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Chemical Composition of Some Non-Conventional and Local Feed Resources for Poultry in Sudan

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Abstract: Groundnut meal is used commercially as the main protein source for poultry diets in Sudan. Because of the higher price and scarcity of groundnut meal from time to time this study has been carried out to find alternative protein resources for poultry diets. Also, to contribute to the feed supply and to solve the problem of the limited availability of poultry feedstuffs in Sudan; Crude Protein (CP), Crude Fibre (CF), fat, Nitrogen Free Extract (NFE), Metabolizable Energy (ME); mineral content and amino acids composition have been determined for some non-conventional and local feed resources. Groundnut cake, sesame cake and sunflower cake had high CP contents (53.44, 44.42 and 31.57%) respectively, whereas baobab seed cake (*Adansonia digitata* L) had the lowest value (15.01%) among all plant samples. The highest ash value was recorded with earthworm (*Lumbricus terrestris*) sample (43.5%) followed by Moleita Baladi (*Sonchus oleraceus*) (22.53%) and sesame cake (14.15%). *Moringa oleifera* seeds and leaves had the highest ME (12.39 and 11.88 MJ/kg), respectively. The greatest CF was observed with cotton seed cake (29.6%). The highest calcium percentage among all seeds cakes was recorded with sesame seed cake (1.93%). Moringa leaves had the greatest calcium value among the rest of the determined samples (2.70%). Sesame cake was the best sample for the phosphorus content (1.17%). The highest values of cooper, zinc and manganese were 109.86, 151.17 and 268.73 mg/kg, respectively. Those values were observed with earthworm. Sesame cake had the greatest value of methionine among all samples (1.29%), while baobab seed cake had the lowest one (0.19%). Earthworm and groundnut cake had the greatest lysine content 2.56 and 1.82%, respectively. Most of determined amino acids were above than 1% in all tested oil seed cakes. Although the amino acids contents in all tested samples were proportionally high, some of the samples had deficiency in particular amino acids. These results encourage the inclusion of several protein resources to avoid the amino acids deficiency when poultry diets are formulated. This study indicated that these non-conventional and local feed resources can be used in poultry diets in Sudan, but because of the presence of secondary compounds, the amount of the feedstuffs used should be decided through further research.

Key words: Non-conventional feedstuffs, oilseeds, protein contents, anti-nutritional factors

INTRODUCTION

Several oilseed cakes and meals are produced in Sudan on large amount as by-product of industry of oil for human consumption. In Sudan, sesame, groundnut, cotton seed and sunflower are the most common oilseeds. These cakes and meals are rich in protein content and usually used for livestock feeds. Babiker *et al*. (2009) reported that sorghum, groundnut cake, sesame cake and wheat bran are considered the main source of protein and energy for poultry in Sudan. Although, groundnut meal is used commercially as the main source of protein for poultry in Sudan, it has anti-nutritional properties and highly susceptible for aflatoxin contamination (Ali *et al*., 2011). Crude protein of peanut meal ranged from 40.1 to 50.9% with mean 45.6% whereas, nitrogen-corrected metabolizable energy ranged from 2273 to 3009 kcal/kg (Batal *et al*., 2005). The higher price and scarcity of groundnut meal and other main poultry feed ingredients from time to time make the nutritionists and breeders in Sudan seeking for alternative feedstuffs. Singh and Parasad (1979) reported that broiler growth was improved by replacing the groundnut cake with sunflower cake. Sunflower meal is rich in sulphur amino acids but is deficient in lysine and thrionine (Mickael and Sunde, 1985). Mukhopadhyay and Ray (1999) reported that sesame whole seed, oil and meal are considered as animal feed for long time. Cotton seed meal can be an attractive alternative protein source for poultry feed (Lordelo *et al*., 2008). Cotton seed meal has high level of gossypol which discourages its use. Cotton seed meal with high level of gossypol decreased the broilers weight gain (Waldroup, 1981). However, cotton seed meal containing low level of gossypol can be used for broilers diet with no negative effect on body weight (Watkins *et al*., 1994).

