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Chemical Composition of Processed Cowpea Tender Leaves and Husks

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Abstract- The study examined the chemical composition of fresh, sundried tender leaves and husks of cowpea (*Vigna unguiculata*). The tender leaves and husks were parboiled and sundried. Proximate, micronutrient, phytochemical and antinutrient compositions were determined using standard procedures. Dried leaves had higher protein content than those of fresh leaves (FL) and dried husks (HU). Dried leaves (DL) and husks had lower fat content than the control (1.31 and 0.75 vs 9.10% ($p<0.05$). Sun drying increased the ash in both the DL and HU. Carbohydrate increased more the in HU than in the DL. The micronutrients in both DL and HU were reduced by sun drying. Tannins, saponins, flavonoids and polyphenols were decreased in the processed samples. Antinutrients were low. Haemaglutinin a food toxicant had slight increases. Cowpea leaves and husks have high nutrient potentials to justify the cultivation, processing, consumption and diversification.

Index Terms- Cowpea ,leaves, husks, composition , phytochemical

I. Introduction

The scarcity of documented information on the nutrient potentials of most of the foods consumed in Nigeria has precipitated ineffectiveness of nutrition education programmes to meet the nutrient needs of a vast segment of the Nigerian population. This led to wrong choices of foods, low nutrients intake and delay in embracing food diversification. The knowledge of effect of processing on chemical composition of foods is imperative for optimizing nutrient interaction during handling and processing of our local food materials (Ibok *et al*., 2008).

Nutrients in fruits and vegetables do more than preventing diseases such as beriberi or rickets. Certain vitamins or their precursors, such as ascorbate, beta-carotene as well as polyphenols are powerful antioxidants (Consumer Report on Health, 1998). Antioxidants prevent molecular damage and fend off many diseases and muscular degeneration (Islam *et al.*, 2002).

Cowpea is one of the most important tropical dual-purpose legumes. It is used as leafy vegetable, grain, as fresh cut-and-carry foliage and for hay and silage. Cowpea has much variability within the species. The species studied in this report is a local species with coiled pods called ***Adengee*** in Tiv, of Benue State, Nigeria. The fresh seeds are greenish and golden brown when dried. They are relatively small in size as compared with common black eyed pea. This crop is used at all stages of growth as a vegetable crop. The tender green leaves are an important food source in Tiv communities in Benue of State, Nigeria. The green leaves serve as an ingredient in egusi (melon) soup as spinach is used in egusi soup. The leaves are blanched and sun dried for preparation of egusi soups all year round. The immature pods are boiled and the seeds are eaten as vegetable. The husks are sun-dried and prepared as egusi soup. The objective of this study was to determine and compare the chemical composition of fresh and processed cowpea tender leaves and husks.

II. MATERIALS AND METHODS

Materials

Cowpea leaves and husks were collected from a local the family farm 40 days after planting.

Processing of material.

Processing of cowpea of leaves and husks. Fresh tender leaves (forty days old) of cowpea were plucked at 4-7cm from the tip of the plant into baskets for processing. The plucked tender leaves were sorted, washed, drained and then divided into two portions. One portion was packaged in polythene bag, labeled and stored in a refrigerator (10^oC) for analysis. The second portion was parboiled for five minutes, drained, sundried (36 ± 2^oC) for 5days, packaged in a polythene, labeled and stored prior to analysis. The fresh pods (two to three months old) were plucked from a local farm, sorted, washed in cold water, and then boiled for 30 minutes in an aluminum pot, drained and cooled. The seeds were separated from the husk manually. The husks were washed in cold water, sundried (36 ± 2^oC) for 5 days packaged, labeled and stored prior analysis.

Chemical analyses

Proximate (Protein, moisture, fat, fibre, ash and carbohydrate), some minerals, vitamins, phytochemicals, antioxidants and antinutrients of the fresh, parboiled, sundried leaves, and husks were determined in triplicates. Moisture was determined using the AOAC, (1990) procedure. Protein content were determined using Hach (1990) method. Fat was determined with petroleum ether (B.P 40-60 ^0C) using Tecator Soxtec apparatus as described by the AOAC, (1995) method. The ash and crude fibre contents were determined by the AOAC (1995) procedures. The carbohydrate content was obtained by difference (100-% protein, , fat, ash, crude fibre and moisture).

Mineral determination: Calcium (Ca), iodine (I), iron (Fe) and zinc (Zn) contents were determined using atomic absorption spectrophotometer after ashing of the samples (IITA,(2002).

