International Journal of Advance Research and Innovation
Vol. 9(2), Apr-Jun 2021, pp. 10-16
Doi: 10.51976/ijari.922102

Article Info

Received: 12 Feb 2021 | Revised Submission: 28 Apr 2021 | Accepted: 05 May 2021 | Available Online: 15 Jun 2021

Nutritional Composition of Two Cowpea Varieties Sold in Port Harcourt

Nneji Worukwo-Emma Joy, E. C. Chuku** and S. S. Agbagwa****

ABSTRACT

Cowpea (Vigna unguiculate (L.)) is a leguminous crop that is very rich in protein and consumed in different parts of the word. The seeds can be cooked and consumed whole or it can be processed into powder or other forms and used in preparing different delicacies. The nutritional composition of two cowpea variety (White: 1T89KD-288) and Brown: IT90K-82)) sold in major markets in Port Harcourt, Rivers State was determined. The cowpea of the aforementioned variety with different sizes-big white, small white, big brown and small brown seeds were bought from Mile III, Mile I, New market (Borikiri) and Rumuokoro markets. Cowpea seeds were taken to the laboratory and were sorted according to sizes and colour. The proximate composition of the cowpea seeds was carried out in accordance with the Association of Official Analytical Chemists procedure. The mineral content, vitamins, anti-nutritional and phytochemical properties inherent in the seeds were evaluated using standard methods. The result showed that the % moisture, Ash, Lipid, Fibre, Carbohydrate and Protein content of the seeds ranged from 7.75±0.31-8.6±0.76, 3.45±0.42 3.79±0.22, 2.08±0.18-2.49±0.36, 1.85±85.64-44.54±0.09, 56.26±1.85-57.76±1.01, and 26.45±0.8-27.85±0.79, respectively. The small white seeds were found to be richer in fibre while the small brown seeds had higher proteins. The mineral contents showed that the % calcium present in the seeds ranged from 89.73±1.03% to 91.38±0.99%. The small white cowpea seeds had the highest calcium while the big brown cowpea seeds had the lowest calcium. Despite the variation, no significant difference was observed. The phosphorus contents also ranged from 407.75±24.23% to 431.53±36.4. The big white recorded more phosphorus content. More so, the potassium, iron, sodium and magnesium contents of the big white cowpea seeds, small white cowpea seeds, small brown cowpea seeds and the big brown cowpea seeds ranged from 248.25±5.12% to 251.25±4.11%, 3.93±0.15 to 4.03±0.07, 83.6±1.73 to 85.58±2.35, and 171.75±1.83 to 159±2.22, respectively. There were no significant differences in the phosphorus content, potassium content, iron content and sodium content of the cowpea seeds. The big brown cowpea seeds had the highest magnesium content followed by the small brown cowpea seeds while the small white cowpea seeds had the least magnesium content. The micronutrient present in the seeds showed that the vitamin A content of big white, small white, small brown and big brown cowpea are 48.28±1.03, 46.8±0.45, 46.28±0.57 and 46.45±1.83, respectively. The small white cowpea seeds had the highest vitamin A content while the small brown cowpea seeds had the least vitamin A content. It could be deduced that the nutrient composition of the seeds varied slightly except for fibre content. Thus, the choice of the cowpea seeds to consume between this variety is dependent on the actual nutrient being sourced for. They are all rich in protein and phytochemicals.

Keywords: *Cowpea; Proximate composition; Vitamins; Anti-nutritional; Phytochemicals.*

