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Comparative Studies on Functional Properties of Whole and Dehulled Cowpea Seed Flour (*Vigna unguiculata*)

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Abstract: This study was conducted to investigate the functional properties and production of flour from cowpea (*Vigna unguiculata*). Flour samples were produces from dehulled and whole cowpea seeds. Matured cowpea seeds purchased at 'obada' market in Iree, Osun State, Nigerian were carefully cleaned, sorted, graded, soaked, drained, sundries and milled into flour. The flour samples were thereafter subjected to functional prosperities determination the result of functional properties revealed higher value in bulk density for whole cowpea flour (1.35 g/cm^3) and lower value (1.08 g/cm^3) in dehulled flour, water, fact absorptions capacities viscosity of whole cowpea flour were 4.37 gg^{-1}, 2.74 gg^{-1}, 85 compared to dehulled flour recorded 2.56 gg^{-1}, 1.76 gg^{-1} and 70 Ns/m^2 respectively, the emulsion and foaming capacities of whole and dehulled cowpea flour were 23.20%, 57% and 25.10%, 35% respectively. The swelling power, water and oil retention, gelation capacity were 39.75%, 0.85 mg/g, 3.87% for whole cowpea flour. Flour produced from whole cowpea to dehulled cowpea flour.

Key words: Cowpea, food processing, fat absorption

INTRODUCTION

Cowpea (*Vigna unguiculata*) is a common name for large seeds of the general febaceae (formerly leguminosae). Dry beans are widely consumed in most Latin American, Asian and African countries and for economic reasons are important sources of proteins and calories for those countries (Sanni *et al*., 2006; Rayus-Daurte *et al*., 1998). Cowpea is of considerable importance in Nigeria and in many Africa countries as a nutritious leguminous crop providing an alternative source to animal protein (Dovlo *et al*., 1976). The consumption of beans is however curtailed because of the long cooking time needed to achieve the desired palatability and digestibility (Sefa-Debeh *et al*., 1978; Tian and Phillips, 1991).

Cowpea has found utilization in various ways in traditional and modern food processing in the world. The dried from, sprouted or group into flour, an intermediate product etc. Being in the class of legume they are often referred to as poor man's meat, owing to their use as primary protein sources. They represent one of the dietary staples in many parts of the world. It is most widely grown legume in Nigeria (Mohammed *et al*., 1979) and is one of the cheapest source of plant protein widely used in the Nigerian diet (Elegbede, 1998).

Processing of cowpea sometimes involves the removal of testa (hull), which represents about 6% of the weight of the whole cowpea. However, cooking of cowpea does not involve the removal of testa as it is cooked together to from porridge and consumed as food without any attendant problem except flatulence that some people complained of. The presence of tannin and trypsin inhibitor has limited the utilization of cowpea testa. These compounds are however reduced drastically during processing of the seeds.

Cowpea testa has been shown to be rich in mineral elements (Akpapunam and Daribe, 1994). Thus, the inclusion of cowpea testa in cowpea products will serve as a form of food enrichment. Studies have shown the improvement in flour quality when supplemented with legumes. Other workers have also reported improvements protein content of several cereal food supplemented with legumes such as bambara ground nut, sesame seed and fluted pumpkin seeds (Giami and Barba, 2003; Akpapunam and Daribe, 1994; Alobo, 2001).

Cowpea flour is an intermediate product from cowpea processing which can be used for the production of beans cake, traditional soup gbegiri cowpea pudding, cowpea pie etc. This serve as a means of preservation and utilization of the procedure. The flour is less prone to insect and pest attack and can be stored for relatively longer period of time. Cowpea flour production involves cowpea grain cleaning sorting and grading soaking in water to remove the hull, draining, drying, milling, into flour and packaging.

This research work is on the comparative studies on functional prosperities of whole and dehulled cowpea seed were flour produced from cowpea seed were subjected to functional properties determined methods. Flour have their prosperities that enhance their wide utilization which includes water and oil abstraction capacity, gelation, foaming capacity, emulsion capacity etc. (Adeyeye *et al*., 1994; Abbey and Ibeh, 1998).