Vitamins: The beta carotene (retinol) content of the samples was determined using spectrophotometric method based on UV inactivation as described by International Vitamin A

Consultative Group (IVACG, 1982).Vitamin C was determined using the procedure described by AOAC (2005).

Phytochemical composition: Flavonoids were determined by the method of Salchi *et al*, (1992). Saponins were determined as described by Sharva *et al*,(1964).

Anti nutrient composition: Oxalate was determined by titration method of Salchi *et al*, (1992).

Statistical analysis

The data from the triplicate determinations were analysed using analysis of variance (Steel and Torrie, 1980). Means where significantly different were separated by Least significant deference (LSD) test. Significance was accepted at P<0.05.

III. RESULTS AND DISCUSSION

Proximate composition of cowpea tender leaves and husks

Table 1 shows the proximate composition of processed tender leaves and husks of cowpea. The protein content of the leaves and husks varied from 13.95 to 39.24%.The dried leaves had significantly higher (P<0.05 protein content than those of the fresh leaves and husks. The higher protein (39.24%) content of the dried tender leaves was due to concentration effect. Ahenkora *et al.* (1998) reported 27.1 to 34.7% (dry weight basis) protein for cowpea grown in Ghana. Imungi and Potter (1983) using cowpea from Kenya grown for their leaves as vegetable obtained protein values that ranged from 32.8 to 34.3%. In addition, Mwandi *et al.* (2008) studied the nutrients and anti-nutrients content of raw and sundried sweet potato leaves and reported crude protein content that varied from 26.37 to 37.06% (dry weight baiss).The value obtained in this was comparable to those reported previously.

The fat content of the fresh leaves (9.00%) was higher (P<0.05) than that of the DL and HU. Vegetables generally have low fat content to maintain the cell wall integrity. Mamiro *et al.* (2011) reported improved varieties of cowpea leaves have high fat content ranging from 8 to 11.2% as compared to the local varieties (5.4%). Oguntona (1998) reported that, fat content for green leafy vegetables scarcely exceeds 1.0%.

The decreases in fat content due to drying might be associated with loss of some volatile compounds. Mamiro *et al.* (2011) reported that the improved varieties of cowpea leaves have high fat content ranging from 8 to 11.2% as compared that of to the local varieties (5.4%), however, Oguntona (1998) observed that, fat value for green leafy vegetables scarcely exceeds 1.0%.

The ash content of the leaves and husks varied, values ranged from 4.80 to 14.80 %. Ash value increased due to loss of moisture by sun drying in the dried leaves and husks samples relative to the fresh leaves (P<0.05). Parboiling with sundrying decreased fibre in dried leaves and the husks as against the fresh leaves (P<0.05). Fibre has beneficial effects on blood cholesterol. It aids prevention of bowel disease. In diabetics, fibre improves glucose tolerance (Ashaye, 2010). However, high crude fibre of some legumes inhibits absorption of some minerals, such as, calcium (Chikwendu, 2007).

Carbohydrate value was affected by treatments. The dried husks (53.99) had much higher value carbohydrate content than the fresh and dried leaves. The higher carbohydrate value (53.99%) for dried husks was due to its lower moisture, high fibre and low fat contents. This value agreed with Ohler *et al.* (1996) who reported 36 to 56% carbohydrate in some cowpea varieties with varying foliage age. High carbohydrate value for dried husks suggests that dried husks could supply more energy in diets than the leaves. Bubenhein *et al.*(1990) documented that, low fat, high complex carbohydrate and moderate protein are characteristics of edible portion that is suitable for vegetarian diet in a space-deployed bio-generative life support system. These qualities make cowpea a candidate crop for controlled ecological life support systems (CELSS) (Ahenkora et al., 1998; Bubenhein, *et al.*, 1990).

Table 1: Proximate composition of processed tender leaves and husks of cowpea (dry weight)

Sample	Protein(%)	Fat(%)	Ash(%)	Fibre(%)	Carbohydrate(%)
FL	21.98^{b}±0.01	9.00^{a} ±0.01	4.80^{c}±0.01	25.11^{a} ±0.01	39.11^{a} ±0.01
DL	39.24^{a}±0.02	1.31^{b} ±0.01	14.80^{a}±0.03	14.26^{c} ±0.04	30.39^{b}±0.04
HU	13.95^{c}±0.01	0.78^{c}±0.68	10.86^{b}±0.01	20.42^{a} ±0.03	53.9^{c}± 0.03

FL= fresh leaves, DL= Dried leaves, HU= Husks of cowpea .Means ± SEM of three determinations
Values at the same vertical column with different superscripts were significantly different (P<0.05).

