



UNIVERSITY  
of  
GREENWICH | Natural  
Resources  
Institute



Enabling poor rural people  
to overcome poverty

# CASSAVA PRODUCTS OF BRAZIL

Large Grant  
Agreement:  
2000000473

By Julie Crenn, NRI



IFAD- WEST AND CENTRAL AFRICA DIVISION

## CONTENT

CONTENT .....	0
List of Figures .....	1
INTRODUCTION .....	2
STARCH .....	3
<i>Cassava starch/Fécula/polvilho doce</i> .....	3
<i>Polvilho azedo/Sour starch/fermented sun-dried starch</i> .....	3
FERMENTED PRODUCTS .....	5
<i>Puba flour</i> .....	5
<i>Carimã flour</i> .....	5
<i>Fermented roasted flour/Farinha d'agua / Gari</i> .....	5
<i>Tucupi / Fermented savoury syrup</i> .....	6
<i>Tiquira</i> .....	7
UNFERMENTED PRODUCTS .....	8
Unfermented Gari / <i>Farinha de mandioca</i> .....	8
<i>Beijus/Cassava flatbread</i> .....	8
Fried Cassava/Cassava fries/cassava chips .....	8
Cassava crisps .....	10
POPULAR FOODS MADE FROM CASSAVA .....	11
<i>Pão de queijo /Cheese bread</i> .....	11
Puffed biscuits/ <i>Biscoitos de polvilho azedo</i> .....	11
<i>Farofa</i> .....	11
REFERENCES .....	12

## List of Figures

Figure 1 Starch production and by product .....	4
Figure 2 Fermented products .....	6
Figure 3 Tiquira production process .....	7
Figure 4 Unfermented products .....	9

## INTRODUCTION

Cassava is considered as one of the oldest cultivated crops, its domestication started about 5000 and 7,000 years ago in the Amazon rainforest (Allem, 2002).

Cassava is currently grown in 105 countries around the world and although cassava is predominantly used for human consumption worldwide, its utilization vary greatly by regions (FAO, 2017; Latif and Müller, 2015).

In developing and tropical countries, cassava has nutritional and economical importance. It feeds between 500 million and up to 1 billion people worldwide and is the 4<sup>th</sup> major staple crops in terms of calories after wheat, rice and maize (FAOstat, 2017; Latif and Müller, 2015).

Cassava varieties are commonly classified in 2 categories: 'Sweet' and 'Bitter' according to the concentration of cyanogenic glycosides in the crop. Sweet cassava contains low levels of cyanogenic glycosides (>100ppm) while bitter varieties contain higher levels of cyanogenic potential. The cyanogenic potential is not directly correlated with the bitterness of the plant (Bechoff, 2017). The high levels of cyanogenic glycosides require thorough detoxification process to reduce to compounds to safe level (Montagnac, Davis and Tanumihardjo, 2009b).

Cassava is also bulky and prone to bruising/wounding during post-harvest handling making it difficult and costly to transport. It also has a high water content (60-75% on wet basis) (Falade and Akingbala, 2010) which requires rapid processing or semi-processing into intermediate products to facilitate transportation, reduce transportation cost and increase its shelf-life and storability (Tomlins and Bennett, 2017; Falade and Akingbala, 2010).

Cassava processing in Brazil includes the production of flours (where the peeled roots are grated, pressed and then dried or toasted) and of starch, also known as *polvilho* which can then be processed further into confectionery products such as biscuits, breads, cakes and pancakes, as well as pasta, ice-cream and so on.

# STARCH

Cassava roots are high in carbohydrate and starch, but contains very low amount of protein, fat and vitamins (Montagnac, Davis and Tanumihardjo, 2009a).

Starch production in Brazil is well established. It is carried out from small artisanal to large industrial scale, difference being the type and size of the equipment. The dry matter content of the roots will influence both the yield and production cost (Cereda and Brito, 2016).

