Influencing the Proximate, Mineral, Vitamins, Anti-Nutrient and Amino acid profile of Red Kidney Bean with Different Processing Methods

[1]Abdullahi, A. I., [1]Yusuf, S. Z., [1]Edeh, I. Edeh
Department of Animal Science and Range management, ModibboAdama University, Yola, Adamawa State, Nigeria.
Corresponding author:jimetaaisha@yahoo.com:+234 8038389552

Abstract
The study was conducted to evaluate the proximate composition, vitamins, minerals, levels of anti-nutritional factors and amino acid profile of Red kidney bean (Phaseoulus vulgaris) seeds subjected to different processing methods. Each representative sample was analysed for Crude Protein, Crude Fibre, Either Extract Nitrogen Free extract, Amino-acids and levels of anti-nutritional factors using standard laboratory procedure. The result indicated an increase in the CP (21.03 to 23.87%), ash (3.10 to 3.27%), with a decreased in CF (3.48 to 3.06%)) EE, (3.69 to 2.87%), NFE (56.28 to 46.81%) and some amino acid content as lysine (7.09 to 7.28%), methionine (1.58 to 1.63%) while threonine (3.31 to 3. 42%) value decreased. SimilarlyTanins, oxalates, phytates, saponins and flavonoids were decreased. Taninis (1.03 to 1.12mg/100g), oxalates (0.93 to 1.26mg/100g), phytate (0.95 to 1.18mg/100g) and flavonoids (0.82 to 1.70mg/100g) which were significant ($P<0.05$) decreased. Values obtained for the vitamins and minerals were increased with processing. Vitamins A (18.21 to 72.42g/100g), Vitamin B2 (0.29 to o.31g/100g) Vitamin C (3.90 to 4.30g/100g) were significantly ($P<0.05$) increased. The values for the minerals were not significant ($P>0.05$). It can be concluded that processing methods as Toasting, and Dhulling has beneficial influence but Boiling has the most influence in improving the nutritional quality of Red Kidney Bean seed (Phaseolus vulgaris) seed.

Keywords: Red Kidney Beans**,** Phyto chemicals, Nutrients, Processing Methods

Description of Problem

The utilization of lesser-known legumes will go a long way in addressing the feed crisses that has engulfed the Nigerian livestock industry Adegbenro [2]. Legumes refer to the seeds of leguminosae including pea, beans and pulses, Audu [10]. They have a unique nutritive value besides being cheap as a source of valuable proteins, sacchrides and several micro nutrients including mineral and vitamins Krupa, [13]. One of such under exploited legume seed is (*Phaseolus vulgaris*.) Its amino acid content is similar to that of soya bean except for a lower level of methionine Emiola [7]. Processing methods needs to be explored in addition to heat treatment in order to reduce the anti-nutritional factors to tolerable levels that can improve the nutritional quality of the seed Davis [11], Olomu 19]. The objective of the work is to determine the influence of different processing methods on the proximate, mineral, vitamin, anti-nutrient and amino acid profile of Red kidney bean seed (*Phaseolus vulgaris*).

Materials and Method

The kidney bean seeds were purchased at Mangu market in Mangu Local Government Area of Plateau State, Nigeria. The seeds were divided into 5 portions tagged as: Raw RKB (T1), Toasted RKB (T2), Boiled RKB (T3), Dehulled (DRKB (T4).

Proximate,Vitamins, Minerals,[6] Amino acids Speckman [21] and phytochemicals Audu[10], Gurfinke [12],Qayyum[20] analysis of the Kidney bean were carried out at the Animal science Laboratory, Modibbo Adama University, Yola, Adamawa State, Nigeria.All data were subjected to analysis of variance and means separated were compared with multiple range test using SPSS(version 20,IBM SPSS Statistics,US.

Results and Discussions

Proximate Composition of Raw and Processed Red Kidney Bean Seed Meal

The results of the proximate and metabolizable enegry composition of Raw and differently processed Red Kidney Bean Seed Meal are presented on Table 1. The crude protein content for dehulled red kidney bean was 21.03%, while the toasted red kidney bean

