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Nutrient and anti-nutrient compositions of cowpea (*Vigna unguiculata*) and mung bean (*Vigna radiata*) seeds grown in humid Southeast Nigeria: A comparison

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Abstract. *Enyiukwu DN, Chukwu LA, Bassey IN. 2020. Nutrient and anti-nutrient compositions of southern pea* (Vigna unguiculata) *and mung bean* (Vigna radiata) *seeds grown in humid Southeast Nigeria: A comparison. Trop Drylands 3: 41-45.* Pulses are important components of African cuisines. Cowpeas (*Vigna unguiculata* (L.) Walp.) are commonly consumed in most parts of Nigeria, but mung bean (*Vigna radiata* (L.) Wilczek) though new in the agro-landscape, is gradually gaining popularity. Its popularity is based on the speculation that it is of higher nutritional content than cowpeas. This work evaluated the nutritional compositions of seeds of both pulse crops grown in humid southeast Nigeria using classical and spectrometric analysis. Results obtained from the study showed that the mean proximate compositions of mung bean (17.70%) did not statistically ($P \geq 0.05$) differ from that recorded for cowpea seeds (17.30%). However, irrespective of the high magnesium content (62.39 mg g^{-1}) of mung bean, the mean mineral nutrients in cowpea (270.69 mg g^{-1}) is grossly higher than (145.58 mg g^{-1}) recorded in mung bean due largely to high presence of potassium (1.29 g 100 g^{-1}) in cowpeas than in the former. Data from this study also showed that higher contents of flavonoids (11.31 mg g^{-1}) make the mean content of phytochemicals in mung bean (4.21 mg g^{-1}) to be slightly higher than but statistically ($P \geq 0.05$) at par with that obtained in cowpea seeds (3.67 mg g^{-1}). Generally, the nutrient contents in mung beans are not substantially higher than that of cowpea and vice versa. It is therefore recommended based on data obtained from this study that both be used to supplement each other in African diets due to their differential contents of flavonoids, magnesium, and potassium for better well-being and health.

Keywords: Cowpea, green gram, mung bean, nutrient composition, southern pea

INTRODUCTION

Southern pea or cowpea (*Vigna unguiculata* (L.) Walp.) and green gram or mung bean (*Vigna radiata* (L.) Wilczek) are members of the same botanical family, i.e., Fabaceae. Cowpea originated from West or Southern Africa, while the later speciated from Indo-Burma; from these centers of origin they spread throughout the tropical world (Sha et al. 2011; Enyiukwu et al. 2018a,). Both crops are short-duration crops conspicuously present in many farming systems of the tropics where they function as bio-fertilizers in marginal soils, as forage crops for animal husbandry and catch crops between seasons (Islam et al. 2011; Enyiukwu et al. 2018b).

Cowpea and mung bean may be prepared in diverse food forms, either as vegetables for soups and sauces or pulses (Dakora and Belane 2019; Owade et al. 2019). Pulse-derived flours of these crops, for instance, have also been reported to be used in making noodles, bread, and soups (Abbas and Shah 2007). Medicinal properties relating to anti-hypertensive, anti-diabetic, anticancer, anti-hepatitis, anti-gastritis and body weight regulation have been ascribed to eating some of these legumes (Shasheen et al. 2012; Noel et al. 2019).

Cowpea and mung bean are important sources of energy (calories), proteins, vitamins (A, B-complex, C and K); and minerals such as iron, copper, magnesium, manganese and phosphorus in human diets (Abbas and Shah 2007; Oghbaei and Prakash 2016; Dakora and Belane 2019). Generally, proteins derived from grain legumes are rich in several amino acids, such as lysine and tryptophan; but deficient in sulfur-based amino acids methionine and cysteine − a factor that makes these grains slightly inferior to animal-derived proteins (FAO 2018). In meat-scarce communities of the tropics, blending or supplementing pulse grains with cereals, such as fonios which contain substantial amount of these sulfur-based amino acids, is strongly warranted for balancing diets (FAO 2018; Enyiukwu et al. 2018a, 2020). Also, pulses contain low amounts of saturated fat, sodium, cholesterol but considerable quantities of several non-nutritional compounds (NNCs) including protease inhibitors, lectins, phenolics, phytates, tannins, saponins and alkaloids such as vicine and convincing which are concentrated in their seed coats and cotyledons. Though termed NNCs, these phytochemicals have been associated with contributing to prevention of certain diseases such as cancers, inflammation, hypertension, diabetes, and hyperlipidemia in humans (Tajoddin et al. 2010; Gulewicz et al. 2014,; Jayanthlake et al. 2018). Phytates, for instance, have been reported to demonstrate protection against DNA damage, phenolics demonstrate antioxidant activity and prebiotic activity has been ascribed to galato-oligosaccharides; making these classes of compounds to be touted as neutraceuticals (Campos-Vegas et al. 2010; Dhole and Srinivasalu 2015). Due to their high contents of NNCs, these sources remarked that frequent consumption of these legumes (4 or more times per week) has been significantly and substantially linked with lower risks of coronary heart disease (CHD) or cardiovascular disease (CVD). Nevertheless, several farm households in third-world nations including Pakistan and Uzbekistan have been reported to have little knowledge of the health benefits of consuming these legumes (Rani et al. 2018).

