Online Journal of Animal and Feed Research

Volume 1, Issue 2: 67-72 (2011)

MONITORING FEED NUTRIENT CONTENT OF AVAILABLE COMMERCIAL POULTRY FEEDS IN BOTSWANA

A.A. AGANGA*, G. NOBO and T. GOPADILENG

Department of Animal Production, Botswana College of agriculture, P/Bag 0027, Gaborone, Botswana

*Email: aaganga@bca.bw

ABSTRACT: *Nutrient quality in a feedstuff is the concentration of that nutrient in quantities that are sufficient for normal metabolic activities of a particular animal. Hence the study was carried out to determine nutrient quality of various locally available concentrate poultry feeds in the market and compare determined feed contents with nutrient values on labels. The samples were obtained from broiler farmers in Gaborone region. Mean analysis values from manufacturer A feeds were 19.64, 3.29, 0.19 and 0.43 for starter, 16.39, 3.98, 0.11 and 0.57 for grower, and 16.94, 4.27, 0.16 and 0.48 for finisher in g/100g on dry matter basis, crude protein, fats, phosphorus and calcium respectively. Feed label stated 22, 2.5, 0.6 and 8 for starter, 20, 2.5, 0.55 and 0.8 for grower and 18, 2.5, 0.5 and 0.8 for finisher in g/100g on dry matter basis for crude protein, fats, phosphorus and calcium respectively. Grower feeds from manufacturer B contained 18.33, 2.65, 0.24 and 0.66 in g/100g as compared to feed label values of 18.0, 2.5, 0.55 and 0.7 in g/100g on dry matter basis for crude protein, fats, phosphorus and calcium respectively. Manufacturer C finisher feed also contained 18.16, 4.1, 0.17 and 0.52 in g/100g on dry matter basis for crude protein, fats, phosphorus and calcium respectively. The quantity of minerals was found to be lower in all feeds from all manufacturers with manufacturer A lower in almost all other organic nutrients (except fats) compared to values stated on feed labels.*

Keywords: *Nutrient content, commercial poultry feed, Botswana.*

ORIGINAL ARTICLE

INTRODUCTION

There is a need for good manufacturing practice of animal feed during procurement, handling storage, processing and distribution of formulated and compound animal feeds to ensure high feed quality. There is a need for consistent quality animal feed and this can be achieved by implementing sound quality control procedures. Quality animal feeds can only be made from the use of quality feed ingredient sources and not from spoilt or contaminated ingredients. Selection and purchasing of raw ingredients including ingredient quality control is essential. The ingredients used for animal feed must be wholesome and safe. It is inevitable that the quality of ingredients will vary, even from the same supplies from batch to batch. Therefore, it is important that this variability should be characterized and monitored. There is a need for periodic sampling to verify the ingredient and specifications. Nutritional and analytical characteristics of feeding stuffs are necessary. Also, the specifications should include origins, sources and contaminations if any. All ingredients should be inspected and labeled. Moldy ingredients should not be used. This is because of mycotoxins in moldy feedstuffs may have detrimental effects on animals even at very low concentrations. Manufacturing quality control must insure that the feed produced will be consistently of a quality appropriate to the species fed. Animal feed processing should include a comprehensive system of record keeping documenting that the appropriate standards of a formula are being met throughout the period of manufacturing to make the product fully traceable. Feed ingredients which are dry before processing should be kept dry and cool and used on a first-in, first-out basis. As a general rule the moisture percentage should be less than 13% particularly in the humid areas.

To cite this paper: Aganga, A.A., Nobo, G. and Gopadileng, T. 2011. Monitoring feed nutrient content of available commercial poultry feeds in Botswana. *Online J. Anim. Feed Res.*, 1(2): 67-72.
Journal homepage: http://www.ojafr.ir

There are different physical forms of dry animal feeds. It may be a meal, cake, pellets, crumbles, range cubes, blocks or scratch. A complete monogastric feed consists of grains, plant proteins, animal proteins, grain byproducts, macrominerals, specialty products, vitamins and trace minerals. Supplements usually are compounded from plant proteins, animal proteins, grain byproducts, macrominerals, specialty products, vitamins and trace minerals. A base-mix consists of grain byproducts, macrominerals, specialty products, vitamins and trace minerals. A premix consists of specialty products, vitamins and trace minerals. Grains are feeds such as maize, millet, sorghum. Plant proteins are feeds like soya bean meals, oilseed cakes like cottonseed cake, sunflower seed meal etc. Animal proteins are feeds like fishmeals, milk powder etc. Grain byproducts are dry mill byproducts from dry maize milling for example homing feed, milo germ from dry sorghum milling. Wet mill byproducts like gluten meals from fermented grain products dry brewer's spent grains. Macrominerals are from limestone (calcium), oystershell rock phosphate (calcium and phosphorous), dicalcium phosphate (calcium and phosphorous), Monosodium phosphate (phosphorous), common salt (sodium and chlorine), iodized salt contains iodine (0.007% iodine). Specialty products may include antibiotics, chemotherapeutic agents and others. Vitamins may be purchased individually or as mixtures. Trace mineral vary in utilization or biological availability. Factors to consider in biological availability include solubility in water or dilute acid, effectiveness in preventing or curing deficiency symptoms and tissue concentrating effect in animals.

