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Proximate Composition and Mineral Contents of Raw and Cooked Vigna Unguiculata L. and Phaseolus Lunatus L. Procured From an Open Market in South East, Nigeria

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Abstract- Encouraging consumption of indigenous legumes has great potential in ensuring adequate nutrient and energy intake by women of child bearing age, infants and children in poor settings. Therefore, research attention is being focused on better utilization of legumes in addressing protein energy malnutrition and food security issues in the developing countries. The objective of this study was to evaluate the proximate composition and Mineral contents of unprocessed and processed Vigna unguiculata L. and Phaseolus lunatus L. procured from an open market in South East Nigeria. The proximate analysis was carried out using standard procedure while the mineral contents were determined using Atomic Absorption Spectrophotometer (AAS). Moisture content of cooked samples ranged from 13-20% while that of raw samples ranged from 10-15%. Protein content of cooked samples ranged from 23.19- 28% while that of raw samples ranged from 20-28%. Also, carbohydrate was in the range of 49.8-53.9% and 51-62.97% for cooked and raw samples respectively. The dehusked raw lima beans (d/r) had the highest Zn content of 0.6506 mg/kg while the whole cooked cowpea (w/c) had the highest Fe value of 4.0949 mg/kg. The whole raw Cowpea (w/r) recorded the highest Mg and Cu values of 9.7008 mg/kg and 1.5080 mg/kg respectively. Whole cooked lima beans (w/c) recorded the highest Na value of 3.9859 mg/kg while dehusked cooked cowpea (d/c) had the highest value of 3.8572 mg/kg for K. The result showed that both legumes are rich sources of nutrient and energy. However, apart from dehusked raw cowpea (d/r), all samples of cowpea recorded higher values of protein than their lima beans counterpart and are therefore better protein source compared to lima beans.

Keywords- Legume, Vigna unguiculata, Phaseolus lunatus, cowpea, lima beans, proximate, mineral

I. INTRODUCTION

In the tropics, legumes are the next important food crop after cereals (Uzoechina, 2009). Legumes are sources of low-cost dietary vegetable protein and minerals when compared with animal products such as meat, fish and egg (Dhull, Kinabo and Uebersax, 2023, Jimenez-Lopez, et al., 2020; Fabbri and Crosby, 2016). Processing such as fermentation, toasting and sprouting improved the nutrients composition of formulated complementary foods produced from maize, soybean and pumpkin seed

(Ademulegun, et al., 2024).

Cowpea (Vigna unguiculata) is one of the most ancient crops known to man. The largest production is in Africa, with Nigeria and Niger predominating, but Brazil, Haiti, India, Myanmar, Sri Lanka, Australia, the U.S., Bosnia and Herzegovina all have significant production. The United States is the only developed country producing large amount of cowpea (Henshaw, 2008). The protein in cowpea seed is rich in the amino acids, lysine and tryptophan, compared to cereal grains. Therefore, cowpea seed is valued as a nutritional supplement to cereals and an extender of animal proteins (Gulzar and Minnaar, 2017). Cowpea can be used at all stages of growth as a vegetable crop.

Lima beans (Phaseolus lunatus), like many other legumes, are a good source of dietary fiber, and a virtually fat-free source of high quality protein. Most markets carry dried lima beans and when the beans are in season, fresh lima beans can be found at some farmers' markets (Wang et al., 2010; Siqueira et al., 2013). Lima beans also provide folate and magnesium. Folate lowers levels of homocysteine, an amino acid that is an intermediate product in an important metabolic process called the methylation cycle. Elevated blood levels of homocysteine are an independent risk factor for heart attack, stroke and peripheral vascular disease. The magnesium content of lima beans is a calcium channel blocker. When enough magnesium is present, veins and arteries relax, which reduces resistance and improves the flow of blood, oxygen and nutrients throughout the body (Carvalho et al., 2012).

Therefore, the objective of this study was to evaluate the proximate composition and mineral contents of unprocessed and processed Vigna unguiculata L. and Phaseolus lunatus L. procured from an open market in South East Nigeria.

II. MATERIALS AND METHODS

Dried Lima beans and Cowpea samples were bought from Ogbete market Enugu. The samples were identified as lima beans and cowpea by a taxonomist and were screened to remove bad ones, labeled and then stored in the laboratory at room temperature.

