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RESEARCH ARTICLE

Assessment of Poultry Feed Ingredients Used in Commercial Compound Feed

Muhammad Ashraf Anjum, Zahid Hussain*, Sohail Hassan Khan, Naveed Ahmad, Muhammad Yasin Amer and Naveed Iftikhar
Poultry Research Institute, Murree Road, Shamsabad, Rawalpindi, Pakistan

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***Corresponding Author:**
zhussain60k@gmail.com

ABSTRACT
A total of 208 samples of raw materials used in commercial poultry feed were analyzed for the estimation of proximate analysis from various parts of Pakistan over a period of three years from April 2011 to March 2014. The mean values of crude protein (CP), crude fiber (CF), ether extract (EE) and total ash in corn were found to be 9.77, 4.20, 10.15 and 2.50%, respectively. The mean values of CP, CF, EE and total ash in soybean meal were found 42.48, 6.80, 4.14 and 7.25%, respectively. The minimum and maximum values of CP, CF, EE and total ash in canola meal were recorded as 33.8 to 43.7%, 2.0 to10.0%, 3.3 to 9.9% and 10.50 to 12.0%, respectively. The minimum and maximum values of CP, CF, EE and total ash in sunflower meal were found 27.1 to 28.0%, 9.5 to 22.50%, 1.0 to 5.30% and 4.0 to 7.5%, respectively. Among animal protein sources, the mean values of CP, CF, EE and total ash in feather meal were found 39.47, 2.00, 19.87 and 11.87%, respectively. The mean values of CP, EE and total ash in fish meal samples were found 50.68, 6.0 and 20.0%, respectively. Large variation was found in analytical values among poultry ingredients, which may be attributed to genetic factors, environmental influences, fertilizer, milling degree and storage conditions among different areas.

INTRODUCTION

Poultry feed industry is closely connected to the primary agricultural production and forms an essential component of the food chain. Feed represents the major cost of poultry production which lies between 65 and 75%. So, any improvement in the performance of broilers and layers due to their diet can unavoidably have a strong effect on profitability. Poultry feeds are composed primarily of a mixture of several feedstuffs such as cereal grains, soybean meal, animal by-product meals, fats, and vitamin and mineral premixes. These feedstuffs, together with water, provide the energy and nutrients that are essential for the bird's growth, reproduction, and health, namely proteins (amino acids), carbohydrates, fats, minerals, and vitamins. Balanced diets involves the mixture of the right proportions of various ingredients to produce diet with all essential nutrients ultimate for normal functioning of a concerned or particular animal. Unbalanced diets may produce economic loss in terms of animal health, feed conversion efficiency and eventually the output of animal products (Gizzi and Givens, 2004). Formulation of a diet is a matter of combining feed ingredients to make a diet that will be eaten in the amount needed to supply the daily nutrient requirements of the animal (Lalman and Sewell, 1993).

Seasonal availability of locally produced feed ingredients together with variations in quality of some ingredients has made the feed situation in Pakistan unsatisfactory from the quality standpoint. Inadequate feed analytical services as well as lack of statutory control over feed quality have further provoked the situation. Number of feed mills is increasing rapidly in the Punjab province to meet the high demand. Recently, it was reported that there were 121 feed mills with 7.66 million tons capacity that were producing 4.231 million tons different types of poultry feed and distributing poultry feed all over the country (Statistical Report, 2011-12). Few of the feed mills are maintaining feed quality. On the other hand, farmers do not have access to adequate facilities to analyze and monitor quality of commercial feeds. In view of the limited availability and varying sources of different feed ingredients, nutrients level in prepared feeds may differ from what is actually required. The objective of the present study was to analytically characterize different poultry feed ingredients for their nutritional constituents such as crude protein, crude fiber, crude fat and total ash value.

