La Chamba: modelo de transformación industrial y desarrollo en la pos cosecha

Chamba: model for industrial transformation and post-harvest development

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RESUMEN

La Campomanesia lineatifolia es un fruto exótico nativo de la Amazonía, en Colombia conocida comúnmente como chamba o Champa se ha encontrado en el Chocó, Caquetá, Casanare, Cundinamarca y Boyacá, produciendo tan solo en Boyacá alrededor de 500 toneladas al año, de forma artesanal, principalmente en el municipio de Miraflores ubicado en la provincia de lengupa al suroriente del Departamento y en las poblaciones vecinas de Berbeo y San Eduardo. Este fruto se encuentra presente en la memoria de los adultos mayores y en el desconocimiento de las nuevas generaciones; su sabor y aroma sólo genera la nostalgia de los abuelos debido al riesgo de su extinción por la falta de un uso de cultivos sistémicos y altas brechas en las tecnologías en la cosecha y pos cosecha.

El Centro de Diseño y Metrología Regional Distrito Capital SENA, mediante la estrategia SENNOVA, fortalece e incentiva la cultura a la innovación y el desarrollo de proyectos que impacten el beneficio de comunidades, por esto propone una investigación en el campo tecnológico, alimentario y ambiental, donde se ha evidenciado una Brecha tecnológica en los modelos de transformación y envasado de los productos derivados de la chamba, específicamente en la fase de Pos cosecha.

El proyecto hace parte de la línea de innovación con impacto social y emplea una metodología de investigación aplicada, basada en métodos del diseño industrial, asociados con la valoración cuantitativa en visitas técnicas, con el fin de medir los hallazgos que se puedan generar mediante la caracterización del sector y un modelamiento tecnológico desde el diseño industrial y la metrología, en pro de incubar un impacto social en la comunidad productora. Debido al alto factor de desperdicio en el proceso de transformación del fruto (tan solo el 2% de la producción se aprovecha comercialmente), los métodos inadecuados de recolección de frutos, el bajo nivel de diseño industrial en los envases y la poca tecnología disponible para esta industria específica, son factores que limitan su expansión en el mercado regional, nacional e internacional. Este contexto dan origen a una pregunta problemática referente a; ¿Cómo disminuir la brecha tecnológica en el sector productor de la Chamba mediante el planteamiento de modelos de transformación y envasado de la pulpa en su post cosecha?

El presente documento, es el resultado de una investigación realizada en el departamento de Boyacá, con el propósito de conocer las características, procesos de transformación y desarrollo industrial del fruto Chamba en la pos cosecha, la muestra se obtuvo a través de información primaria utilizando un muestreo probabilístico. Se aplicaron encuestas y entrevistas como instrumentos para la minería de datos del proceso de la pos-cosecha, de la cadena de productiva y de distribución y de los productos derivados de la chamba.

Palabras Claves: *aislamiento de microalgas, Medio Conway,*

ABSTRACT

The Campomanesia lineatifolia is a native exotic fruit of the Amazon in Colombia commonly known as Chamba or Champa has been found in the Chocó, Caquetá, Casanare, Cundinamarca and Boyacá, producing only in Boyacá about 500 tons a year, by hand mainly in the municipality of Miraflores located Lengupá province in the southeast of the Department and in the neighboring towns of Berbeo and San Eduardo. This fruit is present in the memory of older adults and the lack of new generations; its flavor and aroma only generates nostalgia for the grandparents because of the risk of their extinction by the lack of a systemic use of crops and large gaps technologies in harvest and postharvest.

Design Center and Metrology, District Regional Capital SENA, through SENNOVA strategy, strengthens and encourages a culture of innovation and development projects that impact the benefit of communities, so proposes research in technology, food and environmental field where it has demonstrated a technology gap in models of processing and packaging of products derived from Chamba, specifically in the post-harvest phase.

The project is part of the line of innovation with social impact and uses a research methodology based on methods of industrial design, associated with quantitative assessment of technical visits, in order to measure the findings that can be generated by characterizing industry and technology from industrial design modeling and metrology, towards incubating a social impact on the farming community.

Due to the high waste factor in the process of transformation of the fruit (only 2% of production is commercially exploited), inadequate methods of collecting fruits, the low level of industrial design in packaging and low technology available for this specific industry, are factors that limit its expansion in the regional, national and international markets. This context gives rise to a question concerning problematic; How to reduce the technological gap in the production sector of Chamba by posing models processing and packaging of the pulp in the post-harvest stage?

