples were dried at room temperature until a consistent weight was obtained. The dried feather samples (1kg) were added to (6 litres) of boiling water and allowed to cook for 40 minutes, at 100°C in a pressure pot as recommended by Strzetelski *et al*., (1999). The cooked feather samples were drained using a sieve and were oven dried for 2 hours at 75°C. The dried samples after cooling off were resized using an Electric blender (BLG – 452) and later grinded into powdered form using mortar and pestle. All samples were well packaged in labelled plastic container for subsequent laboratory assessments.

Proximate and chemical analysis

Determination of crude protein, total ash, crude fibre, crude fat, and nitrogen free extract (NFE) were done according to the procedure of AOAC, 2005. The analysis of proximate composition was done at the Animal Science Laboratory, ABU Zaria; chemical analysis was carried out in duplicates.

Results and Discussions

Table 1 shows the Proximate Composition of broiler chicken head and shank meal, hatchery by-product meal, fish offal meal and feather meal. The values obtained for Dry matter content were 92.16, 88.67, 86.90 and 96.55% for fish offal meal, broiler chicken head and shank meal, hatchery by-product meal and Feather meal, respectively. Feather meal had the highest value (96.55%) with hatchery by-product meal having the lowest value (86.90%). The high dry matter content in Feather meal may result from the presence of keratin in feather which constitutes about 7% weight of the live bird; this produces a considerable mass which is converted into valuable meal. Adeniji *et al*., (2007) also obtained similar result of 91.00% dry matter in the feeding value of hatchery by-product meal in the diets of early-weaned piglets.

The result also showed crude protein content for broiler chicken head and shank meal, hatchery by-product meal, fish offal meal and feather meal 22.12, 30.57, 29.58 and 49.31% respectively. The highest value for crude protein was obtained in Feather meal at 49.31% while the lowest 22.12% was obtained in Fish offal meal. The value obtained for fish offal meal, 22.12%, does not correlate with the range as recommended by Gündoğdu, (2020) who reported that High-quality fishmeal normally contains between 60% and 72% crude protein by weight. The current result obtained was likely because fish offal (an unconventional protein source) was used, and it contains higher levels of oil which is seen to depress protein content in feedstuff. The CP value obtained for feather meal was 49.31%. The result disagrees with Cotanch, *et al*. (2007) who reported a range of 84.10%–92.00% for crude protein content of feather meal; this might be due to the processing method used. Swetlana and

Ajayi and Iyayi (2014) also reported that feather meal contained 83.80%–89.90% crude protein. Values for Crude fibre content were recorded highest at 14.79% for broiler chicken head and shank meal, and lowest for Fish offal meal at 0.04% respectively. The Crude fibre content was highest in broiler chicken head and shank meal (14.79%). The reason for high value could be because of the presence of bones and muscles (collagens) that do not disintegrate easily. This agrees with Castaneda and Monrroy, (2010) who stated that high levels of protein indicate a higher proportion of meat and less bone. The values recorded for oil content were highest (8.78%) in Hatchery by-product meal and lowest (0.74%) in poultry by product meal. Values for ash content were highest (16.35%) in poultry by-product meal, and lowest in feather meal (5.47%).

The mineral Compositions of broiler chicken head and shank meal, hatchery by-product meal, fish offal meal and feather meal are presented in table 2. The values for calcium content were 1.26, 1.36, 1.06 and 0.30% for fish offal meal, broiler chicken head and shank meal, hatchery by-product meal and feather meal, respectively. The highest value 1.36% obtained in broiler chicken head and shank meal disagrees with Pesti *et al.* (1986) who reported 5.14% for calcium content, while value of 0.30% obtained in feather meal agrees with the range (0.35%) as recommended by Bisi, (2006). The result also showed that phosphorus content was obtained highest (1.52%) in Poultry by-product meal, and lowest 0.34% in Feather meal. Pesti *et al.* (1986) reported a higher value of 2.36% in broiler chicken head and shank meal, while Bisi, (2006) reported 0.56% phosphorus in feather meal. The values recorded for potassium have the highest (0.27%) for hatchery by-product meal and the lowest (0.11%) for feather meal, respectively. The Iron content was highest (2.21%) in feather meal and lowest (0.75%) in hatchery by-product meal, respectively. Values for Magnesium were highest (0.62%) in broiler chicken head and shank meal and lowest (0.57%) in Hatchery by-product meal. The values obtained for copper content were highest in feather meal (0.21%) and lowest in Hatchery by-product meal (0.09%).

Table 1: Proximate Composition of broiler chicken head and shank meal, hatchery by-product meal, fish offal meal and feather meal

Parameters (%)	Samples of the animal by-product meals			
	FOM	BCHSM	HBPM	FM
Dry Matter	92.16	88.67	86.90	96.55
Crude Protein	22.12	30.57	29.58	49.31
Crude Fibre	0.04	14.79	3.75	1.52
Oil	6.11	0.74	8.78	2.11
Ash	9.00	16.35	13.98	5.47
NFE	62.73	37.50	43.99	41.59

Results are mean values of duplicate sample readings. NFE: Nitrogen Free Extract, FOM: Fish Offal meal, BCHSM: Broiler Chicken Head and Shank Meal, HBPM: Hatchery by-product Meal, FM: Feather meal

Table 2: Mineral Composition of Broiler chicken head and shank meal, hatchery by-product meal, fish offal meal and feather meal

Parameters (mg/kg)	FOM	BCHSM	HBPM	FM
Calcium	1.26	1.36	1.06	0.30
Phosphorus	0.78	1.52	0.39	0.34
Potassium	0.20	0.18	0.27	0.11
Iron	1.38	0.80	0.75	2.21
Magnesium	0.60	0.62	0.57	0.59
Copper	0.01	0.12	0.09	0.02

Results are mean values of duplicate sample readings, FOM: Fish Offal meal, BCHSM: Broiler Chicken Head and Shank Meal, HBPM: Hatchery by-product Meal, FM: Feather meal

Conclusion

The Crude protein content for broiler chicken head and shank meal, hatchery by-product meal, fish offal meal and feather meal were 22.12, 30.57, 29.58, and 49.31%, respectively; this suggests they are a good source of animal base protein feedstuff. All samples (broiler chicken head and shank meal, hatchery by-product meal, fish offal meal and feather meal) had good mineral profile. However, hatchery by-product meal and broiler chicken head and shank meal can be used as replacement for bone meal and limestone in livestock diet (calcium content 1.26, 1.36, 1.06, and 0.30% and phosphorus 0.78, 1.52, 0.39, and 0.34% respectively).

Recommendations

- The values obtained from this study are all above the recommended value for crude proteins (20%), hence, can be considered as protein feedstuffs.
- Further study should be conducted on feeding trial to ascertain the palatability and utilization of the unconventional feedstuff.

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