MATERIALS AND METHODS

Samples collection and proximate analysis

For the estimation of proximate analysis , a total of 208 samples of different types of raw materials were received and analyzed at Feed Testing Laboratory, Poultry Research Institute, Rawalpindi from various parts of Pakistan (Islamabad, Rawalpindi, Toba Tek Singh, Abbotabad, Attock, Bahawalpur, Bhakkar, Chakwal, Faisalabad, Layyah, Peshawar, Rahim Yar Khan, Azad Kashmir, Sialkot, Gilgit, Jhelum, Gujrat, Multan, Sargodha, Bahawal Nagar, DG Khan, Mianwali, Gujranwala, Lahore, Mandi Bahudin) over a period of three years from April 2011 to March 2014. A total of 208 samples of different feed raw materials received consisted of 33 corns, 10 rice broken, 48 rice polish, 16 soybean meal, 20 canola meals, 10 sunflower meal, 10 feather meals and 61 fish meal. Samples were sent by the poultry farmers themselves or in some cases these samples were collected by feed samplers of the laboratory. Feed samples were properly packed in polythene bag on collection and particulars of the farm and feed stuff were provided separately on Performa. In some cases samples were received by post.

When feed samples were received in feed testing laboratory, these were stored in glass bottles with tight caps and kept in dry and ventilated room. Prior to analysis, poultry feed samples were ground using a blender (Lab mill-1 QC-114, Hungary). Five gram of feed ingredients were taken for proximate analysis. These samples were chemically analyzed by following the standard methods (AOAC, 2011). *Micro-Kjeldahl* and Soxhlet apparatus were used for analysis of crude protein (CP) and ether extract (EE).

Data analysis

Collected data were statistically analyzed (Standard Deviation) by using computer Statistical Software Mstatc and Microsoft Office Excel.

RESULTS AND DISCUSSION

Proximate analysis is a type of scientific study done to determine the approximate amounts of substances within a material and is utilized by different scientists to study. The poultry feed is formulated after the evaluation of feed ingredient on the basis of their CP, EE, crude fiber (CF) and total ash. The estimation of CP, CF, EE and total ash in feed ingredients tested are given in Table 1&2. In this study a total of 208 different feed ingredients samples were received and analyzed.

Corn: Out of 208 samples, 33 corn samples were tested. The mean values of CP, CF, EE and total ash in corn were found as 9.77, 4.20, 10.15 and 2.50%, respectively. In another study, the average values of CP, CF, EE and total ash in corn were found as 9.50, 3.3, 4.30 and 1.4%, respectively (White and Johnson, 2003). The values of EE and total ash were less in the current study than the above analysis. Kim and Allee (2003) reported that high oil corn varieties contained about 80% more oil than normal corn (average EE; 6.71% vs 3.72%) and about 29% more protein (average CP; 9.54% vs 7.38%). Protein is the major growth promoting factor in feed. The study from 15 countries showed the mean value of CP was found 8.01% which is comparatively low than the current study (Thomas, 2002).

Rice and rice polishing: 10 samples of rice broken were tested for proximate analysis. The mean values of CP, CF, EE and total ash in rice broken were found as 6.56, 1.80, 7.60 and 1.50%, respectively. Rice is an excellent energy source with low but fairly good quality protein content. The different varieties of rice contained EE as 7.40, 7.18, and 7.28% for Kernel, variety 86 and KSE, respectively (Abbas et al., 2011). These values are very close to the value of the current study. The chemical and nutritional quality of rice grain varies considerably and this may be attributed to genetic factors, environmental influences, fertilizer treatments, degree of milling and storage conditions.

The mean values of CP, CF, EE and total ash in rice polishing samples (48 No.) were observed as 11.50,

Table 1: Estimation of crude protein (CP), crude fiber (CF) and ether extract (EE) and total ash on dry matter basis

Type of Ingredients	No. of Samples analyzed	Nutrients (%)	Range	Mean± SD
Corn	33	CP	7.8-10.5	9.77± 1.75
		CF	2.0-6.5	4.20± 0.76
		EE	6.3-16.6	10.15± 2.45
		Ash	1.0-8.0	2.50± 1.10
Rice broken	10	CP	6.12-7.87	6.56± 2.51
		CF	1.5-2.0	1.80± 0.40
		EE	6.9-8.3	7.60± 0.90
		Ash	1.0-2.0	1.50± 0.50
Rice polishing	48	CP	9.0-14	11.50± 2.56
		CF	7.0-31.5	14.80± 3.30
		EE	6.6-23.3	15.12± 4.00
		Ash	10-24.50	14.00± 2.55