Starch is the main ingredient of several processed foods such as tapioca pearls, confectionery and in baby food, sauces, soups, broths and condiments as a thickening agent.

Brazil produces two types of starch – native or unmodified starch commonly called sweet starch (*polvilho doce* or *fécúla*) and sour starch, a fermented and sun-dried starch unique to South America.

## *Cassava starch/Fécúla/polvilho doce*

The starch is extracted following a simple process.

1. Wash and peel the roots
2. Grate the peeled cassava into a wet pulp
3. Mix the grated pulp with a large amount of clean water
4. Remove the fibres by sieving the mash through a fine sieve
5. Let the starch settle in the water
6. Decant the surface water from the settled starch
7. Wash the starch with water
8. Dry the starch (sun-dry or mechanically dry).
9. Once dry, mill or sieve the starch to remove any foreign material and get a free-flowing fine powder.
10. Package, label and store the dry starch

*Fécúla* and sweet starch are technically identical products, they vary simply in the type of drying. Sweet starch is sun-dried while *fécúla* is mechanically dried. Most starch in Brazil are flash-dried (Cereda and Brito, 2016).

The starch can then be transformed into sour starch or used for making other products.

## *Polvilho azedo/Sour starch/fermented sun-dried starch*

Sour starch/Fermented starch is unique to Latin America. In Brazil it is commonly known as *polvilho azedo* or *almidón agreo* in Colombia (Cereda and Brito, 2016). Sour starch has unique properties and flavour profile. It has the ability to expand baked goods without the use leavening agents such as baking soda or yeasts or the presence of gluten (Cereda and Brito, 2016). Sour starch has an acidic flavour.

Compare to normal starch, sour starch is naturally fermented in large fermentation tanks for about 30 days.

Fermented/Sour Cassava starch is traditionally produced by:

1. Placing the starch in stainless steel or tiled tanks
2. Covering the starch with up to 20 cm of water to create the ideal condition for the natural fermentation
3. Letting the starch fermenting undisturbed for 30 days (it can take longer if the temperature are low (~20c). The signs of fermentation are visible after a few days where bubbles can be observed on the surface of the water and a sour smell starts developing.
4. Removing the excess water once the fermentation is done
5. Scrapping the impurities from the surface
6. Crumbling the compacted starch
7. Spreading thinly on large concrete slabs covered with black plastic sheets to be sundried until it reaches a moisture content of about 12% for as many hours as possible.
8. Milling the dried starch
9. Packing, labelling and storing for up to 1 year.

It is the fermentation and the sun-drying that gives its unique characteristic to the starch. No other traditional methods of drying has so far conferred the same properties to the starch. Sour starch is then used in a multitude of very popular products and snacks in Brazil and Colombia. The most consumed snacks are a type of cheese bread (*pão de queijo*) and flavoured puffed biscuits (*Biscuitos de polvilho azedo*).

