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Effect of Traditional Processing on the Nutritional Value of Some Legumes Seeds Produced in Sudan for Poultry Feeding

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Abstract: Three local legumes seeds produced in Sudan were subjected in their two preliminary forms (whole and decorticated seeds) to different traditional processing and then analyzed for their composition of nutrients, minerals and amino acids. All seeds were found as good source of protein and digestible carbohydrate which support their supplementation approach in poultry diets. They show as well substantial quantities of minerals with an abundance of potassium and phosphorus. Amino acid analysis revealed high lysine, leucine, phenylalanine and arginine while sulfur-containing amino acids methionine and cystine were found deficient. Decortications and its further following processing were of worse effect mainly upon mineral contents, in addition to their impact on somewhat wastefulness of nutrient components owing to the inefficiency of dehulling, besides its cost effects. Roasting in spite of its negligible effects was inferior to both of germination and boiling of pre-soaked whole seeds with regard to amino acids. Boiling of presoaked whole seeds was found appropriate to all studied legumes while the 72 hour germination of presoaked seeds was superior to boiling for *L. purpureus* seeds.

Key words: Legumes seeds, traditional processing, minerals, amino acids, nutrients

INTRODUCTION

The cheapness of most legumes seeds as plant protein sources compared to animal ones can encourage their utilization in feeding animals and poultry especially in the underdeveloped tropical countries where climatic conditions are suitable for their growth and occurrence. *Lablab purpureus*, *Cajanus cajan* and *Vigna unguiculata* commonly named as hyacinth beans, pigeon pea and cow pea and locally named in Sudan as lubia affin, lubia adassi and lubia hillu respectively are promising legumes able to grow in diverse environmental conditions (Wilson and Murtagh, 1962; Mayer *et al*., 1986).

Legumes seeds show lower lipid contents and are free of cholesterol as well as holding different minerals and vitamins; they as well are good sources of proteins and complex carbohydrates to all monogastrics (Sebastiá *et al*., 2001; Deka and Sarkar, 1990; Khandelwal *et al*., 2009; Elhardallou and Walker, 1994). Considering their therapeutic value for humans legumes are regarded as controller to cardiovascular disease and diabetes (Hu, 2003; Jacobs and Gallaher, 2004; Tharanathan and Mahadevamma, 2003). Poor digestibility in raw state and holding flatulence factors in addition to some anti-nutritional factors made legumes seeds underutilized. Different individual traditional processing or combinations of them are pronounced of reducing anti-nutritional factors and raising nutrients bioavailability.

How efficient processing might affect composition of nutrients and to which extent it will decrease anti-nutritional factors are still considered as vital issue to be searched. Such work will be of potential benefits, offers recommendations to manufacturers and helps to formulate accurate diets to animals.

This paper will focus mainly on the nutritional attributes of the studied legumes seeds with regard to the composition of nutrients, amino acids and minerals as affected by some of domestic traditional processing of whole and decorticated seeds.

MATERIALS AND METHODS

Three batches of mature seeds for the investigated legumes were purchased from the local market and then manually cleaned. Every batch was initially subdivided to two groups either left in its raw state as whole seeds (W.S) or processed by decortications (Dec.S). Each batch of legume seeds priori to chemical analysis was prepared in different treatment forms as follows:

1. Raw whole seeds group [raw W.S]

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2. 48 h soaking period of whole seeds [48 h soaked W.S]
3. 30 min boiling of 48 h soaked whole seeds [boiled pre-soaked 48 h W.S]
4. 72 h germination of 24 h soaked whole seed [germinated pre-soaked W.S]
5. 20 min roasting at 110°C of whole seeds [roasted W.S]
6. Raw decorticated seeds group [raw Dec.S]
7. 24 h soaking period of decorticated seeds [24 h soaked Dec.S]
8. 48 h soaking period of decorticated seeds [48 h soaked Dec.S]
9. 30 min boiling of 24 h soaked decorticated seeds [boiled pre-soaked 24 h Dec.S]
10. 30 min boiling of 48 h soaked decorticated seeds [boiled pre-soaked 48 h Dec.S]

