

THE SWEET POTATO SUPPLY CHAIN FOR THE MANUFACTURING PROCESS OF FLOUR

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ABSTRACT

This article discusses the supply chain management of sweet potato flour as a tool to analyze the characteristics of the sectors involved in the production process, and allows the identification of strengths and weaknesses along this chain. The methodology employed was analysis of the productive chain for case study, conducted through interviews persons belonging to various links in the supply chain, seeking to identify how it works and how it organizes the chain of sweet potato flour in the State of Sergipe. The results of this study indicate that for the location from where it's produced the sweet potato it has great economic representativeness, the sweet potato flour came in an innovative way for the cooperative of family agriculture in Moita Bonita/SE. To view all links in the chain of production of sweet potato flour you can see clearly the cooperative prioritizes for offering a final product focusing on quality, reliability and nutritional value that the product will provide its clients finals.

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INTRODUCTION

The companies aim to improve the competitive strategies to ensure a standard on all your sectors, securing your perfect operation, to analyze a supply chain the goal is that each stage is in line, in order to ensure the quality of your final product. When the standard of quality decreases on a chain link this fact can probably reflect in every chain (POTER, 2011). To studying the supply chain of the sweet potato flour it's necessary to analyze the production of raw materials, the sweet potato. In this sense, will be addressed issues related to the supply chain of the sweet-potato flour, with a focus on the production of sweet potatoes.

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In the State of Sergipe agricultural activities are strongly linked to the production of sweet potatoes as generation of employment and income for many farmers. The analysis of the supply chain of the sweet potato flour was driven by the potential that this product has to be a candidate for a geographical indication. To receive the certification of a geographical indication the entire production process of the product must be known and well characterized, showing your characterization and differentiation that makes them candidates for a geographical indication, so the configuration of the supply chain of sweet potato flour it's done necessary. With the description one can understand the foundations of the process seeking to understand the standardization of the product and highlighting local and regional specificities. With certification by a geographical indication you can obtain in all links in the supply chain a harmonic distribution, balanced, where the consumer is aware of the origin of the product you are purchasing, the producer knows where your product is

intended, avoiding the opportunism between the links in the chain (RANGNEKAR *et al.*, 2004). Products with certification by a geographical indication have characteristics that differentiate them from other products, this differential can be given by handmade, as family farming differs from the industrial production. With the changes of consumer profiles, where there's an appreciation of the origin of the product, these certified features become attractive. In this scenario it's necessary to formulate the following hypothesis: The diagnosis of the supply chain of the sweet potato flour will provide the characterization of the sectors involved in the production process, In addition to permit the identification of strengths and weaknesses along this chain. The main purpose of this article is to analyze the chain of sweet potato flour in order to characterize the sectors involved in the whole process of production of this.

MATERIALS AND METHODS

It's necessary a previous review of the literature concerning the themes that make up this research. First issues related to sweet potatoes and then on the supply chain.

The culture of sweet potato: Sweet potatoes have owned scientific name *Ipomoea* potatoes, the history of distribution of this root path is reported first in Peru there are approximately 8000 years before Christ (BC), it's noted that a traditional food throughout tropical America 1000 BC. The sweet potato crossed the Pacific and New Zealand in the 14th century, at the beginning of the 16th century was exported to Spain then the Philippines and to the Indies, with the hunger crisis in China, The sweet potato has been incorporated into the menu as food security feed, it was the Portuguese through the slave traders who took this food to Africa, in the 18th century it arrives in Japan coming from China (LEONEL, CEREDA, 2002). According to data from FAOSTAT (2016) the sweet potato culture is among the 10 with the highest production and world importance losing in quantity to the wheat, rice, corn, potatoes, barley and cassava.

The cultivation of sweet potatoes occurs throughout the Brazilian territory, being the Southern region with higher production followed by the Northeast, it's a rustic plant tolerant to dry climate. Stands out from the other vegetables for its nutritional value, which may be amended according to the region planted, because of climate differentiation, planting method and harvesting (SILVA, 1995). The specificity of soil for the cultivation of sweet potatoes is varied, who have better adaptation are deep soils, moderately fertile and franco-sandy, which can produce more robust roots with high quality reserve, planting beds require proper drainage and soil ventilation. Fertile soils provide improved roots, however nitrogen-enriched soils provide intensified growth of the leaves of this culture and atrophying the roots. The strengthening of the soil can be accomplished by making use of the foliage of the previous harvest or animal manures (LIN *et al.*, 2018 e MU *et al.*, 2017). For family agriculture, one of its obstacles can be considered the scarcity of labor, with in such cases sweet potatoes can be planted in flat beds, planting takes place through the Rama Rama sweet potatoes with, of at least 20 cm in length, with spacing between the branches of 25-30 cm, this space control makes it change the size of the roots, when they are planted more closely the plant produces a larger number of smaller-sized roots, which may be requested as a preference for some purchasing sector (LIN, *et al.* 2018 e MU *et al.*,