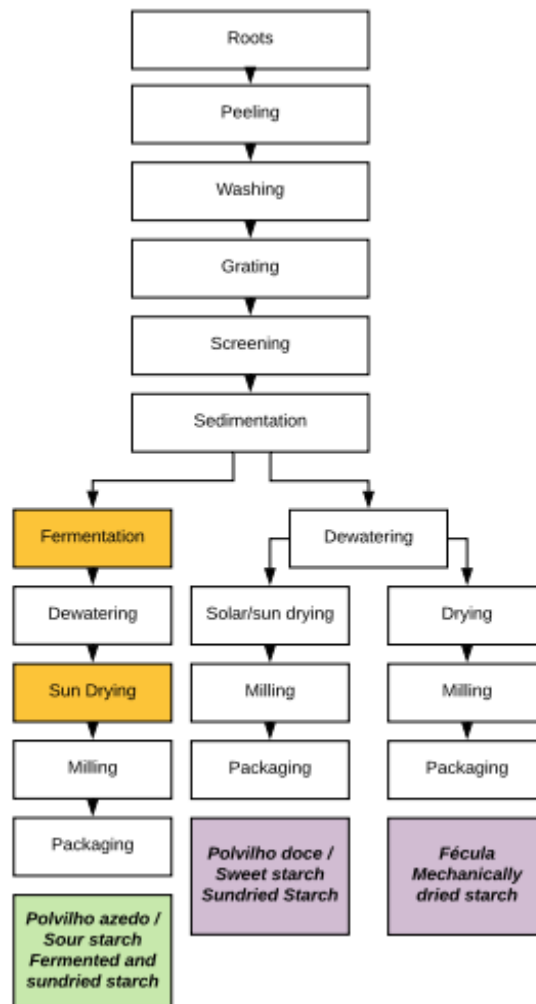


Figure 1 Starch production and by product

## FERMENTED PRODUCTS

### *Puba flour*

*Puba* is very similar to *fufu*. It is a fermented dough or flour that is used in the preparation of cakes, porridge, couscous and other dishes – the main difference between *puba* and *fufu* is that the whole root, including its peel is placed into water to ferment.

The finished product can be bought wet or dry, like *fufu*.

*Puba* is obtained by spontaneous fermentation of the cassava root:

1. Wash the root
2. Placed the whole root in water
3. Soak them for 5 days until the root has soften and the peel is breaking
4. Sieve and mash the soften root until only the fibres remain
5. Wash the dough several times
6. Sun-dry or mechanically dry
  - Wet *puba* is dried (sundried or mechanically dry) to about 50%
  - Dry *puba* flour is dried (sundried or mechanically dry) to about 12% - 14%

(Filho et al., 2013)

### *Carimã flour*

*Carimã flour* is an extra fine yellow flour made by milling of dried fermented roots (Cereda and Brito, 2016)

### *Fermented roasted flour/Farinha d'agua / Gari*

*Farinha* is seen as the 'ancestor' of *gari*. *Farinha* is a fermented and roasted coarse flour, developed overtime to have the dual purpose of detoxifying the local bitter cassava varieties and increasing its storability (Diop, 1998).

The traditional production of *farinha d'agua* consist of:

1. Washing and peeling the roots
2. Soaking in water for about 4 days
3. Grating the peeled cassava into a wet pulp
4. Pressing
5. Screening (optional)
6. Roasting into a large pan
7. Sieving
8. Packaging, labelling and storing the product.

