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Chemical Composition and Amino Acids Profile of *Leucaena leucocephala* Seeds

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Abstract: The utilization of grain legumes such as *Leucaena leucocephala* by the feed industry is limited because of uncertainty about their nutritional quality. Although the analyzed total amino acid and energy contents of many grain legumes are quite similar, their protein qualities and metabolizable energy values are quite variable. *Leucaena leucocephala* seeds were analyzed for chemical composition and amino acids profile. The analyzed nutrient composition indicated that leucaena seeds are potential source of protein and energy. The protein content was 31.1% and the calculated metabolizable energy of the seeds was 2573.26 kcal/kg. Amino acids profile of leucaena seeds were 1.39% lysine%, 0.36% methionine, 0.35% cystine, 2.62% arginine, 4.63% glutamic acid, 0.87% threonine, 1.38% glycine, 1.11% alanine, 1.11% valine, 0.93% isoleucine, 1.81% leucine and 0.71% methionine + cystine. Antinutritional Factors (ANFs) were 0.75% tannin and 697.50 mg/100g phytate. Leucaena seed was incorporated at 0, 3, 6, 9 and 12% in broiler chicks' diets. One hundred twenty one-day old unsexed broilers (Ross 308) were used. The performance revealed that, the overall feed intake and body weight gain were significantly ($p \leq 0.01$) depressed with the inclusion of 6, 9 and 12% leucaena seeds in the diet.

Key words: *Leucaena leucocephala*, amino acids, tannin, phytate, broiler

INTRODUCTION

Feed constitutes the major cost in poultry industry, which may reach 70% of the total cost. A major restriction to livestock production in developing countries is the scarcity and fluctuating quantity and quality of the continual feed supply. These countries face serious shortages in animal feeds of the conventional type. Legumes are potential substitute for soybean meal because of the similarity in their amino acids and energy profile (Wiryawan, 1997). Although there are differences in amino acids concentration between legumes, there may be much variation between samples of one legume (Evans, 1985). The amino acids content of grain legumes varies according to cultivar and environment (Igbasan and Guenter, 1996). The presence of Antinutritional (ANFs) and low bioavailability of sulfur containing amino acids in grain legumes (Prieto *et al*., 1994) are main factors responsible for their limited use in poultry feed. It is well established that the composition of grain legumes varies between and within species (Wiryawan, 1997).

One such grain legume (*Leucaena leucocephala*), belongs to the Leguminasae family and it is one of the fastest-growing leguminous trees in drought-prone and semi-arid areas (Sethi and Kulkarni, 1995). Leucaena seeds are ovoid in shape and have brown hulls and yellow kernels. The hull: kernel ratio is 50:50 by weight (Sethi and Kulkarni, 1995). The seed is low in oil, 5.1-10% (Yadav and Yadav, 1988) and rich in protein, 24.5-46%. The kernels have an oil content of 11.9-15.3% and a protein content of 52.5-66.4%. Thus, the nutrients are concentrated in the kernels (Sethi and Kulkarni, 1995). It is significant that the proteins of *L. leucocephala* (Ter Meulen *et al*., 1979) seeds are fairly rich in the essential amino acids isoleucine, leucine, phenylalanine and histidine. Lysine and methionine are also present in moderate amounts. Leucaena seed has high calcium and phosphorus levels (Sethi and Kulkarni, 1995). The genus Leucaena is also reported to contain hydrocyanic acid, leucaenine, quercitrin and tannic acid (James 1983). The mimosine content of the Leucaena plant vary considerably in different species (Kewalramani *et al*., 1987) and even within the same species, that is, *L. leucocephala* itself, for the various cultivars.

Thus, in order to evaluate the nutritional value of leucaena seeds, it is necessary to determine its nutrient contents. The objective of this study is to determine the chemical composition and amino acids profile of leucaena seeds and its effect on broiler performance.

MATERIALS AND METHODS

Leucaena leucocephala seeds were obtained from Elmatama Province forest located about 180 km north of Khartoum. Leucaena seeds samples (Fig. 1) were analyzed for proximate composition according to the methods outlined in the AOAC (1990). Calculated metabolizable energy for poultry was determined according to the equation of Lodhi *et al*. (1976). Tannin

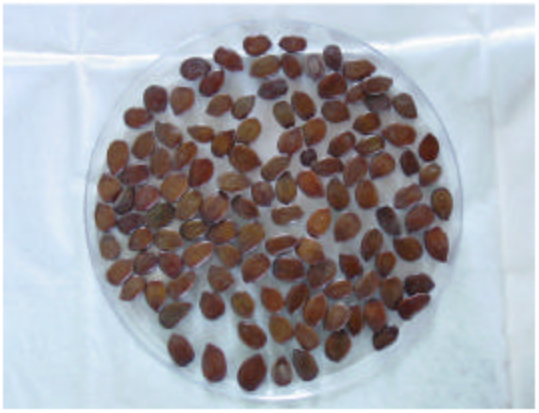

Fig. 1: *Leucaena leucocephala* seeds

content of the seeds was determined using the modified vanillin HCl in methanol method described by Price *et al.* (1980). Phytic acid content of the seeds was determined according to the method described by Wheeler and Ferrel (1971).