There are several studies have been carried out to evaluate the chemical composition of *Moringa oleifera* leaves. Ayssiwede *et al*. (2011) revealed that the crude protein and fibre content of *Moringa oleifera* leaves were 28.5% and 11.7%, respectively. In Sudan, *Moringa oleifera* is used as medicinal plant. There is a paucity of information about the nutritive value of baobab tree

(*Adansonia digitata* L) seed cake and its possibility to be used as source of protein for poultry. Baobab tree forms belts in Central Sudan, in Kordofan, Darfur and Blue Nile (El Amin, 1990). Igboeldi *et al.* (1997) reported that baobab seed is rich in oil, protein and energy. Owen (1970) revealed that all parts of baobab tree are useful. Moleita Baladi (*Sonchus oleraceus*) is used as medicinal plant and as green salad in Sudanese rural communities especially during autumn. The data concerning its nutritional value as poultry feed is lacking and needed to be investigated.

In Sudan, earthworm (*Lumbricus terrestris*) is found in large amounts in wet places such as irrigated agricultural schemes and beside the drainage system of the waste water of cities and the industries. Agunbiadi *et al.* (2010) reported that earthworm meal is rich in protein (670 g/kg) and (18.2 MJ/kg) for gross energy. They also revealed that earthworm meal can completely replace the fishmeal in broiler starter diets with microbial account of 2.5 x 105 CFU/ml.

The justification of increasing of effective feed utilization of non-conventional feed sources is associated with inadequate supplies and rising of feed costs. Feed cost represents 60 to 65% of the total cost of poultry production and protein costs about 13% of the feed cost (Banerjee, 1992).

Sudan needs to give attention to non-conventional feed resource as valuable feed by conducting research to improve the efficiency of animal production. Therefore the present study was undertaken to evaluate the nutrient content of some non-conventional and local feed resources available in Sudan and their possibility to be used in poultry diets.

MATERIALS AND METHODS

The various oil seed cakes (groundnut, sesame, cotton and sunflower) and *Moringa oleifera* (seeds and leaves) were brought from local markets of Khartoum the capital of Sudan. Baobab seed cake samples were brought from North Kordofan State (El-Obied city). Earthworm and Moleita Baladi (*Sonchus oleraceus*) were collected from Khartoum beside the River Nile. Moleita Baladi and earthworm samples were sun dried and ground. The chemical analyses have been carried out at the Laboratory of Institute of Animal Sciences and the Central Laboratory of Berlin University of Humboldt (Germany). Amino acids content were determined at Food Research Center, Technical University of Munchen (Germany). Dry matter, crude protein, crude fibre and ash were measured using the standardized methods described by VDLUFA III ed. Naumann and Bassler (1997). Amino acids content were provided by the standard method described by VDLUFA IV ed. Naumann and Bassler (1997). The measurement was done by Ion-chromatography Fa/Typ: BIOCHROM 30. Amino acids analysed were Methionine, Lysine, 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 simultaneously 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

Table 1 shows the proximate analysis and metabolizable energy of all samples. Groundnut cake had the highest crude protein contents followed by sesame and sunflower cakes. Baobab seed cake had the lowest crude protein content among several seed cakes. Batal *et al.* (2005) reported that crude protein and metabolizable energy means of peanut meal were 45.6% and 11.15 MJ/kg, respectively. These results were remarkably similar to the results of the current study. Although, groundnut meal contains high level of anti-nutritional factors, it is widely used as protein source for poultry nutrition (Ali *et al.*, 2011). The crude protein of sesame cake was higher by 4.3% than that reported by Jacob *et al.* (1996) who reported that the sesame cake crude protein ranged from 42.1 to 42.6%. Daghir and Kevorkian (1970) reported that sesame meal can not be used as main source of protein for broilers because of its deficiency in lysine, but it can be used in combination with soybean due to its high levels of methionine, cystine and tryptophan. So, sesame meal can be used in Sudan with combination with groundnut meal in poultry diets. Table 1 shows that the highest crude fibre among the seed cakes were observed with cotton seed cake followed by sunflower seed cake and baobab seed cake. The high level of crude fibre is inversely proportional to the concentration of protein (Nagalakshmi *et al.*, 2007). Our results agree with the findings of Nagalakshmi *et al.* (2007) who revealed that the crude protein of undecorticated cotton seed meal ranged from 22.2 to 30.31%. Moringa seed had the highest fibre content when compared with the other tested feed samples (Table 1). The results of the current study are congruence with Villamide and San Juan (1998) who reported that crude protein and fibre

Table 1: Proximate analysis of some non-conventional and local feed resources for poultry (dry matter basis)