1.0 Introduction

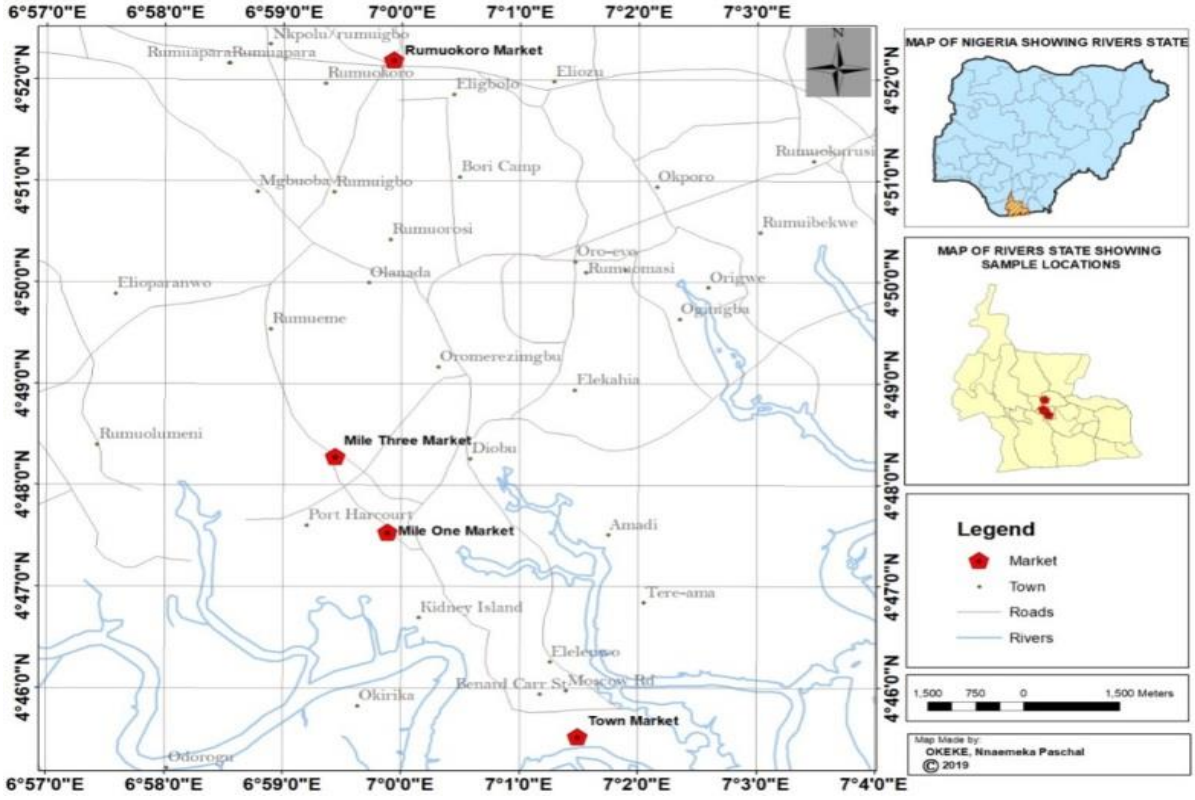
There are lots of food crops with promising nutritional properties that are very much unexploited in Nigeria (Ibeabuchi et al., 2017). Though this is not the case in most leguminous plants like the cowpea. Studies have shown that legumes are staple foods for a large number of persons in different parts of the world and the seeds have an average of twice as much protein as cereals by percentage and usually

**Corresponding author; Department of Plant Science and Biotechnology, Faculty of Science, Rivers State University, Port Harcourt, Rivers State, Nigeria (E-mail: joynneji2015@gmail.com)*
,Department of Plant Science and Biotechnology, Faculty of Science, Rivers State University, Port Harcourt, Rivers State, Nigeria*

contain more balanced profile of essential amino acids. They range from the highly utilized legumes such as soybean, groundnut, and cowpea to the lesser known ones like Sphenostylis stenocarpa, Mucuna cochinchinensis and Mucuna flagellipes (Uche et al., 2014).