recorded the highest value (23.87%). Boiled red kidney bean had (22.56%) while the raw red kidney bean recored (21.45%). These values obtained are in conformity with that obtained by Asogwa [9]. However, this is not consistent with the findings of Onu [18] who reported a higher result of (21.03 to 27.15%). The crude fibre content obtained in this study ranged from (3.06 to 3.48%) with the Boiled Red Kidney Bean recording the lowest value while the Raw Red Kidney Bean recorded the highest fibre value. This value obtained from the raw is lower that the value (3.60%) reported by Suarez [22]. The Ash content of (3.14%) was observed in the RRKB while the value (3.21%) TRKB, (3.27%) BRKB and (3.10%) DRKB respectively. This increase in values for ash agrees with the findings of Amefube [5], that processing reduces levels of anti-nutrients thereby improving bioavailability of the Minerals. The ether extract (EE) values ranged from (2.87 to 3.69%).These values are lower than the findings of Amefube [5] who stated a range of (3.00 to 5.00%) for some legume seeds which also supports the observation of other authors AOAC, [6], Asogwa[9]. The Nitrogen free extract (Carbonhydrates) has the highest composition by percentage in RRKB (56.28%) than values of (46.81%) (TRKB), (54.10%) (BRKB) and (54.12%) (DRKB). This decrease in values observed was a result of effects of processing, which is due to breakdown of materials during processing Obatolu [15]. The Energy content obtained for the study was between (2755.10 kcal/ME) and (3196.50) kcal/ME). RRKB has the highest value (3196.50 kcal/ME) while the lowest value was observed for BRKB (2755.10) kcal/ME).This result compares well findings of Adeyeye [3].

Table 1: Proximate Composition of Raw and Processed Red Kidney Bean Seed.

Nutrients	(T1)RRKB	(T2)TRKB	(T3)BRKB	(T4)DRKB	SEM
Crude protein	21.45^{a}	23.87^{b}	22.56^{ab}	21.03^{a}	0.52*
Crude fibre	3.48	3.28	3.06	3.32	0.31^{ns}
Ether Extract	3.69	2.87	3.33	3.43	0.25^{ns}
Ash Total	3.14	3.21	3.27	3.10	0.10^{ns}
Nitrogenfree extract	56.28^{b}	46.81^{c}	54.10^{a}	54.12^{a}	0.19*
ME(Kcal/kg)	3196.50^{a}	3179.40^{a}	2755.10^{b}	3155.9^{a}	2.15*

RAW: Raw Red Kidney Bean, BRKB: Boiled Kidney Bean, TRKB: Toasted Red Kidney Bean, DRKB: Dehulled Red Kidney Bean.

Effects of Processing on Vitamin and Mineral Composition of RKB

Table 2 presents the vitamin and Mineral composition of Raw and processed kidney bean seed. The results shows that the vitamin A was ($P<0.05$) significantly highest for the BRKB (72.42/iu/100g) and lowest for RRKBS. Howerver there was a reduction pattern in vitamins for B1, B2 and B3 for all the processed samples, much lower that the recommended daily allowance of 15mg/day for monogastric animals Asogwa [9]. Vitamins C though not ($P>0.05$) significant was highest (4.30/iu/100g) for RRKB and lowest (3.90/iu/100g) BRKB. This result concurred with the findings of Onimawo [17] that vitamins are required for normal body functions as digestion, absorption, excretion, growth, and metabolism. Emiola [7] reported that vitamins (A) are an anti oxidant that plays a major role in fighting diseases.

Table 2: Vitamin and Mineral Composition of Raw and Processed Red Kidney Bean Seed Meal

	RRKB	TRKB	BRKB	DRKB	SEM
Vitamins (mg/100g)					
Riboflavin (B_2)	0.30	0.29	0.27	0.30	0.10^{NS}
Thiamine (B_1)	0.42	0.41	0.35	0.41	0.02^{NS}
Niacin (B_3)	2.40	2.30	2.00	2.41	0.40^{NS}
Ascorbic acid	4.30	4.00	3.90	4.26	0.44^{NS}
Vitamin A (IU/100g)	18.21^{c}	70.20^{a}	72.42^{a}	28.15^{b}	16.50*
Pyridoxine (B_6)	0.41	0.39	0.35	0.40	0.26^{NS}
Minerals (mg/100g)					
Sodium	0.07	0.19	0.013	0.09	0.003^{NS}

Potassium	0.415	0.502	0.481	0.425	0.053^{NS}
Calcium	0.012	0.153	0.230	0.110	0.07^{NS}
Phosphorus	0.230	0.0327	0.351	0.271	0.050^{NS}
Magnesium	0.085	0.254	0.366	0.154	0.154^{NS}