Tap water was used for soaking and boiling. Seeds were washed and rinsed thoroughly prior and after soaking. Soaking water was changed every 24 h and as well for the boiling process. Soaking and germination were carried out at 35°C. The seedlings after germination were removed carefully and the cotyledons were sliced up. Seeds processed by soaking, boiling of presoaked seeds and germination were left to dry thoroughly in an open sun rays for four days. Roasting was carried out in an oven adjusted at 110°C for 20 min. All seeds samples after processing were grounded by laboratory hammer mill to a particle size of 1 mm and stored in screw-cover tight bottles.

Nutrients and amino acid analyses of all samples were determined according to the harmonized methods of the European Commission due to Regulation (EC) 152/2009. Amino acids were separated by ion chromatography and photometrically determined after Ninhydrin reaction by an amino acid analyzer (Biochrom 30) in the raw whole seeds, boiled 48 pre-soaked whole seeds, germinated and roasted whole seeds for all the essential and the following non-essential amino acids cystine, asparagine, serine, glutamine, glycine, alanine and proline.

Minerals were tested after grinding due to the harmonized method of CEN/TC 15621 by inductively coupled plasma optical emission spectrometry (thermo iCAP 6300 DuoMFC) after microwave pressure digestion with 65% nitric acid and 30% hydrogen peroxide (MarsXpress). All samples were analyzed in duplicates and each test solution was measured three times. This technique is able to measure concomitantly different minerals.

RESULTS

Nutrients: The results of proximate analysis are shown in Table 1.

Legumes seeds processed by decortications, 48 h soaking of whole seeds, boiling of 48 h pre-soaked whole seeds, germination and roasting were contrasted against raw whole seeds while those processed by soaking of decorticated seeds for 24 and 48 h and boiling of 24 and 48 h pre-soaked decorticated seeds were evaluated against raw decorticated seeds.

No wider variation was noticed for the Crude Protein (CP) of studied legumes whole seeds. The processing effect on the CP of whole seeds was remarkable to *L. purpureus*; however, the CP was almost increased due entire processing methods, a part of germination was superior rating at 23%. Decortications on the other side were of more impact only on *L. purpureus* CP.

Crude fat of the three legumes seeds was to some extent comparable and within the cited ranges for most legume seeds. No serious changes displayed to fat content owing to different processing method. On contrast to only 36% Crude Fiber (CF) reduction to *V. unguiculata* owing to decortications, both of *L. purpureus* and *C. cajan* lost up to 83% and 77%, respectively. Further processing carried out to both of whole and decorticated seeds almost moderately increased CF.

Decortications increased NFE of all legumes; however, the increase for *V. unguiculata* is slight, while germination decreased NFE of all. However, the consequence is either slight for *V. unguiculata*. Roasting has mention less impact on NFE of all. Noteworthy is the positive effect on NFE owing to further processing carried out to all decorticated seeds.

Ash contents of the whole legumes seeds seems to be comparable. Ash losses due decortications was only up to 9%. Decorticated seeds exposed to more intensive processing lost much ash contents up to 81% [boiling of pre-soaked 48 h Dec.S].

Minerals: Results of minerals (macro and micro) are presented in Table 2.

Phosphorus contents (P) were about 2.5 times higher to that of calcium (Ca) for *C. cajan* and *L. purpureus* and about 4 times higher to that of *V. unguiculata*. About 66% on average of Ca was lost due decortications from *C. cajan* and *L. purpureus*, opposite to only 33% from *V. unguiculata*. Due to opposite trend of Ca and P contents in whole and decorticated seeds, the Ca/P ratio negatively changed from 1:3 on average up to 1:7.

The positive increase of Ca and P is remarkable due germination as compared to roasting.

Whichever the effect of decortications on Sulphur (S), Potassium (K) and Magnesium (Mg) of the studied beans is, further processing of decorticated seeds followed a similar way, as more decrease in S, K and Mg contents owing to more intensive processing.

