Vol. 08, No. 01; 2023

ISSN: 2456-8643

INDUSTRIALIZATION, PRODUCTION, AND PROCESSING OF CASSAVA (Manihot Esculenta Crantz) FOR THE EXTRACTION OF FLOUR AND POTENTIAL COMMERCIAL USAGE

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https://doi.org/10.35410/IJAEB.2023.5795

ABSTRACT

Cassava flour can be made into high-quality flour as a partial substitute for wheat flour and other cereals. Also, cassava can be presented in food formulations such as bread, pasta, cookies, cake mixes, pizza dough, arepas, empanadas, pancakes, etc. The flour of cassava provides convenience in the baking area before a society concerned about good health and nutrition, with the obtaining of bread with high fiber content. This would add to the production of bread and other products. In addition to a decrease in the raw material, a component in terms of nutrition and health are not found in many current bakery foods and that society demands today. The content of crude fiber in cassava flour is greater than in wheat flour, this characteristic makes the products made with said flour acquire greater nutritional value since it presents fiber contents similar to those of wholemeal flours. Cassava flour is gluten-free and low in fat, low in calories, and sugar, making it a good alternative for people with celiac disease, diabetes, hypertension, or cholesterol tall. It can also be consumed by people with sensitive digestive disorders due to its easy digestion. Cassava for flour production has a high potential worldwide and could reduce wheat imports for bakeries.

Keywords: Cassava, Cassava flour, Pizza dough, Pancakes, Fiber.

1. INTRODUCTION

The world population, in general, lives better than a decade ago, but the advances to ensure that development benefits as basic as food security are humans on the planet in 2030 are not fast enough and require a boost urgently. The Food and Agriculture Organization of the United Nations (FAO) has published the work Food and agriculture. Keys for the execution of the 2030 Agenda for Sustainable Development which, concisely, it explains what strategies are carried out to make the SDGs a reality. Feeding and agriculture are at the center of the agenda, be it to eradicate poverty and hunger, respond to climate change or conserve natural resources. Currently, in the world there is enough food for everyone even though 800 million people continue to suffer hunger; Overcoming this reality is not only about producing more food. Also, about building resilient and sustainable food systems or strengthening markets so that people can have access to healthy and nutritious food. This agenda recognizes the challenge that we face to end hunger. Natural resources are deteriorating biodiversity is being lost and climate change threatens the production of global food supply, so the agenda must address these challenges. For this, the FAO develops an integrated approach to sustainability in agriculture, forestry, and fishing based on five key principles that are: improve the efficiency in the use of means; conserve, protect and enhance natural ecosystems; protect and enhance rural livelihoods and social welfare; increase the resilience of people, communities, and ecosystems; and promote good management of natural systems and humans (FAO, 2018).

Manihot esculenta Crantz, known as cassava, manioc, or cassava, is a perennial plant, monoica belonging to the Euphorbiaceae family, native to the Northwest of Brazil. Cassava ranks fourth in the world as a staple product, after rice (*Oryza sativa* L.), wheat (*Triticum sativum* Lam. = *Triticum sativum* (L.), and maize (*Zea mays* L.). It is a source of calories and a basic component in the diet of more than 1000 million people with scarce economic resources (Morrillo, 2009) cited by Aragón and et al; (2012). *Manihot esculenta* Crantz, known as cassava, manioc, or cassava, is a perennial plant, monoica belonging to the Euphorbiaceae family, native to the Northwest of Brazil. Cassava ranks fourth in the world as a staple product, after rice (*Oryza sativa* L.), and wheat (Triticum sativum Lam. *Triticum sativum* (L.) and maize (*Zea mays* L.). It is a source of calories and a basic component in the diet of more than 1000 million people with scarce economic resources (Morrillo, 2009) cited by Aragón and et al; (2012).

Worldwide, cassava is widely accepted as a staple in the diet, and its production is increasing, since between 2007 and 2013, there were 212 and 276.7 million tons (t), respectively (Aristizábal et al; 2007) cited by Ulloa, (2018). According to the Food and Agriculture Organization FAO (2013) cited by Ulloa, (2018), the production of world cassava has increased by 60 % since 2000 and continues to increase in the current decade. Africa produces 50% of cassava, followed by Asia with 30% and America with 16% (Ulloa, 2018). Cassava constitutes in some Latin American countries the main food in the daily diet. At the national level, cassava is the crop of roots and tubers tropical plants with the largest planted area. Its consumption occurs in the national market as internationally. One of the advantages of this crop is its low production costs. production, constituting a production alternative mainly for the small producer". As cassava is a product of vegetable origin, whose common characteristic is its great richness in starch or starch. For this reason, they are a magnificent source of energy, although their content of other nutrients, such as proteins and fats, is low (Cedeño and Maldonado, 2003) cited by Ulloa, (2018).

