



Available online at www.jlls.org

JOURNAL OF LANGUAGE AND LINGUISTIC STUDIES

ISSN: 1305-578X

Journal of Language and Linguistic Studies, 18(2), 1181-1193; 2022

Cost-Benefit Analysis Of Tomato Sauce Production By Hydroponic Cultivation

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APA Citation:

Vladimir, D.P.M., Wlamyr, P.A., Junior, C.R.A. (2022). Cost-Benefit Analysis Of Tomato Sauce Production By Hydroponic Cultivation, *Journal of Language and Linguistic Studies*, 18(2), 1181-1193.

Submission Date: 21/10/2021

Acceptance Date: 26/01/2022

Abstract

The conservation of resources and the optimization of time have become one of the greatest challenges of the industrial engineer today, since the needs of consumers and the easy access to information have given rise to an era that is so fluctuating in terms of market and innovation. This is why there is a latent need to innovate processes and products on a daily basis, offering a differentiating value to the competition, according to (Chiavaneto, 2008). "Organizations must be internally prepared to solve any impact or need that may arise, generating administrative and commercial strategies". Norte de Santander is one of the departments with the best availability of resources (water, land and minerals) that, due to lack of information, inappropriate use of land and planting of illicit crops have been squandered indiscriminately, generating negative impacts in the region, which is why the challenge as professionals is greater, since the inventiveness and approach to solutions must be efficient. This research work contains a technical and economic analysis of the creation of a tomato sauce production plant using hydroponic tomatoes.

Keywords: activity, standard, method, process, process, variable

1. Introduction

Norte de Santander is one of the departments with the best availability of resources (water, land and minerals) that due to lack of information, inappropriate use of land and planting of illicit crops have been squandered indiscriminately, generating negative impacts in the region, which is why the challenge as professionals is greater, since the inventiveness and approach to solutions must be efficient.

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Resource conservation and time optimization have become one of the greatest challenges for industrial engineers today, as consumer needs and easy access to information have ushered in an era that is so fluctuating in terms of market and innovation.

This is why there is a latent need to innovate processes and products on a daily basis, offering a differentiating value to the competition, according to (Chiavaneto, 2008). "Organizations must be internally prepared to solve any impact or need that may arise, generating administrative and commercial strategies".

One of the solutions that has sounded the most is the creation of companies, since it is considered that generating employment mitigates negative social, economic and environmental impacts, therefore, given these facts so inopportune for the economic development of the region and the capital city, the need to propose business ideas that innovate and offer a wide variety of solutions both economically and in the satisfaction of needs is born. The companies are a fundamental boom for society, thanks to them the development, the economic growth and the quality of life of the inhabitants are visualized, there are different types of companies in the region, but they are not enough for the needs of the people.

According to the above, this project will seek to make a design proposal and plant layout for the production of tomato sauce, where the good use of resources was available and projected as a pioneer company in this aspect and one of the first companies in the region of this type of food production, for this will begin with the location of the appropriate site from the study of macro and micro location, then determine the distribution of spaces and processes required. Finally, the design of the industrial plant will be defined, which will have to be adjusted to the selected context in the manufacture of tomato sauce and thus contribute positively to the industry of the region.

2. Article structure

Research hypothesis

What business opportunity would a tomato sauce factory (Salsa oriente) have in the department?

2.1 Market Research

The Oriente tomato sauce is a mixture of the finest ingredients, 100% Colombian, which are obtained in a chemical-free environmentally friendly cultivation, harvested and processed with dedication by personnel from the North of Santander. Our product has 70% less sugar compared to other sauces. It is available in the market in two presentations, one of 350 g and the other of 1000 g. Each presentation has a value of 3500 and 8000 COP respectively. Our product is designed and thought for all the public, especially for those dressing lovers who wish to accompany their meals with the good taste of a delicious tomato pulp.

2.1.1 Market segmentation. Companies that choose to operate in large markets recognize that they usually cannot serve all customers, because they are too numerous and dispersed, and because their requirements are too different. Therefore, rather than competing everywhere, often against superior competitors, they need to identify the most attractive market segments that they can serve effectively. In this sense, segmenting is differentiating the total market for a product or service into different groups of consumers, homogeneous among themselves and different from each other in terms of habits, needs and tastes, which might require different

products or marketing combinations.

There are many ways to segment the market. However, not all of them are effective. In this sense, the company, in order to proceed with an effective segmentation, should require that the resulting segment is (Tirado, 2015).