Balanced diets entails the mixture of the right proportions of various ingredients to produce diet with all essential nutrients ideal for normal functioning of a concerned or particular animal. Meanwhile, farmers who produce their own feeds on the farms need to know chemical composition of each crop on farm, as this is essential in planning what crop types to plant in order to meet balanced diet requirement. Although chemical analysis is vital, nutritional value of feeds provides information on how feedstuff are digested and metabolized by the animal, mainly through interpreting differences between the input into and output out of an animal. Unbalanced diets may also produce economic loss in terms of animal health, feed conversion efficiency and, ultimately, the output of animal products, (Gizzi and Givens, 2004). Formulating of a ration is a matter of combining feeds to make a ration that will be eaten in the amount needed to supply the daily nutrient requirements of the animal (Lalman and Sewell, 1993). The objective of this study is to evaluate nutrient composition of chicken concentrate feeds and compare values obtained with the manufacturer's feed label values.

MATERIALS AND METHODS

The experiment was conducted in Botswana College of Agriculture (BCA) which is located at in the southern part of Botswana. This site is at an altitude of 991m (S 24.58455; E 025.94304). The average monthly temperature ranges from18^{0}C minimum to 33.4^{0}C maximum. The climate is semiarid which experiences unreliable rainfall. The type of vegetation in this area is mixed acacia/combretum tree savanna. The average annual rainfall is 450 mm

Feed samples were collected from BCA farm and nine other farms around Gaborone, and then the nutrient analysis was done in the College laboratory. Samples of broiler starter, grower, finisher and layers mash were collected in *ziplock* polythene plastics to prevent any form of contamination from the farm, grounded to pass through 1mm sieve and stored in bags before chemical analysis. Contamination of feeds was avoided by sampling from freshly opened feed bags. Four replicates of each feed from three manufacturers were sampled. Mean nutrients composition was compared to the tag values for significance differences. The dry matter, water, crude protein (Kjeldahl method), neutral detergent fiber (NDF), acid detergent fiber (ADF), ether extract (Soxhlet method), ash, calcium (Ca), phosphorus (P) and magnesium (Mg) were analyzed. Rrepresentative samples of broiler mash and layer's mash were weighed and put in the oven at 70^{o}C for 48 hours. Feed samples were analysed according to the procedures of AOAC (1996). Calcium was analyzed using ICP (Inductively Coupled Plasma/ Optimal Spectroscopy) after digesting the samples. Determination of phosphorus was carried out using UV-Vis Spectrophotometer. 1ml of the standard solutions was pipetted accurately into clean dry vials. 1ml of each sample was pipetted into another set of clean vials. To each of these vials (standards as well as samples) 10ml of dilute chloromolybdic acid was added. 1ml of stamous chloride was added to the vials, first to the standards then the samples. The solutions were left for 10 minutes. The absorbance was then read on the spectrophotometer, reading the standards first then the samples. The design was the complete randomized block design. Data collected was analyzed using ANOVA (analysis of variance), (SAS, 2004).

RESULTS AND DISCUSSION

Poultry feed ingredients include energy concentrates such as corn, oats, wheat, barley, sorghum, and milling by-products. Protein concentrates include soybean meal and other oilseed meals (peanut, sesame, safflower, sunflower, etc.), cottonseed meal, animal protein sources (meat and bone meal, dried whey, fish meal, etc.), grain legumes such as dry beans and field peas, and alfalfa. Grains are usually ground to improve digestibility. Soybeans need to be heated-usually by extruding or roasting-before feeding in order to deactivate a protein inhibitor. Soybeans are usually fed in the

To cite this paper: Aganga, A.A., Nobo, G. and Gopadileng, T. 2011. Monitoring feed nutrient content of available commercial poultry feeds in Botswana. *Online J. Anim. Feed Res.*, 1(2): 67-72.
Journal homepage: http://www.ojafr.ir

form of soybean meal, not in "full-fat" form, because the valuable oil is extracted first. Whole, roasted soybeans are high in fat which provides energy to the birds.