Noteworthy is the considerable decrease in K and Mg in all up to 97% and 83.8% on average, respectively owing to the intensive processing [boiled pre-soaked 48 hr Dec.S). And as well the reduction due to the exhaustive

Table 1: Proximate chemical composition of traditionally processed legume seeds (% DM)

Treatments	Dry matter[1]	Ash[1]	Crude protein[1]	Crude fat[2]	Crude fiber[2]	NFE[3]
Cajanus cajan						
1 [Raw W.S]	93.37	4.01	22.25	1.25	7.76	64.74
2 [48 h soaked W.S]	88.35	3.49	23.87	1.44	8.75	62.45
3 [Boiled pre-soaked 48 h W.S]	88.07	2.37	24.11	1.65	9.34	62.52
4 [Germinated pre-soaked W.S]	93.09	3.75	23.58	1.37	9.38	61.91
5 [Roasted W.S]	91.69	3.94	22.24	1.28	8.18	64.37
6 [Raw Dec.S]	93.36	3.70	23.18	1.35	1.82	69.95
7 [24 h soaked Dec.S]	91.32	2.09	23.02	2.03	2.23	70.63
8 [48 h soaked Dec.S]	87.67	0.93	21.60	2.11	2.42	72.94
9 [Boiled pre-soaked 24 h Dec.S]	87.81	1.03	23.36	1.63	2.53	71.44
10 [Boiled pre-soaked 48 h Dec.S]	89.33	0.76	21.38	1.48	2.64	73.75
Lablab purpureus						
1 [Raw W.S]	93.26	3.73	23.36	0.92	10.15	61.84
2 [48 h Soaked W.S]	91.82	2.73	25.15	1.16	11.06	59.90
3 [Boiled pre-soaked 48 h W.S]	88.96	2.20	25.70	2.12	11.52	58.47
4 [Germinated pre-soaked W.S]	94.28	3.99	28.76	1.10	11.79	54.37
5 [Roasted W.S]	92.28	3.90	23.58	1.03	9.76	61.73
6 [Raw Dec.S]	93.17	3.53	26.33	0.95	1.73	67.46
7 [24 h soaked Dec.S]	90.69	1.85	26.22	1.37	1.95	68.61
8 [48 h soaked Dec.S]	87.97	0.70	25.18	1.11	2.13	70.88
9 [Boiled pre-soaked 24 h Dec.S]	86.05	0.82	26.67	1.48	2.24	68.79
10 [Boiled pre-soaked 48 h Dec.S]	89.66	0.88	25.08	1.38	2.28	70.39
Vigna unguiculata						
1 [Raw W.S]	93.33	3.80	23.55	1.38	2.73	68.53
2 [48 h Soaked W.S]	91.81	1.31	23.53	2.39	3.29	69.48
3 [Boiled pre-soaked 48 h W.S]	87.90	1.04	23.38	2.12	3.55	69.90
4 [Germinated pre-soaked W.S]	87.84	3.84	23.87	1.65	2.93	67.71
5 [Roasted W.S]	95.58	3.84	23.22	1.41	2.60	68.93
6 [Raw Dec.S]	93.12	3.48	22.63	1.29	1.75	70.85
7 [24 h soaked Dec.S]	90.94	2.04	22.90	2.22	1.88	70.95
8 [48 h soaked Dec.S]	89.26	0.93	21.42	2.39	2.14	73.12
9 [Boiled pre-soaked 24 h Dec.S]	88.67	1.01	23.01	2.00	2.06	71.92
10 [Boiled pre-soaked 48 h Dec.S]	88.46	0.74	21.18	1.96	2.27	73.85

[1]Values are averages of three determinations. [2]Values are averages of two determinations.
[3]Values are calculated by difference as following: Nitrogen-free- extract solubles (NFE) (% DM) = 100 - (Ash + crude protein + crude fat + crude fiber)

processing of whole seeds with an average up to 93.4% and 68% for K and Mg, respectively.