The cassava root is used for human, animal, and industrial consumption, and due to its high perishability is required to be processed. It is a highly perishable tuber whose main

sign of deterioration is the vascular striatum, which manifests itself in the form of bluish-black bundles in the parenchyma. Due to the rapid deterioration of cassava, there is a need to transform this raw material extracted directly from the ground, into a finished product that is easy to prepare (Rojas-Rivera, 2012), Aristizábal et al; (2007) cited by Ulloa, (2018). Cassava constitutes a food security and food sovereignty that is important in income generation, especially in drought-prone regions is the fourth most important staple product after rice, wheat, and maize and is a components table in the diet of more than 1 billion people, it is eaten fresh or subjected to an artisan agro-industrial process to obtain starch (Guillén et al; 2015) cited by Ulloa, (2018).

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ISSN: 2456-8643

One way to preserve fresh cassava is to chop it, dry it and grind it to be incorporated into concentrated feeds for poultry, shrimp, pork, and dairy cattle. The flour cassava can be used in the food industry. The market potential of flour cassava for use in food products other than bread has created the need to evaluate systems to produce meals at the root processing plant level. Cassava can be made into high-quality flour to be used as a flour substitute for wheat, corn, and rice among others. Food formulations include bread, pizzas, pancakes, pasta, and cassava mixes. Cassava mixes can also be used for production as a thickener and extender for dehydrated soups, condiments, baby food, and sweets (Ulloa, 2018).

Cassava flour is gluten-free and low in fat, low in calories, and sugars, so it is a good alternative for people with celiac disease, diabetes, hypertension, or high cholesterol. It can also be consumed by people with systems or sensitive digestive disorders (irritable bowel or irritable colon) due to its easy digestion. It is great for baking: cookies, brownies, pancakes, cakes, etc. have excellent results as a thickener for the preparation of sauces or pouring. Behaves in a way extraordinary in the preparation of crepe and pizza doughs. It is a good option for making hamburgers or tempuras (Aponte, 2016). Hence, the elaboration of new products from cassava will help the interested sector to improve its structure through the creation of a cassava flour processing and exporting company that will benefit producers and exporters of cassava and its derivatives through the use of raw materials and the generation of foreign currency and employment for the country. The general objective of this research was to industrialize, produce and process Cassava (*Manihot esculenta* Crantz) for flour extraction and commercial usage.

2. MATERIALS AND METHODS

2.1. Raw material

The raw material was washed with water and then manually peeled. The raw material was immediately washed with cold water to remove the shell remains. Then, the material was crushed it. The raw material was used to carry out control of the physical and chemical specifications. All analyzes were done in triplicate and then average the measurements.

2.2 Flour production process

The process to produce cassava flours was done using a diagram: (1) At the reception: A visual inspection of the raw material was carried out and determined its weight was to establish performance parameters for the process same. (2) Washing: The cassavas were cleaned with water. This stage is important because, if the roots have adhered to the soil, the final product will result in a high ash content, especially silica, which reduces its quality. (3) Peeled: to make flour, the shell was removed manually with knives. (4) Cut off: It cut the cassava into small, uniform pieces. (5) Shredded: for the roots to dry more quickly it is necessary to increase the surface area exposed to hot air, for which the cassava was crushed to obtain a porridge. (6) Drying: It was carried out using an experimental horizontal dryer. The porridge was obtained in the previous stage, and it was arranged in aluminum trays, 9.5 cm long, 9 cm wide and 0.8 cm deep. Then, they were taken to the dryer at a temperature of 50 ± 2^{o} C with an air velocity of 4.19 m/s. The time required for the product to reach the weight constant was 4 hours. After this operation, the treated material was placed in containers for subsequent physicochemical analysis. (7) Pulverized: The size reduction of the dry material was carried out through a mill-sieve. Sieving:

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The fine powder was passed through a series of meshes to determine its granulometry. (8) Packaging: The cassava flour obtained was packaged in polyethylene bags.