Measurable: The size, purchasing power and profiles of the segments should be measurable (e.g., it would be difficult to identify the segment of smokers between 10 and 20 years old who smoke as an act of rebellion against their parents).

Profitable: The segment must be large enough or profitable enough to be served (e.g., car companies do not manufacture cars for handicapped people because it is not profitable for them).

Accessible: The segment must be able to be reached and served effectively (e.g., a perfume company discovers that its brand attracts single women who stay in bars late at night. It would be difficult to reach them).

Operational: It must be possible to design effective programs to attract and serve the segment (e.g., an airline identifies seven potential market segments. However, its staff is too limited to develop specific marketing programs for each of them).

2.1.2 Segmentation criteria.

"There is no single way to segment the market. The marketer will have to choose from a wide number of variables, individually or in combination, to find the most useful way to segment his market and identify his market niche" (Tirado, 2015).

Figures 3 show the variables most commonly used in the segmentation of consumer and industrial markets, respectively. Some of these variables do not apply to all products.

Demographic segmentation. As evidenced below.


Table 1. Demographic segmentation of the market

Categories	Selected variables
Age	5 - 70 years
Sex	Product offered to the general public, regardless of gender.
Education	Not applicable
Social class	Any social stratum can access the product, but with emphasis on strata 1, 2 and 3, which are the ones that buy and consume the most, through fast food.
Family cycle	Not applicable
Race	Not applicable
Revenues	Less than or equal to one SMMLV
Occupation	Not applicable
Religion	Not applicable
Social classes	Not applicable

Source: Own elaboration

Geographic segmentation. As evidenced below. The economic and population information was extracted from the 2019 TRIAGE for the department, this study was conducted by DANE.

Table 2. Geographic market segmentation

Categories	Selected variables
Region	Oriental
Department	Norte de Santander
Capital	Cúcuta
Inhabitants	1,346,806 million inhabitants
Image	
Territorial extension	21,648 km ² (21,648 sq. km)
Departmental economy	In terms of departmental GDP in 2017, Cúcuta contributed an added value of 57%, Ocaña contributed 6%, Villa del Rosario, Los Patios and Tibú (4% each) and the other municipalities contributed an added value of less than 3%: El Zulia, Pamplona, Sardinata, Ábrego, San Cayetano, Chinácota, La Esperanza, Toledo, El Carmen, Teorama, Convención, Bochalema, San Calixto, Salazar, Puerto Santander, El Tarra, Cáchira, La Playa, Chitagá, Hacarí, Cucutilla, Arboledas, Silos, Durania, Pamplonita, Labateca, Lourdes, Ragonvalia, Bucarasica, Mutiscua, Gramalote, Villa Caro, Santiago, Herrán and Cúcota.
City or municipality	Cúcuta, Ocaña and Villa del Rosario are the municipalities of Norte de Santander with more than 100,000 inhabitants and represent 62.5% of the total number of people in the department; Los Patios, Tibú, Pamplona and Abrego are the municipalities with population between 30,000 and 100,000 inhabitants representing 15% and the municipalities with population less than 30,000 inhabitants El Zulia, Sardinata, El Tarra, Convención, Chinácota, Teorama, Toledo, El Carmen, San Calixto, Chitagá, La Esperanza, Cachirá, Salazar, Hacarí, Arboledas, Puerto Santander, Bochalema, Cucutilla, La Playa, Gramalote, San Cayetano, Herrán, Labateca, Bucarasica, Silos, Ragonvalia, Pamplonita, Villa Caro, Durania, Mutiscua, Lourdes, Santiago and Cúcota, which represent 22.5% of the department's total population.
Density	Urban-Rural
Land access roads	<p>Each of the 5 selected sectors has excellent roads, some of them close to national and in the case of Villa del Rosario international roads.</p> <p>The municipalities, with the exception of Pamplona, have access to the capital city of Cúcuta through ring roads.</p> <p>The two main roads in the department are Cúcuta-Pamplona-Bucaramanga Cúcuta-Ocaña-Atlantic Coast.</p> <p>The first road communicates with the center of the country and the other with the entire Atlantic coast.</p>
Other access routes	The department has one airport (Camilo Daza) located in the capital city. This airport does not handle international flights, only domestic flights.

Weather	The climatic conditions in the region are very varied, and especially in each selected sector, there are hot, cold and other climates.
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Source: Own elaboration

Behavioral segmentation.

