Global Scientific JOURNALS

GSJ: Volume 8, Issue 12, December 2020, Online: ISSN 2320-9186
www.globalscientificjournal.com

EFFECT OF VARIOUS DRYING TEMPERATURES ON THE PROXIMATE COMPOSITION AND FUNCTIONAL PROPERTIES OF HIGH QUALITY CASSAVA FLOUR.

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ABSTRACT

The effect of various drying temperatures on the proximate composition and functional properties of High Quality Cassava Flour were investigated in this research work. The Proximate composition and functional properties were determined using standard methods. The results of the proximate composition calculated on dry weight basis showed that the moisture contents for the various dying temperature ranged from $9.90 \pm 0.23\%$ to $10.33 \pm 0.03\%$, Ash contents ranged from $1.04 \pm 0.02\%$ to $2.15 \pm 0.14\%$, Crude fibre ranged from $0.60 \pm 0.12\%$ to 2.64 ± 0.02, Fat content varied between $0.28 \pm 0.19\%$ to $0.28 \pm 0.19\%$, protein contents of $4.75 \pm 0.24\%$, $4.53 \pm 0.18\%$ and $3.73 \pm 0.08\%$ were obtained for High Quality Cassava Flour dried at 80^0C, 100^0C and 120^0C respectively while the carbohydrate contents ranged from $81.91 \pm 0.04\%$ to $83.66 \pm 0.14\%$. The functional Properties showed significant difference ($P \leq 0.05$) among the various drying temperature. The result of this research showed that drying temperature have great effect on both the proximate composition and functional properties of the flour

Keywords: Cassava, Temperature, Flour, Proximate,

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INTRODUCTION

Cassava (*Manihot esculenta*) is an important staple food in virtually all parts of the country. It is a root crop which is grown in the tropical and sub-tropical areas of the world (Burrel, 2003). Cassava root is a highly energy food with a high water and carbohydrate content. It contains about 60-65% water, 30-35% carbohydrate on fresh weight basis and 80 – 90% on dry matter basis (Balogopeten *et al.*, 1988). It is a poor source of protein as it contains only 1 – 3% protein on dry matter basis (Montagnae et al., 2009) and is low in essential amino acid such as Methionine, Lysine, Tryptophan, Phenylalanine and Tyrosine (Falade and Akingbala, 2010). Cassava has been marked as the crop that can spur rural industrial development and raise income for producer, processors and traders (Echebiri and Edaba 2008). The advantages of cassava as

food security crop in sub-sahara Africa usually outweigh the nutritional draw backs that sometimes make cassava appear as an inferior food (Osungbaro et al., 2010). Cassava can be used to attain house hold food security and increasing food availability (Lebot., 2009).

The major component of cassava root is starch and its use in primarily determined by its physicochemical properties (Onitolo *et al.,*2007). Cassava starch has many advantages over other grains or root crop which include high purity level, excellent thickening characteristics, a neutral taste, desirable textual characteristics, is relatively cheap and contains high concentration of starch (Dry- matter basis) (Masambet *et al.,* 2001).

High quality cassava flour (HQCF) can be used as an alternative for cassava starch. It is simple unfermented cassava flour. The properties of cassava flour are rather similar to those of wheat flour and therefore High Quality cassava flour can partially be substituted for wheat flour in many wheat based Products such as bread, cake and pasta.