2.3 Drying curves

The data of the drying process (solid moisture vs time) up to constant weight were obtained by periodically weighing the samples every 5 minutes intervals for 3 hours. The percentage of dry solids (Ws) of the fresh material before the experimental process was determined according to the infrared lamp method established by (AOAC INTERNATIONAL). The east value remained constant during drying. Then, the moisture content was determined at the end of the dry samples using a balance.

To obtain the moisture values on a dry basis (Xt), the following equation was applied:

$$Xt = \frac{W-WS}{WS}$$

Where:

Xt = Moisture on a dry basis of the sample

W= Weight of the sample

Ws= Weight of dry solids

Subsequently, the average humidity was calculated, averaging the humidity values freely obtained. Finally, the drying rate is obtained by relating the amount of water that is removed during a given time in the defined drying area. Namely, a differential of x means y of time is calculated to calculate the rate of drying using the following formula:

$$R = \frac{W2 \times (AX)}{A\ (AT)}$$

2.4 Granulometry

Sieving was done using a set of Tyler brand sieves of various microns. Plus 90% of the flour must pass the 70 mesh, so it must meet the requirement of particle size of the INEN 517 standard, which requires that 95% of the particles must pass mesh No. 70 with an opening of 210 µm (0.210 mm).

2.5 Physicochemical characteristics

The pH, humidity, and ashes of the flour were determined by AOAC methods. like the raw material. The determination of ashes was carried out by calcination in a muffle, and the density was done by measuring the volume occupied by a given mass when compacted in a beaker. These analyzes were performed in triplicate.

3. RESULTS

3.1 Employ a methodology for the production and processing of cassava flour.

Cassava can be processed to obtain quality flour that reduces dependence on farmers. Right now, imported grains (Rendón et al; 2012), since the method of obtaining cassava flour has advantages: it is easy to obtain, it can be done by hand, it is considerably cheaper than its wheat counterpart, is nutritious, palatable, and retains much of its flavor, color for long periods. Furthermore, cassava is available in any season and during the dehydration process has a loss minimum of nutritional substances. In addition, it can be consumed by people with intolerance to gluten (Hoover, 2001).

3.2 Carry out a granulometric analysis of cassava flour (*Manihot esculenta* crantz).

Sieving was done using a set of Tyler brand sieves of various microns. Plus 90% of the flour must pass the 70 mesh, so it must meet the requirement of particle size of the INEN 517 standard, which requires that 95% of the particles must pass mesh No. 70 with an opening of 210 µm (0.210 mm). Sifting of cassava flour was carried out using sieves no. 16, 20, 40, 60, 100, and 200. For this, the AOAC methodology 9.56.22. According to Table 4.1 and Figure 4.1, sieve 16 with an opening of 1180 micromol with a % of retained flour of 9.43 was the one that let the highest % of the flour with 90.57 (Annex 1).

Table 4.2: Sieving of Cassava Flour in Industrialization, Production, and Processing of Cassava (*Manihot esculenta* Crantz) for the Extraction of Flour and its use Commercial.

Determination		**Results**			**Methodology**
		Sample (s) Identified (s) as			
		37154-V1 **Cassava flour**			
Sieving		**% Detained**	**% Detained Accumulated**	**% Pass**	
Sieve No.	**Opening (µm)**				
16	1180	9,43	9,43	90,67	

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20	850	15,43	24,86	75,14	AOAC 956.22
40	425	47,13	71,99	28,01	
60	250	20,43	92,42	7,68	
100	150	4,63	97,05	2,95	
200	75	1,83	98,88	1,12	
Base	-	1,12	100,00	-	
Density a 20 °C g/cm³		0.51392			Aoac 936,300 (d)