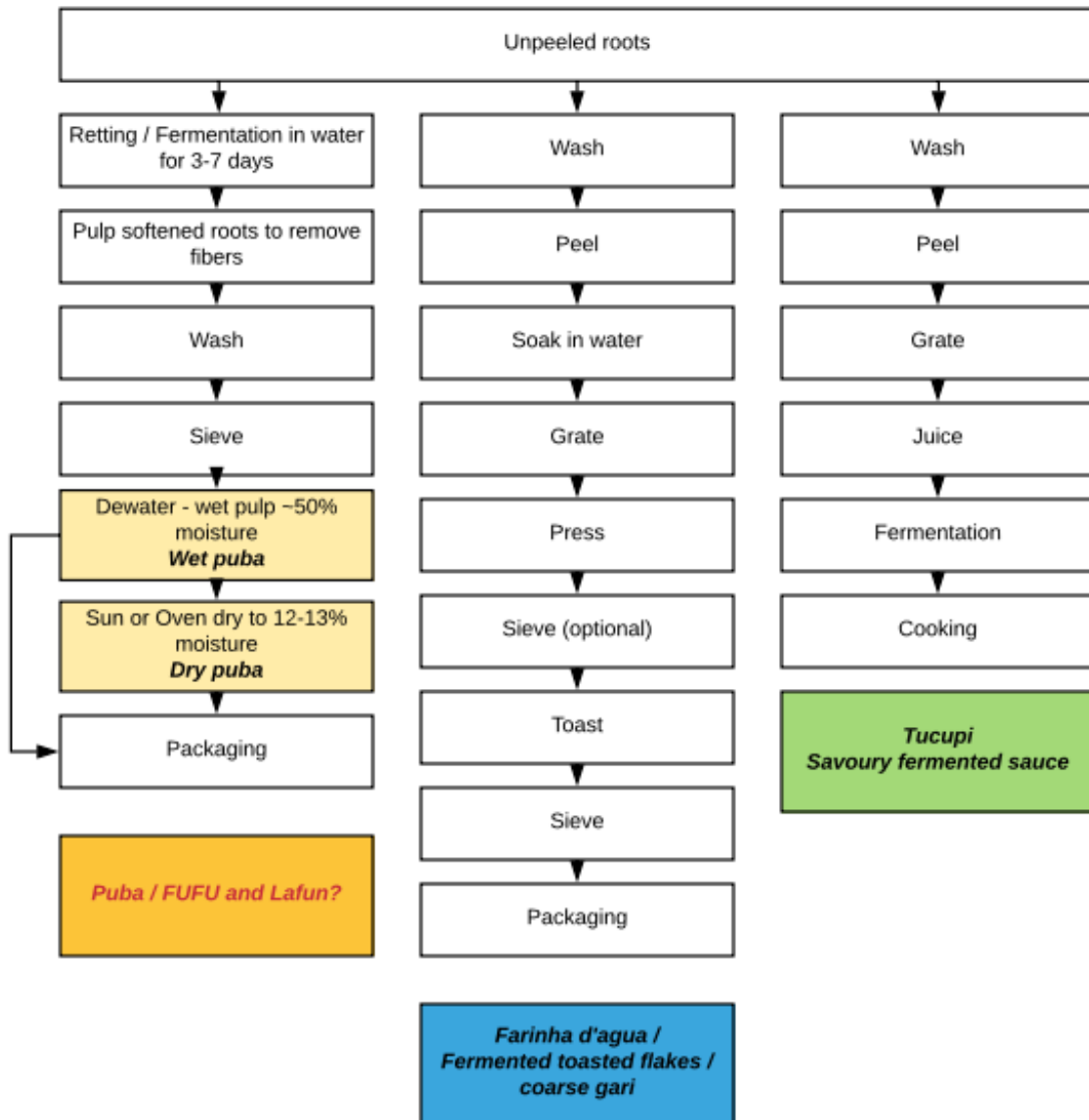


Figure 2 Fermented products

### Tucupi/ Fermented savoury syrup

*Tucupi* is an artisanal ameridian delicacy. It is a fermented and seasoned savoury broth made from the residual juice of cassava flour processing. *Tucupi* is traditionally made from bitter cassava which gives the broth its typical yellow colour. When made from the juice of sweet cassava, the broth will have a lighter, whiter colour.

*Tucupi* is a by-product of cassava flour processing. It is traditionally prepared by:

1. Washing and peeling the roots
2. Grating the peeled cassava into a wet pulp
3. Extracting the juice by squeezing the pulp with a press
4. Settling and fermentation - The juice (called *manipueira*) containing some starch is left to settle and partially ferment for 1 to 2 days
5. Seasoning the juice and boiling for at least 40 mins to a thick syrup and eliminate the toxic compound present in large quantity which could be lethal if consumed at this stage
6. Adding water to dilute the syrup if wanted
7. Packaging - Traditionally, the broth is packaged in plastic bottles or similar



The *tupuci* can then be used as a sauce in cooking. It is seasoned with salt, black peppers, chillies, garlic leaf or garlic, coriander, pepper and salt and reduced down through boiling until it becomes syrupy. It can be served with meat, fish or seafoods (Campos et al., 2016; Embrapa.br, 2018).

## Tiquira

*Tiquira* is a strong alcoholic spirit/liqueur. *Tiquira* is produced mainly in the north region of Brazil. It is a time-consuming artisanal enterprise as such new processing methods are being adopted to increase the speed of production and its quality without impacting on its sensory characteristics. *Tiquira* is the only fermented beverage made from cassava which is regulated by Brazilian legislation.