Five isocaloric and isonitrogenous starter and finisher broiler chicks' diets were formulated according to nutrient specifications of the standards published by the National Research Council (NRC, 1994). Diet A was the control with 0% of leucaena seeds. Leucaena seeds were incorporated at 3, 6, 9 and 12% in diets B, C, D and E, respectively. Feed intake, body weight gain, Feed Conversion Ratio (FCR) and Protein Efficiency Ratio (PER) were determined weekly on a replicate basis.

The design for this experiment was a Completely Randomized Design (CRD). Data were analyzed with the analysis of variance (ANOVA) procedure. Duncan multiple range test was used to separate the mean values (Steel and Torrie, 1980) in SAS (1985) version 6.12.

RESULTS AND DISCUSSION

Chemical composition and amino acids profile of leucaena seeds are given in Table 1 and 2, respectively. The results showed that the seeds contain high level of protein (31.3%). The chemical Composition of *Leucaena leucocephala* seeds revealed that it had higher crude protein and lower ether extract compared to that evaluated by Babiker (1997). The amino acids profile of leucaena seeds in the current study was 1.39% for lysine and 0.36% for methionine. These values were superior to that obtained by Palafox and Reid (1961), who showed that leucaena seeds contained 4.3 arginine:, 0.6 cystine:, 1.9 isoleucine:, 2.4 leucine:, 2.9 lysine:, 0.38 methionine and 1.9 threonine: (g/16gN). The composition of leucaena seeds as compared with soybean meal (NRC, 1994) revealed that it's lower than soybean in content of crude protein, amino acids profile and total phosphorus and it is higher in ME, EE and CF. This variation may occur even among the different

Table 1: Chemical composition of *Leucaena leucocephala* seeds

Item	Analysis
ME'	2573.26±4.24 kcal/kg
Crude protein	311.00±3.61 g/kg
Crude fat	56.00±4.0 g/kg
Crude fiber	132.00±2.0 g/kg
Dry matter	948.00±1.0 g/kg
Crude ash	45.00±5.0 g/kg
NFE	404.00±2.0 g/kg
Calcium	3.70±0.1 g/kg
Total phosphorous	3.40±0.001 g/kg
Tannin%	0.75±0.02
Phytate mg/100g	697.50±1.5

'ME calculated according to Lodhi *et al.* (1976), Values are means ± SD of triplicate samples

Table 2: Amino acids composition of *Leucaena leucocephala* seeds

Amino acids	g/kg	g/16 gN
Cystine	3.50±0.1	1.13
Arginine	26.20±2.0	8.42
Methionine	3.60±0.05	1.16
Glutamic Acid	46.30±0.27	14.89
Threonine	8.70±0.1	2.80
Glycine	13.80±0.1	4.44
Alanine	11.10±0.1	3.57
Valine	11.10±0.2	3.57
Isoleucine	9.30±0.3	2.99
Leucine	18.10±0.3	5.82
Lysine	13.90±0.2	4.47
Methionine+Cystine	7.10±0.02	2.28

Values are means ± SD of triplicate samples

cultivars of *Leucaena leucocephala* species (Ter Meulen *et al.*, 1979). It seems likely, that the nutritional value of leucaena seeds depends on cultivars and geographical location (National Academy of Sciences, 1977). However, leucaena seeds contained low level of tannin compared to black gram and it is higher than that presented in chickpea, faba bean, field bean, lupin, pigeon pea and soybean (Wiryawan, 1997).

Weekly feed intake of broiler chicks as affected by inclusion of graded levels of leucaena seeds is shown in Table 3. In the first week, feed intake of birds fed leucaena diets was not significantly different ($p \geq 0.05$). On the other hand, feed intake in other weeks was significantly reduced by dietary leucaena. However, there was a non significant difference between the control diet and 3% leucaena seeds, throughout the duration of the experiment. The better improvement in the performance of broiler chicks fed 3% leucaena seeds could be attributed the role of combining different protein source in raising the protein quality (Scott *et al.*, 1982).