Sodium (Na) content was approximately raised three times by germination. 50% of iron (Fe) was lost due decortications.

Manganese (Mn) content of *L. purpureus* is about twice that of others, however, 50% of Mn lost from *L. purpureus* by decortications. Processing effect on Copper (Cu), Mn and Zinc (Zn) for whole and decorticated seeds followed a similar way of causing negligible impact due further processing.

Amino acids: Amino acids data are illustrated in Table 3. Most of the individual variation to the essential and non-essential amino acids of raw whole seeds is of narrower limits, however, that eventually reflected in close proximity values for the total essential and non essential amino acids. All studied legumes seeds are rich in lysine, leucine, phenylalanine and arginine and are deficient in sulphur containing amino acid, methionine and cystine followed orderly by tryptophan.

Boiling: This process raised the contents of entire essential and non essential amino acids of *C. cajan* seeds up to 22%; however some exhibited slight increase of 2% and 3%. The amino acids contents of *L. purpureus* were raised due boiling up to the range between 11-21%, apart from asparagine was lost at 63%. With regard to *V. unguiculata* it is of note the more reduction in cystine for about 26% while methionine was only lost for about 1%. Half of *V. unguiculata* non-essential amino acids were reduced due boiling while the remaining as well as the essentials were slightly increased.

Germination: *L. purpureus* was superior to other legumes; all of its amino acids were positively raised at various rates due this process followed in order by *C. cajan* which most of its amino acids were slightly increased. Lysine and methionine of *C. cajan* and *V. unguiculata* in addition to similarly four and two different non-essential amino acids were negatively affected by germination. It is of note the positive increase

Table 2: Mineral contents (mg/100 g) of traditionally processed legumes seeds[*]

