Essential mineral elements in flours from two improved varieties of cowpea

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Abstract

Two cowpea varieties IT90K-277-2 and IT97K-568-18 were evaluated for their proximate, micro and macro nutrient contents. The processed beans had protein content from 20.30- 20.70 %, fat; 1.68- 1.89 %, ash 3.25- 3.49 %, crude fibre; 2.65- 2.90 %, carbohydrate content from 59.42- 60.78 % and moisture content; 11.34- 11.58 %. Manganese was in the range of 12.64- 17.10 mg kg^{-1}, Iron 13.14- 20.58 mg kg^{-1}, Zinc 23.02- 25.20 mg kg^{-1} and Copper content was in the range of 2.21- 3.00 mg kg^{-1}. Sodium content was from 5.73- 23.70 mg kg^{-1}, Potassium 10900-11600 mg kg^{-1}, Calcium 700- 900 mg kg^{-1}, Magnesium 1400- 1600 mg kg^{-1} and Phosphorus content was from 3300-3500 mg kg^{-1}. Data of the study reveals the appreciable amount of ash, dietary fibre and micronutrient. These varieties contain higher content of essential mineral elements (Calcium, Iron, Zinc, Manganese, Phosphorus and Potassium) than local cowpea seeds. Thus; they are high in micro and micro nutrient essential for body growth and their consumption would reduce the occurrence of nutritional deficiency and its associated health problem in infants, children and pregnant women.

Keywords: micro and macronutrients, improved varieties, cowpea, processing

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1. Introduction

Cowpeas (*Vigna unguiculata L Walp*) are important in the diets of many population groups in Africa. They are popular, inexpensive and readily available sources of food protein (Mamiro *et al*., 2011). Cowpeas are eaten in the form of cooked seeds in a large varieties of dishes (Rachie, 1985). Cooked seeds are important as a companion dish eaten with garri (grated fried cassava). Other flavoured dishes prepared from cowpea seeds are "akara"and "moin-moin. Akara" is served hot and makes an excellent breakfast with corn gruel (Ogi, pap). For "moin-moin" the seasoned paste of cowpea seeds is steamed- cooked. Nwokolo *et al.,* (1987). In developing weaning foods for children and preventing protein malnutrition, cowpea is an alternative to animal products utilized among low income resource mothers and families (WHO, 2000; Ugwu, 2009), mothers (Ilarotimi and Famurewa, 2006; Inyang and Offiong, 2010). Fortified cereals with legumes has been used as weaning diets Okafor *et al.*, (2008); Examples are nut-ogi (corn gruel-peanut), soya-ogi (corn gruel- soya bean), ogi- melon (corn gruel- melon seed) and cowpea-ogi (Okafor and Elemo, 2011).

In recent times, newly developed varieties of cowpea have been developed to meet the needs of farmers including IT90K- 391, IT90K-59-2, IT90K-277-2 and IT97K-568-18 among many others. A lot of work has been done on these new varieties to improve resistance to biotic stresses: insects (Aphids, Thrips), diseases (Viral mosaics and mottling), tolerance to abiotic stress: drought, low phosphorus and soil acidity, quality and acceptability of the seeds: size, colour and texture of seed coat and breeding for nutritional quality: - protein (21-28 %) (Timko and Singh, 2008; Abaidoo *et al*., 2010). This study hence determines some of the micro and macronutrients in two cowpea varieties.

2. Materials and methods

Two varieties of improved cowpea seeds IT90K-277-2 (white seed) and IT97K-568-18 (brown seed) were obtained from the International Institute for Tropical Agriculture (I.I.T.A), Ibadan

Production of cowpea flour

Cowpea seeds were sorted and manually cleaned to remove extraneous matters. The method of Odedeji *et al* (2011) was used to produce cowpea flour. The cowpea seeds were oven dried (Gallenhamp ov-440, England) at 80 ^{o}C for 24 h in order to reduce moisture content of the seeds and facilitate grinding. The dried seeds were ground using a laboratory grinding machine (Polymix Px-MFC 90D, Switzerland) and then sieved using 0.5mm aperture sieve to obtain fine flour. It was packaged in an air-tight low density polythene bag which was placed inside a plastic bucket with cover and stored at 4 ^{0} C until used.