This document is the result of research conducted in the department of Boyacá, in order to know the characteristics, processing and industrial development of the fruit Chamba in post-harvest, the sample was obtained through primary data using a probability sampling. surveys and interviews as tools for data mining process of the post-harvest chain of production and distribution and products derived from Chamba were applied.

Key words: Campomanesia lineatifolia, technological gap, postharvest.

INTRODUCTION

Chamba (Campomanesia lineatifolia R. & P., Myrtaceae family) grows at temperatures between 22 and 30ºC, with precipitations above 1.500 mm a year and requires clay-loamy soil (H. E. Balaguera, Álvarez, & Bonilla, 2009).

The tree is about 4,10 m tall. It displays a small, irregular, slightly ramified top, with thin, hanging branches. The trunk can measure up to 25 cm in diameter, thin and twisted. Brownish-gray, external bark organized in long, thin sheets and milky white internal bark. It displays simple leaves, opposite and without stipule. The sheet is membranous and either elliptic or slightly oval, 10-20 cm long and 8-11 cm wide; acute to cuspidate apex; round, truncated or subcordate base; penninerved, wavy edges; shiny, dark green top and light green undersurface with conspicuous veins. 6-15 mm long fluted petiole. Inflorescence in axillary buds. Bisexual flowers, 3-4 per bud or individual; gamosepalous calyx with 5 whitish sepals; corolla with S free, yellowish petals; abundant stamens; inferior ovary with 4-7 locules. The fruit is a round, slightly flattened berry, with a somewhat kidney shape, up to 7 cm in diameter, average weight 140g; thin, soft, light yellow epicarp when ripe, strongly attached to the fleshy, juicy, sweet and creamy pulp. Seeds range from 8-12 per fruit, 1-1,15 cm long, flat, light brownish-gray, white dotted an bitter flavored{selvanet, 2016 #1}. The fruit is a highly

perishable berry, slightly flattened, weighing around 35 g, with an abundant juicy, sweet-sour pulp and yellow skin when ripe (Balaguera López, 2011). The seed is bitter, and beta-triquetones are extracted from it, which are called champañones A, B, C; these champañones display antibacterial activity (Bonilla, 2005). (Osorio et al., 2006). When extracting aromatic compounds from the pulp, skin, seeds and leaves, it has been found that Beta-triquetones contribute to expressing characteristic aroma of Champa. It is an aromatic fruit with exquisite sweet-sour flavor and a good nutritional content, which may turn it into a fruit with a high acceptance in both national and international markets. However, it also displays a major problem, its high perishability, which is the main reason why most of the production is lost (Balaguera López, 2011).

Chamba (Campomanesia lineatifolia R. & P.) belongs to Myrtaceae family and is a berry which weighs approximately 25 grams.
Photo 1. GIDIME research group.

Around 500 tons are produced yearly in an artisanal manner, mainly in the municipality of Miraflores, located in the province of Lengupá, in the South-East region of the Department of Boyacá, which is the location of our research (H. Balaguera-López, 2011). Nevertheless, only 2% is commercially exploited. (López & Rodríguez, 1995). Fruits are consumed fresh and the pulp is used to make products such as jelly, marmalade, candy, wine, sabajón and ice cream among others (Villachica et al., 1996).

However, research in marketing topics is not as representative and makes this the weakest link so far when talking about sustainability, production and merchandising of the fruit in the municipality of Miraflores.

Because of this, this paper focuses on the quantitative and qualitative analysis of the current structure of post-harvesting and commercialization stages of chamba for the fruit sector and the producing community of Miraflores. An efficient structure will be designed and implemented for organization, commercialization, identification of sectors (markets) and the design of strategies.

The project clearly defines the problem to be addressed, as well as the reasons for its realization and objectives, and at the same time develops a series of studies and analyses which allow solving the problematic situation. Firstly, a general literature review is presented regarding the issue, plus previous studies of physical-chemical analysis, nutritional value. Afterwards, this paper presents results found through the application of surveys on the post-harvesting, packaging and commercialization stage; methodology is analyzed, and finally, a proposal for an organizational model is presented, according to productive and commercial operations of the fruit in the municipality of Miraflores and neighboring suburbs.

Chamba, a fruit grown in Miraflores.

Referring to the developing municipality of Miraflores, located in the province of Lengupá, in the South-East region of the department of Boyacá, Colombian Andean region, at 1.500 meters above sea level, with an average temperature of 20 degrees Celsius, and 258 square Km in extension. This municipality of Muisca, Achagua and Tegua background and posteriorly occupied by other cultures, is a territory of peace and progress, blessed with abundant flora, fauna and rivers Lengupá, Tunjita and Rusa, lakes, wells and creeks.