Table 3. Behavioral market segmentation

Categories	Selected variables
Expectations	Economy, quality, health, durability, presentation, perception, consumer care
Frequency of purchase	Alta, the product is frequently purchased as it is widely used in informal establishments and is a good accompaniment to meals.
Price sensitivity	Positive
Brand loyalty	Consumers have confidence in the brand, as they are very supportive of local industry.
Purchasing habits	Frequent in the fast food establishment on average every 2 days, in households about every 10 days.

Source: Own elaboration

Demand is the quantity of goods or services that a local, regional, national or international community requires to satisfy a specific need or desire at a given price (Martinez, 2020), and in a feasibility project it is important to note that there are two types of demand, one potential and the other real, according to (Martinez, 2020).

Potential demand is that which is global, i.e. all the specific public, and actual demand is that which requires the fulfillment of several factors. In the realization of the project, due to the limited availability of time and the sanitary situation of Covid 19, which prevents data collection and real-time interaction with consumers. The municipality of Los Patios was taken as the center of study of brand acceptance and frequency of purchase of the product, this information was collected through a Google forms, for this in the first place it was identified that the potential demand would be the families of the municipality of Los Patios, but as it has a standard data of the number of families 77,000 inhabitants of the municipality, since it is a food product of easy acquisition in the market, it can reach the entire population. However, as the idea is to take into account the families of the municipality, since the tendency to buy is stronger in them, we proceed to make a calculation of these for this we have a recent data from a DANE study in which it was stated that 60% of the population was or formed a household.

That is, of the 77,000*60% = 46,200 inhabitants. Based on this number of inhabitants, a sampling formula was applied to determine the number of people to be surveyed, the procedure was as follows.

Figure 1. Sample calculation formula

$$n = \frac{N \times Z_a^2 \times p \times q}{d^2 \times (N - 1) + Z_a^2 \times p \times q}$$

Where, N = population size, Z = confidence level, P = probability of success, Q = probability of failure D = precision (maximum admissible error in terms of proportion). According to these values we proceeded to calculate the sample size, taking a confidence level of 95%, because the population data, not the most recent, is from the year 2019. The Z for 95% is 1.96 and the margin of error expected from the sampling is 5%.

$$\text{MUESTRA} = \frac{46200 \text{ habitantes} * 1,96^2 * 0,05 * 0,05}{0,05^2 * (46200 - 1) + 1,96^2 * 0,05 * 0,05} = 382 \text{ habitantes}$$

Once the sample size was known, and taking into account the factors described above, such as time and the health crisis, 13% of the total sample, i.e. 50 inhabitants, was taken as the study sample. The survey evaluated questions such as the acceptance of a new brand, as well as the identification of the segment that buys the most (men or women) and the frequency of this purchase. The survey was applied through the use of virtual tools and was disseminated to people of all ages living in the different sectors of the patios and the metropolitan area, since due to the proximity to these sectors, it is to be expected that there is a potential market there.

3. Method

The type of research implemented is exploratory, according to (Paneque, 1998) Exploratory studies determine trends, identify potential relationships between variables and establish the general line of more rigorous subsequent research, therefore they lack hypotheses. exploratory studies are normally carried out when the objective is to examine a topic or research problem that has not been studied much, or has not been addressed before (Sampieri H 1997, page 13).

In view of the impossibility of conducting physical surveys and visits to the different commercial premises to obtain information by direct observation of the inhabitants' consumption habits, information based on opinions and market trends was used; it is important to note that in the case of tomato sauce there is a consumption trend and there are already some market niches. Repositories, web pages, videos, virtual libraries. As well as the use of other projects already carried out in relation to the topic.

Taking into account that the project is a business proposal and that currently there is not a great variety of information related to the consumption of tomato sauce in the region and the country. The calculation of the potential demand is made taking into account the data obtained in the frequency of purchase of the survey. It is important to note that according to (Chavez, Portafolio, 2018), director of the marketing area of Fruco, in an interview she gave to the magazine dinero she stated that "In the country almost one kilo of tomato sauce is consumed per month, on average, per household, and in the last year the market has grown 1.6%".

Potential demand was calculated as follows.

$$\text{Potential annual demand} = (\% \text{Fr. Monthly} * 12 \text{ month}) + (\% \text{Fr. Weekly} * 58 \text{ weeks}) + (\text{Fr. Biweekly} * 24 \text{ fortnights}) + (\% \text{Fr every 2 days} * 182 \text{ days}).$$

According to figures given by the DANE in 2018, the percentage of population growth in the municipality of Los Patios is 1.22% per year, according to this we proceed to perform the calculation. After performing the calculations we obtain the following results.