In the traditional method of cassava spirit production:

1. Wash and peel the roots
2. Grate the root into a wet pulp
3. Shape the wet pulp into large balls (of a diameter of about 30 cm and 3 to 4 cm thick) and flatten
4. Toast the flatten dough in an oven or in a pan (also called *beijus*)
5. The toasted *beijus* are left to mould naturally for several days in a place with high humidity and temperature – water is sprinkled regularly to promote mould growth.
6. Mix the mouldy *beijus* with water
7. Ferment for a minimum of 8 days
8. Distil
9. Package and label.

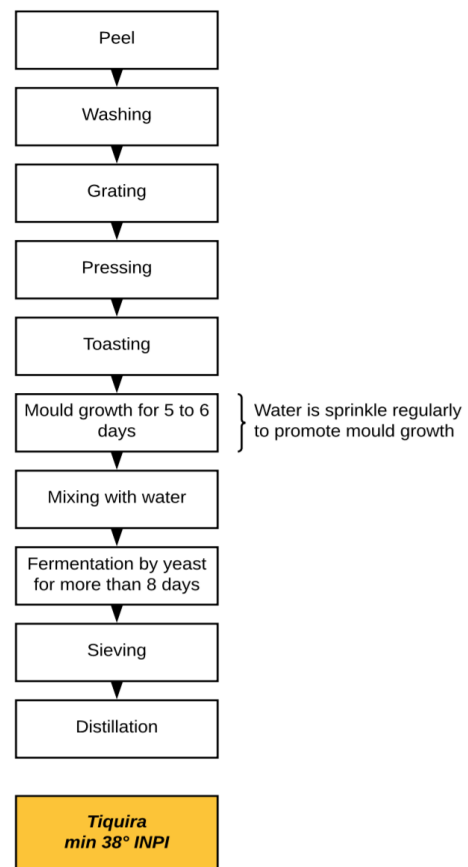


Figure 3 Tiquira production process (adapted from Cereda and Brito, 2016)

## UNFERMENTED PRODUCTS

Freshly harvested cassava roots, free from damages, should be used for making the following products. The roots should ideally be harvested on the day of processing or the day before.

### Unfermented Gari / *Farinha de mandioca*

Gari and *Farinha* are similar in terms of the process steps used at the exception of the fermentation which does not happen in the case of *farinha*. *Tupuci* is for example the fermented by-product of the flour processing (Embrapa.br, 2018).

The traditional production of *farinha* consist of:

1. Washing and peeling the roots
2. Grating the peeled cassava into a wet pulp
3. Pressing
4. Screening (optional)
5. Roasting into a large pan
6. Sieving
7. Packaging, labelling and storing the product.

### *Beijus*/Cassava flatbread

*Beijus* are similar in shape to large pancakes or flatbread.

There are 2 production methods. The roots are grated and pressed, the wet pulp is then shaped into balls and flatten or they are made with starch which has been rehydrated with water (1 part starch, 2 parts water). The paste is then lightly toasted in an oven or in a pre-heated hot pan.

Recently, innovation in the production methods of *beijus* has allowed to create coloured and flavoured *beijus* by replacing the water used to make the dough with either fruit or vegetable juices. For vegetable flavour, consumer acceptance revealed a preference for *beijus* made with beet and onion. In the case of fruit flavoured *beijus*, preference were for the ones prepared with guava, passion fruit and pineapple juice (Motta, 2012).

*Beijus* are used as precursors for *tiquira*, a fermented cassava liqueur.

### Fried Cassava/Cassava fries/cassava chips

Fried Cassava, or *Mandioca Frita*, is a simple and popular Brazilian. They must be pre-cooked before being fried to ensure they are safe for consumption.