1. Treatment of Samples

15kg each of cowpea and lima beans samples were shelled using a sheller and sift to remove the husk. 10kg each of the dehusked lima beans and dehusked cowpea samples were labeled and stored in air tight containers at room temperature. Also, 10kg each of whole lima beans and cowpea were labeled and stored in air tight containers. 5kg of each sample, dehusked Lima beans, dehusked Cowpea, whole Lima beans and whole Cowpea were cooked separately for 1 hour.

At the end of the cooking process, the samples were dried in the oven at 40oC for 48 hours and then ground to powder (355/180 mesh) using a mechanical grinder. The powder samples were kept in screw capped air tight containers, labeled and stored in glass desiccators until needed for analysis. 5kg of each uncooked sample, dehusked Lima beans, dehusked Cowpea, whole Lima beans and whole Cowpea were also kept in screw capped air tight containers and stored in glass desiccators until needed for analysis.

The eight samples were labeled Lima beans (dehusked/cooked), Cowpea (dehusked/cooked), Lima beans (whole/cooked), Cowpea (whole/cooked), Lima beans (dehusked/raw), Cowpea (dehusked/raw), Lima beans (Whole/raw) and Cowpea (whole/raw).

2. Proximate Analysis

The methods of the Association of Official Analytical Chemists (AOAC, 2005) were used for the determination of moisture content, ash content, crude protein, lipids and crude fibre of the samples.

3. Mineral Analysis

The mineral compositions of the samples were determined using Atomic Absorption Spectrophotometer (AAS). Zinc (Zn), Iron (Fe), Magnesium (Mg), Sodium (Na), Copper (Cu) and Potassium (K) were estimated.

III. RESULT AND DISCUSSION

1. Proximate Composition

Proximate parameters of the legume samples are shown in Tables 1 - 3. In this study, the moisture contents of cowpea ranged from 13 – 15% with cowpea (d/r) recording the highest moisture content of 15%.

Table 1: Proximate Analysis (%) of Lima beans (d/c), Cowpea (d/c), Lima beans (w/c), Cowpea (w/c), Lima beans (d/r), Cowpea (d/r), Lima beans (w/r) and Cowpea (w/r)

Samples	Moisture	Ash	Nitrogen	Protein	Lipid	CHO	EV (Kcal/100g)
Lima beans (d/c)	14	4.0	4.13	25.81	3.4	52.79	345.0
Cowpea (d/c)	13	5.2	4.48	28.00	3.6	50.20	345.0
Lima beans (w/c)	20	4.2	3.71	23.19	2.8	49.81	317.2
Cowpea (w/c)	14	3.8	4.27	26.69	1.6	53.91	336.8
Lima beans (d/r)	13	5.4	4.48	28.00	1.4	53.20	337.4
Cowpea (d/r)	15	5.8	4.20	26.25	2.0	51.00	326.8
Lima beans (w/r)	10	4.5	3.22	20.13	2.4	62.97	354.0
Cowpea (w/r)	13	4.4	4.48	28.00	1.4	53.20	337.4

Legend: d/c = dehusked/cooked, w/c = whole/cooked, d/r = dehusked/raw
w/r = whole/raw

The range was higher than the value of 9.2% reported for cowpea flour obtained from the six geo-political zones of Nigeria (Arawande and Borokini, 2010). Moisture content of cowpea samples in the study were also higher than the value of 6.5% reported by Betancur-Ancona et al., (2012) for cowpea collected from Yucatan, Mexico. The moisture content of lima beans in the study were higher than the moisture contents (9.19 – 11.83%) reported for five lima beans accessions flour obtained from Crop Research Institute, Ghana (Yellavilla et al., 2015). They were also higher than the value of 7% reported for lima beans in Mexico (Betancur-Ancona et al., 2012).

