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# Nutrient Composition of Main Poultry Feed Ingredients Used in Sudan and Their Variations from Local Standard Tables Values

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**Abstract:** Sorghum (Feterita), Groundnut Cake (GC), Sesame Cake (SC) and Wheat Bran (WB) are considered the main poultry feed ingredients in Sudan. Because the nutrient values of these ingredients are reported in the form of fixed figures in local standard tables, a study was undertaken to know if it is necessary to make analyses for feed ingredients before formulating the diets. Samples of the feed components were brought from local markets of Khartoum. Each sample was analyzed for proximate composition, minerals and amino acid contents. Considerable variations were observed between samples and the local standard table's values. Crude protein of sorghum (Feterita) was 16.65%, whereas Metabolizable Energy (ME) was 14.25 MJ/kg. Values for fat, fibre and ash were 3.86, 1.97 and 1.81%, respectively. Total concentrations of critical Amino Acids (AA) were: methionine, 0.2925%; lysine, 0.3501% and threonine, 0.4822%. Levels of Calcium (Ca) and Phosphorus (P) were 0.03 and 0.41%, respectively. Crude protein of GC was 53.44%, whereas calculated ME was 11.80 MJ/kg. Values for fat, fibre and ash were 7.47, 8.55 and 5.27%, respectively. Total concentrations of critical AA for groundnut cake were: methionine, 0.4868%; lysine, 1.8185% and threonine, 1.4230%. The GC levels of Ca and P were 0.08 and 0.65%, respectively. Crude protein of SC was 44.42%, whereas calculated ME was 11.53 MJ/kg. Values for fat, fibre and ash were 13.11, 8.75 and 14.15%, respectively. Total concentrations of critical AA for SC were: methionine, 1.2852%; lysine, 1.0943% and threonine, 1.5449%. Levels of Ca and P were 1.93 and 1.17%, respectively. Crude protein of WB was 18.69%, whereas ME was 12.43 MJ/kg. Values for fat, fibre and ash were 4.88, 8.75 and 5.66%, respectively. Total concentrations of critical AA for WB were: methionine, 0.2676%; lysine, 0.8136% and threonine, 0.6036%. Levels of Ca and P for WB were 0.08 and 1.36%, respectively. The variation observed between samples and tables values strongly indicates that confirmatory analyses should be conducted prior to use of sample for formulating the poultry diets especially in the field of research.

**Key words:** Nutrient composition, sorghum (Feterita), sesame cake, groundnut cake, wheat bran

## INTRODUCTION

The poultry feeding costs constitute about 50-70% of the total cost of poultry production. Because of that the development of poultry industry depends upon the large extent on the availability of feedstuffs that are used or can be made suitable for use in poultry nutrition. Yellow maize and soybean meal are the two major ingredients used in poultry nutrition. The availability of these two feed ingredients in some areas like Sudan is very rare due to their high cost. This has made poultry nutritionists in Sudan to search and use feed ingredients produced locally at low cost.

Sorghum (Feterita), groundnut cake, sesame cake and wheat bran are considered as the main source of energy and protein in poultry diets in Sudan. The relatively lower price has made sorghum (Feterita) preferable to other cereals as a source of energy for poultry diets in Sudan. Some factors affect the chemical composition of sorghum, groundnut, sesame and wheat. Reasons for that variability in the chemical composition can be intrinsic (variety) and extrinsic factors (growing conditions, storage, growing season, geographical locations, etc.), both of which affect nutrient availability. However these factors are not always considered when formulating the rations for poultry. Nelson *et al*. (1975) reported a high variability in the metabolizable energy values of sorghum grains. The protein content in whole sorghum grain is in the range of 7-15% (FAO, 1995; Beta *et al*., 1995). Wheat chemical and physical traits may vary depend upon variety. For example wheat hardness (Oury *et al*., 1998; Morris, 2002; Chantret *et al*., 2005), activity of phytase (Kim *et al*., 2003), total non starch polysaccharides (Carré *et al*., 2002) have been shown to depend on wheat cultivar. The energy value is not constant and that may happens due to the conditions of harvesting (Zijlstra *et al*., 1999), post-harvest storage (Kim *et al*., 2003) or growing location (George and McCracken, 2003) that influence chemical composition

within the same cultivar. Growing season has an effect on specific weight, endosperm hardness, content of crude protein and starch and total non starch polysaccharides content of wheat (Kim *et al*., 2003). Post-harvest storage and conditions change the chemical composition (Kim *et al*., 2003) and hence the nutritional value of wheat (Choct and Hughes, 1997, 1999; McNab and Knox, 1999; Pirgozliev *et al*., 2006). Jacob *et al*. (1996) concluded that the same sunflower cake and sesame cake are high yielding protein source in layer diets. Lee *et al*. (2005) reported that sesame seed is composed of 45-50% lipid, 15-20% protein and 10-15% carbohydrate. Mamputu and Buhr (1995) revealed that sesame meal is considered as an important source of protein (47.1%). Kaneko *et al*. (2002) reported that sesame meal contained 52.9% crude protein. Batal *et al*. (2005) revealed that peanut nitrogen-corrected metabolizable energy ranged from 2,273-3,009 kcal/kg with a mean 2,664 kcal/kg whereas crude protein ranged from 40.1-50.90% with a mean of 45.6%. They concluded that available peanut meal generally has lower crude protein and higher nitrogen-corrected metabolizable energy value than that reported by the NRC (1994). Most of Sudanese nutritionists formulate their poultry diets depend on local standard tables (Bulletin III) reported by (Sulieman and Mabrouk, 1999). Detailed values of these local standard tables are available on the following Web site: http//www.sudanimals.com/feeds/. These tables include the chemical composition of these ingredients in fixed figures without considering the variability in nutrients which may happen due to any external factors such as soil type, climatic conditions, season of growing, etc. Because of intrinsic and extrinsic factors affecting these values this study was conducted to show the importance of the analysis of these ingredients prior to diets formulations for poultry.