Table 1 shows the ingredients and their amounts used in commercial poultry feeds as indicated on the bag labels and Table 2 show the analyzed results of the same feeds. As indicated in Tables 1 and 2 the amounts of ingredients as labeled and the amount of ingredients analyzed does not match. This simply means that what is indicated in the label does not mean it is the actual content amount of the ingredients stated. Analyzed protein content of Starter's mash was 19% and labeled protein content was 22%. Kingori *et al* (2003) stated in a stress free environment, given adequate intake of essential nutrients, growth will increase until a genetically determined upper limit is reached, but feeding animals below their protein requirement does not improve protein utilization. Protein deficiency in a feed reduces growth as a consequence of depressed appetite and thus intake of nutrients.

Table 1 - Composition in commercial poultry feeds as indicated on the bag labels.

Ingredients	Starter's mash	Layer's mash
Protein (%)	22	16
Moisture (%)	12	12
Fibre (%)	5.0	7.0
Calcium (%)	0.8	4.5
Phosphorus (%)	0.7	2.5
Lysine (%)	1.1	0.6

Chicken feed usually contains soybean meal which is a by-product of the oilseed industry. In the industry, soybeans are dehulled and cut into thin pieces (flaked) to improve the action of the solvent (usually hexane) which is passed through the soybean to extract the valuable oil. Vegetable oils such as soybean oil are used for edible and industrial purposes. The soybean is then toasted as a method of heat treatment to deactivate an inhibitor which would otherwise interfere with protein digestion in the animal.

Feeding the above protein requirements may not result in an increase in protein deposition, but nitrogen excretion through the urine increases rapidly (Bikker *et al*., 2004). The amino acid concentration of typical maize-soya diets (160 and 180g CP/kg) meets the requirements of growing layer chickens (NRC, 1984).

Table 2 - Proximate analysis of the Starter's mash and Layer's mash

Ingredients	Starter's mash	Layer's mash
Dry Matter (%)	90.05	84.65
Moisture (%)	9.95	15.35
Protein (%)	19	12
Calcium (%)	0.5	2.5
Phosphorus (%)	0.2	0.3

Calcium (%) for chicks as indicated on bag labels and analyzed was 0.8% and 0.5% respectively. Calcium (%) for layers as indicated on bag labels and analyzed was 4.5% and 2.5% respectively. Calcium is important for proper egg shell formation. The calcium requirement will vary with the age of the bird, environmental temperature, rate of lay and egg size. A general recommendation for laying hens is a daily calcium intake of 3.4 grams. After 40 weeks of age, this intake should be increased to 3.8grams. Phosphorus (%) for chicks as indicated on bag labels and analyzed was 0.7% and 0.2% respectively. Phosphorus (%) for layers as indicated on bag labels and analyzed was 2.5% and 0.3% respectively. It is necessary to assure that the phosphorus level in the diet is not excessive since excess phosphorus tends to inhibit calcium absorption from the gastro-intestinal tract tract. For layers a level of 0.3% to 0.4% available phosphorus, which is equivalent to 0.5% to 0.6% total phosphorus, is adequate. Feed analysis is important for quality assurance in feed manufacturing and for identifying the presence and concentrations of undesirable substances in feeds which can adversely affect animals' health and productivity (Adesogan, 2002). Table 3 shows the nutrient contents of all feeds sampled and analyzed. Table 4 shows the nutrients on the feed labels as presented by the manufacturer. Table 5 shows composition of broiler starter from manufacturer A. Table 6 highlights the suggested nutrient specification for different classes of poultry.

Chemical analysis of starter mash revealed low crude protein (CP), calcium (Ca) and phosphorus (P) content as compared to manufacturer A feed label values with a difference of 2.36, 0.37 and 0.41 g/100g respectively. Dry matter

To cite this paper: Aganga, A.A., Nobo, G. and Gopadileng, T. 2011. Monitoring feed nutrient content of available commercial poultry feeds in Botswana. *Online J. Anim. Feed Res*., 1(2): 67-72.
Journal homepage: http://www.ojafr.ir

and fats are above the stated amounts by a difference of 3.2 and 0.79 g/100g. The levels of crude protein, calcium and phosphorus content were also lower than the minimal levels (21.0, 1.0 and 0.6 g/100g CP, Ca, and P respectively) recommended by the National Research Inventory (NRI, 1988) to be optimum for normal broiler chick.

Grower mash from manufacturer A, DM and fats were above the stated amounts by a difference of 2.3 and 1.48g/100g. Ca, P and CP are lower by 0.23, 0.44 and 3.61 g/100g respectively from feed label values. CP, DM and fats are above feed label values by 0.33, 1.0 and 0.14 g/100g respectively in manufacturer B feeds. Ca and P are lower by 0.04 and 0.31 g/100g respectively.