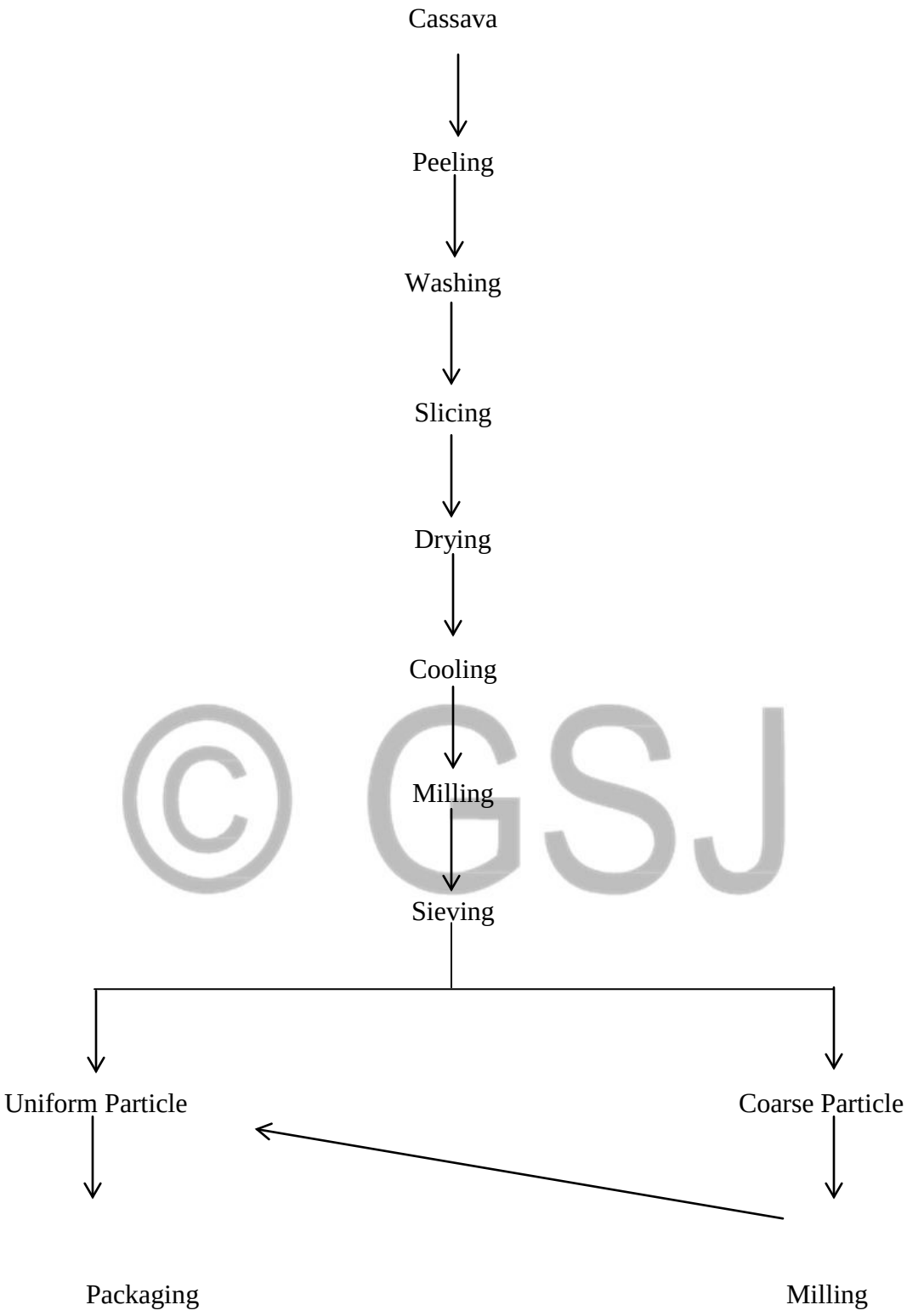
High quality cassava flour is a highly needed product for industrial use. Because of this, there is a need for data on the proximate and functional properties of high quality cassava flour and the aim of this work was to produce and analyse high quality cassava dried at various oven temperatures.

MATERIALS AND METHODS.

High yield, low cyanide cassava roots of improved cultivar TMS 30572 were sourced from the international Institute of Tropical Agriculture (IITA), Ibadan, Oyo- State, Nigeria. The cassava roots were transported in a clean jute bag to the food process and Engineering Workshop of the Department of Food Technology, Federal Polytechnic, Ilaro, Ogun State, Nigeria for processing into High Quality Cassava Flour (HQCF) for subsequent analyses.

High Quality Cassava Flour (HQCF) Production

The cassava tubers were weighed using Ohaus, CKW Weighing scale, peeled with a stainless steel knife, washed, sliced and soaked in 0.25% sodium metabisulphite solution for 10minutes. The soaking solution was drained, re-washed with clean running water and dried with cabinet dryer using various drying temperatures (60^0C, 80^0C and 120^0C) for 10 hours. The dried cassava slicers were milled into flour using warring blender, sieved through a 80 micron mesh sieve and stored in High Density Polyethylene (HDPE) bags before Analysis.



Flow Chat for production of High Quality Cassava Flour.

ANALYSIS

MOISTURE CONTENT DETERMINATION

The moisture content of the sample was determined using standard method according to (AOAC 2000).

