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# THE PROCESS OF PRODUCTION OF CASSAVA DERIVATIVES FROM THE VIEWPOINT OF THE "WATER LAW"

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**ABSTRACT**

This article aims to verify how the "Water Law" can be applied in the process of production of cassava derivatives, in order to ensure the availability of water resources within the quality standards appropriate to the respective uses. The research was divided in 4 phases: bibliographic survey; consolidation of a manufacturing model; identification of effluents and application of the "Water Law". As a result, it can be observed that the production of cassava derivatives directly affects the available water resources through the emission of their effluents (I and II). It was also observed that the instruments listed to achieve the objectives of the "Water Law" act in a systemic way, regulating the use of water resources in terms of quantity and quality.



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## INTRODUCTION

Cassava (*Manihot esculenta Crantz*) is produced in more than 100 countries, recording average growth of 13.9% over the last five years and reached 242 million tons in 2017. Nigeria was the country with the largest world production, with 45 million tonnes, followed by Thailand with 30.1 million tonnes and Brazil accounting for 26.6 million tonnes (ANA, 2017). A large part of this production, approximately 60%, is destined for the production of products derived from cassava. From this processing, liquid effluents are generated and, at some point, they will be discharged into rivers / lakes and could compromise water resources if they are not treated. On January 8, 1997, it was enacted Law No. 9433, which established the National Water Resources Policy (PNRH) in Brazil and created the National System of Water Resources Management (SINGREH). The law became known as the Water Law of Brazil and completely changed the paradigm of water resources in the country, raising water to a higher level in national public policy priorities (BRASIL, 2010).

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The objectives of the PNRH are:

- I - assure the current and future generations of the necessary water availability, in quality standards appropriate to their respective uses;
- II - the rational and integrated use of water resources, including water transport, with a view to sustainable development;
- III - prevention and defense against critical hydrological events of natural origin or arising from the inappropriate use of natural resources.
- IV - to encourage and promote the abstraction, preservation and use of rainwater (BRASIL, 2010).

To achieve these objectives, the PNRH uses the following instruments:

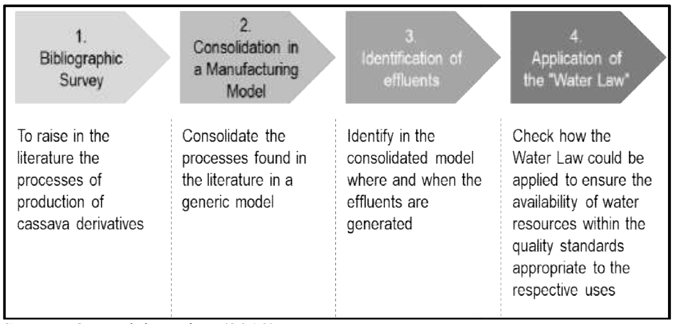
- I - the Water Resources Plans;
- II - the classification of bodies of water into classes, according to the prevailing uses of water;
- III - the granting of rights to use water resources;

IV - charging for the use of water resources;
V - compensation to municipalities;
VI - the Information System on Water Resources (BRASIL, 2010).

Thus, the purpose of this paper is to verify how the "Water Law" can be applied in the production process of cassava derivatives in order to ensure the availability of water resources within the quality standards appropriate to the respective uses.

## MATERIALS AND METHODS

This work is characterized as a bibliographical research. We searched the literature for the manufacturing processes of cassava derivatives in order to identify when the effluents are generated. Once identified, it was verified how the Water Law could be applied to ensure the availability of water resources within the quality standards appropriate to their respective uses. Figure 1 outlines the methodological process of this research.