Aerial view of Miraflores, Boyacá
Photo 2. GIDIME research group.

Miraflores, capital of the province of Lengupá, also called: “The city of pink poui (La Ciudad del los Ocobos)”, after the namesake tree, endemic to Central and South America, an emblem of the region. Its imposing height and colorful flowers embellish the landscape and lives of locals and visitors. Miraflores is an agrarian, commercial, industrial and touristic municipality. The most famous fruit is Chamba or Champa. Besides, sugar cane, panela, alfondoque, coffee, corn, plantain, lulo, tomato, pitaya and guava are also grown among other important products. (["SELVANET," 2016])

Blossoming pink poui in the main square of Miraflores.
Photo 3. Leonardo A. Alfonso Medina

Consequently, chamba is appreciated for its flavor and aroma, but it also generates nostalgia from grandparents. It is grown in farms neighboring the city, called Michinche, also known scientifically as Campomanesia lineatifolia, but today it is almost extinct in the area.

When the fruit opens, everything around it is impregnated with its exquisite aroma.
Photo 4. Blog luna9lunaverde.

Discussing fruit characterization, its pleasant aroma and juicy, sweet-sour pulp is highly perishable; it remains in a fresh state for approximately 8 days, according to studies performed (H. Balaguera-López, 2011); processing, storage and commercialization in fresh is also limited for its yearly harvest. Studies show an estimate loss of 96% to 97% in both harvest and post-harvest stages. However, discussing artisanal method (90% of population surveyed) and industrial method, using industrial machinery for sterilization pulping and packaging (10% of population surveyed), on the other hand extract, pack and commercialize pulp. This sustainable exploitation of biodiversity of Lengupá region allows a "local competitive advantage through the implementation of long, short and middle-term strategies, based on the analysis of critical points in the productive chain"*. (Arcos, et at.2044, p.14)

The high demand of natural and exotic colors, flavors and perfumes gives chamba the position of most representative and one of the best ambassadors before the world. Therefore, accessing new markets with competitive products represents a challenge for the producing community and the producing society "Las Delicias" of Miraflores, since they must comply with the dynamics and adaptation of the existing green market, generating a solution to the needs of the country and the opportunities the market may offer.

VI Province Festival of Chamba, October 16, 2016. Stand "las Delicias" producing association.
Photo 5. GIDIME Research group.

Previous studies on the fruit and its commercialization.

Studies performed by secretary Pro Tempore Treaty for Amazonic Cooperation and the Institute for Food Science and Technology (ICTA) (Pro Tempore Tratado de Cooperación Amazónica y el Instituto de Ciencia y Tecnología de Alimentos (ICTA)) have determined champa's nutritional value, high quantity of acids and sugar concentration, and catalogued it as one of the most acid fruits in the region; what draws attention from these results is its

representative content of sugar “this makes this sweet-acid relationship quite particular and pleasant for consumption. This is a great potential for commercialization since its flavor is quite attractive” (H. Balaguera-López, 2011).

Table 1. Nutritional value per every 100 gr of Chamba pulp.

NUTRITIONAL VALUE OF 100 gr of Chamba pulp or Michinche.	
COMPONENT	**VALUE**
Water	82,8 g
Valor Energetic value	64 cal.
Protein	1,6 g
Lipids	1,0 g
Carbohydrates	13,9 g
Fiber	0,8 g
Ash	0,7 g
Calcium	38 mg
Phosphorus	29 mg
Iron	3,2 mg
Vitamin B1	0,04 mg
Vitamin B2	0,04 mg
Niacin	0,05 mg
Vitamin C	33 mg

Source: “Frutos y Hortalizas promisorias de la Amazonia” (Promising fruits and vegetables from Amazonia) Secretaria Pro Tempore Tratado de Cooperación Amazónica. Pro Tempore Treaty for Amazonic Cooperation and the Institute for Food Science and Technology

According to table 1, Chamba is highly appreciated due to its aroma, high nutritional content. Its consumption is mostly domestic, in shakes and juice in both water and milk. From this it is inferred that around 80% of the pulp is water, with a high content of iron and vitamin C.

Although there are exact records of chamba production (500 tons yearly and weekly 100 to 1200 kilograms are processed), it is important to highlight that, to date, there are no concrete data on financial information, due to the need of the producers to sell the total amount of the fruit in order not to register loss in the harvest stage, rather than generating profit. This situation causes that in most cases the fruit is lost or commercialization is limited to regional centers neighboring the production place (town stores, open market and informal selling).

Fruit processing, obtaining chamba pulp.
Photo 6. GIDIME Research group.

