The Proximate Composition of Flour Made from Soybean, COWPEA, CFO 289 Cassava, Yellow Cassava and CFC00414 CASSAVA

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Abstract: ***The aim and objective of this research was to analyze the proximate content of Soybean (Glycine max), Cowpea (Vigna Unguiculata), CFO 289, Yellow cassava and CFO 0414 in other to explore its nutritional values and storage condition for local food processors in Liberia. Crops analyzed were Soybean (Glycine max) flour, Cowpea flour, and cassava flour of three improved varieties: CFO 289 cassava, Yellow Cassava and CF0414 cassava where obtained from Central Agricultural Research Institute (CARI), Liberia and outreach farmers in person of Joseph KF Jorkeah Bong County. While soya beans and cowpeas products were purchased from the local markets. Standard procedures of Animal nutrition Laboratory Njala University were followed to analyze the proximate compositions of Soybean (Glycine max), Cowpea, CFO 289, Yellow cassava and CFO 0414. The carbohydrate content was calculated from moisture content, ash, crude fat, crude fibre, and crude protein. The analysis indicated that Soybean (Glycine max) have higher protein content (33.49%) then Cowpea (19.92%) and the three cassava varieties presented low protein content with non-different statistical CFO 289 (3.28%), Yellow cassava (2.85%) and CFO 0414 (2.75%). The result revealed fat content for Soybean (Glycine max) 15.23%, Cowpea 2.48%, CFO 289 0.40%, Yellow Cassava 0.60% and CFO 0414 0.57%, the fat content of Soybean (Glycine max) was seven time greater than Cowpea and twenty-five times higher than each of the three cassava flour varieties used. Also the fiber content shows no much variation between Cowpea (Vigna unguiculata) 3.67%, CFO 289 3.93%, CF0414 3.23%, but Soybean (Glycine max) 7.93% and Yellow Cassava 4.53% fiber. The result revealed the flour moisture content within range for storage as 14% moisture content is consider the maximum for flour storage.***

Keywords: proximate composition, Soybean (Glycine max), Cowpea, Cassava, flour

1. Introduction

Cereal and tuber crops(Rice & Cassava) constitute one of the most important staple food commodities in Liberia. The major cereal and tuber includes rice, maize, Soybean (Glycine max) (*Glycine max* L.), cassava, yam, and cocoyam. The tubers are usually high in moisture content which affects storage under ambient conditions. According to Akama (2013) harvested fleshy portion of cassava tuber contain 62% moisture, 35% starch, 1% protein, 0.3% fat, 2% fiber and 1%. Cassava the most important root crop and staple food for over 500 million people in the development world (Falade, 2010) and it flour has become essential substitute in local food processing section, therefore need for improved technology dissemination amongst various agricultural stakeholders is vital in the cassava value added chain process in Liberia. The demand for high quality cassava flour is at increase as there is a wide acceptance among consumers and means of replacing part of wheat flour in bakery products (Eriksson E, 2013). High quality cassava flour may offer export opportunities and market to local farmers therefore for local improved variety to compete in the international market the nutritional component need to be analyzed and chartered. Basically high quality cassava flour came into being by International Institute for Tropical Agriculture (IITA) in Ibadan, Nigeria as an another means of reducing importation of wheat flour for local food industry (Falade K, et al;, 2008) and also it was introduced to CARI in 2006-2007 by International Institute for Tropical Agriculture (IITA).

Many infants in developing countries like Liberia suffer from malnutrition during transitional phase of wearing and growth, this is because of lack of or poor protein diet, this really result of ignorance and exorbitant cost of animal source of protein thereby making it out of reach of the low class and average man (Patrick, 1998). Brest feeding in Africa normally last for three to four month, after it is necessary to introduce other soft and swallow food alongside breast milk as breast milk alone cannot meet the infants nutrition requirement (Oniofiok and Nnanyelogo, 1992), therefore Soybean (Glycine max) and Cowpea (Vigna unguiculata) flour can serve as major ingredient and easy source of obtaining access to protein energy food source in infants food preparation.