In particular, beans are a significant wellspring of protein, calcium, vitality, folic acid, dietary fiber and starches (Katungi et al., 2009; Buruchara, 2007). They additionally contain lysine, a supplement that is moderately lacking in most stable weight control plans and this makes them a decent supplement to maize, rice, vegetables, banana, cassava or potatoes to give a fair eating routine (Mukunya and Keya, 1979). Beans are likewise advanced for customary utilization byhealth organizations as they diminish the danger of malignant growth (cancer), diabetes and coronary heart illnesses since they have low fat substance (Katungi et al., 2009). Youthful units of specific assortments are utilized as green vegetables or canned as prepared beans. At times, green leaves are utilized as pot herbs or vegetable (Katungi et al., 2009). Beans along these lines assume a vital job of easing lack of healthy sustenance as well as other wellbeing related capacities (Katungi et al., 2009). In a study of the effect of fungi contamination of two Cowpea varieties sold in Port Harcourt, it was reported that cowpea which are leguminous plants are very rich in crude protein and amino acid profile which makes them a potential substitute for other protein sources for human consumption and that they are used for the production of fish meal and animal feeds (Nneji et al., 2020). Numerous assortments of legumes are found all through the world. They furnish people with plant proteins with decreased production costs, simpler preparation and have, higher possibility of boosting vitality effectiveness than acquired from animal proteins. legumes are among the food sources perceived and suggested for utilization for the respectable neutralizing acids in the body framework (Elemo et al., 2011). Beans are frequently developed as money crop by little scope ranchers and utilized as a significant nourishment vegetable in numerous pieces of Nigeria, where they are devoured in various kinds of conventional dishes [Oshone et al., 2014] on account of their taste and supplements structure. Cowpea, Vigna unguiculata (L.) with vernacular names, for example, bruised eye

Figure 1: A Map Showing the Area Under Study



pea, field pea, southern pea, crowder pea, and so forth is ordinarily developed as a nutritious and exceptionally agreeable nourishment source [Sheahan, 2012]. The seed is accounted for to contain 24% unrefined protein, 53% starches, and 2% fat [FAO, 2012]. Assortments might be short and shaggy, prostrate, or tall and vine-like. Covering statures can be 2–3 feet, contingent upon the assortment [Sheahan, 2012].

There is usually a misconception in the nutrient constituent between the White (1T89KD-288) and Brown (IT90K-82) varieties of the cowpea Vigna unguiculata (L.) Walp. Some eaters in Nigeria believe that the brown variety is more nutritious and thus preferable to the white variety, while others think otherwise. The research on the proximate composition between this variety is lacking. Thus, this current study is aimed at bridging this gap and thereby providing information on the nutrient composition of both variety as well as their sizes.

2.0 Materials and Method

2.1 Study area

The study was conducted in four major markets located in two local government areas: Port Harcourt City Local Government Area and Obio-Akpor Local Government Area. These markets are known for high influx of traders who come from different localities to display and sell their produce. The map of the area studied is illustrated in Fig 1.

2.2 Sample collection

Cowpea seeds of different variety (brown and white) were bought from four major markets in Port Harcourt metropolis from different distributors. The major markets include; Mile III, Mile I, New market (Borikiri) and Rumuokoro market. The cowpea seeds were taken to the Department of Plant Science and Biotechnology, Rivers State University for identification. Confirmation included the verification of the sizes and colour of the different varieties. In the laboratory, the samples were sorted according to size, and wholesomeness for further analysis. The varieties of the cowpea are presented in Table 1.

2.3 Proximate analysis

Proximate analysis of the cowpea seeds was carried out to determine crude protein, crude fibre, total ash, crude fibre, total carbohydrate, crude lipid and moisture content using the methods of AOAC (2000).

Table 1: Cowpea Variety Studied

S/N	Cow pea Variety	Seed size	Representing key
1	IT/2246	Big	Big Brown (BB)
	IT/2246	Small	Small Brown (SB)
2	IT/84E	Big	Big White (BW)
	IT/84E	Small	Small White (SW)

2.4 Minerals analysis

This was done as described by Yellavila *et al.,* (2015). In this method, aliquots were analyzed for mineral components of calcium, potassium, iron, sodium, magnesium using atomic absorption spectrophotometer while phosphorus was determined calorimetrically.

2.5 Statistical analysis

Analysis of variance (ANOVA) using SPSS (version 22, IBM SPSS Statistics) was adopted in the statistical analysis of the obtained data. The means were separated using the least significant difference (LSD).

3.0 Result and Discussion

3.1 Proximate, mineral content, vitamins, antinutritional and phytochemical composition of cowpea

The result for the proximate analysis of the cowpea seeds showed that the moisture content of the seeds was 8.6±0.76, 8.58±0.66, 8.13±0.57 and 7.75±0.31% for the big white cowpea seeds, small white cowpea seeds, small brown cowpea seeds and big brown cowpea seeds (Table 2), respectively. Despite the variations in the moisture content of the cowpea seeds, there was no significant difference ($P \leq 0.05$). The big white cowpea seeds had the highest moisture content while the big brown had the lowest moisture content. The ash content of the big white cowpea seeds, small white cowpea seeds, small brown cowpea seeds and big brown cowpea seeds are 3.79±0.22, 3.58±0.25, 3.45±0.42 and 3.6±0.27% (Table 2), respectively.