## MATERIALS AND METHODS

Sorghum (Feterita), wheat bran, groundnut cake and sesame cake samples were brought randomly from local markets of Khartoum the capital of Sudan to investigate their chemical composition and compare the results with their values in the tables of the nutrient composition of Sudanese animal feeds (Bulletin III) which was reported by (Suleiman and Mabrouk, 1999). The chemical composition of these ingredients is presented in Table 1. The sorghum (Feterita), groundnut cake, sesame cake and wheat bran were subjected to proximate analysis by standardized method according to VDLUFA III Ed. Naumann and Bassler (1996), for the crude protein, crude fibre, moisture, ash and fat. Amino acids levels were provided by the standard method described by VDLUFA IV Ed. Naumann and Bassler (1996). The measurement was done by Ion-chromatography Fa/Typ: BIOCHROM 30. Amino acids analyzed were Methionine, Lysine, Asparagine, Threonine, Serine, Glutamine, Glysine, Alanine, Valine, Isoleucine, Leucine, Phenylalanine, Histidine, Arginine and Proline. For minerals analysis the samples were dried by oven, milled with 1 mm mash size. To make the sample soluble it was treated with 65% $HNO_3$ and 30% $H_2O_2$ and cracked in the microwave (Type MarsXpress). The measurement was done with the Inductively Coupled Plasma-Optical Emission Spectrometry (ICP-OES) iCAP 6300 Duo MFC Fa. Thermo. This method allows a simultaneous measurement of the different elements. All values have been adjusted to dry matter basis. Metabolizable energy values in the Tables were calculated by the modified equation of Ellis (1981):

ME = 1.549 + 0.0102 CP + 0.0275 oil + 0.0148 NFE-0.0034 fibre.

ME: Metabolizable energy (MJ/kg).

CP: Crude Protein (g/kg).

NFE: Nitrogen free extracts (g/kg).

## RESULTS AND DISCUSSION

Proximate analysis and metabolizable energy of all ingredients are presented in Table 2. Minerals and amino acids composition of the ingredients are presented in (Table 3 and 4), respectively. The values presented in Table 1 were reported from the local standard tables (Bulletin III). The sorghum (Feterita) crude protein and fat values were higher by 19% and 46%, respectively from that reported in Table 1, whereas metabolizable energy, crude fiber and ash were lower. In addition to the higher value of sorghum crude protein also the amino acids lysine and methionine were higher

Table 1: Chemical composition of the main poultry feed ingredients (dry matter basis)

| Composition | Sorghum (Feterita) | Groundnut cake | Sesame cake | Wheat bran |
|---|---|---|---|---|
| Crude fat (%) | 2.65 | 8.34 | 13.42 | 3.45 |
| Crude protein (%) | 14.00 | 45.68 | 43.94 | 18.00 |
| Fibre (%) | 2.93 | 10.19 | 8.65 | 13.56 |
| Ash (%) | 2.28 | 9.70 | 14.65 | 5.82 |
| Nitrogen free extract (%) | 78.44 | 26.09 | 19.33 | 51.97 |
| Metabolizable energy (MJ/kg) | 15.22 | 12.01 | 12.29 | 8.46 |
| Calcium (%) | 0.05 | 0.65 | 2.12 | 0.18 |
| Phosphorus (%) | 0.33 | 0.59 | 0.98 | 0.78 |
| Available phosphorus (%) | 0.099 | 0.177 | 0.294 | 0.234 |
| Lysine (%) | 0.23 | 1.32 | 0.96 | 0.65 |
| Methionine (%) | 0.16 | 0.47 | 1.289 | 0.25 |

Table 2: Analyzed nutrient composition of the main poultry feed ingredients (dry matter basis)

| Composition | Sorghum (Feterita) | Groundnut cake | Sesame cake | Wheat bran |
|---|---|---|---|---|
| Crud fat (%) | 3.86 | 7.47 | 13.11 | 4.88 |
| Crude protein (%) | 16.65 | 53.44 | 44.42 | 18.69 |
| Fibre (%) | 1.97 | 8.55 | 8.75 | 8.75 |
| Ash (%) | 1.81 | 5.27 | 14.15 | 5.66 |
| Nitrogen free extract (%) | 67.65 | 20.54 | 14.48 | 53.61 |
| Metabolizable energy (MJ/kg) | 14.25 | 11.80 | 11.53 | 12.43 |