Soybean (Glycine max) is recognized as an oil seed containing several useful nutrients including protein, carbohydrate, vitamins, and minerals. Soybean (Glycine max) is a very good source of dietary protein and least expensive (Derbyshire, 1976). Soybean (Glycine max) protein can be a very good substituent for animal protein as in nutritional profile is almost similar to that of animal protein since Soybean (Glycine max) protein contain most of the essential amino acids required for animal and human nutrition (Sacks FM, 2006). There is an increasing consumer interest in achieving better health through diet. This attention is increasing consumer demand for soy-based foods and food ingredients.

Cowpea (Vigna unguiculata) is an important source of plant protein and the cheapest source of protein compare to meat and the most commonly food grain legume (Ilesanmi, J.O.Y et al. 2016) and one of the most common legume consumed in West Africa (Ishiwu, 2004). Cowpea is eaten in various forms either alone or in combination with cereal grains like rice and maize, tuber such as cassava yam. Cowpea is also process into paste for preparation of various traditional foods such as moimoi, and "Akara". It can also combine with Soybean (Glycine max) in various proportions during preparation of food. Basically cowpea is wildly know as food in Nigeria than any other West Africa nations and Nigeria is one of the world largest producer (Henshaw F. O., 2008) where most of it production is used domestically.

Flour from various plant products such as wheat, Sorghum, Maize, cassava, Soybean (Glycine max), cowpea, etc., has become the biggest source for food processing industries, both locally and internationally. Of all wheat, Sorghum, and maize flour are top most imported flour to Liberia. Therefore, research institutions have modify several ways of reducing the cost of importation by introducing composite flour from the common available crop plant widely used in the local communities such as Soybean (Glycine max), cowpea and cassava. Hence the present study was aims to characterize the proximate composition of improved varieties of Soybean (Glycine max), Cowpea and three varieties of cassava, with a view to provide baseline information towards their end use quality.

2. Material and Methodology

Proximate analyses were conducted at the Animal Nutrition Laboratory Department of Animal Science, Njala University Sierra Leone.

Plant material and sample preparation: Soybean (Glycine max), Cowpea seed and three improved cassava varieties CFO 289, Yellow Cassava and CF0414 where obtained from Central Agricultural Research Institute (CARI), Liberia, all were grained in to flour and the flour were sent to Njala University Sierra Leone for proximate analysis.

Sample analysis: Moisture, Ash, Crude Protein, Crude Fat and Crude Fibre were determined by Animal nutrition Laboratory standard methods Njala University.

Moisture content was determined as described by AOAC 18th edition, (2005) with modification: The aluminum cups was heated with the lid open in Air Hot Oven at 105^0 C for 1 h, after remove and store in an airtight desiccator to cool to room temperature between 5 – 10 minutes. The cups were weighed and recorded as empty weight of cups. 2g of the powder sample was placed in the aluminum cups and weigh. The weight was recorded as weight of cup plus sample before drying. The samples were transfer to an oven maintaining a temperature of 105^0 C for 2 h. After the 2 h, it was removed and transferred in to desiccator and allowed to cool down to a room temperature for 5 – 10 minutes. The weigh were observed and recorded. This process was repeated till constant weights were maintained (Gupta, *et al.*, 2013). Percentage Moisture contented were calculated as

$$\%\,Moisture\ Content = \frac{(\text{Wt. of cup with sample b4 placeing in oven } - \text{wt. of cup with sample after final drying})}{(\text{Wt. of cup with sample b4 placeing in oven } - \text{wt. of empty cup dry})} \times 100$$

Determination of Crude fat as described by AOAC 18th edition, (2005), revision 4 with modification: Apparatus: Soxhlet's apparatus, thimble with cotton swab, hot air oven, fat extraction unit, balance and weight box, and desiccator.