The ash content of the big white cowpea seeds was higher than other cowpea seeds followed by the big brown while the small brown had the least ash content. There was no significant difference ($P \leq 0.05$) in the ash content of the seeds. The lipid content of the big white cowpea seeds, small white cowpea seeds, small brown cowpea seeds and big brown cowpea seeds are 2.24±0.53, 2.08±0.18, 2.42±0.62 and 2.49±0.36%, respectively. there was

no significant difference ($P \leq 0.05$) between the lipid contents of the cowpea seeds. The fibre content of the big white cowpea seeds, small white cowpea seeds, small brown cowpea seeds and big brown cowpea seeds are 1.86±0.15, 44.54±0.09, 1.9±0.17 and 1.85±85.64 %, respectively. there was no significant difference ($P \leq 0.05$) between the fibre contents of the cowpea variety. The carbohydrate content of the various cowpea seeds was 57.76±1.01, 57.6±0.79, 56.26±1.85 and 57.05±0.62 %, respectively.

The big white and small white cowpea seeds had the highest carbohydrate content. Irrespective of the slight variations in the carbohydrate content, there was no significant difference for the carbohydrate content in all the cowpea seeds. Furthermore, the proximate analysis also showed that the protein contents of the big white cowpea seeds, small white cowpea seeds, small brown cowpea seeds and big brown cowpea seeds are 25.75±0.85, 26.45±0.8, 27.85±0.79 and 27.18±0.91, respectively. The small brown cowpea seeds and the big brown cowpea seeds had the highest proteins while the big white cowpea seeds had the lowest proteins. There is a significant difference in the protein contents of the cowpea seeds varieties. For instance, the protein content of the big white cowpea seeds which was lower was significantly different from the protein content of the small brown cowpea seeds.

The mineral contents of the various cowpea (cowpea seeds) is presented in Table 4. The result showed that the calcium ion present in the cowpea seeds ranged from 89.73±1.03% to 91.38±0.99%. The small white cowpea seeds had the highest calcium ion while the big brown cowpea seeds had the lowest calcium ion but despite this variation, there was no significant difference. The phosphorus contents of the cowpea seeds ranged from 407.75±24.23% to 431.53±36.4, thus, result showed that the big white has more phosphorus content. However, the potassium, iron, sodium and magnesium contents of the big white cowpea seeds, small white cowpea seeds, small brown cowpea seeds and the big brown cowpea seeds ranged from 248.25±5.12% to 251.25±4.11%, 3.93±0.15 to 4.03±0.07, 83.6±1.73 to 85.58±2.35, and 171.75±1.83 to 159±2.22, respectively. There were no significant differences in the phosphorus content, potassium content, iron content and sodium content of the varieties of cowpea. There were significant differences between the white cowpea seeds (big and small) and the brown cowpea seeds (big and small). It was observed that the big brown cowpea seeds had the highest magnesium content followed by the small brown cowpea seeds while the small white cowpea seeds had the least magnesium content.

The micronutrient present in the various cowpea is presented in Table 4. The result showed that the vitamin A content of big white, small white, small brown and big brown cowpea are 48.28±1.03, 46.8±0.45, 46.28±0.57 and 46.45±1.83, respectively. The small white cowpea seeds had the highest vitamin A content while the small brown cowpea seeds had the least vitamin A content. Irrespective of the slight differences in the quantity of vitamins A in the various cowpea, there was no significant difference noted. The result also showed that the thiamin content in the big white, small white, small brown and big brown cowpea are 0.14±0.001, 0.14±0.001, 0.13±0.001 and 0.13±0.01, respectively. Furthermore, the niacin content in the big white, small white, small brown and big brown cowpea are 1.28±0.04, 33.46±0.05, 1.3±0.05 and 1.3±64.36, respectively.

