LIFE Environment and Resource Efficiency

LIFECITRUS

LIFE14 ENV/ES/000326

C2 Cost-benefit and feasibility study report

22 february 2017.

Report prepared by **Grupo Foro Innovación y Tecnología S.L**

Paseo Fotógrafo Verdú 9, bajo. Edificio Minos
30002 – MURCIA (Spain)
T-+34 968 22 55 11 – F-+34 968 22 31 83
administracion@grupoforo.com

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1. INTRODUCTION

1.1. LIFECITRUS Project

At present the high development of the industry leads to the generation of waste, as well as to the improvement and implementation of new techniques or methods for their use. In the food production process, in addition to the desired product, by-products, residues and non-standard products are generated, each of which can be used for human or animal consumption and industrial application, which would bring economic benefits.

The project "Recycling of citrus industry scrap into natural additives for food industries" with the acronym LIFECITRUS is coordinated by the National Technological Center for Canning and Food (CTC) and has the collaboration of the AMC business group and the Cluster AGROFOOD, with soothes in the Region of Murcia (Spain). Another partner is the Italian Federation of Food Industry (FEDERALIMENTARE), based in Rome.

This project is due to the concentration of citrus production in the Mediterranean region, and to the generation of by-products from the industrialization of the same. It can be said that Spain represents almost 60% of the total production of the EU-28, followed by Italy with around 30%. In addition, Spanish production is concentrated in the regions of Murcia and Valencia.

On the other hand, the European citrus sector is strongly oriented towards the fresh produce market; However, the production of citrus juice (orange juice especially) is highly implanted due to modern consumption habits versus the consumption of whole fresh fruits. This agro-industry generates a significant amount of waste, with the following fluctuation in the Region of Murcia:

- From 80,000 to 140,000 tonnes / year of lemon waste

- From 80,000 to 170,000 tonnes / year of orange waste

- Between 30,000 - 50,000 tonnes / year of mandarin waste

This residue is the fruit discarded by low quality, but especially it consists of the parts of the fruit without commercial value (skin / crust) that are removed during the process of transformation. Their management through direct use in animal feed classifies them as by-products, but this solution is not compatible with advanced scientific and technical criteria.

The LIFECITRUS project proposes as a solution the implementation of an innovative process that the CTC has tested in recent years on a laboratory scale in a positive way. It is a process based on physical operations to obtain a new ingredient of application in the food industry. This product can be used as a natural ingredient, with exceptional properties, which can substitute additives such as pectins, antioxidant acids, etc. in the production of jams and other foodstuffs (vegetable purees, sauces, ice creams, etc.). In this way, it seeks to offer the consumer a different product and with the possibility of being classified as ecological.

1.2. Raw material

According to recent FAO data, global citrus production was forecast at 121 million tonnes in 2013/2014, where China, the Mediterranean Region and Brazil are the main producers with a combined productivity of 60% of total world production. Of the total citrus production, about 80% is consumed in the fresh produce market and approximately 20% is processed. On this occasion, Brazil and USA are the main countries dedicated to the transformation of citrus.

In Spain citrus production is 6.5 million tonnes, with 50% of the production of oranges. In addition, it is the country that exports more tons. As for the processing, about 1.5 million tons of citrus are destined to its industrial transformation, where more than 1 million are oranges.

Therefore, in Spain there is a high amount of processed citrus, and especially of oranges, which generate the by-product that can be fed to a process as defined. In fact, Spain is a world power in fruit and vegetable production, as well as in its commercialization.

In 2014 there were 299,478 hectares of citrus cultivated in Spain, 2% more than in 2013, concentrated in the east and southwest coasts of the peninsula, especially in the Comunidad Valenciana (60%), Andalucia (25%), Murcia (10%) and Cataluña (3%).

As far as the activities related to the preparation and commercialization of citrus fruit are concerned, it is mainly concentrated in the Comunidad Valenciana.

The citrus sector abandons exports of fruit from Spain in both value and volume. In 2013, 3.8 million tonnes were exported, of which 1.6 were oranges, 1.5 tangerines and the rest lemons. In terms of volume, exports of orange (11%) and mandarin (1%) declined compared to the previous year, while those of lemons increased (16%).

1.2.1. Oranges

The market for production and export of oranges is one of the most outstanding in agriculture, and in the Spanish economy.

In Europe, Spain stands out as the main producer of Oranges, producing almost 3.4 million tonnes, more than 50% of all European oranges, followed by Italy (1.9 million tonnes) (FAO, 2015). Between the two countries produce a high percentage of the total of the oranges cultivated in Europe.

At national level, the Comunidad Valenciana and Andalucia are the main producers with more than 90% of the production.

Globally, China and the United States are the largest producers of Oranges in the Northern Hemisphere, with a crop of more than 7.5 and 6.5 million tonnes expected for the 2013/2014 season.

1.2.2. Tangerines

China is the main producer of tangerines, with a production of about 18 million tons in the 2013/2014 season. The Mediterranean Region is the next area in production with about 6.5 million tonnes, with countries such as Spain, Morocco and Turkey.

Tangerine has its main destination the commercialization in fresh, because only 5% of the total production is destined to the industry of transformation.