	Macro elements						Micro elements			
Treatments	Ca	P	S	K	Mg	Na	Fe	Cu	Mn	Zn
Cajanus cajan										
1 [Raw W.S]	106.0	287.5	186.7	1697.0	122.5	5.6	10.53	1.75	1.61	3.64
2 [48 h soaked W.S]	168.5	298.9	206.6	1367.8	122.9	7.6	6.09	1.81	1.83	3.62
3 [Boiled pre-soaked 48 h W.S]	173.5	275.7	191.5	801.2	96.1	8.0	6.52	1.53	1.59	3.40
4 [Germinated pre-soaked W.S]	163.5	290.7	214.7	1517.3	135.5	25.7	9.10	1.92	1.90	3.40
5 [Roasted W.S]	108.4	288.4	201.7	1681.8	121.6	2.8	7.35	1.77	1.57	3.90
6 [Raw Dec.S]	35.2	312.8	192.1	1661.9	98.2	3.5	5.16	1.61	1.14	3.51
7 [24 h soaked Dec.S]	41.1	275.6	175.7	874.5	75.2	8.0	5.67	1.25	0.68	2.77
8 [48 h soaked Dec.S]	45.2	240.6	154.0	195.6	32.1	3.2	5.67	0.85	0.41	2.23
9 [Boiled pre-soaked 24 h Dec.S]	60.1	241.3	163.7	229.0	50.2	5.2	6.11	0.98	0.60	2.47
10 [Boiled pre-soaked 48 h Dec.S]	66.2	218.3	160.9	48.6	24.5	3.4	5.81	0.82	0.45	2.40
Lablab purpureus										
1 [Raw W.S]	115.3	290.6	248.8	1543.0	175.6	4.7	11.41	1.32	4.41	3.36
2 [48 h soaked W.S]	138.2	280.4	246.4	966.5	158.2	5.9	14.50	1.13	3.19	3.31
3 [Boiled pre-soaked 48 h W.S]	175.1	252.1	201.9	541.4	129.6	7.3	14.56	1.10	3.98	3.11
4 [Germinated pre-soaked W.S]	148.2	331.4	302.2	1551.7	189.2	14.7	16.99	1.29	3.76	3.52
5 [Roasted W.S]	112.7	290.2	257.6	1493.3	175.6	3.2	43.30	1.36	3.26	3.40
6 [Raw Dec.S]	41.3	315.5	269.3	1548.8	138.6	2.6	7.81	1.11	2.85	3.43
7 [24 h soaked Dec.S]	69.6	248.5	189.1	691.2	83.0	3.3	8.97	0.81	2.39	2.75
8 [48 h soaked Dec.S]	53.4	199.4	124.6	169.5	32.9	2.2	8.84	0.58	1.79	2.39
9 [Boiled pre-soaked 24 h Dec.S]	66.4	198.7	148.9	132.0	44.1	5.5	8.47	0.81	1.73	2.63
10 [Boiled pre-soaked 48 h Dec.S]	57.1	175.3	111.9	48.2	24.2	2.5	7.84	0.61	1.30	2.32
Vigna unguiculata										
1 [Raw W.S]	97.6	396.1	234.3	1498.0	192.0	5.5	13.31	1.07	2.20	4.31
2 [48 h soaked W.S]	96.1	290.2	161.9	263.1	81.8	7.4	8.82	0.75	1.44	3.16
3 [Boiled pre-soaked 48 h W.S]	94.9	247.3	145.6	98.4	59.6	6.3	10.87	0.68	1.31	2.78
4 [Germinated pre-soaked W.S]	108.4	485.1	186.1	1571.6	212.3	14.0	10.40	1.06	1.65	3.63
5 [Roasted W.S]	100.0	359.7	204.0	1431.3	186.8	7.7	15.70	1.04	2.29	4.47
6 [Raw Dec.S]	65.5	350.8	223.3	1485.8	166.4	4.2	5.99	0.98	2.19	4.09
7 [24 h soaked Dec.S]	61.6	290.0	174.9	748.8	111.7	6.2	7.25	0.82	1.38	3.14
8 [48 h soaked Dec.S]	63.5	224.5	132.5	179.0	40.5	4.9	6.28	0.59	0.82	1.98
9 [Boiled pre-soaked 24 h Dec.S]	79.0	227.3	139.1	129.1	64.7	8.4	7.56	0.60	1.17	2.91
10 [Boiled pre-soaked 48 h Dec.S]	53.3	193.6	119.8	49.8	26.9	5.3	5.46	0.57	0.61	1.93

[*]Values are average of six determinations

due germination for asparagine in both of *C. cajan* and *L. purpureus* at 52% and 57%, respectively.

Roasting: Roasting was to some extent raised most of *C. cajan* and *L. purpureus* seeds amino acids while in case of *V. unguiculata* most of the amino acids were decreased. Leucine (essential amino acid) of *V. unguiculata* remained steady whereas, glycine, alanine and tyrosine (non-essential) were faintly increased.

DISCUSSION

The studied legumes seeds were previously searched for by many workers as supplements in feeding poultry at various inclusion levels and different processing form. This study is more investigation on the consequences of traditionally adopted processing on seeds proximate components as well as minerals and amino acids levels. The proximate components of the three legumes (raw whole seeds) shown in Table 1 are within the ranges reported by many workers as (Onimawo and Akpojovwo, 2006; Amarteifio *et al*., 2002; Apata and Ologhobo, 1994; Amaefule and Nwagbara, 2004) for *C. cajan*, (Subagio, 2006; Abeke *et al*., 2007; Khatoon and Prakash, 2004) for *L. purpureus* and (Giami, 2005; Ologhobo and Fetuga, 1984; Longe, 1980-81) for *V. unguiculata*. The slight values variation are thought due to cultivars differences, environmental factors, soil type, nutrient uptake efficiency of plant from soil, seeds storage and agronomic practices (Gupta, 1983; Singh, 1985).

The considerable crude protein content of legumes seeds highlights their importance as good source of this vital nutrient. Decortications led to a notable increase in the CP of *L. purpureus* which refer to cotyledons as main site of protein while it has no serious influence on the other legumes CP. On the other side germination is of extra influence on the CP of *L. purpureus* compared to all remaining processing, this result previously reported by Osman (2007) in similar germinated seeds and he assumed that as to more reduction of carbohydrate which utilized as energy source by germinated seeds.