Proximate composition of flours

Carbohydrate, protein, fat, crude fibre and moisture content were determined by methods of AOAC (2000). Determinates were done in duplicates

Determination of micro and macro nutrients in flours

Micronutrients; Iron, Zinc, Manganese and Copper and micronutrients; Sodium, Potassium, Calcium, Magnesium and Phosphorus were determined as described in AOAC methods (AOAC, 2000). Digested samples solution was determined using the Atomic Absorption Spectrophotometer (Perkin-Elmer model 2380, U.S.A). From the slope obtained and the absorbance value of the sample, Fe content in the flour sample solution was calculated using this formula ppm or mg/kg = Absorbance value x Slope or Gradient x Dilution factor. Determinations were done in duplicates.

*Statistical analysis***:** Analysis of variance was used to test the values and difference of means was tested using Duncan test using SPSS (2012) software.

3. Results and discussion

As shown in Table 1, the protein content of IT90k-277-2 seeds was 20.30 % while in IT97K-568-18 seeds, it was 20.72 %. The protein content in these improved seeds were comparable with other improved seeds such as IT87D-941-1(21.09 %), IT84E-124 (21.24 %) and IT00K-1207 (22.01%) (Olajide *et al.,* 1999). Certain local cowpea varieties had slightly higher protein content than improved seeds of "Ife Brown" (23.87%) and TVXL25 (21.38%) (Olajide *et al.*, 1999; Fasoyiro *et al.*, 2006). Generally improved cowpea seeds such as IT00K-1207, IT97K-499-8 and IT99K-7212-2-1 among many others showed higher protein content ranging from 21-26 % (Mamiro *et al.*, 2011).

The carbohydrate content of IT90K-277-2 seeds was 60.75% while in IT97K-568-18 seeds, it was 59.42%. The carbohydrate content in these seeds is comparable with carbohydrate reported for other cowpea varieties ranging from 61-64 % (Obatolu *et al.*, 2001). However, the carbohydrate content in local seeds such as "Ife Brown is about (55.93% (Fasoyiro *et al*., 2006). Crude fiber contents of IT90K-277-2 and IT97K-568-18 seeds were 2.65% and 2.90% respectively. The crude fibre contents are lower than the values reported for local seeds of "Ife Brown" (3.93%) and fibre content in legumes like lima bean, pigeon pea, groundnut and soybean which ranged from (3.03 to 5.07%). The higher crude fibre content of these legumes could be due to genetic makeup and growing environment (Eillita *et al.*, 2002).

The ash content of IT90K-277-2 and IT97K-568-18 seeds was 3.25 % and 3.49% respectively. The ash content in these improved cowpea seeds are comparable with other improved seeds: IT90K-102-6(3.20 %), IT97K818-35 (3.09 %), IT96D-733 (3.28 %) and IT97K-819-118 (3.40 %) (Olajide *et al.*, 1999; Mamiro *et al*., 2011). The ash content in local seeds were slightly higher in varieties such as: "Banjaram Jambo" (3.92 %) and "Dan Borno" (3.62 %) (Famata *et al*.,2013). In other geographical locations, the ash content in improved seeds was higher. IT93K-425-1(4.08%) and IT95K-499-35(4.46%) than "Kananado" (3.40%) (Owolabi *et al*., 2012).

The fat content of IT90K-277-2 and IT97K-568-18 seeds was 1.68 % and 1.88 % respectively. Other improved cowpea seeds had higher fat content in seeds such as IT84E-124 (2.86%), IT90K-102-6 (2.99%), IT93K-425-1(4.48%) and IT95K-499-35(4.45%) (Olajide *et al*., 1999; Owolabi *et., al* 2012). The variation in fat content in these improved cowpea seeds may be due to interaction between genetic makeup and different growth environment (Pugalenthi *et al*., 2005). The fat content in local seeds such as "Banjaram Jambo", "Kananado", "Ife Brown" and "Dan Borno" ranged from (1.05 to 3.80 %).

The moisture content in the two improved cowpea seeds IT90K-277-2 and IT97K-568-18 was 11.34 % and 11.58 % respectively. The moisture contents in these seeds are comparable with other improved seeds such as IT97K499-8 (11.20 %) and IT97K818-35 (11.59 %) (Mamiro *et al.,2011*). Local cowpea seeds such as "Banjaram Jambo" and "Kananado" had lower moisture content of 7.00 % and 6.00 % respectively (Famata *et al.*, 2013). However in other geographical region, there were no differences in moisture content in improved and local seeds of IAR-48 (8.60 %), IT93K-425-1 (7.83 %) and "Dan Borno" (9.10 %) (Owolabi *et al.*,2012).