However, some researchers argued that NNCs, especially phytates and polyphenols, could bind or make some kinds of mineral nutrients unavailable to consumers. Oligosaccharides, such as raffinose, starchose and verbascose present at 5-8% on dry matter basis in pulse seeds, cause gastro-intestinal discomforts and flatulence (CO_2, H_2, and CH_4) in man and monogastric systems (Mubarak 2005; Ofuya 2006; Sha et al. 2011; Hussain and Burhanddin 2011; Shashen et al. 2012; Akerue and Onwuka 2013). Processing them before eating, particularly sprouting, cooking, roasting, dehulling, de-husking, soaking, and milling (Blessing and Gregory 2010; Tajoddin et al. 2016), could reduce flatulence and other negative effects of these factors (Mubarak et al. 2005; Olanipekun et al. 2013) and improve digestibility and nutrient availability from the grains (Oghbaei and Prakash 2016).

Interest in mung beans as veritable functional food is reported to be growing in China (Shi et al. 2016). In recent times also in Nigeria, the economic and food value of mung bean is rising being even advanced in some quarters as a superior form of grain legume (Chukwu 2019) with complete protein (Ullah et al. 2014). Therefore as part of efforts by scientists to document nutritional information of locally grown grains, this work analyzed and compared the nutrients and anti-nutrient contents of seeds of cowpea and mung bean grown in the humid Umudike area of Southeast Nigeria.

MATERIALS AND METHODS

Source of seeds and preparation of seed samples for analyses

The experiment was conducted at the Analytical Laboratories of the Federal Institute for Industrial Research Oshodi (FIIRO), Lagos, and National Root Crops Research Institute, (NRCRI) Umudike, Nigeria. The seeds of Cowpea (Var. IAR-48) (Fig. 1A) and mung bean (Var. SML-668) (Fig. 1B) were obtained from the Research and Training (R&T) Unit of the College of Crops and Soil Sciences, Michael Okpara University of Agriculture, Umudike were used for the study. One hundred grams of each seed specimen was weighed out separately with a digital balance. Thereafter, they were separately and repeatedly ground into powder with a hand milling machine (Corona Lavesh 250) (Amadioha and Enyiukwu 2019a, b). The powdered specimens were then stored in air-tight bottles and kept in dark wooden cupboard in the laboratory away from UV light which could degrade some of the phytochemical compounds (Enyiukwu et al. 2018a, b).

A B

Figure 1. Pulse grains observed in this study. (A.) Dried seeds of cowpea; (B.) Dried seeds of mung bean; Photo: by DN Enyiukwu

Biochemical analyses of samples

Standard methods based on the protocols of A.O.A.C (2000) were used in the determination of the proximate compositions (moisture, protein, fat, crude fiber, ash, and carbohydrate contents) of the test specimens. The samples were first scanned with digital moisture analyzer (Model: MS-70, A & D Co. Ltd., UK) fitted with light-emitting diode (LED) for their optimum temperature (140ºC), and their percentage moisture contents were determined and displayed automatically on the LED. One gram (1 g) of each ground seed sample was then charred to complete de-carbonization on a hot plate, and then put in the furnace (Model 186A, Fisher Scientific Co.) set at 560ºC to obtain their ashes (Amadioha and Enyiukwu 2019a). The ashes were then separately dissolved in 1N nitric acid and analyzed for calcium, zinc, magnesium, phosphorus, and iron-based on their individual absorbances from the Atomic Absorption Spectrometer (Model: AA 7000, Shimadzu, Japan). Standard and calibration curves generated from the absorbances of the respective samples and standards were then used to determine the respective amounts of the test elements in the samples (Kayode et al. 2008; Enyiukwu et al. 2018a, b). The test for alkaloids, flavonoids, tannins, saponins, and phenols contents of the seed specimens of the legumes were also determined; by separately subjecting 10 g of each test powder to classical and spectrometric analyses using the procedure described by Enyiukwu and Awurum (2013).