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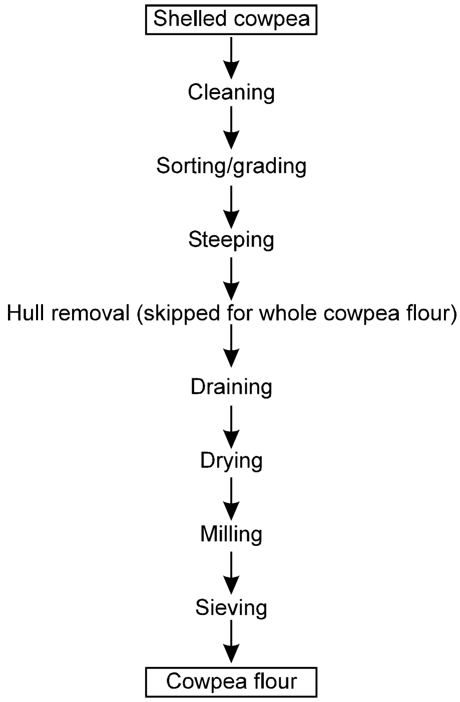

Fig. 1: Flow chart for flour production from cowpea

MATERIALS AND METHODS

The materials used in this research work include cowpea (*Vigna unguiculata*) purchased at “obada” market in iree Osun State, Nigeria. Equipment used include, attrition mill, magnetic stirrer, vertex mixer, centrifuge, water bath, mechanical shaker, dedicator, crucibles and weighing balance all reagents used were of food grade.

Production of cowpea flour: Matured cowpea seed purchased from ‘obama’ market, Iree. Osun State Nigeria were carefully cleaned, shorted to remove defective ones from the lot and graded according to size. The cleaned seed were soaked in water to soften the hull to ease its removal in the production of dehulled flour. This was however skipped for production of flour from whole cowpea. The hull were removed by repeated working between the palms and were fettered always leaving behind dehulled seeds. The seeds were there after darning and dried to reduce moisture content and to facilitate grinding into flour. The dried seeds were milled and sieved with mess sieve to obtain fine powder. This was packaged inside an air fight container for further analytical work.

Functional prosperities determination

Bulk density: Fifty gram flour sample was put into a 100 ml measuring cylinders, the cylinder was tapped several times on a laboratory bench to a constant volume. The volume of sample is recorded:

$$\text{Bulk density (g/cm}^3\text{)} = \frac{\text{Weight of sample}}{\text{Volume of sample often tapping}}$$

Water absorption capacity: 15 ml of distilled water was added to 1 g of the flour in a weighed 25 ml centrifuge tube the tube was agitated on a vortex mixer for 2 min. It was centrifuged at 40 pm for 20 min. The clear supernatant was decanted and discarded. The adhering drops of water was removed and then reweighed. Water absorption capacity is expressed as the weight of water bund by 100 g dried flour.

Fat absorption capacity: 10 ml refined corn oil was added to 1 g of the flour in a weighted 25 or 80 ml centrifuge tube. The tube was agitated on a vertex mixer for 2 min. It was centrifuged at 400 rpm for 20 min. The volume of free oil was recorded and decanted fat absorption capacity is expressed as mill of oil bounds by 100 g dried flour.

Gelatin capacity: 2.20% suspension was prepared with 5 ml distilled water in test tube. The tubes containing the suspension was heated for 1hr in a boiling water bath. It was cooled rapidly under running cold water the test tube was cooled for 2 h at 4^{o}C. The test tube was invested to see if the content will fall or slip off. The sample in the test -tube which does not fall or slip is the least gelation concentration.

Swelling power: 1 g of the sample was weighed into a conical flask. It was hydrated with 15 ml distilled water, shook for 5 min. With mechanical shaker at how speed. Heating was done for 40 min at 80-85^{o}C with constant stirring in a water bath the content was transferred into a clean, dried and pre-weighted tube. 7.5 ml of distill water was added and centrifuge at 2200 pm for 20 min. The supernatant was decanted into a pre-weighted can and dried at 100^{o}C to a constant weight. The sediment was weighted in the centrifuged swelling power was calculated as follow:

$$\frac{\text{Weight of the wet mass of sediment}}{\text{Weight of dry matter in the gel}}$$

Water and oil retention: Add 4 g of sample and 20 ml of water or peanut oil in 30 ml or 50 ml centrifuge tube. Stir sherry occasionally with a glass rod over a 30 min period. Centrifuge at 4000 rpm for 20 min. Measure volume of decanted fluid (water peanut oil). Calculate amount of oil or water retained per grain of sample.

Emulsion capacity: Two gram sample was blended with 25 ml distilled water for 30 sec. In a blender at 1600 pm After complete dispersion, refine corn oil was a separation into two burette and blended until there was a separation into two layers of water and fat emulsifying capacity was expressed as will of oil emulsified by 1 g of flour.

Foaming capacity and stability: Two gram flour sample and 50 ml distilled water was mixed in a blender at room temperature. The suspension was stirred for 5 min at 100 pm. The total volume after 30 sec was recorded. It was allowed to stand at room temperature for 30 min. And the volume of foam recorded. The percentage increase in volume after 30 sec is expressed as foaming capacity.