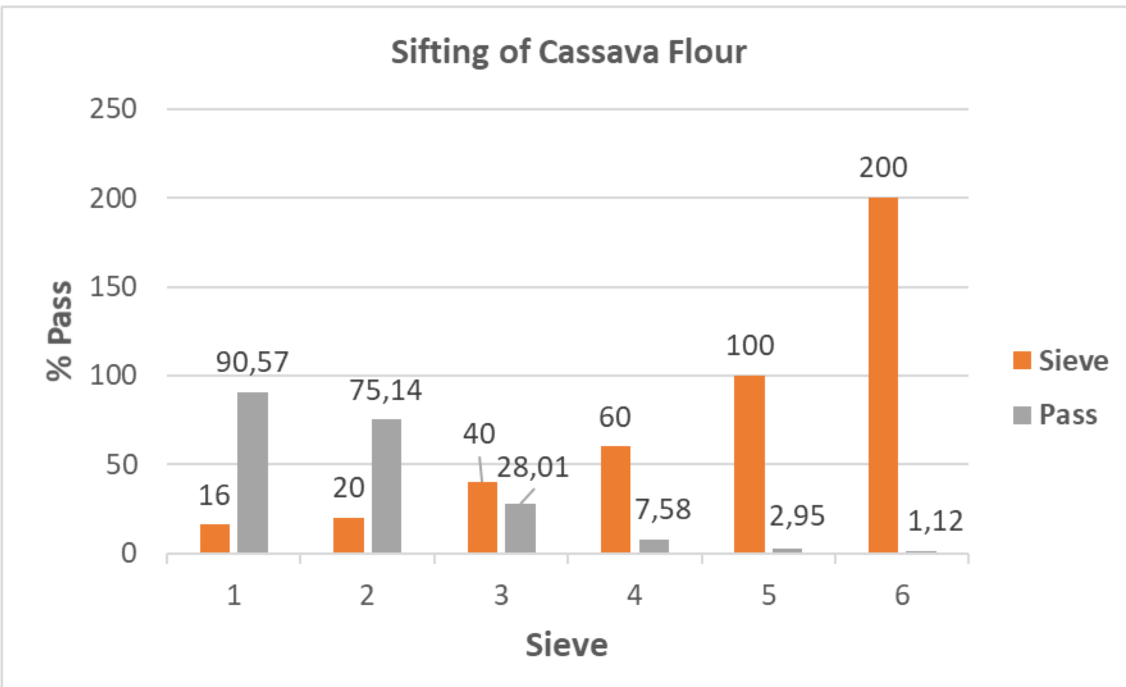

Figure 4.2: Sifting of Cassava Flour in Industrialization, Production, and Processing of Cassava (*Manihot esculenta* Crantz) for the Extraction of Flour and its use Commercial.

Sifted Cassava Flour

3.3 Characterize cassava flour (*Manihot esculenta* Crantz) for commercial uses and Industrial

Quality control of the raw material was carried out through a basic analysis of humidity, ashes, and protein, by gravimetric and colorimetric methods according to the standards of the Association of Analytical Communities (AOAC INTERNATIONAL).

The results were the following:

Table 4.3: Characterization of the cassava flour

Ash % 2.98
Moisture % 11.16
Protein % 1.37
pH at 17.8 degrees C 5.8

The quality of the starch was defined concerning the final product. In general, it can be said that the more careful and cleaner the starch. The flour production process will have a higher value, and wider use in any product. Physicochemical characteristics that determine the quality of the starch are cleanliness, granulometry, color, smell, content moisture, fiber, ash, acidity, and viscosity, among

3.4 Sensory analysis

When comparing the acceptance of the pizza made with cassava flour, the results of the sensory evaluation showed that the judges located the level of liking in "I like it and I Like it very much." While in the attributes the pizza made with cassava flour was located by the judges in the attribute "taste" with the highest score followed by "texture, the smell, the color, and the appearance". This agrees with what was reported by Akubor and Ukwuru, 2003 since in their study they mention that cassava flour improves the flavor and texture of grease and biscuits.

Table 3.4: Attributes of pizza with dough cassava flour								**Average**
Appearance	3	5	3	4	1	4	4	24
Color	3	5	4	5	2	4	4	27
Texture	5	4	3	5	4	4	5	30
Smell	4	5	4	3	5	4	4	29
Flavor	4	5	4	5	5	4	5	32

4. CONCLUSIONS

A method was developed to industrialize cassava flour (*Manihot esculenta* Crantz), and its processing carried out analysis granulometric and characterization. The flour produced could be used for commercial use and industry. Cassava flour represents an attractive raw material to produce products baked due to its high carbohydrate content that at any given time can replace wheat flour. Obtaining cassava flour from surplus production of This crop represents a viable alternative for the use of raw materials and perishables in a more sustainable way allowing the community to improve socioeconomically.

ACKNOWLEDGMENT

Thanks to Dr. Franklin García Fermín and his team from the Ministry of Higher Education, Science and Technology (MESCYT) / National Fund for Innovation in Scientific and Technological Development (FONDOCYT) for financing this research and to the Guaraguanó Company for its support and for providing us with part of the material used.

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