Source: Own elaboration (2019)

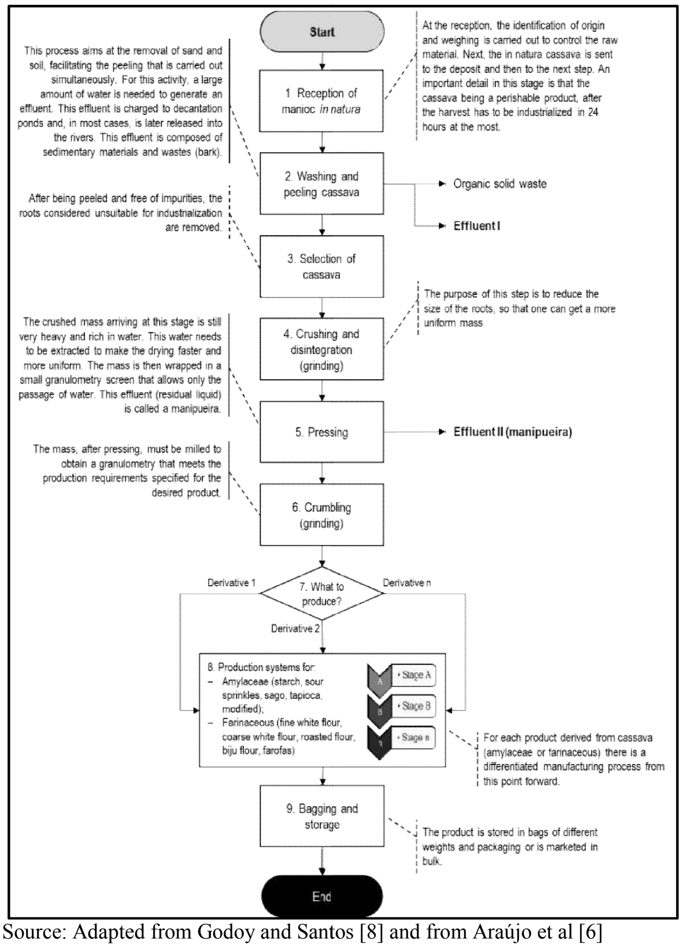
**Figure 1. Method used in the research**

**The process of production of cassava and its effluents**

According to ABAM - Brazilian Association of Cassava Starch[i] (ABAM, 1999), the products derived from cassava can be divided into:

a) Amyláceos - consisting of starch, sour sprinkles, sago, tapioca, modified;
b) Farinaceous - consisting of white flour (fine and coarse), roasted flour (yellow), biju flour (flakes), farofas.