2017). The time of sweet potato growth, varies from 4 to 5 months, not withstanding high temperatures above 35 °c not being resistant to temperatures below 15 °c. The harvest period is flexible, can be harvested as needed, leaving what is not needed still on the ground, not recommended in high periods of drought. In this way it is possible to control the harvest according to the needs that may be climatic variations, market demand, economic appreciation of the product or even availability of labor (CARVALHO e MU *et al.*, 2017). Many benefits are related to daily consumption of sweet potatoes, currently related to gaining muscle mass and appetite control, this tuber still has antioxidant action, improves immunological functionality, assists in the control of diabetes, can contribute to lowering cholesterol and assist in better digestion. With so many benefits it is clear importance to include the sweet potato in the diet of the population, since, evidenced that independent of the baking method presents sources of nutrients important to the health of the human being (VELHO, 2016).

In the state of Sergipe, the cultivation of sweet potatoes presents high socioeconomic importance, according to data from IBGE is the state with the highest production and productivity of culture in northeastern Brazil. The sweet potato presented itself as the most prominent culture at the national level. In the Northeast region represented more than ¼ of production. In the state ranking of the municipalities producing the tuber, Itabaiana occupies the 1st place and Moita Bonita occupies the 5th place, with a production of 22,400 and 11,650 tonnes respectively, the equivalent of 84.55% of the state production (IBGE, 2016). The Brazilian population demonstrates science to the benefits provided to health by sweet potato, a fact observed by the increase in the consumption of greenery. According to information taken from the Brazilian Institute of Geography and Statistics (IBGE) sweet potato production in the last 5 years has been increasing on average, approximately 9% a year. In the ranking of the main Brazilian vegetables is in sixth place, losing to tomatoes, potatoes, watermelon, onions and carrots. Sweet potato has a significant role in exporting being exported more than 20000 tonnes (CARVALHO, 2017).

Supply chain: Some definitions on supply chain can be observed in table 1. When a productive chain is characterized, it must be taken into account the final product relationship, visualizing all the links as a single institution, without divisions of sectors, the structure of a supply chain can be observed in Figure 1 (BRISTOT, 2008). According to Castro (2002) there has been an evolution in agriculture by viewing it as an agribusiness, so it can be analyzed as a large national system focused on the production of agricultural products and segmented in more specific purposes subsystems, the productive chains, it offers excellent opportunities to increase knowledge about the performance of these systems. From that expanded knowledge, it's possible to draw more realistic strategies for its management. The joint efforts of members of a productive chain represent collaborative activities to support decision-making for planning, implementation and evaluation of the entire evolutionary process of your product. By conducting a planning of joint activities is aimed at collective objectives in order to achieve effective and efficient results. All activities along the supply chain are relevant in the representation working together for continuous improvement (DANIA, XING, AMER, 2018). It can be analyzed that with the effort together it is possible to overcome the limitations that exist in the productive chain.

Another important factor present in the supply chain is the collaborative behavioral factor, the sharing of activities covers any possible benefit, include sharing information, and resources, that lead to construction. In supply chain of sweet potato flour It is observed that the main asset shared with this exchange can be emphasized the importance as ways to reduce the risks of misunderstandings and communication failures (DANIA, XING, AMER, 2018).

RESULTS AND DISCUSSION

This research used a case study, including qualitative and quantitative data, to obtain the analysis of the sweet potato supply chain, conducting a bibliographical review on the subject, as well as field work with interviews with all the links of Chain. The research was carried out in the cooperative of production of family agriculture and solidarity Economy of the municipality of Moita Bonita/SE (Cooperafes Moita Bonita), where it was held interview with the Executive director, and producers linked the cooperative to the Identification and analysis of the supply chain of sweet potato flour. Exploratory research was carried out to familiarize themselves with the supply chain of sweet potato flour, the municipality of the Moita Bonita, Sergipe, seeking to identify and analyze the chain in the social and functional aspects. The Cooperafes of Moita Bonita, is a cooperative of family agriculture founded in October 2007, its table of cooperated initially was 31, currently counts with 75 people, mostly producers of sweet potato, the biggest focus of negotiation of the cooperative. This is part of the supply chain of sweet potato flour. When analyzing the IBGE data on the production of sweet potatoes in the municipality, it's understood that after the implementation of the cooperative there was a growth in the yields for the sweet potato, see Figure 3.