The traditional process consists of peeling and cutting the cassava root into pieces and boiling it for at least 10 mins or until the pieces are soft. The pieces are then dried before being placed in a frying pan containing hot oil until the pieces are crispy and turned golden.

The pieces can be cut thinly, like French fries, before being fried (Filho et al., 2013).

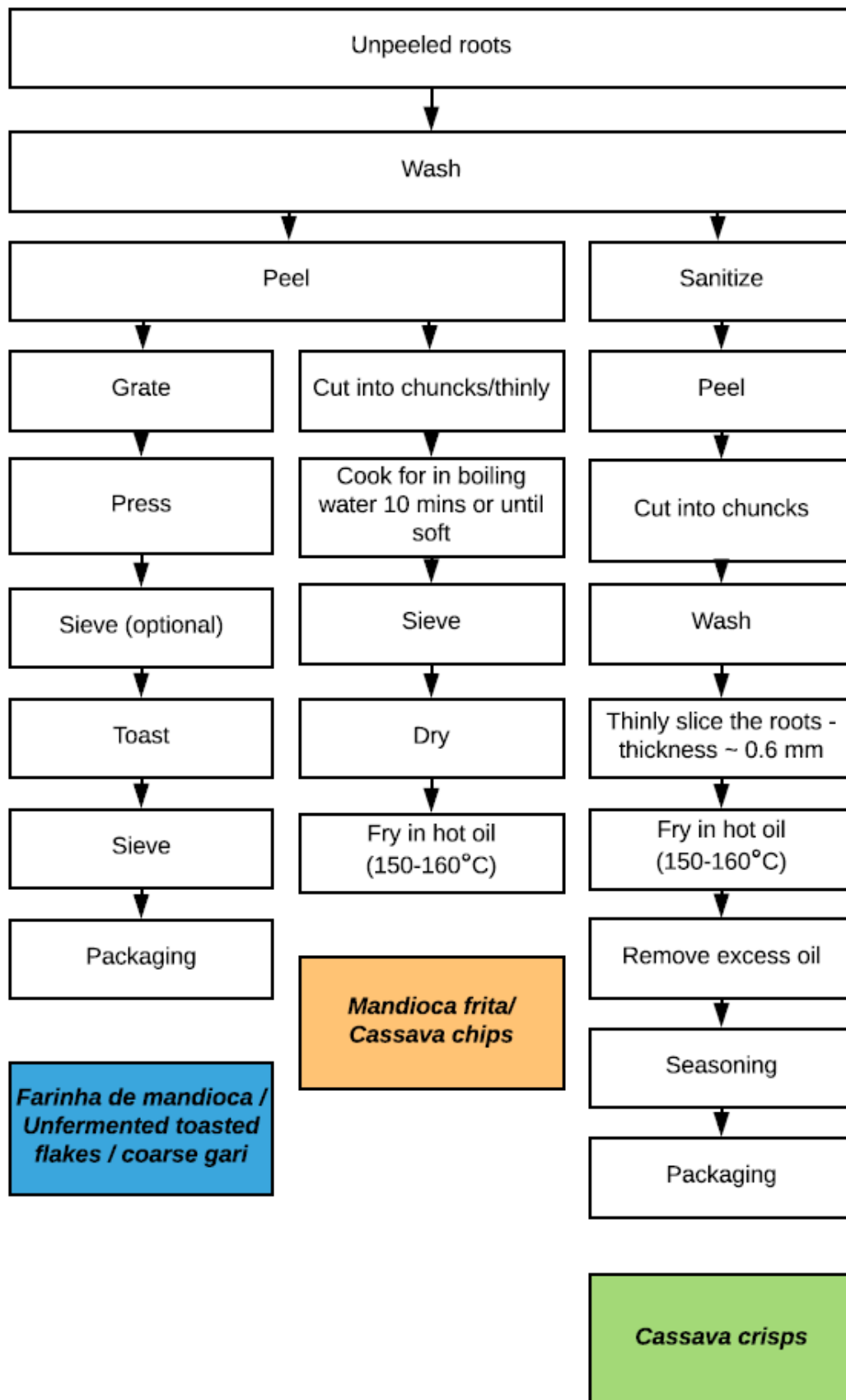


Figure 4 Unfermented products

## Cassava crisps

Like other roots and tuber, cassava can be transformed into chips. The thickness of the slices and the quality of the oil used will have a critical impact on the finished product (Oliveira and Godoy, 2011, 2010).