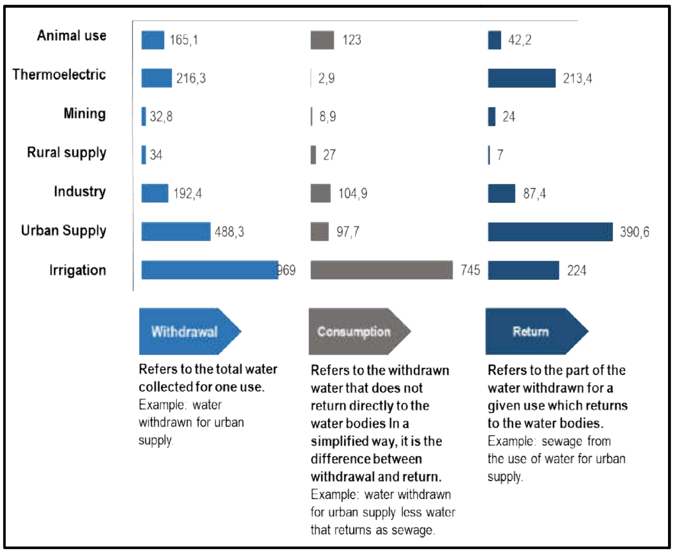
Analyzing the works of Godoy and Santos (Godoy, 2004), and Araújo et al. (de Araújo, 2014), it was possible to consolidate the manufacturing process of cassava in 9 phases, regardless of the derivative to be produced. These 9 phases are listed in: 1 - reception of cassava in natura; 2 - washing and peeling cassava; 3 - selection of cassava; 4 - grinding and disintegration (grinding); 5 - pressing; 6 - crumbling; 7 - production decision; 8 - production system of each derivative; 9 - Bagging and storage. These phases are described in the flowchart outlined in Figure 2. A critical point identified early in the process refers to the time between the harvest of cassava and its arrival at the factory. Because it is a perishable product, this period can not exceed 24 hours (de Araújo, 2014; Fioretto, 2001 and Godoy, 2004). For this reason, the factories are located close to the regions of the raw materials. With regard to the generated effluents, "Effluent I" is a result of the residues from the manioc washing, whose waters are filled with small barks, particles, sand and soil. This effluent must be conditioned according to the legal regulations (CONAMA Resolution 20/1986), where, to be released directly or indirectly into the bodies of water, sedimentable materials must be less than or equal to 1 ml / liter in a 1-hour cone test Imhoff (BRASIL, 1986). "Effluent II" is a liquid residue from the pressing of cassava and is known by the name of manipueira. This effluent presents a high content of organic material and therefore requires treatment so that it can be released into the external environment without causing damage to the environment and affecting the quality of water resources (BRASIL, 2010; de Araújo, 2014; Fioretto, 2001 and Godoy, 2004). The pollution generated by this "Effluent II" is directly linked to its high BOD (Biochemical Oxygen Demand) load and the presence of hydrocyanic acid in its composition, which, due to its toxic effect, differentiates this residue from other agroindustrial residues (Godoy, 2004 and Alves, Alves, 2017). Every 3 kilos of grated and pressed mass is generated 1 liter of manipueira and 1 ton/day of the waste causes a pollution equivalent to a population of 230 to 300 inhabitants/day.




Source: Adapted from Godoy and Santos [8] and from Araújo et al [6]

**Figure 2. Consolidated flowchart of the manufacturing process of cassava derivatives**

**Water resources in Brazil:** The Brazilian territory contains about 12% of all fresh water on the planet. Altogether, there are 200,000 microbasins in 12 hydrographic regions, such as the São Francisco, Paraná and Amazon basins (the latter the most extensive in the world and 60% in Brazil). It is an enormous water potential, capable of providing a volume of water per person 19 times higher than the minimum established by the United Nations - of 1,700 $m^3/s$ per inhabitant per year (ANA, 2017). Despite this abundance, Brazilian water resources are neither inexhaustible nor well distributed. Water does not reach everyone in the same quantity, quality and regularity: the geographic differences of each region, the effluents discharged along the course and the river flow changes caused by the climatic variations during the year affect the distribution. Another point is the indiscriminate use of both surface waters as the underground. Figure 3 shows the demand for water by activity and purpose (withdrawal, consumption and return) in Brazil in 2016. Note that the activities that consume the most are: irrigation - 67.2%; animal use - 11.1%; Industry - 9.5%; and urban supply - 8.8%. These activities together account for more than 95% of Brazil's water consumption.




Source: Brazilian water resources in 2017 [3]