Cooperatives have been developing an important role in front of farmers, making the farmer's connection to the final consumer, contributing to the need to use intermediaries to sell their products, thereby facilitating the economy Agro (HOOKS, 2017). Family agriculture is of great importance in the agro-food economy of Brazil, formed by small and medium-sized producers with historical descent of Europeans and indigenous, due to the fact of the formation of the Brazilian population (MEDINA *et al.*, 2015). Family agriculture contributes to food security, representing more than 70% of agricultural resources, can safeguard cultural heritage as the traditions transmitted from generation to generation. Thus, in addition to contributing to the city of Moita Bonita/SE the cooperative contributes to the social environment working for food safety as also the protector of a great well that is the "know-how" or traditional knowledge maintained by the Cooperative workers (TOADER, 2015). The expectation of the city of Moita Bonita is that in the year 2017 the production of sweet potato has reached 50000 tonnes of Bata-sweet, the tuber, on account of the rainy year, obtained great vintage. The sweet potato agribusiness, represents 70% of the income of family agriculture. As can be seen in Figure 2, before the year 2003, according to IBGE data, the cultivation of cassava surpassed the production of sweet potatoes, currently reverted, farmers choose to produce the sweet potato that represents more than twice the production of cassava, this migration occurred according to the opinion of most cooperated by the fact of the growing time to be less than the cassava. In recent years there has been an increase in the production of sweet

potato, in the region of Moita Bonita/SE, farmers migrated from the production of cassava to sweet potatoes betting that would increase the profitability by the fact of planting time until the harvest of the sweet potato be smaller than the cassava. It's understood the influence that the cooperative has in the production of the municipality, because analyzing the figure 2 after the year of creation of the cooperative is that increased the production of sweet potato. With the change to the production of the municipality becoming more focused on the sweet potato is verified in Figure 3, that from the creation of the cooperative the value of the production of the root there was a growth and since then the expectation is of economic growth. Cooperafes sells its products to institutional markets, Walmart supermarket network in Bahia, Pedro Paes Mendonça Foundation, produce fairs and the federal government for school lunches. Developing innovations in agriculture makes it possible to establish a better position in the market by deciding on an innovation aimed at controlling the quality, or adding a better value to the product associated with innovation allowing a better income the negotiations glimpsing new niche markets (ZILBERMAN, REARDON, LU, 2017).

In the food sector the search to differentiate and innovate is increasing, in this sense it's understood that the cooperative innovated in creating a new product on the basis of sweet potato, fruit that the region produces on a large scale, it was decided to develop the flour of Sweet potato, also known as sweet potato powder (POTER, 2011). The sweet potato flour was created here in the state of Sergipe in the year 2015, the cooperative aimed at consumers who used it as accompaniments of dishes, due to its nutritional value, the flour was implanted in the school lunch, used in the preparation of cakes and accompaniment of dishes, for nutritional enrichment. The cooperatives involved in the productive chain of sweet potato flour hope that just as the tuber has won the public's thanks for its many benefits, flour will also conquer more and more consumers who seek to enhance the training of physical activities. In addition to the fresh product the cooperative produces from the sweet potato flour, acts as beneficiary, retailer and shopkeeper this product able to generate highly nutritious foods rich in beta carotene, Omega 3, fiber, vitamins and minerals. By studying the productive chain of the sweet-potato flour, identifies some sectors highlighted, the producers of the raw materials, the cooperative and the flour mill.

The basic raw material for the production of flour is sweet potatoes, where the cooperative in question does not consume the entire production of the cooperative members, requiring thus go over much of the production to middlemen who distribute the sweet potatoes to various parts of the Brazil. The best conditions for planting of sweet potato for producers related to cooperative is the land being irrigated to farmers who do not have irrigation system opt in plant between the months of March and May. Soil is treated by the cooperative members and their families, using tractor, with 47.4% hire one or more official to assist in the harvest. Seed system sweet potato producers use seedlings (branches), most of these are coming from the farmers themselves, when does not have the previous harvest quest with another producer of the region which have. Cooperafes's farmers choose to plant between crops of sweet potatoes by branches, using one to two branches for the grave, this fact also discussed by Mu *et al.* (2017) that it is recommended to use the two branches for grave, preserving the fact that requires a large number of