Table 1. The proximate composition of raw improved varieties of cowpea Variety

Variety	% Protein	% CHO	% Fat	% C. Fibre	% Ash	% Moisture
IT90K-277-2	20.30±0.04	60.78±0.02	1.68±0.01	2.65±0.02	3.25±0.01	11.34±0.04
IT97K-568-18	20.72±0.03	59.42±0.04	1.88±0.03	2.90±0.04	3.49±0.01	11.52±0.04

The values with standard deviation are mean of duplicate values.

The micronutrient contents of the two improved cowpea seeds are shown in figure 1. Micronutrient results showed that cowpea variety seed with higher iron (Fe) content was IT97K-568-18 (20.58 mg/kg) than IT90K-277-2 (13.14 mg/kg). This is comparable with the iron result of other improved cowpea seeds such as IT93k-425-1 (26.50 mg/kg), IT95K-499-35 (23.30 mg/kg) and IAR-48 (5.40 mg/kg) as reported by (Owolabi *et al*., 2012). The authors explained the lower content of iron (Fe) in IAR-48 could be due to the effect of growing conditions of the soil as well as genetic characteristic of the seed. Local cowpea had lower iron contents. "KANNANADO" (10.40 mg/kg) and "DAN-BORNO" (4.80 mg/kg). However, iron in other grain legumes (pigeon pea, yam bean and lima bean) ranged from 30-40 mg/kg (Fasoyiro *et al*., 2006). This could be due to genetic variability in the seeds.

As shown in Figure 1, the zinc content of cowpea seeds of IT97K-568-18 was (25.20 mg/kg) while in seeds of IT90K-277-2; it was (23.02 mg/kg). This is comparable with the zinc (Zn) content of other improved varieties seed such as IT97K-499-38 (28.30 mg/kg) and IT97K-819-118 (26.10 mg/kg) (Mamiro *et al.*,2011). Local cowpea varieties had lower zinc such as "BANJARAM JAMBO" (8.80 mg/kg) and "KANNANADO" (5.72 mg/kg) (Famata *et al.*, 2012).

In Figure 1, manganese content in cowpea seeds of IT90K-277-2 was (17.10 mg/kg) while in seeds IT97K-568-18, it was (12.64 mg/kg). These improved cowpea seeds have manganese content comparable with other improved seeds such as IT95k-686-2, IT89KD-245 and IT89KD-288 in the range from 7mg/kg to 16 mg/kg (Singh *et al*.,2000). However, soybean has manganese content of 25 mg/kg while other cereal grains: rice, maize and sorghum has manganese content in the range from (6- 18mg/kg) (Mongol, 2014).

Copper content in cowpea seeds of IT90k-277-2 was (2.21mg/kg) while in seeds of IT97k-568-18, it was (3.00mg/kg). In sorghum, millet and groundnut copper had varying content ranging from 2.22-11.81mg/g (Jaryum *et al*., 2013). RDA of Cu for infant/children and adult range from 200- 700µg/ day and 800- 900µg/day respectively (Taylor *et al.*, 2 011).

The macro nutrient contents of the two improved varieties of cowpea seeds are figure 2. Macronutrient content showed that cowpea seeds with higher sodium content was IT90K-277-2 (23.70 mg kg^{-1}) while it was lower in cowpea seeds of IT97K-568-18 (5.73 mg kg^{-1}). This is comparable with sodium content of other improved seeds such as IT93K-425-1 (6.00 mg kg^{-1}), IT95K-499-35 (5.00 mg kg^{-1}) and IAR-48 (5.00 mg kg^{-1}) (Owolabi *et al.,* 2012). The higher content of sodium in IT90K-277-2 could be due to genetic characteristic of the seeds. Local cowpea seeds had lower sodium contents includimg"Kananado"(3.70 mg kg^{-1}) "Dan Borno"(3.90 mg kg^{-1}) and "Banjaram Jambo" (4.80 mg kg^{-1}) (Famata *et al.,* 2013).