**Figure 3. Demand for activity and purpose (withdrawal, consumption and return) in Brazil in 2016**

The withdrawal of water is subject to the regime of granting rights of use of water resources and aims to ensure the quantitative and qualitative control of water uses and the effective exercise of access rights to water. Once granted, the uses of water resources will be charged with the purpose of recognizing water as an economic good and giving the user an indication of its real value (BRASIL, 2010). After the water is withdrawn, it will be consumed and later part of it will be returned to the water bodies. This return must be monitored to ensure the quantity and quality of this resource. Monitoring water quality allows the characterization and analysis of trends in river basins. There are several ways to assess the water quality of a water body. Physico-chemical and biological parameters of water samples collected in rivers and reservoirs are widely used as indicators of water quality. In Brazil, the levels and concentrations of several indicators in water are used as reference for the classification of water bodies according to water quality classes[ii] (ANA, 2017; BRASIL, 1986 and BRASIL, 2010). The Biochemical Oxygen Demand (BOD) indicates the amount of oxygen consumed in biological processes of degradation of organic matter in the aquatic environment. It is, therefore, an indicator of the organic loads in the water bodies. Organic loads from untreated domestic sewage have a strong influence on BOD increase, especially in small rivers and streams with limited self-purification capacity. Industrial effluents may also contain high organic loads, depending on the processes involved. In both situations, the BOD levels can be reduced with adequate effluent treatment and control (ANA, 2017). The dissolved oxygen (DO) concentration in water is essential for the life cycles of fish and other aquatic organisms and for the proper functioning of ecosystems. OD levels indicate the health of these ecosystems, since oxygen is involved in virtually all chemical and biological processes. The extreme deficit of OD can lead to "death of the river", where we can no longer observe the most obvious life forms. OD levels in water also indicate contamination by organic loads and are therefore generally related to BOD. The release of organic loads results in increased consumption of OD by aerobic microorganisms during the stabilization process of organic matter (ANA, 2017). The turbidity reflects the interference of suspended materials in the passage of light through the water. It is, therefore, a good indicator of the amount of suspended solids and, consequently, of erosive processes in the river basin (ANA, 2017).

**The effluents from the cassava production process and the "Water Law":** "Effluent I" is rich in cassava peels, small particles, sand and soil that can directly affect the turbidity of the water as well as interfering in the BOD and OD indices, since the suspended manioc peels are organic materials and their degradation by biological process, consumes oxygen from the aquatic environment. The "Effluent II" (manipueira) presents in its composition high content of organic material (demanding a high BOD load) and the presence of hydrocyanic acid. Both effluents must be treated before being dumped into the water bodies so that there are no sanctions from environmental bodies and water committees and water quality levels can also be guaranteed.

The application of the "Water Law" in the cassava manufacturing process is related to the following items:

- Water resources plans - are master plans that aim to inform and guide the implementation of the National Water Resources Policy and the management of water resources. In this plan, two items are important: the diagnosis of the current situation of water resources (current framework of water resources) and; the goals of rationalization of use, increase of quantity and improvement of the quality of available water resources. The use of water in the cassava production process and, subsequently, the issuance of fluids should not compromise the implementation of the master plan.
- Classification of water bodies into classes - the eviction of the production of cassava-derived effluents can not modify the frameworks of water bodies. This framework is based on CONAMA Resolution 357;
- Granting of rights to use water resources - the objectives of the grant are to ensure the quantitative and qualitative control of water uses and the effective exercise of access rights to water. In the production of cassava derivatives, the grant will only be applied for the generation of "Effluent I" (lavage). "Effluent II" (pressing) does not require water consumption.
- Charging for the use of water resources - the user must be given an indication of their real value in order to recognize water as an economic good so that they are encouraged to use water rationally. The charge will only be applied on the water that is used in the washing of the manioc in natura, generating later "Effluent I". The collection takes into account the mitigating actions that are taken to treat the effluents.

## Conclusions

This work aimed to verify how the "Water Law" can be applied in the manufacturing process of cassava derivatives in order to ensure the availability of water resources within the quality standards appropriate to the respective uses. As a response, it can be observed that the production of cassava derivatives can directly affect the available water resources through the emission of their effluents (I and II), making it essential to apply the "Water Law" to ensure the current and future generations, the necessary availability of water in quality standards appropriate to their respective uses. It was also observed that the instruments listed to achieve the objectives of the law act in a systemic way, regulating the use of the water resource in terms of quantity and quality. The director's plan defines the framework of water bodies and the quantity available for concession that, in turn, will feed the collection system, taking into account the mitigations used in the effluent return process.

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[i] ABAM also brings together machine manufacturers, researchers and flour producers.

[ii] The framing of water bodies Resolution CONAM 357, of March 17, 2005.

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