Procedure: 4g of moisture free sample were weigh in to a weighed extraction thimble (completely dried) having porosity permitting rapid passage of ether. The thimble with sample were placed to a Soxhlet's apparatus in a straight direction so that the condensed ether may drop on it (layer of defatted cotton wool was placed on top of the sample in the thimble to avoid floating). 50 ml of petroleum ether was added in to the extraction cups each (before adding petroleum ether, the cups were dried and weigh and the weight were recorded). The samples were reflux for 20 minutes at a temperature of 90^0C and 15 minutes extra to recover the extract after reflux. The extraction cups were removed and evaporate contents to dryness using hot air oven at a temperature of 105 ^{0}C for 10 to 15 minutes. The cups were cool in desiccator and weigh(Gupta, et al.,2013). Crude fat were Calculated as;

$$\%\,Crude\ Fat = \frac{mass\ of\ fat\ extracted\ in\ to\ cup\ (g)}{dry\ weight\ (g) of\ test\ sample} \times 100$$

Determination of crude fibre as described by AOAC 18th edition, (2005), revision 4. Apparatus: spout less beaker (1 litre), round bottom condenser, measuring cylinder, crucible, muslin cloth, vacuum pump, hot plate, funnel, wash bottle, hot air oven and muffle furnace.

Procedure: 2g of moisture and fat free sample (the residue of crude fat) were weigh and transferred in to the spout less one litre beaker. 200 ml of 1.25% sulphuric acid was added and placed on hot plate and allow refluxing for 30 munities, during the refluxing the beakers were shake after every 5 minute. After the 30 munities, it was remove and filter through a muslin cloth using suction pump. The residues were wash with hot water till it was free from acid and later transfer to the same beaker and 200 ml of 1.25% Sodium hydroxide (NaOH) solution was added again. Second relaxation takes place for 30 minutes. After the 30 munities, it was removed and filter through a muslin cloth and then, the residue was washed with hot water till it was free from alkali, but it was first washed with dilute Hydrochloride (HCl) before washing with hot water to facilitates the removal of alkali. The total residue was transferred to a crucible of know weight and it was placed in hot air oven, allow to dry to a constant weight at $80^0 - 105^0$ C and the weight was recorded. The dried crucible with residue was ignited in muffle furnace at $550^0 - 600^0$ C for 2 – 3 h, cool and weigh again. The loss of weight due to ignition was calculated as the percentage of the crude fibre as follows(Gupta, et al.,2013):

$$\%\ Crude\ Fibre = \frac{Wt.of crude fibre}{Original Wt.of sample} \times 100$$

Determination of crude proteinas described by AOAC 18th edition, (2005), revision 4. Apparatus: scale for weighing, Micro kjeldahl digestion unit for flask capacity of 100ml with water suction pump attachment to remove fumes, Micro kjeldahl digestion unit for flask capacity of 100ml, Micro kjeldahl distillation unit, burette 25ml, Erlenmeyer flask (150ml).

Steps: 2g of sample maximum in kjeldahl flask, 2 tab of digestion mixture in to the flask, 0.1 g of bumping stone in to the flask, 12 ml to 15 ml of Sulphuric acid (H_2SO_4) in to the flask, it was boiled using the digester for 45min/till the solution become clear blue or green. It was later removed and cool to room temperature for 15 – 20 minutes and 75 ml of distil water was added in to the same flask. In a round bottom flask **25ml** of boric acid plus 2 to 3 drops of methyl red, the round bottom flask was placed under the condenser with tip of condenser dipping into solution on the Right-Hand Side (RHS) and the kjeldahl flask on the Left-Hand Side (LHS) with the tip of condenser dipping into solution. On the side of the Kjeldahl Distillation Unit, was placed a 100ml cylinder, filled it with Sodium hydroxide (NaOH) solution and the Alkali tube was dip in to the cylinder till it reached the bottom. The Kjeldahl Distillation Unit was ON, solution was boiled continuously to release the ammonia. The distillate was collected in the Erlenmeyer flask containing boric acid and the ammonia-borax complex to 25ml in a volumetric flask. 10ml was pipetted 10ml it to 50ml beaker for titration. Titration was done to end point using 0.02 M hydrochloric acid and colour change was noted. End point was recorded(Gupta, et al.,2013). Crude protein was calculated as follow:

$$\%N = \frac{(Titration\ value - Blank) \times Normality \times 14.007 \times 100}{sample\ weight\ used\ mg}$$