Table 4. Population Analysis

Current Population (2020)	2021	2022	2023	2024
77000	77939,4	78890,2607	79852,7219	80826,9251

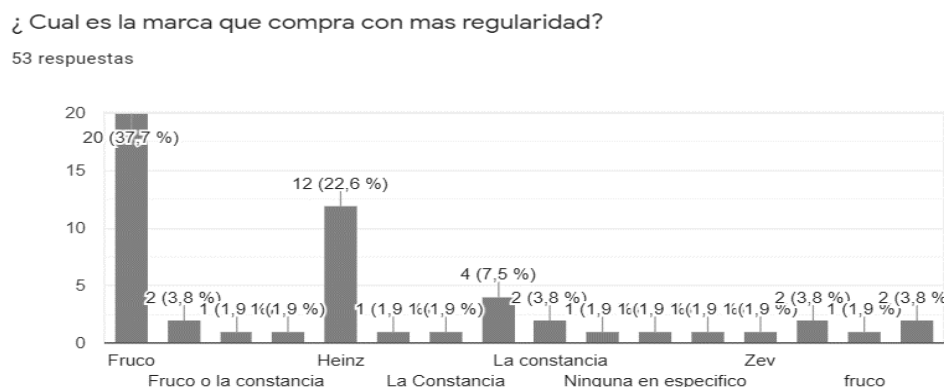
Taking into account this projection, it is expected that by the year 2024, the local population will be 80827 inhabitants. In order to identify the potential demand in each year, it would be important to know the annual reports of the DANE and the geographic segmentation they make.

4.Results

According to the data obtained in the survey, the following aspects were found to be the most relevant. 79.2% of those surveyed would be willing to buy a new brand of tomato sauce. 98.1% of those surveyed buy tomato sauce, 77.4% in supermarkets and 22.6% in neighborhood stores.

The frequency of purchase according to 39.6% of the respondents is monthly, however, 34% buy the product every 15 days, weekly was the purchase frequency of 22.6% of the total respondents and as an anomaly 3.8% make their purchase every 2 days. The best known brand in the municipality and the metropolitan area is Fruco with a choice of 50.9%, followed by Heinz with 32.1%, Constanca is the third brand in this list. The purchase levels of the different brands can be seen below.

Figure 2. Most purchased brands in the municipality and metropolitan area



According to the aforementioned data, we proceed to identify the real demand for the product and the minimum amount of cultivation. Real demand: If we take into account the survey conducted and the population projection already made, we proceed to calculate a projection of the demand for each of the 5 years. Before starting with this calculation, we must take into account that 2% of those surveyed do not buy tomato sauce. And 21% are not willing to buy a brand other than the traditional ones.

$$\text{Actual demand} = 1 - \% \text{ of no purchase}$$

$$\text{Actual demand} = 1 - 0.02 = 0.98$$

After calculating the value of the actual demand, we proceed to design a table to group all relevant data (potential demand, actual demand and number of consumers willing to buy).

Table 5. Calculation of potential consumers

Year		2021	2022	2023	2024
Potential consumers	77000	77939	78890	79853	80827
Potential demand (CP*0.97)	74690	75600,8	76523,3	77457,41	78402,19
Potential household demand (using DANE data)	44814	45360,4	45913,98	46474,44	47041,31
Annual product power demand (DP*33)	147886	1496896,4	1515161,4	1533656	1552363,
Potential demand for monthly products	123238	124741,37	126263,45	127804,7	129363,6
Potential demand average daily product	4107,9	4158,0456	4208,7815	4260,157	4312,120
Actual demand (CP*0.98)	75460	76380,22	77312,2	78255,94	79210,46

The pink cells contain the weighted data of the possible daily and monthly product demands for the next 5 years. Hydroponics is a set of techniques that allows the cultivation of plants in a soil-free environment. Hydroponics allows simple or complex structures to produce mainly herbaceous plants, taking advantage of sites or areas such as rooftops, infertile soils, rough terrain, heated or unheated greenhouses, etc. This method allows an optimization of resources and a reduction of production times.