The antinutritional contents and phytochemicals of the seeds are presented in Table 5 and 6, respectively. The antinutritional contents showed the presence of Phytates, oxalates, Saponins and Tannins.

Table 2: Proximate Composition of the Different Varieties of Cowpea

Varieties (Cowpea)	Moisture%	Ash %	Lipid %	Fibre %	CHO %	Protein %
BW	8.6±0.76^{a}	3.79±0.22^{a}	2.24±0.53^{a}	1.86±0.15^{a}	57.76±1.01^{a}	25.75±0.85^{a}
SW	8.58±0.66^{a}	3.58±0.25^{a}	2.08±0.18^{a}	44.54±0.09^{a}	57.6±0.79^{a}	26.45±0.8^{ab}
SB	8.13±0.57^{a}	3.45±0.42^{a}	2.42±0.62^{a}	1.9±0.17^{a}	56.26±1.85^{a}	27.85±0.79^{b}
BB	7.75±0.31^{a}	3.6±0.27^{a}	2.49±0.36^{a}	1.85±85.64^{a}	57.05±0.62^{a}	27.18±0.91^{ab}

Result presented as Mean ± SD
CHO: Carbohydrate
Keys: BB: Big brown
BW: Big white

SB: Small brown
SW: Small white

Table 3: Mineral Content (Mg/100g) of the Different Cowpea

Varieties (Cow pea)	Ca2+	P+	K	Fe2+	Na	Mg
BW	91.35±1.18[a]	431.53±36.4[a]	250.25±14.36[a]	4.03±0.07[a]	85.58±2.35[a]	173±7.79[a]
SW	91.38±0.99[a]	407.75±24.23[a]	251.25±4.11[a]	4±0.05[a]	84.63±0.46[a]	171.75±1.83[a]
SB	89.8±1.67[a]	423.5±33.9[a]	249.5±17.33[a]	3.93±0.15[a]	85.03±0.83[a]	157±6.48[b]
BB	89.73±1.03[a]	420.75±42.7[a]	248.25±5.12[a]	3.94±0.001[a]	83.6±1.73[a]	159±2.22[b]

Keys: Ca: calcium, P: phosphorus, K: potassium, Fe: iron, Na: sodium, Mg: magnesium, BB: Big brown, BW: Big white, SB: Small brown, SW: Small white.

Table 4: Micronutrients (Mg/100g) Present in the Different Types of Cowpea

Varieties (Cow pea)	Vitamin A	Thiamin	Niacin
BW	48.28±1.03[a]	0.14±0.001[a]	1.28±0.04[a]
SW	46.8±0.45[a]	0.14±0.001[a]	33.46±0.05[a]
SB	46.28±0.57[a]	0.13±0.001[a]	1.3±0.05[a]
BB	46.45±1.83[a]	0.13±0.01[a]	1.3±64.36[a]

Keys: BB: Big brown
BW: Big white
SB: Small brown
SW: Small white

Table 5: Antinutrients (%) of the Different Cowpea

Varieties (Cow pea)	Phytates	Oxalates	Saponins	Tannins
BW	0.05±0.01[a]	0.29±0.48[a]	1.13±0.13[a]	0.014±0.001[b]
SW	0.05±0.001[a]	0.28±0.44[a]	1.14±0.09[a]	0.013±0.001[a b]
SB	0.05±0.01[a]	0.33±0.45[a]	1.14±0.14[a]	0.011±0.001[a]
BB	0.05±0.001[a]	0.33±0.41[a]	1.14±0.12[a]	0.012±0.001[a]

Keys: BB: Big brown
BW: Big white
SB: Small brown
SW: Small white

Table 6: Phytochemicals (%) of the Different Cowpea Seeds

Varieties (Cow pea)	Carotenoids	Polyphenols	Flavonoids	Lignans
BW	0.0005±0.09[a]	0.02±0.22[a]	0.47±0.03[a]	0.99±0.03[b]
SW	0.0005±0.001[a]	0.02±0.01[a]	0.46±0.01[a]	1±0.09[b]
SB	0.64±0.04[b]	0.35±0.21[b]	0.71±0.04[b]	0.88±0.06[a]
BB	0.63±0.001[b]	0.34±0.01[b]	0.71±0.01[b]	0.88±0.08[a]