I. RESULTS

In order to carry out market research to know the working system in post-harvest and commercialization stage of chamba, the population of Miraflores was taken into account, along with neighboring suburbs, namely:

- Fruit- processing families.
- Restaurants.
- Supermarkets.
- Institutions.
- Producers.

The sample was obtained through primary information; using probabilistic sample, a survey was implemented to know post-harvest and commercialization mechanisms in stores, restaurants, bakeries, hotels, supermarkets, ice cream shops and open markets consuming this fruit.

Descriptive study and field work with producers of the municipality of Miraflores. Photo 7. GIDIME Research group.

Once results of the survey were known, under the framework of our research, it was found that the chamba fruit has a great acceptance.

Likewise, 45% of surveyed people claimed that the greatest inconvenience in post-harvest and commercialization stage of chamba pulp is its decomposition time; 38% mentions another important factor, the lack of freezers, and a defined distribution channel for sale. For the case of pulp consumption, 80% claimed that they prefer to buy weekly and 20% monthly; furthermore, 85% buys fruits in the open market in Miraflores, as compared to 10%, who buy from local wholesalers.

Purchase value of 1 kilogram of pulp is $3000, regarding weekly consumption which 90% have, which indicates that pulp is highly known in the local market.

Fruit presentation which 60% manifested would like to acquire fruit is fresh, since, as days go by, pulp tends to lose properties. Regarding pulp presentation, they mentioned that they prefer a more industrial and ergonomic packaging, with different content capacity (250 gr, 500 gr).

Finally, commercialization, which covers the process, from producer selection, who supply the raw materials and goods to process it, the price customers pay, quantity they buy and frequency of sale.

II. METHOD

This research is framed on the descriptive type, which deals with identifying and defining the important characteristics of a social conglomerate around a socioeconomic activity, such as agroindustry; identifying flows and actors in the participation of the productive chain of chamba in the department of Boyacá. Inductive-deductive method was applied, since it starts from concrete situations occurring in the region and the objective is finding data about them, in order to produce a general concept regarding fruit industry, as deduced from general conditions included in the theoretical framework, and consequently adapting it to the current situation of the province of Lengupá.

Research began by verifying and collecting information (post-harvest process, packaging and commercialization) in the municipality of Miraflores (Boyacá), but this stage spread to the municipalities of Berbeo, Páez, San Eduardo and Zetaquira, due to the existence of a number of “producing families”. This enhancement was done in order to know the process and functioning of production and stockpiling available for processing, finding a total of (1) one stockpiling center in the whole region. The type of logistic model which can be designed is determined respectively, according to community specifications.

MODEL FOR TRANSFORMATION AND INDUSTRIAL DEVELOPMENT IN POST-HARVEST OF CHAMBA FRUIT FOR THE MUNICIPALITY OF MIRAFLORES.

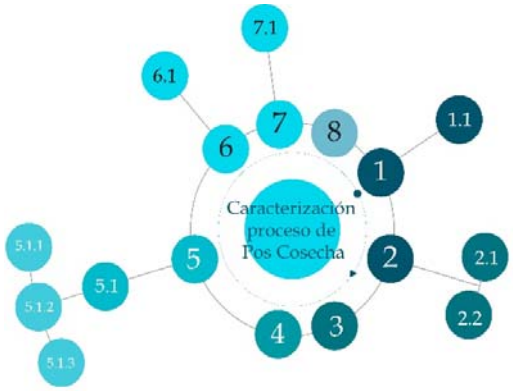
The transformation model proposed is qualitative, which provides a view of reality, related to the following aspects, which influence its development:

Basic variables: they are controlled by the governor's office or the producing associations (products, prices, distribution channels, current technology, proper practice, entrepreneurial culture, financial capacity, economy, politics, eradication of unlawful crops, free trade, competitors, support from the private sector, government's investment in the agrarian-industrial sector, production capability, consumer satisfaction, social and environmental impact).

Medium variables: these variables intend to nurture important points in proper decision making, in order to relate them to the objective of research, and these are: culture, commitment, equality, entrepreneurship, technology, industrial methods, technification, team work, communication and service.

According to this, and bearing in mind current models, it is feasible that there is none that complies with the total system of the community, since it is a small sector trying to penetrate the national market. Because of this, the model proposed is strongly nurtured by the reference model of operations of the SCOR supply network, thus allowing numbering the activities of the producing community which require satisfying the demand from buyers, using a Pull method, generating proper production to current demand of the market, in order to avoid loss due to over production.

Table 2. Characterization of the post-harvest process.



Characterization of the post-harvest process.