Effects of processing on the phytochemical screening of RKBS

Table 3showed the anti-nutritional content of the seeds. The result indicated the presence of Tanins, Saponins, Phytate, Oxalate, Flavonoid and Trypsin inhibitors similar to pigeion pea seeds.The phytic acid for the RRKB (1.18mg/100g) obtained in this study is lower than (12.0mg/100g) reported by Onu [18] and also lower than (24.03mg/100g) reported by Emiola [7].Saponin was highest for the RRKB (1.14mg/100g) and lowest for BRKB (0.93mg/100g).Oxalate and flavonoid values were also highest for RRKB (1.26mg/100g) and BRKB (1.70mg/100g),which was ($P<0.05$) significantly different. RRKB recorded values of (12.90mg/100g) for Trypsin inhibitor for which was significant ($P<0.05$) higher than values obtained for TRBK (8.25 mg/100g) and BRKB (4.32 mg/100g) though similar to value obtained for DRBK (11.21 mg/100g). However, not all the trypsin inhibitor will be removed because some of the the trypsin inhibitor are heat resistant at the temperature applied. These findings agree with the report of Magdi [14].

Table 3:Anti-Nutritional Composition of Raw and Processed Red Kidney Bean Seed.

Parameter	**T_1**	**T_2**	**T_3**	**T_4**	**SEM**
Tannin	1.12	1.10	1.03	1.00	0.05^{NS}
Saponin	1.14^{a}	1.03^{ab}	0.93^{c}	1.13^{a}	0.01*
Phytate	1.18^{a}	1.00^{c}	1.10^{b}	0.95^{d}	0.01*
Oxalate	1.26^{a}	1.10^{b}	0.93^{c}	1.13^{b}	0.03*
Flavonoid	1.70^{a}	0.91^{c}	0.82^{c}	1.56^{b}	0.42*
Trypsin inhibitor (μ/mg)	12.90^{a}	8.25^{b}	4.32^{c}	11.21^{ab}	0.09*

Samples were determined in mg/100g, a,b,c,d mean in the same row with different superscripts are significantly different ($P<0.05$)*. Not Significant Difference ($P<0.05$) NS.SEM-Standard erro mean.

Effects of processing on the Amino Acid Profile of RKBD

Table 4 shows the result of processing methods on amino acid profile of the Red kidney Bean. The result indicated a reduced amino acid values analysed for BRKBS was (5.21%). Amino acid values for the BRKBS were: Trypsin (7.09%), Isoleusin (3.14%), Tryptophan (3.36%), Methionine (1.63%), threonine (3.13%) and Ieusine (7.08%). Were numerically higher as compared to RRKB, TRKB and DRKB values. Phenyalanine was not affected by boiling method.This concurred with the report of Adama [1] in his work with pigeon pea seed. However, the values obtained for Lysine and Methionine in this study were higher compared to the value (6.19 and 1.214%) as earlier reported by Adama [1] in BRKB for Lysine and Methionine respectively.

Table 4: Amino Acid Profile (%) of differently processed RKBSM

	Treatments				
Parameters	**T_1 (RRKB)**	**T_2 (TRKB)**	**T_3 (BRKB)**	**T_4 DRKB**	**SEM**
Leucine	7.33	7.84	7.08	6.95	1.03^{NS}
Lysine	7.28	7.27	7.09	7.16	1.05^{NS}
Isoleucine	3.85	3.16	3.14	3.35	0.07^{NS}
Phenylalamine	4.22	4.13	5.21	4.22	0.09^{NS}
Tryptophan	3.86	3.56	3.36	3.75	0.03^{NS}
Methionine	1.58	1.60	1.63	1.58	0.02^{NS}
Threonine	3.72	3.80	3.84	3.74	0.05^{NS}

a,b,c,d mean in the same row with different superscripts are significantly different ($P<0.05$)*, Not Significant different ($P>0.05$) -NS. SEM- Standard erro mean.

Conclusions and Application

It can be concluded that processing methods reduced anti-nutrients particularly for BRKB which improved the protein content. Also, kidney bean is low in methionine and is a cheap source of valuable mico-nutrients including Vitamis and Minerals, rich in dietary fibre and low in fat. Therefore further studies as fermentation can be carried to compare with boiling as a processed method.