Table 1. Some concepts of supply chain (continues)

Author; year	Supply Chain Concept
(CARBAJAL, TOVAR, ZIMMERMAN, 2017)	Defines a chain as a production system that comprises a group of agents and commercial relations sequential relevant departments, and other elements that intervene in the process of development of a product from the primary sector to the end consumer, and including the services provided throughout the chain
(CASTRO; LIMA; CRISTO, 2002)	An agricultural supply chain would be composed of links that would encompass the organizations supplying basic inputs for agricultural or agroindustry, farms and agro with their productive processes, the marketing units Wholesaler and retailer and end consumers, all connected by capital flows, materials and information.
(PROCHNIK; HAGUENAUER, 2001)	A supply chain is a set of consecutive steps through which the various inputs are transformed and transferred.
(BRISTOT, 2008)	This comprehensive definition allows you to incorporate various forms of chains A set of sectors that contribute to the realization of an activity, having its Linked relationship, thus having interdependence between activities, where Transactions governed by contracts between agents
(BATALHA; SILVA, 2001)	"A company's sustained competitiveness can only be built under an equally competitive system as a whole

Table 2. The links of the productive chain related to the agents executing them

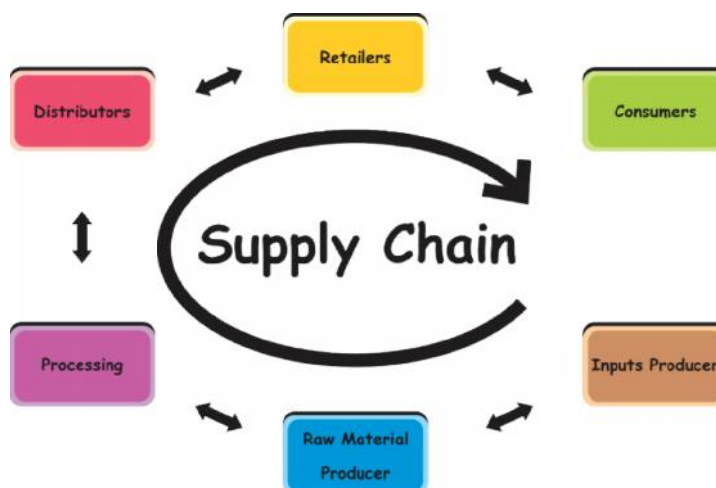
Links of the sweet potato flour supply chain	Agents
Inputs	Farmers Local shopkeepers Cooperative
Production	Group of farmers of family agriculture cooperated from COOPERAFS
Sweet potato processors in flour	Flour House of the municipality Campo do Brito/SE
Distributors	Cooperative
Retailers	Cooperative Natural Products Stores
Consumption	Consumers in general Municipal Schools for school lunches

Source: Prepared by the author

Table 3. The strengths and weaknesses of the supply chain can be observed

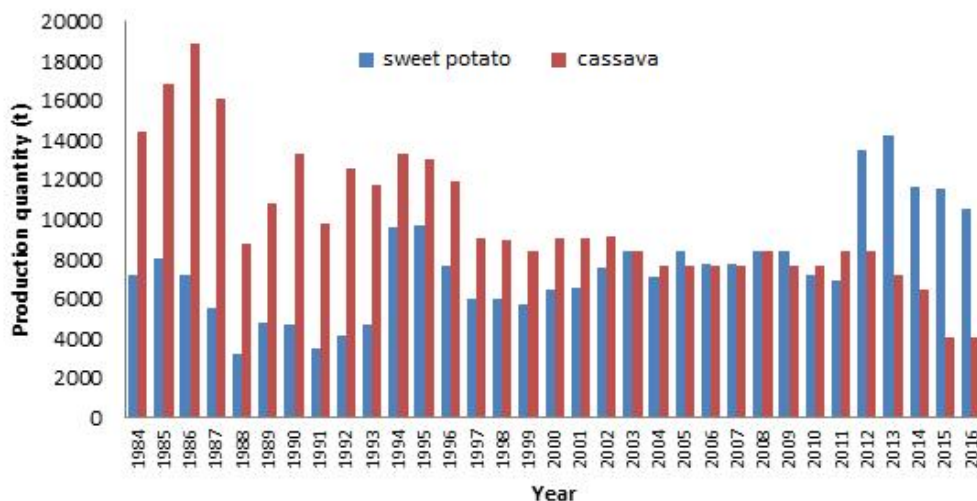
Strengths	Weaknesses
Large-scale production of raw material for sweet potato flour formulation Entrepreneurial and participatory management	Dissemination of the product should be increased There is no digital sale, with a sales site the flour could be resold to all over Brazil
The Cooperafes cooperative, as it strengthens family agriculture and agribusiness in the region of Moita Bonita/SE	The producers of the raw material are participatory in the cooperative, but show no interest in manufacturing and marketing sweet potato flour
Final product of high nutritional power and with many food applications	The flour House of this supply chain needs improvements in the quality standard to maintain the quality pattern in all other links
Product that values traditional knowledge of the region	