Table 2: Proximate Analysis (%) of Lima Beans (d/c), Cowpea (d/c), Lima Beans (w/c) and Cowpea (w/c)

	Moisture	Ash	Nitrogen	Protein	Lipid	CHO
Lima beans (d/c)	14	4	4.13	25.81	3.4	52.79
Cowpea (d/c)	13	5.2	4.48	28	3.6	50.2
Lima beans (w/c)	20	4.2	3.71	23.19	2.8	49.81
Cowpea (w/c)	14	3.8	4.27	26.69	1.6	53.91

Table 3: Proximate Analysis (%) of Lima Beans (d/r), Cowpea (d/r), Lima Beans (w/r) and Cowpea (w/r)

	Moisture	Ash	Nitrogen	Protein	Lipid	CHO
Lima beans (d/r)	13	5.4	4.48	28	1.4	53.2
Cowpea (d/r)	15	5.8	4.2	26.25	2	51.0
Lima beans (w/r)	10	4.5	3.22	20.13	2.4	62.97
Cowpea (w/r)	13	4.4	4.48	28	1.4	53.2

Cowpea (d/r) sample recorded the highest ash value of 5.8% and is higher than the value of 4.7% for dehulled cowpea flour obtained from the six geo-political zones of Nigeria (Arawande and Borokini, 2010). The ash contents of the cowpea samples were lower than 6.5% reported by Betancur-Ancona et al., (2012) in a review of chemical composition of five tropical legume seeds in Mexico.

The ash contents of lima beans (d/c, w/c, d/r and w/r) in the study ranged from 4 - 5.4% with lima beans (d/r) recording the highest ash content of 5.4% and it is comparable to the ash content of 5.6 recorded by Yellavilla et al., (2015) for five lima beans accessions collected from Crop Research Institute, Ghana. However, they were lower than the value of 7% reported for lima beans sample from the Yucatan Peninsula, Mexico by Sullivan and Davenport (1993). Also, the ash contents of all the samples were higher than the values of 2.98 – 3.33% reported by Tresina et al., (2010) for three different varieties of Vigna mungo (L.) procured from the Tamil Nadu Agricultural University, Coimbatore, India.

The protein values of all the samples in the study were comparable to 24.46% (Pigeon pea) and 26.20% (Jack bean) reported for six geopolitical zones in Nigeria by Arawande and Borokini (2010), relatable to the range of 19.94 – 36.95% reported for some tropical legumes grown in Umudike, Nigeria (Ogunji, Wirth and Osuigwe, 2003), comparable to the range of 23.98 – 28.44% reported for processed Soyabeans samples in Ado-Ekiti, Nigeria (Pele et al., 2016), comparable to the range of 21.88 – 26.80% reported in Makurdi, Nigeria by Igbabul, Hiikyaa and Amove (2014) for unfermented and fermented Mahogany bean (Afzelia Africana) flour and also comparable to the range of 24.37 – 26.22% reported for three different varieties of Vigna mungo in India (Tresina et al., (2010). Protein contents of lima beans in this study were comparable to 25% and 24.75% reported by Sullivan and Davenport (1993) and Betancur-Ancona et al., (2012) respectively in Mexico. The values were also relatable to the range of 20.69 – 23.08% reported for five lima bean accessions in Ghana (Yellavilla et al., 2015). The protein values of cowpea in the study were higher than protein value of 25% reported for cowpea by Betancur-Ancona et al., (2012) in Mexico. The values

were also higher than 24.1% reported for cowpea by Arawande and Borokini (2010) in Nigeria. With the exception of lima beans (w/r), the protein values of all the samples in the study were higher than that of commonly consumed legumes, such as chick pea (Cicer arietinum), green pea (Pisum sativum), common bean (Phaseolus vulgaris), pigeon pea (Cajanus cajan) and lentil (Lens culinaris) with a range of 18.5 to 21.9% for the raw grains (Costa et al., 2006).

The lipid (fat) contents of the samples in this study were comparable to the range of 0.89 – 3.39% reported for some tropical legumes grown at Michael Okpara University of Agriculture, Umudike, Nigeria (Ogunji, Wirth and Osuigwe, 2003), 4.78% and 1.95% for Pigeon pea and Jack bean respectively reported in Nigeria by Arawande and Borokini (2010). They were also comparable to the values reported for other legumes, 2.94 – 4.24% for three varieties of Vigna mungo (L.) Hepper in India (Tresina et al., (2010), 1.17% for Psophocarpus tetragonolobus (L.) DC grown in Manipur, Northeast India (Ningombam et al., 2012).