Keys: BB: Big brown
BW: Big white
SB: Small brown
SW: Small white

3.2 Discussion

The moisture content in this study are lower than the values (11.5% and 11.9%) reported by Kedir *et al.* (2014), and 10.13% and 10.27% reported by Mekonen and Admasu (2012). Gabriel and Ruth (2012) who had previously worked on the Jack cowpea seeds cotyledons reported moisture content in the range of 9.37 ± 0.35% to 13.27 ± 0.01% which do not agree with findings in this current study. More so, the moisture content in this current study is higher than the moisture content of the dehulled small red bean and red kidney beans (4.02% and 1.06%) reported by Ibeabuchi *et al.,* (2017). The low moisture content in this study could aid in prolonging the shelf life of the cowpea varieties and reduce microbial spoilages which rely on high moisture content. This agreed with Onyeike *et al.* (1997) who posited that microbial spoilage is influenced by high moisture content. The fibre content in this current study does not agree with the 4.86 to 7.01 % reported by Habtamu (2018). The protein content of the cowpea seeds in this study which ranged from 25.75±0.85 to 27.85±0.79 % were higher than the 22.15 and 26.97% reported by Habtamu (2018). The carbohydrate contents of the cowpea seeds in this study were higher than the 46.54% and 50.18% reported by Uko *et al.* (2017). Though reduction of the carbohydrate content in their study was attributed to soaking of the black-eyed cowpea seeds. Irrespective of the slight variations in the carbohydrate content, there was no significant

difference in the carbohydrate content in all the cowpea seeds. The magnesium content of the cowpea seeds in this study are higher than the 10.05 mg/g and 12.26 mg/g reported by Uko *et al.* (2017) who attributed the reduction to be caused by fermentation.

There were no significant differences in the phosphorus content, potassium content, iron content and sodium content of the cowpea varieties. There was a significant difference in magnesium content between the white cowpea seeds (big and small) and the brown cowpea seeds (big and small). It was observed that the big brown cowpea seeds had the highest magnesium content followed by the small brown cowpea seeds, while the small white cowpea seeds had the least magnesium content.

The micronutrients showed that the small white cowpea seeds had the highest vitamin A content while the small brown cowpea seeds had the least vitamin A content. Irrespective of the slight differences in the quantity of vitamin A in the various cowpea, there was no significant difference noted. There was also no significant difference in the thiamin content of the cowpea varieties assessed. Similar to the vitamin A content and the thiamin content, there was no significant difference in the quantity of the niacin in the different cowpea. The antinutritional contents of the cowpea varieties showed that the tannin content of the big white cowpea was significantly higher than the tannin content of the small brown and big brown cowpea. Minute quantities of phytates, oxalates and saponins were detected in all the cowpea varieties and these quantities were not significantly different across the cowpea varieties.

The Phytates reported in this current study are lower and do not agree with values (13.51 to 23.76 mg g^{-1}) reported by Alemu (2018). The quantities of the carotenoids, polyphenols, flavonoids and lignans in the various cowpea vary slightly. The carotenoids, polyphenols and flavonoids of the small brown cowpea and big brown cowpea was significantly higher than those of the big white and small white cowpea. While the lignan content of the big white and small white cowpea were significantly higher than those of the small brown and big brown cowpea. The low values of phytochemicals reported in this current study could be attributed to the high nutrient quality. Higher values of phytochemicals have been reported by previous study to decrease the dietary composition of cowpea seeds thereby negatively affecting the enzymes responsible for the digestion of proteins and carbohydrates (Admassu and Kumarm, 2005).

4.0 Conclusion

From the findings in this study, it was seen that the proximate composition of the white and brown variety of the big and small cowpea (*Vigna unguiculata* (L.) Walp) contained varied amounts of nutrients and the misconception previously had about these varieties that one is better than the other should be disregarded except in the case of comparing a particular nutrient or choosing a particular nutrient of interest.

References

[1]. Ibeabuchi, J. C., Okafor, D. C; Peter–Ikechukwu, A; Agunwa, I.M. Eluchie, C.N, Ofoedu C.E & Nwatu, N. P. (2017). Comparative study on the proximate composition, functional and sensory properties of three varieties of beans Phaseolus lunatus, Phaseolus vulgaris and Vigna um – bellata. *International Journal of Advancement in Engineering Technology, Management and Applied Science (IJAETMAS), 1*, 1-23.