Two (2) grams of each of the samples was weighed out with an analytical balance into dried, cooled and weighed dish in each case. The samples in the oC dishes were then put into a moisture extraction oven set at 105 and allowed to dry for 3 hours when this time elapsed, the samples were then transferred into a dessicator with a laboratory troy and then allowed to cool for about 20 minutes. They were thereafter weighed again and their respective weights recorded accordingly. These processes were repeated for each sample until a constant weight was obtained in each case. The difference in weight was calculated as a percentage a of the original sample.

$$\% \text{ Moisture} = \frac{\text{loss in weight due to drying} \times 100}{\text{Weight of sample taken} \quad 1}$$

$$= \frac{W2 - W3 \times 100}{W2 - W1 \quad 1}$$

Moisture (%) = Initial weight (g) final weight (g) x 100

Sample weight (g) 1

CRUDE PROTEIN DETERMINATION

Protein is the major compound containing Nitrogen. Nitrogen is used as an index of the protein termed ‘Crude Protein’ as distinct from true protein (AOAC, 2000) Kjeldahl method is the most reliable for insoluble food stuff.

Half a gram (0.5g) of each of the samples was mixed with 10ml of concentrated H_2SO4 acid in a Kjeldahl digestion flask. A tablet of the selenium catalyst was added to each of the samples which were then digested (heated) inside a fume cupboard until a clear solution was obtained in a separate flask in each case. Also, a blank was made by digesting the above reagents without any sample in it. Then, all the digests were carefully transferred into a 100ml volumetric flask in each case and were made up with distilled water. A 100ml portion of each digest was mixed with equal volume of 45% NaOH solutions in a Kjeldahl distilling unit. The resulted mixtures were each distilled and the distillates collected in each case into 10ml of 4% boric acid solution containing three drops of mixed indicators (bromocresol green and methyl red). A total of 50ml of each distillate was obtained and titrated with 0.02 molar H_2SO4 solutions. Titration was done from the initial green color to a deep red end-point. The nitrogen contents of each sample were calculated thus; (AOAC, 2000).

$$\% \text{ Nitrogen} = \frac{\text{Volume of acid Hcl used} \times 0.0014 \times 100 \times 100}{\text{Weight of sample} \quad 10 \quad 1}$$

Note: 1ml of 0.1ml Hcl= 0.0014gN

Crude Protein = % Nitrogen x 6.25%

CRUDE FAT DETERMINATION

Two hundred and fifty milliliters of boiling flasks were washed with water, dried in an oven set at 105ºc for 25minutes, cooled in a desiccator and then used for each sample. The flasks were firstly labeled, weighed with a weighing balance and then filled with 200ml of petroleum ether in each case. Then, five grams of each of the samples was weighed out into a correspondingly labeled thimble. The extraction thimbles were in each case tightly plugged with cotton wool. The soxchlet apparatus was then assembled and allowed to reflux for 6 hours. Thereafter, the thimble

was removed and the petroleum either was collected in each case in the top of the container in the set up and drained into another container for re-use. The flasks were then removed in each case and dried in an oven at 105ºc for 1hour. After drying, they were placed in a desiccator where they cooled for about 20minutes and thereafter weighed. The percentage fat content was calculated for each sample thus: (AOAC, 2000).

$$\text{Crude fat (\%)} = \frac{\text{initial weight(g)} - \text{weight after extraction(g)}}{\text{Sample weight (g)}} \times \frac{100}{1}$$

ASH CONTENT DETERMINATION

Two (2) grams of each of the samples was weighed out using an analytical balance into a dried, cooled and weighed crucible in each case. The samples were then charred by placing them on a Bunsen flame inside a fume cupboard to drive off most of the smoke for 30minutes. The samples were then transferred into a pre- heated furnace at 550ºC with a laboratory tong. They were allowed to stay in the furnace for 3 hours until a white or light grey ash resulted. Samples that remained black or dark in color after this time had elapsed were moisture with small amount of water to dissolve salts, dried in an oven and then the ashing processes repeated again. After ashing, the crucibles were then transferred into a desiccator with a laboratory tong after cooling they were each weighed again and recorded accordingly (AOAC, 2000).

$$\text{ASH (\%)} = \frac{\text{Weight of crucible with ash(g)} \times 100}{\text{Weight of crucible with sample (g)}}$$

CRUDE FIBRE DETERMINATION

Five grains (5g) of each of the samples were used in this determination. The samples were each boiled in 500ml flask containing 200ml of 1.25% *H2SO4* solution under reflux for 30minutes. When this time elapsed, the samples were washed with several portions of hot boiling water

using a two-fold muslin cloth to trap the residual particles. The residual particles in each case were carefully transferred qualitatively back to the flasks and 200ml of 1.25% NaOH solution was then added into each flask. Again, the samples were boiled for 30minutes and washed as before with hot water. Then, they were each carefully transferred into a weighed crucible and then dried in an oven set at 105ºc for 3 hours. The dried samples were then put into desiccator where they cooled for about 20 minutes before being weighed again. They were then put into a muffle furnance set at 550ºC for 2 hours (until ashed).