Further reports for CP increase due germination were viewed before (Igbedioh *et al*., 1994, Alonso *et al*., 2000).

Table 3: Amino acids contents of traditionally processed legumes seeds (%DM)*

	1 Raw W.S			3 Boiled pre-soaked 48 h W.S		
Amino acid	*C .cajan*	*L. purpureus*	*V. unguiculata*	*C .cajan*	*L. purpureus*	*V. unguiculata*
Essential A.A						
Lysine %	1.51	1.52	1.60	1.77	1.76	1.66
Methionine %	0.27	0.17	0.33	0.30	0.18	0.33
Methionine + Cystine %	0.57	0.48	0.58	0.61	0.48	0.51
Isoleucine %	0.81	0.99	0.98	0.97	1.18	1.07
Leucine %	1.60	1.91	1.79	1.92	2.28	2.00
Phenylalanine %	1.88	1.20	1.26	1.94	1.45	1.43
Threonine %	0.76	0.88	0.88	0.89	1.01	0.84
Tryptophan %	0.18	0.23	0.24	0.18	0.27	0.24
Valine %	0.97	1.16	1.15	1.14	1.37	1.24
Arginine %[(a)]	1.46	1.53	1.61	1.62	1.70	1.63
Histidine %[(a)]	0.84	0.72	0.74	0.93	0.83	0.78
Total EAA	10.28	10.31	10.58	11.66	12.03	11.22
Non Essential A.A						
Cystine %	0.30	0.31	0.25	0.31	0.30	0.18
Glutamine %	4.25	3.69	4.04	4.43	4.02	4.06
Glycine %	0.79	0.97	0.89	0.93	1.09	0.86
Proline %	0.99	1.04	1.04	1.20	1.18	0.98
Serine %	1.00	1.29	1.14	1.18	1.52	1.23
Asparagine %	2.17	2.72	2.67	2.41	1.01	2.70
Alanine %	0.93	1.00	0.98	1.14	1.18	0.96
Tyrosine %	0.61	0.86	0.70	0.72	1.01	0.77
Total Non- EAA	11.04	11.88	11.71	12.32	11.31	11.74
	4 Germinated W.S			5 Roasted W.S		
Amino acid	*C .cajan*	*L. purpureus*	*V. unguiculata*	*C .cajan*	*L. purpureus*	*V. unguiculata*
Essential A.A						
Lysine %	1.44	1.67	1.51	1.53	1.54	1.58
Methionine %	0.26	0.19	0.31	0.27	0.16	0.31
Methionine + Cystine %	0.55	0.56	0.54	0.58	0.47	0.55
Isoleucine %	0.85	1.17	1.00	0.83	1.01	0.96
Leucine %	1.63	2.16	1.81	1.61	1.94	1.79
Phenylalanine %	2.01	1.44	1.34	1.90	1.22	1.25
Threonine %	0.77	0.98	0.84	0.77	0.89	0.85
Tryptophan %	0.18	0.29	0.25	0.21	0.24	0.22
Valine %	1.04	1.43	1.18	0.99	1.17	1.14
Arginine %[(a)]	1.36	1.67	1.55	1.46	1.59	1.59
Histidine %[(a)]	0.90	0.87	0.75	0.83	0.74	0.72
Total EAA	10.44	11.87	10.54	10.40	10.50	10.41
Non Essential A.A						
Cystine %	0.29	0.37	0.23	0.31	0.31	0.24
Glutamine %	4.14	3.96	3.95	4.28	3.78	4.00
Glycine %	0.74	1.04	0.85	0.81	0.96	0.89
Proline %	1.12	1.32	1.00	0.98	1.09	0.94
Serine %	1.11	1.55	1.15	1.01	1.30	1.11
Asparagine %	3.31	4.27	3.19	2.19	2.73	2.64
Alanine %	0.91	1.36	1.10	0.96	1.04	0.98
Tyrosine %	0.61	1.03	0.74	0.61	0.87	0.71
Total Non- EAA	12.23	14.9	12.21	11.15	12.08	11.51

[(*)]Values are averages of two determinations. [(a)]Conditionally essential

Legumes are of low fat contents and the moderate increase due soaking and cooking is regarded as possible dissociation of lipid complexes (Akpapunam and Achinewhu, 1985).