Composition	Groundnut cake	Sesame cake	Sunflower cake	Cotton seed cake	Baobab seed cake	Moringa leaves	Moringa seeds	Moleita Baladi	Earth-worm
Crude protein (%)	53.44	44.42	31.57	24.79	15.01	17.14	31.07	21.78	38.87
Crude fibre (%)	8.55	8.75	27.34	29.60	25.99	9.91	28.46	12.05	1.15
Fat (%)	7.47	13.11	11.20	8.91	3.97	7.22	28.72	6.12	3.71
Ash (%)	5.27	14.15	5.32	6.27	9.38	14.07	3.44	22.53	43.50
Nitrogen free extract (%)	20.54	14.48	20.94	25.46	40.84	46.82	5.03	31.74	9.81
Metabolizable energy (MJ/kg)	11.80	11.53	10.02	9.29	9.33	11.88	12.39	7.74	7.99

Table 2: Minerals composition of some non-conventional and local feed resources for poultry (dry matter basis)

Composition	Groundnut cake	Sesame cake	Sunflower cake	Cotton seed cake	Baobab seed cake	Moringa leaves	Moringa seeds	Moleita Baladi	Earth-worm
Calcium (%)	0.08	1.93	0.47	0.28	0.44	2.70	0.31	2.50	0.93
Potassium (%)	1.11	1.10	0.13	1.34	1.45	2.50	0.75	5.50	0.58
Magnesium (%)	0.34	0.65	0.43	0.46	0.43	0.51	0.26	0.47	0.36
Phosphorus (%)	0.65	1.17	0.77	0.52	0.46	0.33	0.67	0.29	0.50
Boron (mg/kg)	27.50	26.55	69.54	59.51	62.74	173.44	51.20	93.91	50.83
Cooper (mg/kg)	15.85	45.51	34.08	18.40	17.56	7.89	9.25	23.27	109.86
Iron (mg/kg)	215.70	304.92	0.31	0.40	0.61	1.22	0.13	1.85	5.69
Manganese (mg/kg)	52.17	71.96	32.17	37.65	118.03	69.95	15.22	134.58	268.73
Molybdenum (mg/kg)	1.07	1.89	1.22	0.58	0.41	1.07	0.29	2.72	0.94
Zinc (mg/kg)	68.54	136.45	93.82	55.16	46.16	19.91	46.76	99.31	151.17

contents of sunflower meal vary from 29 to 45% and from 14 to 32% respectively. The greater metabolizable energy values were observed with Moringa seed and Moringa leaves, respectively. Moleita Baladi had the greatest ash percentage among all plant origin samples (Table 1). The high level of ash in Moleita Baladi may be one of the reasons makes people in Sudanese rural areas use it as medicinal plants to meet the deficiency in one or more of minerals required. The earthworm *Lumbricus terrestris* had high levels of protein and ash (Table 1). These high levels of protein and ash for the earthworm might be due to its animal origin and the nature of feeding and living.

The determined macro- and micromineral compositions of the samples are presented in Table 2. Table 2 shows that the greatest percentage of calcium among all tested seed cakes was reported with sesame cake. The sesame cake calcium and phosphorus values in this study agreed very well with that reported by the NRC (1994). Moleita Baladi had the greatest value of calcium among the rest of the samples. Also, the highest cooper and iron values were reported with sesame cake among all plant origin samples. The iron content of the sesame seed cake was higher than that reported by the NRC (1994). The highest values of cooper, zinc and manganese among all samples determined in this study were reported with earthworm.

Table 3 shows the amino acids composition of some non-conventional and local feed resources in Sudan. Sesame cake had the greatest value of methionine among all samples (Table 3). Methionine and lysine for the sesame cake were higher than those reported by the NRC (1994) by 5% and 17%, respectively. Although, groundnut meal is used commercially as the main source of protein for poultry in Sudan, it has anti-nutritional factors such as trypsin inhibitor and highly susceptible for aflatoxin contamination (Ali *et al*., 2011). Daghir (2008) revealed that groundnut meal should not be used as main source of protein unless the rations are supplemented with methionine and lysine. In the present study the groundnut cake methionine findings confirmed the results reported by NRC (1994). Costa *et al*. (2001) support the hypothesis that solvent-extracted peanut meal can be excellent substitute of soybean meal in poultry diets. Sometimes in Sudan most of groundnut exported to bring hard currency and consequently the price of poultry feeds in the local markets increased. Hence, it is advisable to decrease the amount of groundnut cake by partially substitution or to find another alternative protein source to get rid of it completely during the period of scarcity. Cotton seed meal is low in lysine and methionine (Daghir, 2008). Cotton seed cake methionine of the current study was lower than that reported by NRC (1994) and Reid *et al*. (1984). It will be useful if several sources of plant protein are used for the benefits of their integrations.