The process is as follow (Oliviera et al., 2016)

1. Washing of the roots to remove impurities, ideally with a brush
2. Sanitizing (200 ppm active chlorine for 15 minutes)
3. Peeling and cutting of the root into large chunks, removing the central fibre.
4. Washing of the peeled roots to remove any remaining peel and foreign matter
5. Thinly slicing of the roots – thickness ~ 0.6 mm
6. Frying of the slicing in hot oil (between 150°C to 160°C) until golden brown.
7. Removing the excess oil with absorbent tissue or centrifugation.
8. Seasoning – with salt or other flavourings
9. Weighing and packing in MAP / foiled packaging
10. Label – Shelf-life of about 10 days.



## POPULAR FOODS MADE FROM CASSAVA

The most popular goods made from cassava are Pão de queijo (cheese bread) and Biscoitos de polvilho azedo (puffed biscuits). Other sweet baked items such as Bolo de Macaxeira (Brazilian Cassava Cake), Carimã cake and Tapioca pudding are very common.

### *Pão de queijo /Cheese bread*

*Pão de queijo* is a very popular snack eaten, consumed at different time of day, in Brazil. It is made with sour starch.

The ingredients for the basic recipe are:

- 500 grams of sour starch
- 250 ml of milk
- 125 ml of oil
- 1 egg
- 1 pinch of salt
- 150 g grated cheese

The sour starch and salt is mixed with the boiling water and the warm water. The milk and oil are heated to the boil. They are then added to the sour starch dough and mixed up together. The egg is added and stir until smooth. Half of the cheese is added to the mix. With greased hands with oil, cut off some of the dough and shape it as a ball. Arrange them in a greased tray dish. Add the remaining cheese on the balls. Preheat the oven to 180 degrees and bake for 15 to 20 minutes (Tudogostoso, 2018a).

### *Puffed biscuits/Biscoitos de polvilho azedo*

*Biscoitos de polvilho azedo* are very popular savoury snacks made with sour starch as its main ingredients. They come in different shapes: ring, straight between 10 and 15 cm long or as a ball. They can be flavoured with fennel seeds or cheese.

The ingredients for the basic recipe are:

- 500 g of sour starch
- 200 ml of boiling water
- 150 ml oil at room temperature
- 5 eggs
- salt

The sour starch, salt, boiling water and oil are mixed well. Each egg and then added one at a time, until a consistent smooth dough is formed. The dough is transfer into a piping bag and piped onto a tray. Alternatively, the dough can be shaped by hand. The dough is baked in a preheated oven (180 ° C) for 25 minutes (Tudogostoso, 2018b).

### *Farofa*

Farofa is a similar to gari and is made with coarse cassava flour and toasted with butter. Meat, spices and other foods can be added to flavour the dish.