Statistical analysis

This experiment was designed as Completely Randomized Design (CRD) with three replicates. Means of the data collected in the study were analyzed by analysis of variance (ANOVA). The statistical package employed was Genstat (Genstat Release Windows/PC Vista, version 12.10). Means were separated and compared using Fisher's LSD at probability of 0.05.

RESULTS AND DISCUSSION

Results of the proximate nutrient contents of the test pulses are presented in Table 1. It shows that moisture contents of the test pulse seeds ranged between 11.45-12.06%. The data also revealed that protein and carbohydrate were the most abundant nutrients in the pulse seeds, followed by crude fiber while ash and fat were the least. Both seeds of the pulse crops contain ash and fat at statistically ($P \geq 0.05$) par levels. In terms of protein, carbohydrate, and fat, cowpea recording 25.68, 57.00 and 1.70% was statistically ($P \geq 0.05$) equal in its contents of these nutrients with mung bean where 26.25, 55.30, and 2.13% were obtained for these parameters respectively. Presence of crude fiber in cowpea, however, was statistically ($P \geq 0.05$) inferior compared to value obtained in seeds of mung bean (Table 1). Generally, both seeds are low in contents of fats (1.70-2.13%) but high in protein (25.68-26.25%) and low glycemic index carbohydrates (55.98-57.00%).

The results of the mineral profiling of the test pulse seeds are presented in Table 2. It indicated that K identified at 1.292 mg 100 g^{-1}, P (498.06 mg g^{-1}) and Ca (93.10 mg g^{-1}) were the most abundant elemental nutrients in the pulse seeds, and these were significantly ($P \leq 0.05$) superior to the corresponding values of the same parameters in mung bean (Table 2). With the exception of Fe where 11.00 mg g^{-1} recorded for cowpea was statistically ($P \geq 0.05$) equal with 10.06 mg g^{-1} obtained for mung bean; values obtained for Na and Mg were significantly higher in mung bean than the corresponding values of the same elements in cowpea (Table 2). In general, the mean elemental nutrients (145.58 mg g^{-1}) recorded in mung bean is statistically ($P \geq 0.05$) inferior to (270.69 mg g^{-1}) obtained in cowpea.

Outcomes of the anti-nutrients evaluation of the test pulses are presented in Table 3. It showed that high levels of flavonoids (11.31 mg g^{-1}) and saponins (7.71 mg g^{-1}) were recorded in seeds of mung bean than 7.96 mg g^{-1} and 6.09 mg g^{-1} obtained for the respective parameters in cowpea. Also, 0.76 mg g^{-1} of tannins recorded in cowpea was slightly but statistically ($P \leq 0.05$) greater than 0.23 mg g^{-1} obtained in mung bean. However, values obtained for alkaloids, phytates, and oxalates were statistically ($P \geq 0.05$) at par for the test pulse seeds. Generally, the mean NNCs in mung bean (4.31 mg g^{-1}) is slightly ($P \leq 0.05$) higher than the mean value (3.63 mg g^{-1}) in cowpea.

Table 1. Proximate composition of cowpea and mung bean grown in Umudike, southeast Nigeria

Nutrients (%)	Mung bean	Cowpea
Moisture	11.45	12.06
Protein	26.25	25.68
Carbohydrate	55.98	57.00
Fat	2.03	1.70
Crude fiber	6.75	3.94
Ash	3.65	3.41
Mean	17.70	17.30
LSD (0.05)	0.43	0.45

Note: *Data are means of triplicate determinations from 2 separate experiments

Table 2. Mineral composition of seeds of cowpea and mung bean grown in Umudike, southeast Nigeria

Minerals contents (mg g^{-1})	Mung bean	Cowpea
Calcium	86.71	93.10
Phosphorus	378.01	498.06
Zinc	1.05	0.17
Sodium	1.65	0.13
Magnesium	62.37	0.09
Iron	10.06	11.00
Potassium**	479.23	1292.25
Mean	145.58	270.69
LSD (0.05)	0.78	1.22

Note: *Data are means of triplicate determinations from 2 separate experiments; **values in mg 100 g^{-1}

Table 3. Phytochemical and anti-nutrient factors in seeds of cowpea and mung bean grown in Umudike, southeast Nigeria

Anti-nutrients/ phytochemicals (mg g^{-1})	Mung bean	Cowpea
Alkaloids	6.45	6.87
Flavonoids	11.31	7.96
Tannins	0.23	0.86
Saponins	7.12	6.19
Phytate	0.02	0.03
Oxalate	0.11	0.09
Mean	4.21	3.67
LSD (0.05)	0.11	0.08