Source: Prepared by the author



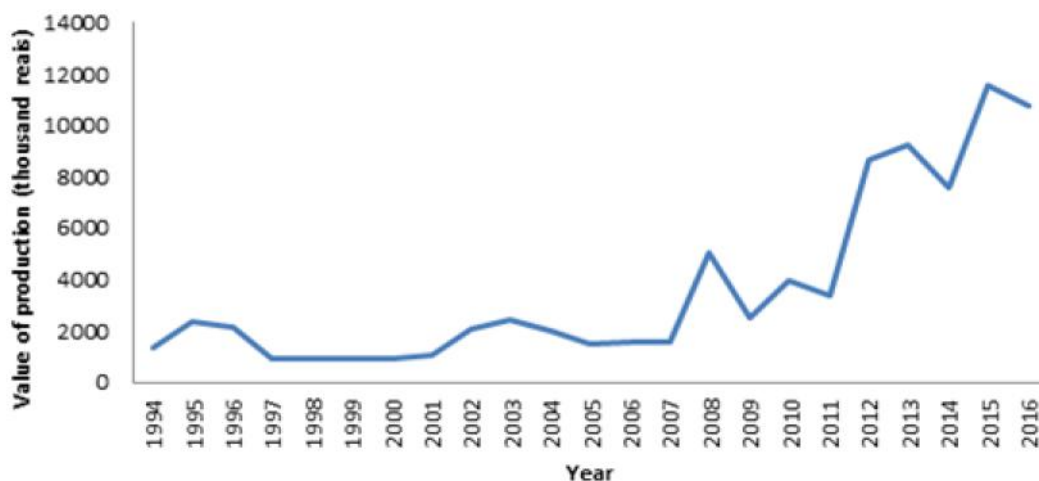
Source: Prepared by the author

Figure 1. Structure of a supply chain



Source: Prepared by the author

Figure 2. Distribution of the quantity produced of sweet potatoes and cassava in the Moita Bonita/ SE of the years 1984 to 2016 according to IBGE data



Source: Prepared by the author

Figure 3. Value of the sweet potato production of the municipality of Moita Bonita (thousand)

planting material if the number is not sufficient to carry out planting only with a. According to these authors, the sweet potato is often planted after other crops such as cereals, for soil turnover, it is not recommended to cultivate other roots because they same nutrients the sweet potatoes, in the case of cooperative members planting always carried out of sweet potatoes, always seeking to accomplish the fertilization to reinvigorate the soils with animal manure. The flour mill located in the town of Campo do Brito, is responsible for processing of sweet potato, is responsible for the production of cassava flour for various regions, the treatments for production of two types of flour are similar if differ from that in the case of the sweet potato is used raw material with the peel and the cassava is peeled, after washing the raw material is pressed and toast, the resulting flour is sieved and results in a little darker than the cassava flour but with distinctive flavor and aroma. The process of turning the sweet potato into flour (sweet potato powder), results in average a ratio of 5 to 7 kilograms of sweet potato is converted to one kilogram of flour. At the end of the process of converting sweet potatoes into flour, it is re-routed to the cooperative so that it's packed.

The packaging process is carried out in a simplified manner by cooperative employees, the following sizes are 250 grams, 500 grams and 2 kilograms. These are sold in the cooperative itself and also resold and distributed by cooperafes to shopkeepers, supermarkets and city Hall. The cooperative seeks with the effect of sweet potato flour on the market, in addition to the consolidation of the brand, recognition, generation of jobs, as well as a way to take advantage of smaller-sized vegetables that don't have resales and exploits of those They are beyond demand. When considering critical factors in a successful supply chain one should consider: Sustainable thinking, after all the food economy is responsible for approximately 29% of the effects of global warming, this fact becomes indispensable environmental concerns relevant. When analyzed the supply chain of sweet potato flour it's understood that its formation is of family agriculture, that by following traditions to aggression to the environment are reduced (SELLITTO, VIAL, VIEGAS, 2018). Heritage and cultural traditions, contradicting the growth of the industrialized, mass production, the "know how to do" of the supply chains make them enriching and differentiated, focusing on quality and tradition, this way gets gained in appreciation of the product and you gain recognition