The lipid contents of cowpea were however lower than 4.37% reported for cowpea flour by Arawande and Borokini (2010) in Nigeria. The lipid contents of the lima beans samples in the study were higher than the range of 0.59 – 1.14% reported for flour of five lima beans accessions in Ghana (Yellavilla et al., 2015). Also, the lipid value of 3.4% recorded for lima beans (d/c) was higher than the value of 2.27% reported by Betancur-Ancona et al., (2012) for samples of lima beans in Mexico. This implies that lima beans and cowpea are good sources of lipid.

The carbohydrate (CHO) values (49.81 – 62.97%) of all the samples in the study were relatable to values reported for other legumes, 57.83% and 56.63% for Jack bean and Pigeon pea respectively in Nigeria (Arawande and Borokini, 2010), higher than the range of 38.48 – 43.52% reported for processed

Soybeans samples procured from Ado-Ekiti, Nigeria (Pele et al., 2016). They were quite higher than the range (9.89 – 25.20%) reported by Igbabul, Hiikyaa and Amove (2014) in Makurdi, Nigeria for unfermented and fermented Mahogany bean (Afzelia africana) flour and higher than 37.19% reported for Mucuna pruriens flour from North-eastern Brazil (Tavares et al., 2015). The CHO content of lima beans samples in the study were comparable to 56.60% reported for cowpea flour from the six geo-political zones of Nigeria (Arawande and Borokini, 2010).

They were also comparable to the range of 54.31 – 59.64% reported for five lima bean accessions developed by Crop Research Institute, Ghana (Yellavilla et al., 2015). The CHO contents of cowpea samples in the study were comparable to 54.5% reported for cowpea by Betancur-Ancona et al., (2012) in Mexico. They were also comparable to 55% CHO reported for lima beans samples in Mexico (Betancur-Ancona et al., 2012).

2. Mineral Composition

Mineral compositions of the legume samples are shown in Table 4. The Zn values recorded for cowpea samples in this study were comparable to 5.7 and 6.0mg100g-1 reported for two varieties of cowpea collected from Nasarawa State, Nigeria (Aremu et al., 2006).

The Zn values recorded for all the samples (lima beans and cowpeas) in the study were higher than 3.0, 3.01, 3.54, 3.73 and 4.18mg mg100g-1 reported by Souci et al. (2000) for Phaseolus vulgaris, peas (Pisum sativum), chickpeas, lentils and soyabeans respectively in Germany.

The values were also higher than 4.1mg mg100g-1 reported by Mugendi et al. (2010) for raw Mucuna bean (Mucuna pruriens L) in Kenya.

They were also higher than 0.98 and 1.19mg100g-1 reported for cooked pinto beans and peas by Fabbri and Crosby (2015) in a review of the impact of preparation and cooking on the nutritional quality of vegetables and legumes conducted in Boston, USA.

Table 4: Mineral Composition (mg kg-1) of Lima beans (d/c), Cowpea (d/c), Lima beans (w/c), Cowpea (w/c), Lima beans (d/r), Cowpea (d/r), Lima beans (w/r) and Cowpea (w/r)

Samples	Zn	Fe	Mg	Na	Cu	K
Lima beans (d/c)	0.5038	2.6930	9.4674	3.8948	0.4980	3.0280
Cowpea (d/c)	0.5225	2.3220	9.2205	3.3526	0.7570	3.8572
Lima beans (w/c)	0.5888	2.1550	9.2313	3.9859	0.4800	3.4342
Cowpea (w/c)	0.5134	4.0949	9.6262		0.7290	3.0280
Lima beans (d/r)	0.6506	3.7190	9.4962	2.3317	0.6720	2.9654
Cowpea (d/r)	0.4317	1.8700	9.5673	2.0045	0.5160	2.7152
Lima beans (w/r)	0.5107	2.3460	9.3831	3.4628	0.7900	3.3764
Cowpea (w/r)	0.5785	2.4700	9.7008	2.7704	1.5080	2.8527