Table 2: Estimation of crude protein (CP), crude fiber (CF) and ether extract (EE) and total ash on dry matter basis in different meals

Type of Ingredients	No. of Samples analyzed	Nutrients (%)	Range	Mean± SD
Soybean meal	16	CP	35.8-47.2	42.48± 4.08
		CF	6.5-7.0	6.80± 2.80
		EE	1.6-13.3	4.14± 0.87
		Ash	6.0-8.0	7.25± 2.00
Canola meal	20	CP	33.8-43.7	36.36± 3.50
		CF	2.0-10.0	5.80± 1.25
		EE	3.3-9.9	6.26± 2.35
		Ash	10.5-12	11.25± 2.13
Sunflower meal	10	CP	27.1-28.0	27.70± 4.80
		CF	9.5-22.5	17.50± 1.90
		EE	5.3-1.0	4.10± 1.76
		Ash	4.0-7.50	5.75± 1.17
Feather meal	10	CP	36.7-43.7	39.47± 4.44
		CF	5.0-2.0	2.00± 0.88
		EE	12.1-26.6	19.87± 1.67
		Ash	6.0-20.5	11.87± 1.60
Fish meal	61	CP	33.2-60.0	50.68± 4.55
		EE	3.0-9.0	6.00± 2.44
		Ash	22-18	20.00± 3.22

14.80, 15.12 and 14.00%, respectively. Rice polishing has great potential as an ingredient in poultry feed with level inclusion varying from 25-40%. Rice polishing, a by-product of rice milling industry is one such product abundantly and cheaply available during the rice milling season. It is about 10% of the paddy by weight. It is derived from the outer layers of the rice caryopsis during milling and consists of pericarp, seed coat, nucleus, aleurone layer, germ and part of sub-aleurone layer of starchy endosperm (Juliano, 1988). Recently, 20 different types of rice polishing samples from different areas of Chittagong, Bangladesh were analyzed and reported that CP content varied from 4.7 to 14.9%, CF content varied from 6.4 to 41.5%, EE content varied from 1.0 to 18.0% and total ash content varied from 7.1 to 17.6% (Hossain et al., 2012). The values of all parameters studied in the present study are also fall in the above mentioned studies the variation in chemical composition different sample might be due to the differences of varieties of rice polishing used for feed or processing condition (Ambreen et al., 2006). Moreover, adulteration may also affect the results. It may be concluded that the quality of rice polish is widely variable. Therefore, to formulate least cost balanced diet, rice polish must be analyzed first in laboratory and then incorporate it into practical ration.

Soybean meal: The mean values of CP, CF, EE and total ash in soybean meal were found as 42.48, 6.80, 4.14 and 7.25%, respectively. Soybean meal is the product remaining after extracting most of the oil from whole soybeans. Soybean meal is one of the highest quality protein sources with the least variability. The results of the present study are in line with the findings of Karr-Lilienthal et al. (2006) who found that CP contents in soybean meal varied from 45.1% to 52.6% and EE contents varied from 4.1% to 9.0%.

Canola meal: The minimum and maximum values of CP, CF, EE and total ash in canola meal were recorded as 33.8 to 43.7%, 2.0 to10.0%, 3.3 to 9.9% and 10.50 to 12.0%, respectively. Canola meal is a commonly used vegetable protein source for poultry diets. The results of the present study are in agreement with findings of Spragg and Rod (2007) who found CP content varied from 31.6 to 41.7%, CF content varied from 9.6 to 13.2%, EE content varied from 8.5 to 17.0% and total ash content varied from 5.5 to 7.1%. Average protein content of canola meal in the present study was found to be 36.36%. This is higher than comparative results for Australian canola meal published on data basis within either the 35.7% or 35.0% (Degussa, 2001).