Viscosity measurement: Viscosity was determined using the Brad ender amylophograpy. The procedure involved dispensing 200 g suspension of 10% (w/v) preparation of each sample into the equipment and monitoring the viscosity of the slurry as the temperature increases.

Table 1: Functional properties of whole and dehulled cowpea flour

	DCF	WCF
Bulk density (g/cm^3)	1.08	1.35
Water absorption capacity (gg^{-1})	2.56	4.37
Fat absorption (gg^{-1})	1.76	2.74
Emulsion capacity (%)	25.10	23.20
Viscosity (Ns/m^2)	70.00	85.00
Swelling power (%)	37.40	39.75
Foaming capacity (%)	35.00	57.00
Gelation capacity (%)	3.15	3.87
Water and oil retention (mg/g)	1.07	0.85

DCF = Dehulled cowpea flour, WCF = Whole cowpea flour

RESULTS AND DISCUSSION

The functional properties determines the application and use of food materials for various food products (Adeleke and Odedeji, 2010). The results of functional prosperities of whole and dehulled cowpea seeds are as presented in Table 1. Bulk densities of dehulled and whole cowpea flour are 1.08 g/cm^3 has the lowest bulk density might be due to be proportion of the seeds coat present in the whole cowpea flour. Bulk density has been found to be a function of flour wetability (Solsuki, 1962). The higher value of bulk density for whole cowpea seed flour implies that the packaging material that will be used for this product will be denser than other packaging material used for the sample. Bulk density is an indication of the porosity of a product which influences packages design and could be used in determining the type of packaging material required. It is also important in infant feeding where less bulk density is desirable (Iwe and Onalope, 2001).

The water absorption capacity of whole cowpea flour (4.37 gg^{-1}) is higher compared to dehulled cowpea flour (2.56 gg^{-1}). The difference in absorption might be due to the quantity of damaged and undamaged starch present with the flour sample (Asiedu, 1989) water absorption in flour correlate positively with the amylase content and also particle size of the cowpea flour (Adeyemi and Beckley, 1986). High water absorption is desirable in flour whole cowpea flour therefore has higher affinity for water during reconstitution than flour from dehulled cowpea, water absorption capacity is an indication of the extent to which protein can be incorporated into food formulation. Increase in water absorption capacity implies high digestibility of the starch. The water absorption characteristic represent the ability of a product to associate with water under condition where water is limiting, in order to improve its handling characteristics and dough making potentials (Iwe and Onalope, 2001).

The fat absorption capacity of whole cowpea flour is higher (2.74 gg^{-1}) than that of dehulled cowpea flour (1.76 gg^{-1}) The mechanism of fat absorption is attributed mainly to the physical entrapment of oil and the blinding of fat to the apolar chain of protein (Wan and Kinsella, 1976). Low fat absorption is highly desirable as far as flour product is concerned. This functional property determines the amount of flour to make good dough. The viscosity value is greater for whole cowpea flour (85 B.U.) than dehulled cowpea flour (70 B.U.) this is attribute to attributable to flour rate. The flow rate of any fluid is a function of its viscosity. The difference in viscosity might be due to the weakness of intermolecular net work which may cause the flour granules to fall a part when gelatinized in hot water forming a paste of relativity low viscosity. It might also be due to changes in flour protein interaction (Ohr, 2004). The difference in viscosity may also be due to reduction in protein as a result of carbohydrate and protein interaction (Cherry and McWaters, 1981).

The emulsion capacity of dehulled flour (25.10%) is greater than the whole flour (23.20%) Emulsion prosperities play a significant role in many food system where the protein have the ability to bind fat such as in meat product, batter, dough and salad dressing (Sathe and Salunkhe, 1981; Adeleke and Odedeji, 2010). The seeds coat in the whole cowpea flour is playing a dilution role on protein content of the flour hence, the lower emulsion capacity.

Conclusion: Production of flour from cowpea (*Vigna unguiculata*) serves as means of preservation and utilization of this produce thereby alleviating the post harvest problem associated with agricultural production. It reduces the preparation and cooking time, reduces low digestibility and antinutritional factors in the produce. Also the consumption of leguinnes and cowpea is drastically reduced through this processing method. Flour produced from whole cowpea seeds however, presents better functional prosperities compared to the dehulled cowpea flour which is common practice in processing of cowpea. This results in production quantity products like beans ball (Akara), steamed beans pudding (*moinmoin*), cowpea pie etc. with reduce processing time, optimal use of fat which eventually lead to process optimization.

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