Finally, they were cooled in desiccator and weighed again. The crude fiber content for each sample was calculated thus (AOAC, 2000).

$$\text{Crude fibre(\%)} = \frac{\text{weight residue with crucible(g)} - \text{wtofash with crucible} \times 100}{\text{Weight of fat free sample (g)}} \quad 1$$

CARBOHYDRATE CONTENT DETERMINATION

The carbohydrate content was calculated by deducting the sum of the values for moisture, crude protein, crude fat, crude fibre and Ash in 100 (AOAC, 1990).

FUNCTIONAL PROPERTIES

The following functional properties were studied were; bulk density, water absorption capacity, solubility, swelling power and dispersibily

WATER ABSORPTION CAPACITY

Water and oil absorption capacities of the flour samples were determined as described by Abbey and Ibey (1988) with slight modification. One gram of flour sample mixed with 10ml of distilled

water or oil was placed in a centrifuge tube. The suspension was agitated for one hour on a griffin flask shaker after which it was centrifuged for 15 min at 2200 rpm. The volume of water or oil on the sediment water was measured. Water and oil absorption capacities were calculated as ml of water or oil absorbed per gram of flour respectively.

SWELLING POWER AND SOLUBILITY

This was determined by the method described by Oladele and Aina (2007). One gram of the flour was mixed with 10 ml distilled water in a centrifuge tube and heated at 80 ^{0}Cfor 30 minutes. This was continuously shaken during the heating period. The tube was removed from the bath, wiped dry, cooled to room temperature (28 ^{0}C) and centrifuged for 15 mins at 2200 rpm. The supernatant was evaporated, and the dried residue weighed to determine the solubility. The swollen sample (paste) obtained from decanting supernatant was also weighed to determine the swelling power. Swelling power was calculated as weight of the paste/weight of dry sample.

BULK DENSITY

This was determined by the method of Wang and Kinsella (1976). A known amount of sample was weighed into 50ml graduated measuring cylinder. The sample was packed by gently tapping the cylinder on the bench top from a height of 5cm. The volume of the sample was recorded.

$$\text{Bulk density} = \frac{\text{Weight of Sample} \quad \text{g/m or g/cm}^3}{\text{Volume of Sample after tapping}}$$

DISPERSIBILITY

This was determined by the method described by Kulkarni (1991). 10g of flour was suspended in 100ml measuring cylinder and distilled water was added to reach a volume of 100ml. The set up was stirred vigorously and allow settling for 3 hours. The volume of settled particles was recorded and subtracted from 100. The difference was reported as percentage dispersibility.

RESULT AND DISCUSION

RESULTS

Table 1: Proximate composition of High Quality Cassava Flour

Sample	Moisture	Ash	Crude Fibre	Fat	Protein	Carbohydrate
A	10.33±0.03	1.04±0.02	0.60±0.12	0.65±0.16	4.75±0.24	82.66±0.14
B	10.05±0.12	1.06±0.14	1.88±0.01	0.46±0.01	4.53±0.18	82.03±0.01
C	9.90±0.23	2.15±0.14	2.64±0.02	0.28±0.19	3.73±0.08	81.91±0.04

Values were mean ± Standard deviation of triplicate determination

Table 2: Functional Properties of High Quality Cassava Parameters

Sample	Bulk Density (g/ml)	Water Absorption Capacity / (g/100g)	Swelling Power (g/g)	Solubility (g)	Dispersibility (%)
A	0.73±0.03	170.00±0.01	4.47±0.02	4.35±0.04	66.00±0.00
B	0.70±0.02	160.00±0.01	4.61±0.01	4.50±0.01	67.5±0.01
C	0.65±0.04	145.00±0.04	5.58±0.03	5.00±0.006	69.5±0.00