% Crude protein = % N x 6.25

Calculation of Carbohydrate: Total percentage of Carbohydrate was calculated method as describe by Onwuka, G. I. (2005). This method involved adding the total values of crude protein, crude fat, crude fibre, moisture and ash constituents of the sample and subtracting it from 100. The value obtained was the percentage carbohydrate constituent of the sample.

Percentage Carbohydrate = 100 – (%Ash+%Moisture content+%fat+%fibre+%protein)

Determination of total Ash as described by AOAC 18th edition, (2005)**.** An empty crucible was dry in a hot air oven for 30 minutes, cool and weigh and the weight was recorded. Approximated 2g of flour sample was measured into the crucible and transferred into the muffle furnace at $550^0 - 600^0$ for 2 to 3h. The sample was ignited and after ignition it was cool and weigh, the loss of weight due to ignition was recorded. Percentage Ash was calculated as follow: (Gupta, et al., 2013)

$$\%\ Ash = \frac{(weight\ of\ crusible\ with\ ignited\ ash - weight\ of\ empty\ crusible\ dried)}{(weight\ crusible\ with\ sample\ before\ ignition - weight\ of\ empty\ crusible)} \times 100$$

Data obtained from the study were analyzed using Microsoft Excel 2013 spread sheet.

3. Result and Description

Table 1

Sample ID	%MC	% Ash	%Fat	% crude Fibre	% Protein	% Carbohydrate
Soybean (Glycine max)	10.21	3.31	15.23	7.93	33.49	29.83
Cowpea (Vigna unguiculata)	9.08	3.40	2.48	3.67	19.92	61.46
CFO 289	12.04	2.92	0.40	3.93	3.28	77.43
Yellow Cassava	13.24	2.44	0.60	4.53	2.85	76.34
CFO 0414	12.23	2.78	0.57	3.23	2.74	78.44

Table 1: Proximate analysis of Soybean (Glycine max), Cowpea (Vigna unguiculata), CFO 289, Yellow cassava and CFO 0414

From the table the result for moisture content, ash, fat, fibre, protein and carbohydrate ranges from 9.08 to13.24%, 2.44 to 3.40%, 0.40 to 0.40 to 15.23%, 3.23 to 7.93%, 2.74 to 33.49% and 61.46 to 78.44% respectively. The moisture content estimates directly the water content and indirectly the dry matter of the samples. Generally, Yellow Cassava presented the highest moisture content (13.24%) and the list obtained from Cowpea (Vigna unguiculata) (9.08%).

According to Hayma J. (2003), flour that contain moisture content below 14% may have better stability of storage and resist to microbial growth.

Furthermore, Soybean (Glycine max) presented high amount of Fat content (15.23%) than Cowpea (Vigna unguiculata), CFO 289, Yellow Cassava and CFO 0414, with CFO 289 having the lowest Fat content of 0.40%. From table 1, ash content varies, with Cowpea (Vigna unguiculata) obtaining the highest 3.40%, second to Soybean (Glycine max) (3.31) and CFO 289, CFO 0414 and Yellow Cassava having 2.92%, 2.78% and 2.44% respectively. The variation of ash content may be due to different area of cultivation.

From the table the result for protein content ranging from 2.74% to 33.49%, with Soybean (Glycine max) taking more than half (33.49%), second highest value obtained by Cowpea (Vigna unguiculata) (19.92%) and the list obtained by CFO 0414 (2.74%).

Generally, carbohydrate which is a cereal crop of highest base component was calculated, the result show consistence for Yellow Cassava, CFO289 and CFO 0414 with carbohydrate content of 78.34%, 77.43% and 78.44% respectively. Cowpea (Vigna unguiculata) obtained 61.46% and the Soybean (Glycine max) obtained the list of 29.83%.