Potassium content in cowpea seeds of IT97K-568-18 was 11600 mg kg^{-1} while in seeds of IT90K-277-2; it was 10900 mg kg^{-1}. There is higher variation in potassium content of other improved seeds such as IT93K-425-1(157 mg kg^{-1}), IT95K-499-35 (177 mg kg^{-1}) and IAR-48(163mg kg-^{1}). The lower potassium content in these other improved seeds may be due to interaction between genetic makeup and the growth environment (Pugalenthi *et al*., 2005). Local cowpea seeds had much lower potassium content in"Ife Brown" (1400 mg kg^{-1}) (Fasoyiro *et al*., 2006). "Banjaram Jambo" and "kananado" contained 600 mg kg^{-1} and 500 mg kg^{-1} respectively (Famata *et al.,* 2013).

As in figure 2, the calcium content in IT90K-277-2 seeds was 900 mg kg-^{1} while in IT97K-568-18 seeds; it was 700 mg kg^{-1}. These calcium content in these improved seeds were higher comparable with calcium content of other improved seeds such as IT97K-499-8 (684.8 mg kg^{-1}) and IT96D-773 (630 mg kg^{-1}) (Ramiro *et al.,* 2011). The difference in values of calcium in these improved seeds could be due to differences of locations of these seeds. Other improved seeds obtained from Northern Nigeria had lower calcium content. IT93K-452-1(325 mg kg^{-1}), IT95K-499-35 (368 mg kg^{-1}) and IAR-48 (150 mg kg^{-1}). Local seeds had lower calcium content compared with improved ones. "Dan Borno" (172 mg kg^{-1}) and "Kananado" (195 mg kg^{-1}) (Owolabi *et al*.,2012). However, in other grain legume e.g soybean the calcium content was 11194 mg kg^{-1} while in other cereal (maize, rice and sorghum) it ranged from 29-56 mg kg^{-1}

(Ongol, 2014). The higher calcium content in soybean could be due to its genetic peculiarity of this legume in being rich in micro and macro nutrient contents.

The magnesium content in IT90K-277-2 seed was 1400 mg kg^{-1} while in IT97K-568-18 seed; it was 1500 mg kg^{-1}. The magnesium content in these improved seeds are comparable with other improved cowpea seeds such as IT84S- 2246 (1500 mg kg^{-1}), IT93K-2045-29 (1700 mg kg^{-1}) and IT93K-452-1(1700 mg kg^{-1}) (Alphonsus *et al.*, 2012). Local cowpea seeds such as “Apagbaala” (1600 mg kg^{-1}) and “Botswana white”(1500 mg kg^{-1}) had magnesium content comparable with improved cowpea seeds hence the magnesium content in local and improved seeds showed little or no variation. However, in other geographical locations, magnesium content in improved cowpea seeds was higher than in local seeds. IT93K-425-1(185 mg kg^{-1}) and IT95K-499-35(140 mg kg^{-1}) while “Kananado” (87 mg kg^{-1}) and “Dan Borno” (90 mg kg^{-1}) (Owolabi *et al.*, 2012). The huge disparity in the magnesium content in improved and local seeds could be due to regional differences and the interaction of genetic makeup and the growth environment.

The phosphorus content of IT90K-277-2 seed was 3300 mg kg^{-1} while in IT97K-568-18 seed; it was 3400 mg kg-1. These values are comparable with other improved cowpea seeds such as IT90K-59 (3600 mg kg^{-1}) and IT93K-2045-29 (3800 mg kg^{-1}) (Alphonsus *et al.* ,2012). Local seeds such as “Botswana white” had a phosphorus content of 3900 mg kg^{-1} while “CH14” had a phosphorus content of 3800 mg kg^{-1}. The phosphorus content in both improved and local seeds showed no variation. However, in other geographical locations, the phosphorus content in local seeds such as “Kananado” (45 mg kg^{-1}) and “Banjara Jambo” (80 mg kg^{-1}). The difference in their phosphorus content could be due to different soil condition and genetic make-up of the seeds (Pugalenthi *et al.*, 2005).