Table 3: Minerals composition of main feed ingredients of poultry in Sudan (dry matter basis)

| Component | Sorghum | Groundnut cake | Sesame cake | Wheat bran |
|---|---|---|---|---|
| Calcium (%) | 0.03 | 0.08 | 1.93 | 0.08 |
| Potassium (%) | 0.34 | 1.11 | 1.10 | 1.16 |
| Magnesium (%) | 0.16 | 0.34 | 0.65 | 0.47 |
| Phosphorus (%) | 0.41 | 0.65 | 1.17 | 1.36 |
| Boron (mg/kg) | 2.07 | 27.50 | 26.55 | 4.69 |
| Cooper (mg/kg) | 7.50 | 15.85 | 45.51 | 15.61 |
| Iron (mg/kg) | 118.22 | 215.70 | 304.92 | 154.17 |
| Manganese (mg/kg) | 19.80 | 52.17 | 71.96 | 147.61 |
| Molybdenum (mg/kg) | 0.61 | 1.07 | 1.89 | 1.27 |
| Zinc (mg/kg) | 41.01 | 68.54 | 136.45 | 104.269 |

Table 4: Total amino acid composition (%) of main feed ingredients of poultry in Sudan (dry matter basis)

| Amino acid | Sorghum | Groundnut cake | Sesame cake | Wheat bran |
|---|---|---|---|---|
| Methionine | 0.2925 | 0.4868 | 1.2852 | 0.2676 |
| Asparagine | 1.2291 | 6.5283 | 3.7549 | 1.3782 |
| Threonine | 0.4822 | 1.4230 | 1.5449 | 0.6036 |
| Serine | 0.6937 | 2.7318 | 2.0958 | 0.7963 |
| Glutamine | 3.6760 | 9.6101 | 8.3284 | 3.7722 |
| Glysine | 0.4786 | 2.9360 | 2.2078 | 1.0207 |
| Alanine | 1.5789 | 2.0991 | 2.0461 | 0.9189 |
| Valine | 0.7779 | 1.9813 | 1.8360 | 0.8124 |
| Isoleucine | 0.6268 | 1.6962 | 1.5155 | 0.5573 |
| Leucine | 2.2946 | 3.3645 | 2.9160 | 1.1494 |
| Phenylalanine | 0.8592 | 2.8017 | 2.010 | 0.7637 |
| Histidine | 0.3482 | 1.2714 | 1.1017 | 0.5227 |
| Lysine | 0.3501 | 1.8185 | 1.0943 | 0.8136 |
| Arginine | 0.6166 | 6.3532 | 5.5518 | 1.3509 |
| Proline | 1.2793 | 2.4955 | 1.6253 | 1.2319 |

by 52 and 82%, respectively. Methionine and lysine are the first and second limiting amino acids, respectively, in poultry diets. Hence sorghum has good level of methionine and lysine. Calcium content of sorghum was lower, whereas phosphorus level was higher.

The groundnut cake crude protein was higher than that in Table 1 (53.44 vs. 45.68%). These results disagreed with Batal *et al.* (2005) who reported that crude protein of peanut meal was lower than that reported by the (NRC, 1994). It was range between 40.1-50.9% with average of 45.6%. These differences might be due to the degree of processing has been done for each. In contrast to the higher of crude protein, samples evaluated in this study had lower ME (11.80 vs. 12.01 MJ/kg). Crude fat, crude fiber and ash were lower by 10, 16 and 46%, respectively. Methionine and lysine were higher than that reported in (Table 1). Phosphorus level was higher, whereas calcium level was lower.

The sesame cake crude protein was higher than that in Table 1 (44.42 vs. 43.94). The values of metabolizable energy, crude fat, ash, calcium and methionine were lower whereas for phosphorus and lysine were higher as compared to the values of (Table 1). These variations might be due to the differences in variety, soil type, dehulling and the method of oil extraction.

The wheat bran values of crude protein, metabolizable energy, crude fat, phosphorus, methionine and lysine were higher, whereas the values of crude fiber and calcium were lower than that reported in (Table 1).

In all ingredients the crude protein and the essential amino acids particularly lysine and methionine were higher than that reported in (Table 1). These promising results will decrease the cost of poultry nutrition because the low quantity of ingredients could supply high level of protein with high essential amino acids contents. The findings of the present study showed that calcium to phosphorus ratios of the ingredients were lower than that in (Table 1). Increasing calcium to phosphorus ratio decreased body weight gain, feed intake, toe ash content and retention of phosphorus and calcium for broilers (Qian *et al.*, 1997). Because of that calcium to phosphorus ratios should be calculated precisely when formulating the diets for poultry. In this study all feed ingredients had variations from the tables reported by (Sulieman and Mabrouk, 1999). These variations might be due to variety, soil type, season of growing and harvesting, type of storage and the method of processing. All of these factors will affect directly or indirectly the values of ingredient chemical composition, so it is very important to make analyses before formulating the poultry diets to insure the accuracy of the expecting nutritional values especially in the field of research.

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