4. Conclusion

The study has established a proximate nutrient of Soybean (Glycine max), Cowpea, CFO 289, Yellow cassava and CFO 0414. The result in this study indicated that the commercial flour moisture content is very much adequate for storage as flour moisture content recommended for storage estimated to be below 14% according to (Hayma J. 2003). This study clearly pointed out the protein content of Soybean (Glycine max)s and Cowpea which can be incorporated with flour that have low nutritional composition like protein content example Cassava flour in order to increase the nutritional content.

References

[1] AOAC 18th edition, (2005), Revision 4. Methods 925.04 (Moisture content), Methods 942.05 (estimation of ash content), Methods 2003.05, 920.39, 954.02, 932.02 (estimation of crude fat content), Methods 960.52 (estimation of crude protein content), Methods 978.10 (estimation of crude fibre content).(2011).

[2] Akama F. O. Physiochemical Properties of dried cassava flour from balls and chunks. International journal of scientific and technology research vol.2. ISSN 2277-8616. Pp 8.(2013).

[3] Derbyshire, E, Wright DJ, Boulter D. Review: Legumin and vicilin, storage proteins of legume seeds. Phytochemistry 1976:15:3.

[4] Eriksson E. Flour from three local varieties of cssava (*ManihotEsculentaCrantz*) physico-chemical properties, bread making quality and sensory evaluation. Faculty of natural resources and agricultural sciences, Swedish University of Agriculture Sciences. Available online at: http://stud.epsilon.slu.se. (2013).

[5] Falade K., Akingbala J. Improved Nutrition and National Development Through the Utilization of Cassava in Baked Foods. Chapter 10 from Using Food Science and Technology to Improve Nutrition and Promote National Development, Robertson, G.L. & Lupien, J.R. (Eds), International Union of Food Science & Technology. (2008).

[6] Falade K., Akingbala J. Utilization of Cassava for Food, Food Reviews International, 27:1, 51-83. (2010):

[7] Gupta, P. C., Khatta, V. K., and Mandal, A. B. (2013). Analytical techniques in Animal Nutrition.Second Edition. 100pp.

[8] Hayma J. The storage of tropical agricultural products. Agromisa Foundation: Wageningen, Netherlands; p 84.(2003).

[9] Henshaw F. O. Varietal Differences in Physical Characteristics and Proximate Composition of Cowpea (*Vigna unguiculata*). World Journal of Agricultural Sciences 4(3): 302-306. ISSN 1817-3047. p5.2008.

[10] Ilesanmi, J.O.Y, and Gungula, D.T. Proximate composition of Cowpea (Vignaunguiculate (L.) Walp) Grains preserved with mixtures of Neem (*AzadirachtaindicaA*.Juss) and Moringa (*Moringaoleifera*) seed oils. Africa Journal of food Science and Technology. ISSN: 2141-5455. Vol. 7(5)pp. 118-124.2016.

[11] Ishiwu, C.N. Effect of Sprouting on Available Lysine content of cowpea (Vigna unguiculata) flour and the Performance of the flour used "Moin-Moin "Production. Nigerian Food Journal 24:7-11.2004

[12] Onofioka, N.O and Nnanyelugo O. Weaning foods in West Africa Nutritional problems and possible solution. J. Food 191:1-13.1992.

[13] Onwuka, G. I. Food Analysis and Instrumentation. Naphtali Print, Surulere, Lagos. Nigeria.P. 93-140.2005.

[14] Patrick, N.O. Cereal grains. Nutritional Quality of Plant Foods 1:32-52.1998

[15] Sacks FM, Lichtenstein A, Van Horn L, Harris W, Kris-Etherton P and Winston M. "Soy Protein, Isoflavones, and Cardiovascular Health. An American Heart Association Science Advisory for Professionals from the Nutrition Committee". Circulation. 2006.