## REFERENCES

- Allem, A. C. (2002) The Origins and Taxonomy of Cassava, In Hillocks, R. J., Thresh, J. M., and Belloti, A. C. (eds.), *Cassava Biology, Production and Utilization*, Oxon, CABI Publishing, 1–16.
- Bechoff, A. (2017) Use and nutritional value of cassava roots and leaves as a traditional food, In *Achieving sustainable cultivation of cassava Volume 1: Cultivation techniques*, Cambridge, UK, Burleigh Dodds Science, 33–55.
- Campos, A. P. R., Carmo, J. R., Carvalho, A. V. and Mattietto, R. A. (2016) Avaliação Da Qualidade Do Tucupi Comercializado Na Cidade De Belém – Pa A.P.R., In *XXV Congresso Brasileiro de Ciencia e Tecnologica de Alimentatos*.
- Cereda, M. P. and Brito, V. H. (2016) Fermented Foods and Beverages from Cassava (*Manihot esculenta* Crantz) in South America, 55(67), 192–213.
- Diop, A. (1998) *Storage and Processing of Roots and Tubers in the Tropics*, Food and Agriculture Organization of the United Nations Agro-industries and Post-Harvest Management Service Agricultural Support Systems Division, [online] Available at: <http://www.fao.org/docrep/X5415E/x5415e00.htm#Contents> (Accessed 8 March 2018).
- Embrapa.br. (2018). *Pesquisa estabelece protocolo de segurança para a fabricação de tucupi*. [online] Available at: <https://www.embrapa.br/busca-de-noticias/-/noticia/25540013/pesquisa-estabelece-protocolo-de-seguranca-para-a-fabricacao-de-tucupi> [Accessed 22 May 2018].
- Falade, K. O. and Akingbala, J. O. (2010) Utilization of Cassava for Food, *Food Reviews International*, Taylor & Francis Group , 27(1), 51–83.
- FAO (2017) *Biannual report on global food markets*, *Food Outlook*, Rome, [online] Available at: <http://www.fao.org/3/a-I8080e.pdf> (Accessed 10 November 2017).
- FAOstat (2017) Food and Agriculture Organization of the United Nations. FAOSTAT Statistics Database., [online] Available at: <http://www.fao.org/faostat/en/#home> (Accessed 14 November 2017).
- Filho, J. R. F., Silveira, H. F. da, Macedo, J. J. G., Lima, M. B. and Cardoso, C. E. L. (2013) *Cultivo, processamento e uso da mandioca, instrucoes practicas*, 1st ed, Brasilia, DF, Brazil, Embrapa.
- Latif, S. and Müller, J. (2015) Potential of cassava leaves in human nutrition: A review, *Trends in Food Science & Technology*, 44(2), 147–158.
- Montagnac, J. A., Davis, C. R. and Tanumihardjo, S. A. (2009a) Nutritional Value of Cassava for Use as a Staple Food and Recent Advances for Improvement, *Comprehensive Reviews in Food Science and Food Safety*, 8(3), 181–194.
- Montagnac, J. A., Davis, C. R. and Tanumihardjo, S. A. (2009b) Processing techniques to reduce toxicity and antinutrients of Cassava for use as a staple food, *Comprehensive Reviews in Food Science and Food Safety*, 8(1), 17–27.
- Motta, J. da S. (2012) *Beijus Coloridos - preparados com frutas e hotilicas*, Cruz das Almas, Embrapa.
- Oliveira, L. A. De and Godoy, R. C. B. De (2010) *Chips de Mandioca*, Cruz das Almas, Embrapa.

Oliveira, L. A. De and Godoy, R. C. B. De (2011) Circular Técnica 101 - Mandioca Chips, *Circular técnica 101*, 6.

Oliviera, L. A. de, Reis, R. C., Santana, H. M. and Santos, V. da S. (2016) Snack de mandioca a partir da variedade BRS Jari, Embrapa.

Tudogostoso (2018a) TudoGostoso - Onde nascem todas as receitas [online] Available at: <http://www.tudogostoso.com.br/receita/13576-pão-de-queijo-com-polvilho-azedo.html> [Accessed 22 May 2018].

Tudogostoso (2018b) TudoGostoso - Onde nascem todas as receitas [online] Available at: <http://www.tudogostoso.com.br/receita/134285-biscoito-de-polvilho-assado-facil.html> [Accessed 22 May 2018].

Tomlins, K. and Bennett, B. (2017) New uses and processes for cassava, In Hershey, C. H. (ed.), *Achieving sustainable cultivation of cassava Volume 1: Cultivation techniques*, Cambridge, UK, Burleigh Dodds Science, 89–98.