Weekly body weight gain of broiler chicks is presented in Table 4. In the first and sixth weeks, body weight gain was not significantly ($p \geq 0.05$) influenced by inclusion of leucaena seeds. The poorest body weight gain was observed for birds fed 9 and 12% leucaena seeds diets. Values for the Feed Conversion Ratio (FCR) of broiler chicks are presented in Table 5. There was no

Table 3: Weekly feed intake (g/bird) of broiler as affected by dietary *Leucaena leucocephala* seeds

Age in week	Dietary levels of *Leucaena leucocephala* seeds, %					
	0	3	6	9	12	±SEM
One	58.33±9.62	52.08±10.49	45.83±15.96	49.50±4.33	46.00±3.27	4.93
Two	183.96 ^{a}±13.27	171.25^{a}±22.51	134.58^{b}±15.89	141.04^{b}±10.92	141.04^{b}±27.60	9.53
Three	298.33 ^{a}±14.58	284.38^{a}±23.62	227.92^{b}±26.65	196.67^{c}±16.46	162.08^{d}±10.98	9.68
Four	389.79 ^{a}±25.27	396.46^{a}±34.29	336.04^{b}±56.39	262.81^{c}±31.23	216.25^{c}±19.30	17.81
Five	466.90^{ab}±54.99	513.54^{a}57.71	404.58^{bc}±45.76	337.83^{cd}±86.70	299.58^{d}±29.71	29.02
Six	589.90^{a}±146.17	594.17^{a}±43.00	481.25^{ab}±66.65	462.83^{ab}±81.17	384.38^{b}±31.50	41.97
Seven	721.15^{abc}±81.68	806.42^{a}±70.51	741.25^{ab}±29.43	682.21^{bc}±101.24	614.38^{c}±57.56	36.11

Values are means (±SD) of 4 replicates per treatment (6 birds/replicate). ^{abcd}Means with different superscripts in the same row were significantly different ($p \leq 0.05$). SEM: Standard error of the means from ANOVA d.f 15

Table 4: Weekly body weight gain (g/bird) of broiler as affected by dietary *Leucaena leucocephala* seeds

Age in week	Dietary levels of *Leucaena leucocephala* seeds, %					
	0	3	6	9	12	±SEM
One	51.67±5.89	49.58±7.98	44.38±2.08	47.50±4.81	43.33±0.00	2.51
Two	80.21^{a}±12.97	77.71^{a}±8.86	41.25^{b}±3.76	41.67^{b}±13.33	34.79^{b}±7.59	4.98
Three	168.54^{a}±21.24	161.67^{a}±21.03	119.17^{b}±1.80	93.13^{c}±12.22	68.13^{d}±8.40	7.47
Four	176.88^{a}±12.29	181.04^{a}±28.77	145.63^{b}±10.92	121.21^{b}±22.40	87.50^{c}±12.40	9.36
Five	219.67^{a}±20.57	230.83^{a}±20.92	169.79^{b}±11.35	174.96^{b}±55.64	100.42^{c}±5.87	14.35
Six	175.21±44.24	205.63±15.13	160.21±36.52	151.04±52.38	132.08±13.68	17.96
Seven	310.33^{ab}±53.98	351.79^{a}±34.71	354.58^{a}±12.20	271.71^{b}±44.85	304.17^{ab}±13.07	17.95

Values are means (±SD) of 4 replicates per treatment (6 birds/replicate). ^{abcd}Means with different superscripts in the same row were significantly different ($p \leq 0.05$). SEM: Standard error of the means from ANOVA d.f 15

Table 5: Weekly feed conversion ratio FCR (g feed/g Bwt gain) of broiler as affected by dietary *Leucaena leucocephala* seeds

Age in week	Dietary levels of *Leucaena leucocephala* seeds					
	0	3	6	9	12	±SEM
One	1.15±0.30	1.05±0.10	1.04±0.39	1.05±0.12	1.04±0.08	0.12
Two	2.32^{b}±0.25	2.20^{b}±0.12	3.27^{ab}±0.34	3.71^{a}±1.37	4.08^{a}±0.45	0.34
Three	1.78^{c}±0.16	1.77^{c}±0.09	1.91^{bc}±0.25	2.12^{ab}±0.12	2.40^{a}±0.28	0.10
Four	2.21±0.18	2.21±0.22	2.30±0.22	2.19±0.16	2.50±0.34	0.12
Five	2.15^{b}±0.43	2.22 ^{b}±0.10	2.38 ^{b}±0.13	2.09^{b}±0.74	2.98^{a}±0.18	0.20
Six	3.37±0.13	2.89±0.19	3.05±0.30	3.24±0.78	2.92±0.28	0.20
Seven	2.37±0.42	2.30±0.13	2.09±0.14	2.60±0.82	2.02±0.15	0.21

Values are means (±SD) of 4 replicates per treatment (6 birds/replicate). ^{abc}Means with different superscripts in the same row were significantly different ($p \leq 0.05$). SEM: Standard error of the means from ANOVA d.f 15

significant ($p \geq 0.05$) difference in FCR among the treatment groups throughout first, fourth, sixth and seventh week. Through the other weeks, the poorest FCR was observed for birds fed 12% leucaena seeds diets.