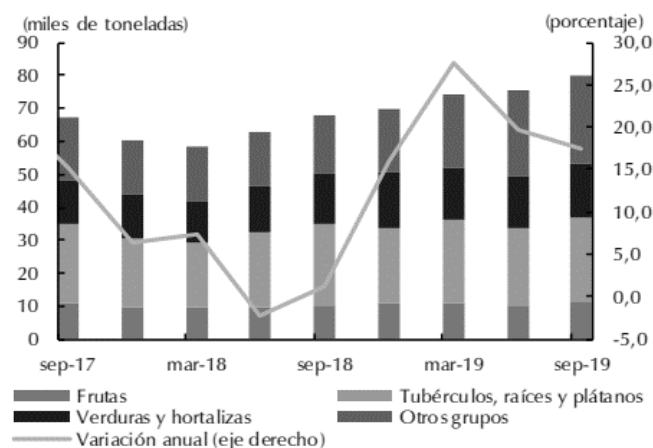
Despite all these benefits, the lack of knowledge of this technique has allowed it not to be the most implemented cultivation method in the country and much less in the region, (Sandoval, 2016) states that: "Colombia is a privileged country due to its geographical location, cultural variety, diverse climates, flora, fauna, watersheds and natural resources. Such strengths have made Colombian agriculture a source of income for part of its inhabitants."

In 2018, Colombian agriculture contributed 6.3% of the country's economic income, i.e. an approximate of 6,277 Million Ds, according to data offered by (mundial, 2018), the contributions have decreased over the years since the economic opportunities of farmers have been diminished by a series of factors unrelated to their production, climatic changes, forced displacement, scarcity of resources, etc.

Norte de Santander is a department located in the northeastern region, which is conformed by departments such as (Boyacá, Arauca and Santander). For the beginning of the III quarter of 2019 the BER (Regional Economic Bulletin) offered by (republica, 2019), offered relevant data of the economy of this region, the agricultural sector had a good performance, improving the percentages compared to the previous year.

The (DANE, 2019) states that, "The volume of food entered the main supply centers in the region during the third quarter of 2019 grew 5.4% in annual terms, the highest variation of the year, interrupting the deceleration observed since mid-2018", the percentages that were evidenced in the capital of Norte de Santander were as follows:

Figure 3. Volumes of incoming food



The graph shows an increase of 17.4 % in the entry of food or food products to the central supply center of Cúcuta, this is due in part to the population increase caused by the migration of foreigners to the city. All this information gives us a solid basis on which we can conclude that the food market and agricultural production in the city-region is favorable, therefore it remains to evaluate aspects of marketing and sales of the product, to attract customers and generate a local economic niche.

The (DANE, 2019), also provides us with an important data of the northeastern region in terms of industry and is that the industry of Santander presented an increase of 8.2%, much of this increase in production is related to beverages and food products, this data is intrinsically related to the activities of Norte de Santander, since the nearest competitor is Santander, and in the particular case of Salsa del Oriente, the competition is a few kilometers away. This should be taken into account in view of future market openings and the acquisition of new potential clients.

Cúcuta is the central axis of the most important economic activities in the region, being the center of collection and distribution of most of the merchandise to the different national markets.

The metropolitan area of the city is home to a large percentage of the native population, most of whom see informal commerce as a profitable source of income and family sustenance. This is why there is little industrial presence in the sector.

To enter more in context, it is important to highlight that the leading companies are the construction and mining companies, these during the last years have been the great standard bearers of economic development in the region, due to the existence of minerals and land with attractive characteristics either in clays, coal, or highly commercial properties and uncommon in other regions. In part this favors the economy of the department, since there is a source of legal employment and exchange of goods, however, this year (2020), it has been evidenced according to data provided by the (DANE, 2019), the mining sector in the region presented a decrease of 54% of its production, due to the almost 42 days of armed strike and other factors, bringing massive layoffs and increased informality in the city and its metropolitan area.

Currently, there are companies in the food sector that are leaders in the region, but they are not enough to reduce the unemployment and informality rate in the department; there is no large manufacturing plant in Cúcuta and its metropolitan area focused on the production of tomato sauces.

The industrial backwardness in the region is mostly due to the lack of interest in promoting industrial strengthening policies that facilitate and contribute to the creation of new production companies that generate employment for the population. According to the Annual Manufacturing Survey (EAM), published on December 06, 2019 by the (DANE, 2019), releases figures on industrial production in the sector, in the creation of food products yielded 5.1% in which 10.9% is occupied in labor, these are low figures that should be taken into account to take actions on these.