Values were mean ± Standard deviation of triplicate determination

DISCUSSION

Table 1 shows the proximate composition of High Quality Cassava flour dried at various drying temperatures. The moisture content for the various drying temperatures ranged from 9.90 ±0.23 to10.33±0.03% for the sample. The moisture contents obtained were slightly higher than the result reported by Oyeyinka, et al 2019 but agreed with the 10% maximum recommended by standard organization of Nigeria (SON)

The lower the initial moisture content of a product to be stored, the better the storage stability of the product. (Adebowale et al., 2011). Flours with moisture content less than 14% can resist microbial growth and hence storage stability. The values obtained fall between 0 – 10 % is within the range acceptable for effective flour storage. The ash contents of the flours obtained ranged from 1.04±0.02% to 2.15 ± 0.14%. These results agreed with what several authors established (Tharise et al., 2014, Oyeyinka, et al 2019). The ash content ranged of 1.30%±2.8% were also reported by Charles et al., 2005) which also agreed with the result obtained in this work. Ash content represents the total mineral content in foods. They play an important role from p hysicochemical technology and nutritional point of view. The fiber contents for all the samples ranged from 0.60±0.12% to 2.64±0.02%. (Tonukari and Emmanuel *et al.,*)reported the fiber content of cassava flour in the range of 1.38 to 3.20%. The HQCF obtained were in the range as it was reported. The lowest fiber content was found in cassava flour dried at 80^0C while highest fibre content was recorded in cassava flour dried at 120^0C. Fiber is made up of the indigestible parts or compounds of plants, which pass relatively unchanged throughout stomach and intestine. The main role of fiber is to keep the digestive system healthy.

The fat content at 0.65±0.16%, 0.46±0.14% and 0.28±0.19% were obtained for cassava flour samples dried out 80^0C, 100^0C and 120^0C respectively. These fat content were within the range obtained by (Adebowale *et al.,* 2011). Cassava flour is low in fat.

The protein contents differed among the methods slightly. The protein contents of the high quality cassava flour ranged from 3.73±0.08% to 4.75±0.24 with the sample dried at 120^0C having the lowest protein content of 3.73±0.12%. These values agreed with 3.6% Protein content of cassava flour obtained by (Montagnac 2009), since they were calculated on dry weight basis. One can conclude that cassava flour is not a major source of protein.

High quality cassava flour as reported in literate constrained 83.88±12.00% carbohydrate (oyeyinka, et al 2019). And the values obtained ranged from 81.91±0.04% to 83.66±0.14% are

similar. It is observed that the highest carbohydrate content was obtained from cassava flour dried at 80^0C. Cassava is a starchy staple food and a good source of carbohydrate, which must not be put under too high temperature so that its nutrient will not be lost during heating (Lebot 2009).

The functional properties of high quality cassava flour dried at three different temperatures are as shown in table 2. The bulk densities of the flour sample ranged from 0.65±0.04g/ml to 0.73±0.03g/ml. Bulk density gives indication of the relative volume packaging materials needed. High bulk density is desirable for greater ease of dispersibility and reduction of paste thickness (Pand manshrel *et al.,* 1987 Udensi and Eke, 2000). Low bulk density of flour are good physical attributes when determining the storability and transportation to the required location (Agunbiade and Sanni, 2003). Also, high bulk density is a good physical attribute when determining initial quality of particulate matter. Water absorption capacities of the high quality cassava flour ranked from 145±0.04mg/100mg to 170±0.01g/100g. In a previous work (Smith and Circle, 1972), highlighted that water absorption capacity is a useful indication of whether flours can be incorporated into aqueous food formulation especially those involving dough handling. (Nibe *et al* .,2001) also stated that water absorption capacity is important in bulking and consistency of products as well as in baking application. The swelling index ranged from 4.47±0.02g/g to 5.58±0.03 g/g in the samples. Cassava shows a little good swelling power unlike other crops like yam which shows high swelling power (Ojinaka et al., 2009). Dipersability is a measure of reconstitution of flour or flour blends in water and the higher the dispersability, the better the flour reconstitutes in water (Kulkani et al., 1991).

However, dispersability recorded in this present work ranged from 66.0% to 69.5%

CONCLUSION

The result of this research showed that drying temperature has great effect on both the proximate composition and functional properties of the result flour. Depending on the end use of the flour, a particular temperature should be adopted for ease of storability as well as transportation

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