The results of Protein Efficiency Ratio (PER) of broiler chicks are given in Table 6. The only significant effect ($p \leq 0.01$) of leucaena seeds on PER was observed in the second and third week. In the second week, PER for birds fed control diet and 3% leucaena seeds was significantly ($p \leq 0.05$) higher compared to that of other groups. In the third week PER of birds fed the control diet, 3 and 6% leucaena seeds was significantly ($p \leq 0.05$) higher than those on 12%.

Overall feed intake and body weight gain is presented in Fig. 2. Both were significantly ($p \leq 0.01$) affected by the dietary treatments. Birds fed control diet and 3% leucaena seeds showed significantly ($p \leq 0.05$) higher

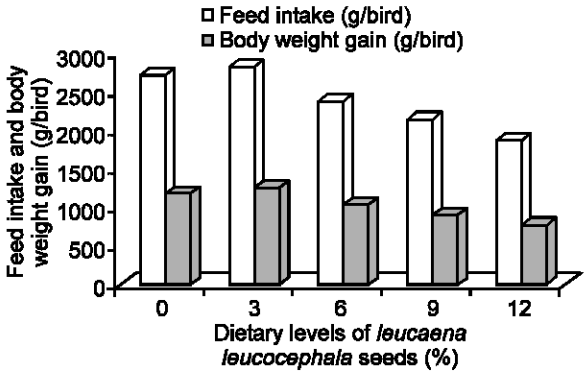

Fig. 2: Overall performance of broiler chicksas affected by dietary *Leucaena leucocephala* seeds

feed intake and body weight gain than the others within which, overall feed intake and weight gain were

Table 6: Weekly protein efficiency ratio PER (Bwt gain/protein consumed) of broiler as affected by dietary *Leucaena leucocephala* seeds

Age in week	Dietary levels of *Leucaena leucocephala* seeds					
	0	3	6	9	12	±SEM
One	3.91±1.04	4.18±0.39	4.61±1.58	4.17±0.44	4.16±0.29	0.45
Two	1.85^{a}±0.18	1.98^{a}±0.10	1.34^{b}±0.13	1.26^{b}±0.34	1.09^{b}±0.11	0.10
Three	2.41^{a}±0.21	2.47^{a}±0.13	2.30^{ab}±0.29	2.05^{bc}±0.14	1.85^{c}±0.21	0.10
Four	2.43±0.20	2.38±0.22	2.23±0.21	2.28±0.17	1.97±0.26	0.11
Five	2.56±0.51	2.35±0.11	2.15±0.11	2.76±1.44	1.64±0.10	0.34
Six	1.59±0.06	1.81±0.13	1.68±0.16	1.60±0.39	1.67±0.16	0.11
Seven	2.31±0.40	2.28±0.13	2.44±0.16	2.03±0.52	2.42±0.18	0.16

Values are means (±SD) of 4 replicates per treatment (6 birds/replicate). ^{abcd}Means with different superscripts in the same row were significantly different ($p \leq 0.05$). SEM: Standard error of the means from ANOVA d.f 15

decreased significantly ($p \leq 0.05$) as dietary inclusion of leucaena seeds increased. Reduction of feed intake of broiler chicks fed leucaena had been reported by El-Harith *et al.* (1979) and Sethi and Kulkarni (1995), who attributed the effect to mimosine which inhibits the appetite of feed. Body weight gain was depressed at 6, 9 and 12% leucaena seeds; despite that it was improved for birds fed 3% when compared to the control. These results are in agreement with the findings of Babiker (1997) and Sethi and Kulkarni (1995), who reported that body weight gain decreased with the increased leucaena seeds in the diet. The decrease in body weight gain for groups fed on leucaena seed diets is possibly related to the inadequate intake of necessary essential nutrients, proteins and essential amino acids. This is coincided with the finding of Scott *et al.* (1982), who attributed the reduced weight gain to inadequate protein and essential amino acids. Furthermore, those authors ascribed the reduction in growth of chicks fed legumes seeds to trypsin and chymotrypsin inhibitors, which inhibit growth; interfere with tryptic digestion of proteins in the gastrointestinal tract of the animal.

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