Mineral composition of cowpea tender leaves and husks

The mineral and vitamin composition of processed tender leaves and husks of cowpea is shown in Table 2. Iron (Fe) value for fresh leaves was significantly (P<0.05) higher in fresh leaves relative to those based on dried samples. The values were fairly higher in fresh and dried leaves Fe (77.29 and 7.50mg) than the husks (0.94mg). The differences in Fe was significant (P<0.05). The higher (77.29mg)(Table 2) in fresh leaves was not a surprise. It is known that some micronutrients are much more available in fresh than in dry form (Udofia, 2005; Wachap, 2005). These workers observed that, many fresh fruits and vegetables from Akwa Ibom and Taraba States, Nigeria contain more Fe than dried samples. The lower Fe for husks (0.94mg) (Table 2) meant that cowpea husks are poor sources of Fe.

Zinc levels differed. The fresh leaves had 12.91mg which was significantly higher (P<0.05) than those of sundried leaves and husks (1.66 and 1.95mg, respectively).

The iodine values in both samples differed. The value for the fresh leaves was 519.47 µg, which was higher (P<0.05) relative to those for sundried leaves and husks. Parboiling and sundrying reduced iodine in both samples. Fresh samples had much more Ca (39.87), phosphorus (383.20), vitamin C, (59.24) and beta carotene (RE)(9.10RE/100g).The higher concentrations of Zinc, calcium, iodine, beta carotene (RE) and ascorbate in fresh cowpea leaves further buttressed the point that, fresh vegetables contain more micronutrients than their dried forms(Table 2). The fair levels of iron and ascorbate is desirable. This is because ascorbate could interact with iron to improve its absorption and utilization when the leaves are consumed as component of a diet (Achinekwu, 1998). Iron is important for its antioxidant effect, production of red blood cell, oxygen transportation and the functioning of many enzymes. Nnam and Onyeke (2003) worked on red and yellow sorrel and observed that ascorbate is a very powerful antioxidant and very good iron enhancer.

The decrease in all the micronutrients in drid leaves and husks of cowpea (Table 2) were contrary to results of Asante, Adu-dapaah and Acheampong (2010). They observed that, fresh cowpea leaves had 265mg calcium and 65mg phosphorus, respectively. Calcium and phosphorus are required for building healthy bones. The Ca/ P ratio is essential for calcium fixation in human body. This makes these vegetables essential for children, pregnant women and the elderly.

The slight β -carotene decreases in leaves and husks after parboiling and sundrying (9.10RE to 0.25 and 0.03RE) might be due to evaporation of volatile compounds. Mosha *et al.* (1996) observed a similar fact that traditional sundrying of cowpea leaves led to severe losses of pro vitamin A. Ohler *et al.* (1996) reported that, raw leaves are high in carotene and folacin. About 80% of these vitamins might be lost during cooking.

The appreciable levels of zinc and iodine in cowpea leaves and husks are very important in human nutrition (Table 2). FAO (1997) reported that, iodine in plant foods depends on its level in food and its availability in the soil. Zinc is vital in the enzyme system, formation of bone tissues, healing of wounds and sores as well as production of proteins. It protects the skin and improves resistance to infections.

Table 2: Mcronutrient composition of processed tender leaves and husks of cowpea per 100g (dry weight)

Sample	Iron(mg)	Zinc(mg)	Calcium (mg)	Iodine(µg)	Phosphorus (mg)	β-carotene (RE)	Vitamin C(mg)
FL	77.29^{a}±0.01	12.91^{a}±0.04	39.87^{a}±0.01	519.47^{a}±0.01	383.20^{a}±0.03	9.10^{a} ±0.01	59.24^{a}±0.01
DL	7.50^{b}±0.00	1.66^{b}±0.01	1.40^{b}±0.01	136.35^{b}±0.01	135.60^{b}±0.01	0.25^{b}±0.00	1.39^{b}±0.01
HU	0.94^{c}±0.01	1.95^{c}±0.01	0.25^{c}±0.00	90.34^{c}±0.01	97.39^{c}±0.05	0.03^{c}±0.00	0.59^{c} ±0.01

FL= fresh leaves, DL= Dried leaves, HU= Husks of cowpea. Means ± SEM of three determinations
Values at the same vertical column with different superscripts were significantly different ($P<0.05$).