Reference

1. Adama, S. I.,T.F., Mbahi and Yakubu, B., (2017). Effects of Graded levels of Toasted Pigeon Pea (*Cajanus cajan*) seed meal on performance of grower pigs. . Journal of Animal Production Research 29 (1): 249-256.
2. Adegbenro, M ., O. Onibi, G. E. ,Agbede, J. O., Aletor, V. A., Aro, S. O. and Adeyeye, S.A., evaluation of the nutrients and anti-nutritonal factors in some under-utilized seeds.*Proc of the 16th Annual Conference of Animal Science Association of Nigeria.(ASAN*) September, 12th-15th, 2011. Kwara State University,Anyigba, Nigeria.2011:96-98
3. Adeyeye, E. I. and Aye, P. A. (1998). The effect of sample preparation on the proximate composition and the functional properties of the African yam bean flour. Note I. *La Rivista Italian DelleSostanze Grasse, 75: 253-261.*
4. Alonso R, Rubio L.A, Muzquiz M, Marzo F. (2001). The effect of extrusion cooking on mineral bioavailability in pea and kidney bean seeds meals. *Anim. Feed. Sci. Tech. 94: 1-13.*
5. Amaefube, K. U. and Nwagbara N. N. (2004). The effect of processing on nutrient utilization of pigeon pea (*Cajanus cajan*) meal on the performance, nutrient retention and carcass characteristics of weaner rabbits. *Nigerian Journal of Animal Production. 31: 194 – 199.*
6. AOAC (2000). Association of Official A nalytical chemists. Official Method of Analysis. 13thadition.Washington DC,
7. Apata, D. F. (1990): Biochemical nutritional and toxicological assessment of some tropical legume seeds. Ph.D Thesis, University of Ibadan.
8. Apata, D. F. and A. D. Ologhobo, (1997): Trypsin inhibitor and other anti-nutritional factors in tropical legume seeds. *Tropical Science* 37:52-59.
9. Asogwa, I. S. and Onweluzo, J. C.,(2010), Effects of processing methods on the chemical composition of flour , moimoin and Akara from *Mucuna prureins, Journal of Tropical Agriculture Food Enviromentanf Extension 9 (3): 200-208.*
10. Audu, S. S. and Aremu, M. O. (2011). Effect of processing on chemical composition of Red Kidney Bean (*Phaseoulus vulgaris) Flour. Pakistan journal of Agriculture food Chemistry 34:189-192.*
11. Davis, K. R. (1981). Effects of prcessing on composition and tetrahymena relative nutritive value of green and yellow peas and lentils and white peas and beans. *Ceraels Chemistry 58:544-560.*
12. Gurfinkel, D. M., and Rao, A.V (2002). Determination of Saponins in legumes by direct densitometry. *Journal of Agriculture Food Chemistry 50(3):426-430.*
13. Krupa, U. (2008). Main Nutritional and anti-nutritional compounds of bean seeds: A review. *Polish Science*, 58(2): 149.
14. Magdi, A.O. (2007): Effect of Different Processing Methods on Nutrient Composition, Anti-nutritional Factors, and in Vitro Protein Digestibility of Dolichos Labalb Bean. *Pakistan journal of Nutrition* 6:299 – 303.
15. Obatolu, V. A., Fasoyiro, S. B. and Ogunsumi, I. O. (2001) .Anappresal of chemical, Physical and Sensory characristics of Twelve cowpea varieties grown in Nigeria. *Moor, journal of Agriculture, 2: 162-167.*
16. Olanipekun, O. T., Omenna, E. C., Olapade, O. A., Suleiman, P. and Omodara, O. G. (2015). Effect of boiling and roasting on the nutrient composition of kidney beans seed flour, *Sky Journal of food Science Vol, 4(2): 24-29*

17. Onimawo, I. A. and Akpojovwo, A. E. (2006): Toasting (dry heat) and nutrient composition, functional properties and anti-nutritional factors pigeon pea (*Cajanus cajan*) seed meal, *Journal of Food Processing and Preservation*. 30 (12), 742 – 753.
18. Onu, P. N., Nwakpu, P. E. and Okongwu, S. N. (2006): Effect of processing on the nutritive value of pigeon pea (*cajanuscajan*) seeds for finisher broilers. *Inter. J. of Agric. Rural Dev.* 7(1): 37 – 43.
19. Price, M. I., Hagerman, A, E. and Butler, I. G. (1980). Tannin content of cowpea, chickpea, pigeonpea, and mung bean, *Journal of Agriculture Food Chemistry 28: 459-461*
20. Qayyum, M, M, N, Butt, M. S., Anjum, F, M and Nawaz, H, (2012) Composition analysis of some selected legumes for protein isolates recovery , The Journal of Animal and Plant Sciences, 22(4), 1156-1162.
21. Speckman, D. H., Stein, W.H. and Mare, S. (1958). Automatic recording apparatus for use in the chromatography of amino acids. Analytical chemistry 301: 1185-1190.
22. Suarez, F. L., Apringfield, J., Furne, J. K., Lohrman, T. T., Kerr, P. S. and M. D. Levitt, (1999): Production in Humans Ingesting Soyabean Flour Derived from Beans Naturally Low in Oligosaccharides. *American Journal of Clinical Nutrition.*69: 135 – 140.