[2]. Uche, S. N., Charity, U. N., Abbas, O., Aliyu, M., Francis, G. B. & Oche, O. (2014). Proximate, antinutrients and mineral composition of raw and processed (boiled and roasted) sphenostylis stenocarpa Seeds from Southern Kaduna, Northwest Nigeria. International Scholarly Research Notices (ISRN Nutrition) Hindawi publications.

[3]. Elemo, G.N, Elemo, B.O., Oladunmoye, O.O. and Erukainure OL. (2011). Comprehensive investigation into the nutritional composition of dehulled and defatted African locust bean seed (Parkiabiglobosa). *African Journal of Plant Science, 5*(5), 291-295.

[4]. Oshone K, Gebeyehu S. and Tesfaye K. (2014). Assessment of common bean (Phaseolus vulgaris L.) seed quality produced under different cropping systems by smallholder farmers in Eastern Ethiopia. African Journal of Food, Agriculture, Nutrition and Development;14(1):8566-8584.

[5]. Sheahan CM. (2012). Plant guide for cowpea (Vigna unguiculata). USDA-Natural Resources Conservation Service, Cape May Plant Materials Center, Cape May, NJ.

[6]. Food and Agriculture Organization (FAO) (2012). Grassland species index. Vigna unguiculata; http://www.fao.org/ag/AGP/AGPC/doc/Gbase/data/pf000090.htm

[7]. Katungi E., Farrow A, Chianu J., Sperling L. and Beebe, S. (2009). Common bean in Eastern and Southern Africa. A situation and outlook analysis. International Centre for Tropical Agriculture (CIAT). Cali, Colombia.

[8]. Buruchara, R. (2007). Background information and common beans (Phaseolus vulgaris L.) in biotechnology, breeding and seed system for Africa crops. The Rockefeller Foundation, Nairobi- Kenya. http://www.africacrops.net/rockerfeller/ccrop/beans/index.htm

[9]. Mukunya D. M. and S. O. Keya. (1979). The influence of seed-borne anthracnose and halo blight on yield and disease development in a Canadian wonder bean selection at Kabete. Plant Protection Program. University of Nairobi, Nairobi, Kenya.

[10]. Yellavila, S.B., Agbenorhevi, J.K., Asibuo, J.Y. and Sampson, G.O. (2015). "Proximate

[11]. Composition, Minerals Content and Functional Properties of Five Lima Bean Accessions." Journal of Food Security; 3, (3): 69-74.

[12]. AOAC (2000). Association of Official Analytical Chemists. Official Method of Analysis. 13th edition. Washington DC.

[13]. Kedir, O., Setegn, G. and Kindie, T. (2014). Assessment of Common Cowpea seeds (Phaseolus Vulgaris L.) Seed Quality Produced Under Different Cropping Systems by Smallholder Farmers in Eastern Ethiopia. African journal of food, Agriculture, Nutrition and Development; 14 (1): 1-20.

[14]. Mekonen, D. and Admasu, S. (2012) Canning quality evaluation of common cowpea seeds (Phaseolus vulgaris L.) varieties grown in the central rii valley of Ethiopia. East African Journal of Sciences; 6: 65-78.

[15]. Onyeike, E. N., Olungwe, T. and Uwakwe, A. A. (1997). Effect of heat treatment and defatting on the proximate composition of some Nigeria local soup thickeners. Journal of Food Chemicals; 53:173–175.

[16]. Habtamu, A. (2018). Breeding Common Cowpea seeds (Phaseolus vulgaris L.) for Canning Quality Traits: A Review. Journal of Agricultural Science and Food Research; 9:1.

[17]. Uko, M. P., Umoren, M. D., Bassey, M. P., Umana, S. I., and Akan, O. D. (2017). Effects of Processing Techniques on the Microbial Quality, Nutritional and Mineral Composition of Black-eyed Cowpea seeds (Vignaungui culata). Journal of Advances in Microbiology; 6(3): 1-6.