The values of Iron (Fe) recorded for cowpea samples in this study are higher than 5.5 and 6.7mg100g-1 reported for two varieties of cowpea from Nasarawa State, Nigeria (Aremu, et al., 2006) while the values recorded for lima beans are higher than the range of 2.45 to 2.67mg100g-1 reported for five lima bean accessions in Ghana by Yellavila et al. (2015). The values of Fe recorded in this study for lima beans and cowpea were higher than 7.0, 7.36, 6.96, 7.50 and 6.64mg mg100g-1 reported by Souci et al. (2000) in Germany for Phaseolus vulgaris, peas (Pisum sativum), chickpeas, lentils and soyabeans respectively. The values recorded were also higher than 7.9mg100g-1 reported by Mugendi et al. (2010) for raw Mucuna bean (Mucuna pruriens L) in Kenya. They were also higher than 2.09 and 1.54mg100g-1 reported for cooked pinto beans and peas by Fabbri and Crosby (2015) in a review of the impact of preparation and cooking on the nutritional quality of vegetables and legumes conducted in Boston, USA.

The Magnesium (Mg) values recorded for cowpea samples in this study were higher than 67.7 and 54.6mg100g-1 reported for two varieties of cowpea in Nigeria (Aremu et al., 2006). The contents of Mg in the lima beans and cowpea samples in the study were lower than 250, 132, 155, 129 and 220mg mg100g-1 reported by Souci et al. (2000) in Germany for Phaseolus vulgaris, peas (Pisum sativum), chickpeas, lentils and soyabeans respectively. However, the values of Mg recorded for lima beans and cowpea were higher than 8.8mg mg100g-1 reported in Kenya by Mugendi et al. (2010) for raw Mucuna bean (Mucuna pruriens L). They were also higher than 50 and 39mg100g-1 reported in review in Boston, USA for cooked pinto beans and peas (Fabbri and Crosby, 2015).

In this study, the values of Sodium (Na) recorded for cowpea samples were higher than 6.9 and 6.5mg100g-1 reported for two varieties of cowpea in Nigeria (Aremu et al., 2006) while the value recorded for lima beans were higher than the range of 19.99 to 21.33 mg100g-1 reported for five lima bean accessions in Ghana by Yellavila et al. (2015). The values of Na recorded for all the samples in this study were lower than 149mg mg100g-1 reported by Mugendi et al. (2010) in Kenya for raw Mucuna bean (Mucuna pruriens L). They were, however, higher than 1 and 3mg100g-1 reported for cooked pinto beans and peas in a review carried out by Fabbri and Crosby (2015) in Boston, USA.

The values of Copper (Cu) recorded for cowpea samples in this study were higher than 0.3mg100g-1 reported for two varieties of cowpea in Nigeria (Aremu et al., 2006). The Cu compositions of lima beans and cowpea in this study were lower than 807mg mg100g-1 reported by Mugendi et al, (2010) in Kenya for raw Mucuna bean (Mucuna pruriens L).

The values of Potassium (K) recorded for cowpea samples in this study were comparable to 35.7 and 40.4mg100g-1 reported for two varieties of cowpea collected from Nasarawa State, Nigeria (Aremu et al., 2006). The K composition of the lima beans samples in the study were lower than the range of 50.04 to 52.08 mg100g-1 reported for five lima bean accessions in Ghana by Yellavila et al. (2015). Potassium composition of lima beans and cowpea were also lower than 807mg mg100g-1 reported in Kenya by Mugendi et al. (2010) for raw Mucuna bean (Mucuna pruriens L). The values were lower than 436 and 271mg100g-1 reported in Boston, USA for cooked pinto beans and peas (Fabbri and Crosby, 2015).

IV. CONCLUSION

The dehusked cooked cowpea and lima beans have higher moisture contents compared to the dehusked raw samples while the whole cooked cowpea and lima beans have higher moisture content than the whole raw samples. The dehsuked raw cowpea and lima beans have higher ash contents compared to the dehusked cooked samples. Protein and carbohydrate contents of raw and cooked cowpea and lima beans are comparable. Nevertheless, cooking of legumes increases their protein digestibility and availability. The cowpea and lima beans used in this study had good levels of macro minerals (Na, Mg, and K) and also good quantities of micro minerals (Zn, Fe, Cu). However, mineral content of agricultural commodities varies with soil type, geographical location, genetic origin and levels of soil fertility.

The study also showed that cowpeas and lima beans are good sources of protein, dietary fibre, starch and minerals. However, cowpea have higher protein content than lima beans and are therefore better source of affordable alternative protein to poor resource people in many tropical countries.

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