Phytochemical content of cowpea tender leaves and husks

The higher levels of tannins, saponins and polyphenols have some health implications (Table 3). Formally, these phytochemicals were known as antinutrients. They inhibit absorption and bioavailability of nutrients. For example, phytate reacts with metals to form insoluble phytate-metal complexes (Nnam and Onyeke, 2003). Recent information depicts that tannins and saponnins have the capability to lower serum cholesterol and fight cancers in low concentrations in the body (Whitney and Rolfes, 2005). Drying reduced flavonoids in fresh leaves from 26.72 to 3.77% more than five times the original value (26.72%) (Table 3). Fresh leaves had significantly high flavonoids than dried leaves and husks (26.72 vs. 3.77 and 1.13%, each).The decrease in flavonoids in dried leaves and husks was probably due to heat. Processing may decrease or completely remove flavonoids. They are heat stable but may leach into cooking water (Grodner and Anderson, 2005). Fresh leaves had higher polyphenol (32.56mg) relative to those of sundried leaves and husks (32.56 vs. 9.55 and 9.05mg, each) The appreciable levels of polyphenols (9.05 to 32.56mg/100g) and tannins (2.75 to 4.12mg) showed that this vegetable has non-nutritive substances (phytochemicals) that might have disease fighting properties.

Table 3: Phytochemical composition of processed tender leaves and husks of cowpea per 100g*

Sample	Tannins (mg)	Saponins (mg)	Flavonoids (%)	Polyphenols (mg)
FL	4.12^{a}	0.23^{a}	26.72^{a}	32.56^{a}
DL	2.75^{c}	0.06^{c}	3.77^{b}	9.55^{b}
HU	3.05^{b}	0.14^{b}	1.13^{c}	9.05^{c}

FL= fresh leaves, DL= Dried leaves, HU= Cowpea Husks. Means ± SD of three determinations
Values in the same vertical column with different superscripts were significantly different ($P<0.05$).

Antinutrient and food toxicant content of cowpea tender leaves and husks

Parboiling and sundrying increased haemaglutinin in both leaves and husks .Value for dried leaves much higher than those of fresh leaves and dried husks (5.91 vs.4.86 and 4.99Hu/mg). There was a significant difference among samples($P<0.05$).The higher levels of haemaglutinin in dried leaves and husks (Table 4) strongly suggests that fresh leaves could be better consumed to avoid high consumption of this food toxicant higher in dried leaves and husks. Sundrying caused decreases in oxalate in leaves and husks (4.59 to 1.42 and 1.58mg). The decrease was much more in leaves as against husk (1.42 vs. 1.58mg). Phytate was decreased in dried leaves and husks from 5.99 to 2.90 and 4.04mg. The decrease was much more in dried leaves (2.90mg).

Fresh leaves had the highest value (5.99mg). Drying caused 3.09mg decrease in dried leaves (5.99-2.90mg).There was a significant difference in all samples (P<0.05). However, the levels of phytate, oxalate and haemaglutinin were within safety levels. The zinc: phytate ratio was between 4.95 in fresh leaves and 8.8 for dried leaves and 8.27 for dried husks, respectively. Wucher and Brown (2000) reported that the zinc phytate ratio of <5 produces good zinc bio-availability. However, values between 5-15 produces moderate zinc bioavailability and values above 15 precipitates poor zinc bioavailability in the body.

Table 4: Anti nutrient composition of processed tender leaves and husks of cowpea per 100g

Sample	Phytate (mg)	Oxalate (%)	Heamaglutinin (Hu/g)
FL	5.99^{a} ±0.01	4.59^{a}±0.00	4.86^{c} ±0.01
DL	2.90^{c} ±0.01	1.42^{c} 0.01	5.91^{a} ±0.01
HU	$4.04^{\mathbf{b}}$ ±0.01	1.58^{b} 0.01	4.99^{b} ±0.01

FL= fresh leaves, DL= Dried leaves, HU= Husks of cowpea. Means ± SD of three determinations

Values at the same vertical column with different superscripts were significantly different (P<0.05).

As judged by the results, the vegetative parts of cowpea (leaves and husks) have promising nutritional attributes. Comparisons with other leafy vegetables (sweet potato edible leaves) indicate good potential for processing to increase dry matter. The low levels of antinutrients and food toxicant contents are of nutritional importance. This is because the presence of antinutrients reduce bioavailability of nutrients. The consumption of these vegetative parts of cowpea (leaves and husks) may serve as good sources of nutrients for vegetarians, school children, pregnant women and adults.

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