Note: *Data are means of triplicate determinations from 2 separate experiments

Discussion

Mineral, proximate and other compositions of legumes are reported to be influenced by genetic especially species or varietal factors and environmental parameters (Abbas et al. 2007; Dhole et al. 2015). Nutrients profiling in this study revealed that the test pulse seeds contain substantial amounts of proximate compounds, a variety of minerals, and anti-nutrient factors; thus confirming the reports of Otituju et al. (2015), Ayogu et al. (2016), and Dakora and Belane (2019) where all these factors were identified in seeds of locally grown legumes in Nigeria, and other parts of Africa. The high contents of protein and carbohydrates in both seeds of the pulse crops agree with observations by Otituju et al. (2015) and FAO (2018) where these nutrients were reported in high amounts also. Finding in this study also showed that levels of protein, carbohydrates, fat, and ash did not significantly ($P \geq 0.05$) differ in both pulse seeds; a trend which also conformed with FAO (2018) where these parameters did not differ ($P \geq 0.05$) with each other in the pulse seeds. However, substantially ($P \leq 0.05$) higher presence of crude fiber in mung bean compared to cowpea in this study (Table 1) did not agree with the trend where it was only marginally higher (4.8% and 4.2% respectively) as noted in FAO (2018). Carbohydrate delivers energy to consumers (Abbas and Shah 2007). They are made up of sugars and polymers such as oligo-saccharides. Galacto-oligosaccharides for example play significant roles in nutrition as prebiotics and preventers of some forms of cancers (Campos-Vegas et al. 2010; Enyiukwu et al. 2018a,b). In general, oligosaccharides are present in legumes in the range of 5-8% (Mubarak 2005); some including raffinose, stachyose and verbanose are difficult to break down by human enzymes complex resulting in flatulence. Lower values of these flatulence causing oligosaccharides are reported to occur in mung beans than cowpea (Shasheen et al. 2012), and this may have accounted for the lower value of carbohydrate (55.98%) obtained in this study; and thus might be one reason for advancing mung bean as of higher nutritional quality than cowpea.

Both pulse seeds analyzed in this study are rich sources of valuable mineral elements (Ca, P, K, Mg, Zn, and Fe). However, cowpea seeds are exceptionally rich in potassium (1.29 g 100 g^{-1}) compared to 479.23 mg g^{-1} in mung bean seeds; whereas mung bean seeds on the other hand are significantly superior in content of magnesium (62.37 mg g^{-1}) (Table 2). This agrees with the reports of Alayande et al. (2012) that K occurring at 741 mg 100 g^{-1} was the highest occurring mineral in white-coated seeds of cowpea. It is also supported by Olayiwole et al. (2012) who noted potassium content of up to 1.38 g 100 g^{-1} in flours derived from some seeds of cowpea used for improving tuber-based recipes in Nigeria.

Anti-nutrient factors, such as alkaloids, flavonoids tannins, saponins, oxalates, phenolic compounds, and phytates, are associated with seeds of legumes or pulses (Okwu and Orji 2007; Campos-Vegas et al. 2010; Towo et al. 2013; Ayogu et al. 2016) usually in amounts which correlates with the seed color (Dahiya et al. 2015). Though NNCs are commonly regarded as reducing the nutrient quality of pulses by affecting protein digestibility and mineral bio-availability (Towo et al. 2003); some of these compounds are held up in recent research findings as potent antioxidants, prebiotics and nutraceuticals (Campos-Vegas et al. 2010). With the exception of flavonoids which were significantly higher in mung beans, the mean anti-nutrient factors were not substantially ($P \geq 0.05$) different from each other in both pulse seeds under evaluation. Flavonoids give brilliant colors to flowers and seeds; and have been reported to actively participate in maintaining seeds viability and priming body defense systems against pathogenic invasion in humans (Enyiukwu and Awurum 2013; Tajoddin et al. 2010). Perhaps the high flavonoid content of mung bean may explain in part the reason why mung bean is touted as a superior legume over cowpea.

Overall, findings from the nutritional profiling conducted in this study did not seem to suggest any profound superiority of mung bean over cowpea as held in some quarters and vice versa. With the exception of potassium and flavonoids, both seeds contain significant quantities of nutrients (proximate, mineral, and phytochemical compounds) which did not differ substantially ($P \geq 0.05$) from each other. Hence, based on the above findings, it is recommended that consumption of both seeds should be supplemented with the other in our local diets so as to boost cell electrical conductivity, improve cardiac health, and general body immunity.

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