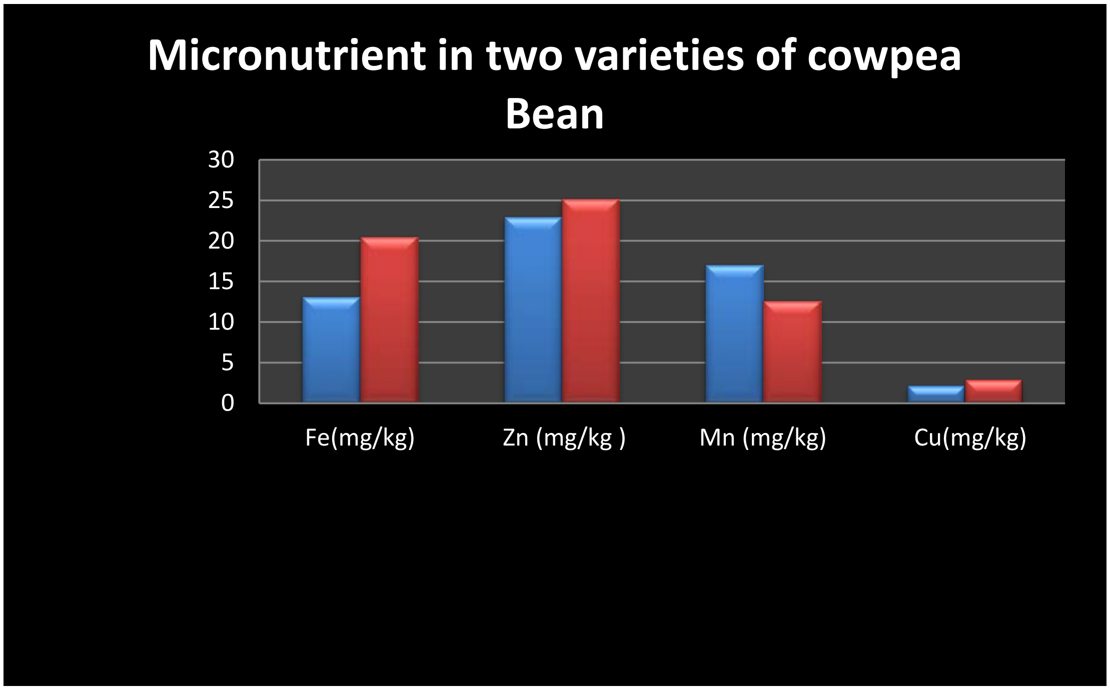

Figure 1. Bar chart of the micronutrient contents in the two raw improved varieties of cowpea.

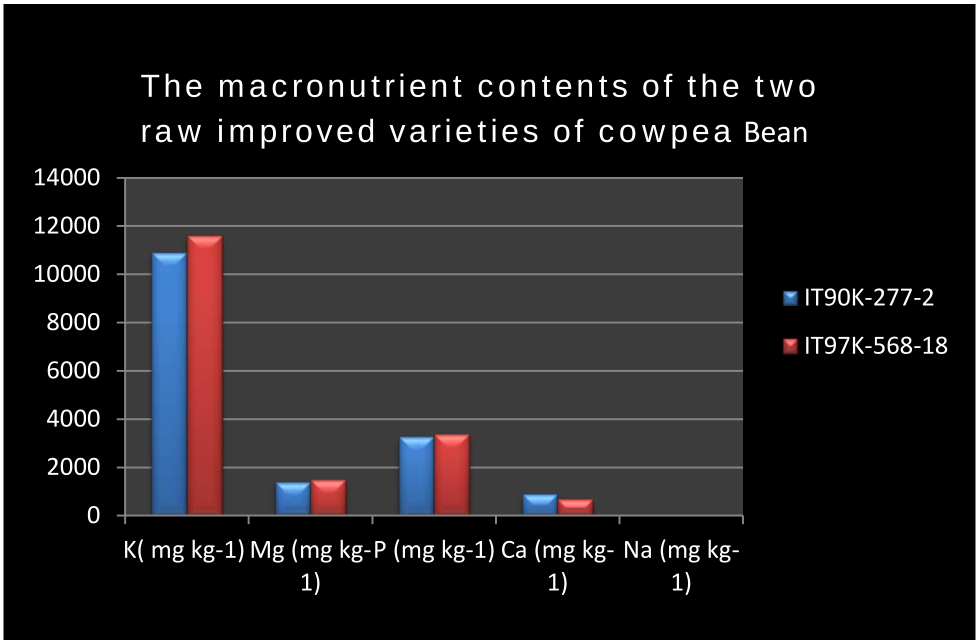

Figure 2. Bar chart of macronutrient contents in the two raw improved varieties of cowpea.

4. Conclusion

The two improved cowpea varieties are good sources of ash, dietary fibre and micronutrients. These varieties contain higher content of essential mineral elements (Calcium, Iron, Zinc, Manganese, Phosphorus and Potassium than local cowpea seeds. Thus they are nutritionally better. Its choice of consumption to local breed in the diet would reduce the occurrence of nutritional deficiency and its associated health problem in infant, children and pregnant women.

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