1. Fruit selection

   1.1. $15.000 pesos per 25Kg basket.
2. Washing
   - 2.1.1. It is washed with hot water
   - 2.1.2. Peduncle is removed ()
3. Mechanical de-pulping with industrial machine.
4. Blending
5. Pulp collecting
   - 5.1.1. Collecting in a 55-galon vessel
     - 5.1.1.1. Placement of vessels 1 meter above the ground
     - 5.1.1.2. Adaptation of regulating tab at the bottom of the vessel
     - 5.1.1.3. High density Polyethylene
6. Pulp packing in PE bag
   - 6.1.1. 1kg plastic bag
7. Sealing

7.1.1. Electric Thermosealing machine

8. Freezing stage.

This table shows the basic process of characterization in post-harvest of chamba fruit, and determines the operational and logistical processes of pulp as follows:

Planning: it begins with the need or demand from the client, which must be established by the producing association, in order to make a budget of economic resources, raw material and goods (post-harvesting, processing, packaging and commercialization), which will be required for this labor.

Material Supply: it is the process in which the product flows from post-harvest stage (producers) to the consumption or distribution points; at this point, producers drop the fruit at the stockpiling center “Las Delicias” and are paid, according to the quantities selected and processed or are given the chance to continue with the complete process of transformation and packaging.

Development of production (post-harvest): It begins with the selection and purchase of the fruit, which is in turn divided in the following processes:

a. It is important to determine that the development in post-harvest and commercialization stage revolves around creating value for the customers and other actors interested in the process of fruit production and sale. This value is expressed in terms of time and place, mainly in the proper methods for production, transport, information flow and inventory. Transport adds a greater place value to the product, whereas industrial machinery and stock maintenance add value in time.

b. **Intermittent production system (Modular):** For this case, transformation processes of this type occur at irregular intervals with no flow continuity through baskets (30 kg of fruit each); products are delivered based on the study of market demand and for this reason, assets are produced in small scale. This system produces a wide range of sizes, and as a consequence, other characteristics intrinsic to the asset may vary; for this reason, the producer must have flexibility for continuous production, generating a cycle of “raw material-conversion-results”. This process is modular since it allows the producer to divide the process in discrete, scalable, reusable modules, in order to generate independent, isolated elements (byproducts from chamba fruit). After the main product (pulp) is processed, byproduct manufacturing is the next step.

Pulping and pulp collecting process.

Photo 8. GIDIME Research group.

c. **Storage:** in the area of storage, a record is kept regarding incoming, outgoing and packed goods, which must be filled out by the person in charge of the storage area. Likewise, a dispatch record will be filled out with two copies, one for the transporter, one

for the customer and one for the stockpiling center “Las Delicias”; this, in order to generate proper practices in sale record and inventory control.

d. **Distribution and transport:** This is a very important item for logistics and packaging costs, for this reason, it is a priority to analyze the type of transport, according to the needs of the producer who merchandises, or the producer association “Las Delicias”. Finally, it is necessary to generate a “better service” culture in the producing community towards customers, with the aim of facilitating the process for placing orders; making the operation faster via phone communication or email. Creating an information management system, which stores customer data, thus allowing constant follow-up on the regularity of orders and the level of satisfaction with the product. Furthermore, this management system allows control through different channels (telephone, email and on delivery) and consequent feedback with suggestions for the improvement of both the process and service.

III. CONCLUSIONS

In the framework of this research, it was demonstrated that, through document approach, the reciprocal interrelationship between research methods and their tools can be valuable elements as a continuous improvement process towards the producing community, thus decreasing the technological gap in fruit transformation processes.

Obtaining qualitative information supplied by the community under research, regarding the processes of harvest and post-harvest allowed identifying the lack of “good practices” in food processing, as well as the lack of technification in the farms of producers and the stockpiling center.

The modular system proposed under the model of industrial transformation and development in post-harvest, allows the producer to produce for their customers, rather than for the market in such a way that before the product processing is complete, sale or distribution is already guaranteed.

In the post-harvest stage, when the fruit is collected, they do so in a practical manner, shaking the tree so the fruit plummets to the floor, causing damage; from this moment on, the process of oxidation is accelerated, which increases the level of waste, since the fruit rots almost immediately.

The analysis, design and implementation of the Big Data, obtained in both primary and secondary sources, enabled the transference of knowledge about standards, technologies, processes and procedures analyzed in the model, generating a seminar called: “good practices of the industry and innovation with social impact in the fruit sector” for the community of the municipality of Miraflores and neighboring suburbs in August 2016, which begins an innovation culture and fosters in producers the need to create a differentiating advantage with other products dedicated to transformation and commercialization.

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