of the region in which the product is inserted. The formation of the Cooperafes is consolidated by the family agriculture thus using the traditional knowledge of the region (SELLITTO, VIAL, VIEGAS, 2018). Cultural heritage is an immaterial asset incorporated in the production and consumption of foods highly associated with tourism (SELLITTO, VIAL, VIEGAS, 2018). Consumer Health show that the product of the supply chain is focused on consumer welfare, the consumption of healthy food rich in nutrients (SELLITTO, VIAL, VIEGAS, 2018). In table 2, the links of the sweet potato supply chain and its agents are summarized, as analyzed the inputs are made up of the supply of equipment, machines and fertilizers, in the case of sweet potato flour, are provided by local shopkeepers of Moita Bonita/SE, as well as by the cooperative itself and in the case of fertilizing animal manure are the farmers themselves who pass.

The production of the raw material is fully provided by the cooperatives belonging to the family agriculture of Moita Bonita/SE. The conversion of the raw material to flour is performed in the Flour house of the Campo do Brito/SE. Both the process of packing the flour and the distribution for sale is carried out by Cooperafes, which is also responsible for the sale to the final consumer, in addition to Distribute to shops, supermarkets and city Hall. The consumption can be done by all who are interested, as is already inserted in the school lunch some schools that receive use in the manufacture of cakes and other meals. One of the positive points when analyzing the supply chain of sweet potato flour is the growing demand for foods with low glycemic index, and the numerous reports and accounts of nutritionists and nutrition professionals recommending sweet potato to be inserted into the daily feed, the flour would come as an alternative to inserting this nutritious food. One of the points characterized as the differential of the links of the supply chain of sweet potato flour was the house of flour located in the municipality of Campo do Brito/SE, this weakens the chain for the precariousness and the lack of standards of appropriate qualities. As can be confirmed in Amorim (2017) that reports all the lack of hygiene necessary for the proper functioning of the flour houses and after a diagnosis reveals the need for actions to benefit the units, both in the structural and the hand of Work. An improvement observed would be greater dissemination through the media, digital selling points, and greater integration and participation of the producers of the sweet potato with the final product. Cooperafes seeks, in all the procedures and links of the supply chain of sweet potato flour, for a strong performance aiming to improve its processes, products and services, focusing on the reliability and quality of its products for consolidation in the market. In this case study one can understand the operation of the supply chain of sweet potato flour concerning the cooperative of the Municipality of Moita Bonita/SE of the state of Sergipe. In this chain there was a need for some improvements to the consolidation of the same in the market, that if a more defined division of functions is obtained, the relationship of the producers of sweet potatoes and the final product there is little interest, in return the cooperative It strives to maintain a close, competent and reliable relationship with the distribution of sweet potato flour to both the retailers and the final consumer.

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Conclusion

The creation of the Cooperative of family agriculture of Moita Bonita/SE it brought changes in the agricultural productions, left the focus of the municipality the planting of cassava and became the culture of the sweet potato, as the economic sector of the city is moved by agriculture, we see that COOPERAFES has an important influence role in the municipal economy, with increased jobs and reduction of the crossers contributing to the strengthening of family agriculture. There's a great productivity of sweet potatoes in the Moita Bonita municipality, which would be of great profit to increase the production of sweet potato flour. What can be proposed for this is to increase the dissemination and distribution of the product by digital and physical means. A possible improvement of the supply chain of sweet potato flour, could be the construction of the flour House of the cooperative itself or a partnership with a house of flour that would bind the cooperative to follow the same paths and goals; The flour produced by the cooperatives needs to gain strength to negotiate their production in better conditions, they must offer greater reliability to their customers, a geographical indication project can make the product more valued and reliable in Market. It was observed a clear and objective action well-coordinated by the pins of the production of sweet potato flour, participating in all the development along the studied chain. Despite the strong market interest in nutritional, specialized and differential foods, producers find a large and challenging distribution resistance to the market. The sweet potato agribusiness has a strong importance for the economy of the interior of the state of Sergipe. The agents of the supply chain of sweet potato flour bet on the quality of their product, in a critical view it is understood that one of the weaknesses would be the dissemination and sale of the product.

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