Table 3 - Chemical composition of broiler in g/100g on dry matter basis.

Feed class	Manufacturer	DM	NDF	ADF	CP	FATS	ASH	Mg	P	Ca
Starter	A	91.2± 0.98	20.50± 1.48	7.53± 0.89	19.64± 1.914	3.29± 0.558	4.21± 0.49	0.11± 0.03	0.19± 0.035	0.43± 0.07
	A	90.32± 042	24.31± 1.48	7.72± 0.867	16.39± 0643	3.98± 028	4.20± 0.32	0.11± 0.00	0.11± 0.03	0.57± 0.12
Grower	B	89± 0.66	17.38± 3.28	7.92± 1.37	18.33± 1.02	2.65± 0.44	5.5± 0.51	0.12± 0.004	0.24± 0.04	0.66± 0.19
	A	90.6± 0.51	24.74± 1.04	7.75± 0.30	16.94± 0.57	4.267± 0227	4.146± 0.573	0.114± 0.007	0.16± 0.015	0.48± 0.037
Finisher	C	88.8± 0.88	24.33± 1.80	9.392± 0.0522	18.16± 0.98	4.1± 0.39	4.53± 0.99	0.12± 0.01	0.17± 0.03	0.52± 0.064

Table 4 - The nutrient concentration of commercial poultry mash as stated on feed labels by manufacturer g/100g

Feed class	Manufacturer	DM	H_2O	CP	FATS	P	Ca
Starter	A	88	12	22	2.5	0.6	0.8
	A	88	12	20	2.5	0.55	0.8
Grower	B	88	12	18	2.5	0.55	0.7
	A	88	12	18	2.5	0.5	0.8
Finisher	C	–	–	–	–	–	–

Table 5 - Mean composition of starter mash produced by manufacturer A in g/100g on dry matter basis

Variable	Mean	Standard deviation	Minimum	Maximum
DM	91.20	0.98	90.00	92.40
H_2O	8.80	0.98	7.60	10.00
NDF	20.50	1.48	18.93	22.86
ADF	7.53	0.89	6.90	8.91
CP	19.64	1.91	16.63	21.59
FATS	3.29	0.56	2.65	3.95
ASH	4.21	0.49	3.49	4.76
Mg	0.11	0.03	0.08	0.16
P	0.19	0.03	0.15	0.23
Ca	0.43	0.07	0.34	0.52

To cite this paper: Aganga, A.A., Nobo, G. and Gopadileng, T. 2011. Monitoring feed nutrient content of available commercial poultry feeds in Botswana. *Online J. Anim. Feed Res.*, 1(2): 67-72.
Journal homepage: http://www.ojafr.ir

Table 6 - Suggested nutrient specifications for different classes of poultry*

Nutrient composition, %	Diet type							
	Layers			Broiler breeder			Broiler	
	starter	grower	Layer ratios	starter	grower	layer	starter	finisher
ME (Kcal/kg)	2800	2800	2750	2800	2800	2800	2800	2800
CP	17.5	16	17	18.5	16	16	20	18.5
CF (max)	5	5	5	4.5	4	4	5	5
Ca	1	1	3.6	0.9	0.95	3.2	0.9	0.9
P (available)	0.47	0.4	0.40	0.45	0.40	0.40	0.42	0.38
Linoleic acid	0.8	1.3	0.8	0.7	1.0	1.2	0.8	0.70
Lysine	1.00	0.70	0.76	1.00	0.76	0.78	1.00	0.96
Methionine	0.40	0.33	0.35	0.45	0.36	0.38	0.50	0.48
Meth+ Cyst	0.67	0.58	0.60	0.74	0.60	0.62	0.83	077

*Source: NRC, 1984.

Table 7 - Nutrient requirements of broilers*

Nutrient	0 to 3 weeks old	3 to 6 weeks old	6 to 8 weeks old
Metabolizable energy, Mcal/Kg	3200	3200	3200
Crude protein, %	23	20	18
Lysine, %	1.1	1.0	0.85
Methionine, %	0.50	0.38	0.32
Methionine + Cystine, %	0.90	0.72	0.60
Linoleic, %	1.00	1.00	1.00
Calcium, %	1.00	0.90	0.80
Magnesium, %	600	600	600
Nonphytate phosphorus	0.45	0.35	0.30
Niacin, mg	35	30	25

*Source: Perry, Cullison and Lowrey (2004)