All decorticated seeds have similar fiber contents. The higher fiber of *L. purpureus* and *C. cajan* whole seeds refers to their thickened covers compared to *V. unguiculata*. 15% whole seeds inclusion level in poultry diets of *L. purpureus* and *C. cajan* produces about 0.9% on average fiber increase in whole diet. Then up to 15%

whole seeds inclusion nullifies the need for decortications.

The higher rate of K followed by P and lower Na and Ca, is in close proximity to previous investigation on different legumes seeds types as jack bean, pigeon pea, bambara beans and kidney beans (Apata and Ologhobo, 1994; D'mello *et al*., 1985). Micro minerals are often required in small amounts and their requirements are normally fulfilled by their normal concentrations in the un-processed feed (NRC, 1994). Taking into account the slight reduction in micro minerals contents due processing, practically, slight additives is advised.

Ash losses due further processing are bigger to decorticated seeds compared to whole seeds. Ash loss up to 34-40% due processing was noticed previously by Attia *et al*. (1994). Ash loss due intensive processing (boiling of presoaked seeds) is thought for the leaching of minerals, mainly for Ca, S, K, Mg, Fe and Mn from decorticated seeds or K, Mg and Cu mostly from whole seeds. Those minerals are thought to be drained off with water by ending the process, the same elucidation previously accounted for by Rincon *et al*. (1993).

The imbalanced ratio of Ca to P which is either getting worse due decortications, require an external sources of Ca, for fulfilling proper Ca/P ratio to ensure better bones growth. For example for laying hens higher calcium is needed for eggshell formation and the ratio might change from 2 Ca to 1 non- phytate P to as high as 12 Ca to 1 P (weight/weight) (NRC, 1994). The notable increase of P in germinated *V. unguiculata* seeds is in consonance with the previous reports of Akpapunam and Achinewhu (1985).

All seeds have high amount of lysine and are deficient in sulphur containing amino acids in addition to tryptophan and threonine. This trend is in consonance to previous reports of Singh *et al*. (1990) and Apata and Ologhobo, (1994). Legumes supplementation will help in fulfilling the deficiency of cereals in lysine in poultry feeding while the deficiencies in sulphur containing amino acids could be substituted for by industrial sources (Apata and Ologhobo, 1990;1994). Reports for cystine reduction during boiling similarly to the impact upon *V. unguiculata* were viewed previously to other legumes seeds (Ziena *et al*., 1991; Khalil and Mansour, 1995).

Chau *et al*. (1997) reported reduction in methionine and cystine of *L. purpureus* for about 28,0% and 18,6%, respectively due intensive boiling. In this study methionine and cystine were not reduced in *L .purpureus* due boiling, this could be attributed to differences in boiling intensity which was higher and of longer period for Chau *et al*. (1997) processing. Youssef *et al*. (1986) previously have found that severe heat processing decreases some of EAA levels. The noticeable increase in aspartic acid due germination was previously observed by Bau *et al*. (1997) in germinated soya beans.

Conclusion: Decortications and further processing to it are not preferred due to their negative influence on minerals and some nutrients besides their additional costs. It is as well of lower influence in fiber level of whole formulated diet. Roasting is inferior to others regarding the effect upon amino acids. Boiling of pre-soaked whole seeds is suitable to all legumes, whereas germination is much better for *L. purpureus* regarding crude protein, total amino acids and minerals. The processing methods adopted in this study were evaluated basing upon their impact on the nutrients components; further assessment study for their influence on the anti-nutritional factors might be of another aspects and preference trends.

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