Agunbiadi *et al*. (2010) reported that protein level of earthworm was 67% which is higher than that reported in our study by 72%. These differences may be due to the age of the earthworm and/or the type of the soil where the earthworm lived. Also, the plane of earthworm nutrition may affect its protein contents. The highest value of lysine in the present study was recorded with earthworm (Table 3). The levels of other amino acids of the earthworm are relatively high, so earthworm can be good source of animal protein to replace the imported poultry concentrates which increase the feeding cost of poultry. Agunbiadi *et al*. (2010) concluded that earthworm meal could completely replace fishmeal in broilers starter diets without negative effect on performance or histopathological changes. Further investigations are needed to test the inclusion of

Table 3: Amino acids composition (%) of some non-conventional and local feed resources for poultry (dry matter basis)

Composition	Groundnut cake	Sesame cake	Sunflower cake	Cotton seed cake	Baobab seed cake	Moringa leaves	Moringa seeds	Moleita Baladi	Earth-worm
Methionine	0.49	1.29	0.63	0.38	0.19	0.28	0.55	0.37	0.68
Threonine	1.42	1.54	1.06	0.82	0.39	0.70	0.72	0.96	1.88
Serine	2.73	2.10	1.22	1.07	0.60	0.68	0.84	0.84	1.83
Glutamine	9.61	8.33	6.10	4.84	2.92	1.87	5.85	2.23	5.29
Glysine	2.94	2.21	1.64	1.03	0.60	0.80	1.51	1.07	1.73
Alanine	2.10	2.05	1.22	0.96	0.54	0.91	1.11	1.13	1.96
Valine	1.98	1.84	1.38	1.03	0.59	0.82	1.05	1.21	1.66
Isoleucine	1.70	1.52	1.18	0.79	0.43	0.68	0.91	0.91	1.62
Leucine	3.36	2.92	1.92	1.48	0.81	1.36	1.66	1.74	2.97
Phenylalanine	2.80	2.01	1.42	1.33	0.58	0.87	1.23	1.17	1.64
Histidine	1.27	1.10	0.74	0.68	0.28	0.35	0.67	0.47	0.91
Lysine	1.82	1.09	1.07	1.10	0.66	0.91	0.60	1.23	2.56
Arginine	6.35	5.55	2.51	2.69	1.27	0.88	4.08	1.06	2.48
Proline	2.50	1.63	1.30	0.98	0.56	0.75	1.65	1.41	1.47

earthworm meal in the diets of other poultry types and categories. Table 3 shows that the methionine and lysine were relatively low for baobab seed cake, Moringa leaves and seeds and Moleita Baladi. The medicinal properties of baobab seed cake, Moringa leaves and seeds and Moleita Baladi may encourage their inclusion in poultry diets. Kakengi *et al*. (2007) reported that there were unclear effects on egg weight when hens fed 10% Moringa leaves meal in layers diets. Olugbemi *et al*. (2010) revealed that the broilers performance was negatively affected by the inclusion of Moringa leaves meal by more than 5%. *Moringa oleifera* seeds reduced turbidity and bacterial account when used in turbid Nile water in Sudan (Madsen *et al*., 1987). Hence, Moringa oleifera seeds may enhance the immunity of poultry if it used in poultry diets. Data concerning the inclusion of Moleita Baladi and baobab seed cake in poultry diets is lacking. Many of non-conventional feed resources contain substances that are deleterious to poultry health such as tannin and other anti-nutritional factors. All of these anti-nutritional factors must be removed by different techniques and treatments. The real prospects for effective utilization of non-conventional feed resources are associated with their nutritive value and the cost of collection, detoxification and processing that increase their benefits. The current study explained the nutrients contents of these non-conventional and local feed resources. So, research is needed to determine the effect of these tested feeds as protein source or feed additives in poultry diets in Sudan.

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