Finisher's mash content of CP, P, and Ca were lower by 1.04, 0.34 and 0.32 g/100g respectively from the manufacturer A feed label values. Fats were above the stated feed label value by 1.77 g/100g. NRI (1988) suggested that poultry feeds produce good quality broiler if they contain a maximum of 21%, 5%, 8%, 1%, 0.6% and 1.2%, a minimum of 18%, 4%, 0.9%, 0.6% and 0.8% crude protein, crude fat, crude fiber, calcium, phosphorus, and lysine respectively. On the other hand layers chicks with an age of range of 0-8 weeks would need diet which contain a maximum of 18.5%, 4%,8%, 1%, 0.7% and a minimum of 17%, 4.5%, 0%, 0.9%, 0.65% and 0.85% crude protein, crude fat, crude fiber, calcium, phosphorus and lysine respectively.

All the feeds contain excessive amounts of fiber as indicated by the neutral detergent fiber and acid detergent fiber content, which is above the recommended content of five percent. Chemical analysis revealed lower nutrient concentration in all feed classes from manufacturer A (except fat content, which is higher). Feeds from manufacturers B and C had mineral contents that were much lower than what was indicated on the feed labels. However, these lower nutrient contents indicated that farmers were sold feeds of lower nutrients quantity. Since any deficit of one nutrient could compromise functional value of other sufficient nutrients. Hence, feeds are of lower monetary value, since the prices attached should be in relation to the nutrient composition of the feeds as stated on the feed labels. Quality control is essential at all stages in the production of compound feed if the maximum and most efficient returns are to be obtained by the feed compounder and farmers.

To cite this paper: Aganga, A.A., Nobo, G. and Gopadileng, T. 2011. Monitoring feed nutrient content of available commercial poultry feeds in Botswana. *Online J. Anim. Feed Res.*, 1(2): 67-72.
Journal homepage: http://www.ojafr.ir

CONCLUSION

Feeds nutrient concentration do not conform to the recommended (Perry *et al.*, 2004) concentration, mainly in minerals. However, manufacturer A was found to be most deficient in almost all nutrients compared to manufacturers B and C. The results obtained did not match all the manufacturer's feed tag labels. For optimum growth of poultry, recommended amounts of protein, calcium and phosphorus should be fed. Protein amounts of 160g/kg and 220g/kg for layers and starters respectively are recommended. Manufacturers need to improve the nutrient concentration to at least the minimal recommended amounts for normal broiler growth and indicate the actual feed nutrients composition values on their feed tags.

REFERENCES

AdesoganAT (2002). What are feeds worth? A critical evaluation of selected nutritive value techniques. Proceedings of the 13th Annual Florida Ruminant Nutrition Symposium, 33-47.

AOAC (1996). Official Methods of Analysis (16th edition), Association of Official Analytical Chemists, Arlington, Virginia.

Bikker P, Verstegen MWA and Tamminga S. (2004). Partitioning of dietary nitrogen between body components and waste in young pigs. Neth. J. Agric. Sci. 42:37-45.

Gizzi G and Givens DI . (2004). Variability in feed composition and its impact on animal production. In. Assessing quality and safety of animal feeds. FAO Animal production and health. 160 paper. ISSN 0254-6019. ISBN 92-5-105046-5.

Kingori, AM Tuitoek JK Muiruri HK and Wachira AM. (2003). Protein requirements of growing indigenous chickens during the 14-21 weeks growing period. South African Journal of Animal Science. 33: 78-81. Retrieved on 18/09/2010 from http:www.sasas.co.za/Sajas.html

Lalman DL and Sewell HB. 1993. Rations for growing and finishing beef cattle. Extension.missouri.edu. www.nmt179.com/resources/rations-for-beef-cattle.html. accessed 11-02-2011.

NRC 1984. Nutrient requirements of domestic animals.1. Nutrient requirements of poultry. National Academy of Sciences, Washington D.C.

NRI 1988. Small-scale manufacture of compound Animal feed.87 p. Sleekfreak. ath. cx: 81 /3wdev /CD3WD /FOODPROC /NR09SE /INDEX. HTM. accessed 11-02''-2011.

Perry TW, Cullison AE and Lowrey RS. 2004. Feeds and feeding. 6th Edition. Prentice Hall. New Jersey.

SAS Institute. 2004. SAS/STAT 9.1 User's Guide. SAS Institute, Cary, North Carolina, USA.

To cite this paper: Aganga, A.A., Nobo, G. and Gopadileng, T. 2011. Monitoring feed nutrient content of available commercial poultry feeds in Botswana. *Online J. Anim. Feed Res.*, 1(2): 67-72.
Journal homepage: http://www.ojafr.ir