Sunflower meal: Minimum and maximum values of CP, CF, EE and total ash in sunflower meal were found as 27.1 to 28.0%, 9.5 to 22.50%, 1.0 to 5.30% and 4.0 to 7.5%, respectively. Sunflower meal plays an important role as alternative and cost effective source of nutrients for poultry. It is the fourth largest source of protein supplement after soybean, cottonseed, and canola meals in the world. Amount and composition of meal is affected by oil content of seed, extent of hull removal, and efficiency of oil extraction. Maheri-Sis et al. (2011) observed that the mean values of CP, CF, EE and total ash content of sunflower meal (not de-hulled) were found 30, 16, 5 and 5.5 %, respectively. In the present study, mean value of CP contents in sunflower meal was lower (27.70%) than the above mentioned studies. Generally, wide variation existed in the chemical composition of the meals between investigations, because chemical composition of them can be affected by many factor such as year, geographical origin, procedure of production or treatment and method of oil extraction (Anjum et al., 2012).

Feather meal: The mean values of CP, CF, EE and total ash in feather meal were found as 39.47, 2.00, 19.87 and 11.87%, respectively. The hydrolyzed feather meal in another study contained 82.0% CP, 0.6% CF, 6.0% EE and total ash 4.0% (Chandler, 2009). In this study, mean value of CP contents in feather meal is very low than the above studies. The unprocessed feathers are high in CP, but are highly indigestible. Primary feather protein is keratin, which contains a high amount of cystine, approximately 10% (Animal Feed Resources Information System, 2010). This cross-linking of cystine is the reason why the CP fraction of feathers is highly indigestible. When feathers are processed or hydrolyzed by cooking at a high temperature under sufficient pressure the CP digestibility will be more than 75% and normally ranges from 80 to 85%. Feathers can be processed either at low pressure at 130^{o} C for two and half hours or under high pressure at 145^{o} C for thirty minutes.. Processing conditions also affect the quality of feather meal. At low steam pressure, long hydrolysis times are needed to increase feather meal density and to improve digestibility (Moritz and Latshaw, 2001). At high pressures, there is a concern that “gumming” would occur.

Fish meal: Maximum number of fish meal samples (61) was received among all ingredients. The mean values of CP, EE and total ash in fish meal samples were found as 50.68, 6.0 and 20.0%, respectively. Fish meal is a ground solid product that has been obtained by removing most of the water and some or all of the oil from fish or fish waste. In Asian countries, fish meal is prepared from mixture of trash fish and byproducts of the canning industry, resulting in a product of very variable composition. Fish meal is an excellent source of protein. It is considered to be one of the best ingredients for broilers and layers rations, as it enhances the feed consumption and feed efficiency and improves the egg production and feed conversion efficiency (Naulia and Singh, 1998). Fish meal samples (148) were assayed for proximate analysis and found CP contents varied from 42.29 to 56.39%, EE varied from 11.0 to 15.83% and total ash contents varied from 21.03 to 25.71% (Khatoon et al., 2006). The mean values of all parameters in the current study are also within range as mentioned in the above studies. The nutrient composition of fish meal can vary, depending on the type and species of fish, the freshness of the fish before processing and the processing methods. According to National Research Council (1994), protein content of fish meal varies from 60.00 to 72.30% due to type of fish and method of preparation. Al Mahmud (2012) found that mean range of CP and EE in fish meal was 51.32-65.34% and 3.69-12.50%, respectively. The range values of CP mentioned in above studies were higher than the present study. The fat content of the fish meal normally indicates the species used. Fluctuations in oil levels are seasonal and occur within species. Herring and capelin are fatty fish while blue whiting is considered a lean fish (Aberoumand and Hossein, 2010). Fish meals from white fish are naturally low in fat. The salt content in body fluids of all fish is nearly the same. In general there are three grades of fish meal; Low temperature (LT), Norsea mink (NSM) and standard and those are categorized according to the freshness of raw fish and processing techniques (Aberoumand and Hossein, 2010). The production of LT meal implies reduced heating (70°C or lower in the dryer instead of 90°C). The price difference between three grades of fish meal used in poultry feeds is about 12% for each increase in quality. Highest grade of fish meal used in poultry feeds, LT costs about 25% more than standard fish meal and about 12% more than NSM.

CONCLUSION

Large variation was found in analytical values among poultry ingredients, which may be attributed to genetic factors, environmental influences, fertilizer, milling degree and storage conditions among different areas.

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