Tomatoes also stand out as the second most transitory product in the region for human consumption, with a percentage of 17.9%. In addition to this, the manufacturing industry of Norte de Santander, including the food sector, has a GDP of 5.6% as of March 27, 2020. It is important to add that the economic growth for the department in manufacturing industries has registered a growth of 3.4%.

As mentioned above, the economy that the industry would generate in the food sector in Norte de Santander would be an important alternative to accelerate the economic growth of the sector and therefore provide benefits in terms of employment and development to the inhabitants of the region, since there is no good tomato sauce manufacturing plant in the department.

Domestic market opportunities. Norte de Santander's entrepreneurs struggle daily to survive in a highly fluctuating market with very little margin for error, which is also accompanied by the desire to turn Norte de Santander into a leading department in Colombian industry.

Cúcuta, as the capital and economic hub of the region, has not yet been able to overcome the multiple problems mentioned above (inflation, unemployment, migration, etc.). In view of this situation, the search for proposals to strengthen the city's industry and become a source of employment is a priority. Since the percentage of industries dedicated to the elaboration of tomato sauces is very low, if not null, there is a great opportunity to undertake a project that is favorable since the essential resources for development exist, only the capital is lacking, which is the most important thing to start and the most difficult to obtain, the government and some entities are favoring these initiatives, some of these programs are the SENA entrepreneurship fund, from the Ministry of ICT, it is established that there is an opportunity to invest in the region, since through decrees 752 and 753 of 2014, from the Ministry of Industry and Tourism, free zones are established with investments amounting up to 1.6 million.

In addition, due to the growing informality of the city, there is a large number of fast food sales, which generates a high demand for dressings or sauces necessary for the preparation of their products, which is a great opportunity to establish a potential consumer market. However, the sale of tomato as a fruit for cooking or other purposes may be a viable alternative for the company if sales of sauces are not the desired ones at the beginning.

5. Conclusions

The North Santander industry has represented an increase in terms of exports, of different products, this is a point in favor, since the interest in products made in the domestic market has good perception in other parts of the world, on the other hand; According to figures given by him (DANE, 2019). Exports at the national level have increased by 32.4% between 2018 and 2019 and the trend as of March 02, 2020 shows that it is increasing; It is worth noting that the products with the highest increase are mining-energy products.

Salsa del Oriente, being a company that ventures into the manufacture of sauces and despite the small number of companies engaged in this economic activity in the region, makes it impossible to obtain updated data on the export of this type of goods, however it is important to note that the export of tomatoes can be an initial alternative parallel to the interests of the company, all this in the regional context.

If we were to take the country as a central axis of analysis, we can orient ourselves by the activities employed by Fruco, one of the leading brands of the organization Unilever Colombia SCC SAS (Nit: 900677748), which carried out exports for 2019 for a value of 18, 477,099 million pesos, data obtained by a report of (Veritrade, 2019).

(Chavez, Fruco, the local brand that weighs on Unilever's portfolio, 2019), marketing director of Unilever Colombia, in an interview conducted by dinero magazine in May 2018, stated that:

The country consumes almost one kilo of tomato sauce per month, on average, per household, and in the last year the market has grown 1.6%.

Consumers are moving away from foods high in fat, sugar, sodium, gluten or other ingredients that they consider unhealthy or unnatural, and are replacing them with a balanced diet. This is why with Fruco we have taken care of strengthening our light and low-calorie lines," said the director in the interview. Although in the department it is scarce, not to say

There are almost no ketchup and dressing production plants, which is understandable because the commercial interests of the region revolve around other types of activities, as these require less investment and compliance with regulations, which is why regionally there is no company that has competition in this area, however the high demand for this type of products in the fast food sector and others has staged a competition between marketers on a larger and smaller scale, where brands such as Heinz, Fruco, Mavesa, etc. stand out. Which are consolidated brands both nationally and internationally, food production is very strong in regions such as Santander, Cundinamarca, Valle del Cauca.

With the above, it can be concluded that market policies should be oriented to achieve regional recognition of Salsa del Oriente as a leading company in the manufacture of tomato sauce, thus achieving the attention of new and larger national markets.

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Makalenin T3rk3e bařlıđı buraya yazılır....

3zet

T3rk3e 3zet.

Anahtar s3zc3kler: anahtar s3zc3kler1; anahtar s3zc3kler2; anahtar s3zc3kler3

AUTHOR BIODATA

Insert here author biodata.