1.2.3. Lemons

Lemon (citrus lemon) is the third most important citrus species in the world, behind orange and mandarin. This fruit, consumed in the form of juice, is characterized by the large amount of nutrients beneficial to the health it contains, such as vitamin C or potassium.

Cultivated in Murcia since the 15th century, the conditions generated by the Mediterranean climate make this region suitable for production, especially along the entire Vega del Río Segura. Currently, Spain is the main lemon-producing country in the Mediterranean region, with a production of 1 million tonnes (data 2013-2014), surpassing Italy and Turkey. It is also the world's leading exporting country (FAO, 2015).

1.3. Juice industry

The juices and nectars industry plays an important role in the agri-food sector in Spain. The juice sector in Spain is made up of about fifty companies, including some subsidiaries of important multinational operators, such as Danone, Nestlé and Schweppes. In fact, 10 groups produce almost 75% of the total, while the remaining 25% is distributed among 30 other companies. These companies are dedicated to the transformation of the raw material and the production of semi-processed vegetables (concentrates, cremogenates or purees and other derivatives) as well as industries exclusively packaging juice and nectars and commercializing both own brands and distribution brands. These companies supply the domestic market and part of the foreign market, giving direct employment to 4,000 people, in addition to generating another 10,000 indirect jobs.

The Spanish market for juices and nectars in 2014 was 968 million liters, according to the European Fruit Juice Association's (AIJN) annual report on juices and nectars in Europe. This volume would place Spain, with almost 10% of the total European market for juices and nectars, behind Germany (with 2,405 million liters), France (1,551 million liters) or United Kingdom (1,192 million liters) but On top of Italy, Turkey and Poland (890, 705 and 699 million liters respectively).

Total consumption of juices and nectars in the European Union stood at 9.702 million liters in 2014. Globally, consumption was 38.5 billion liters, with the EU as the region of greatest consumption, followed by North America. Development in the Asia-Pacific region was boosted by good sales of nectars, while both the volume of fruit juice and nectar increased in the region of Africa and the Middle East. In Western Europe, the shift from fruit juices and nectars to healthier beverages by consumers in major markets, such as Germany and France, has affected volumes considerably.

As for per capita consumption, Spanish people are in a satisfactory position within Europe, with 20.8 liters in 2014, close to the European average but, obviously, behind the large consuming countries that have less access to fruit Fresh, such as Germany, Holland and Finland (with more than 25 liters per inhabitant in the same period).

The three most consumed flavors in Spain are orange, pineapple and peach, which represent 80% of the market, although you can find many flavors from the red fruits, to the apple, the must, the pear, the tomato and others many.

Within the agri-food industry, the juices and nectars sector maintains a strong presence in the foreign market. In 2014, 791,547 tonnes were exported, with an economic value of 613.50 million euros, -6.9% less than in 2013 in value but 6% more in volume.

Fruit juices continue to represent a significant part of the Spanish market in agri-food products, largely due to the price reduction in 2014. For flavors, orange juice with a volume of 259,804 tonnes is flavor more sold abroad, followed very closely by the grape, with a total of 257,281 tons.

All of this highlights the importance of orange processing, which is committed to sustainable production. Respect for the environment and commitment to citizens and society are values that are making a dent in consumers and, of course, demand from companies. The Spanish agri-food industry has made progress in terms of sustainability, and the processing companies of juices and nectars as part of it, are also going this way.

The environmental impact generated by the juice factories is mainly produced by solid waste and wastewater. Hence, for this sector the main challenge in terms of sustainability is the maximum use of the byproducts generated in its elaboration (pulps, bark), since this reduces the possible damage to the environment that could generate these residues. In the case of citrus fruits, between 35% and 55% of processed fruit is a by-product that can be used to obtain value-added compounds for application in different sectors: food fiber, essential oils, seeds or fruit sugars for its use as a natural ingredient in yogurts or baby foods.

1.4. Food additives from by-products

The objective of food manufacturers is to produce attractive, tasteful and pleasing textured foods of high quality that maintain the organoleptic and nutritional characteristics of the freshly prepared food over a long period of time. That is why the food industry needs raw materials and high-quality processing / packaging equipment and, where necessary, the use of food additives.

In addition, currently tends to a market of products where food is intended to cover more than nutritional needs. The interest of the food industry is to position itself in a new market that includes "functional additives" that improve their food from the point of view of health.

We talk about functional foods, for example their content in dietary fiber is related to the prevention of certain chronic and degenerative diseases. A diet rich in fiber also provides natural chemical compounds, antioxidants, vitamins and micronutrients that help a good digestion and keep us in good general health.

The case of dietary fiber is of interest because of its high content in citrus by-products. These by-products are generated in large quantities due to their high industrialization, which in Spain was over 1.5 million tonnes in the 2013/2014 season, accounting for 57% of the industrialized citrus fruit of the Mediterranean Region (Statistics FAO, 2015).

On the other hand, the valuation of these by-products can turn them into new products - substitutes for non-natural ingredients - and gain added value from entering new markets without becoming waste, allowing economic and environmental costs to be saved.

1.5. Ecological product

The market for organic products is booming and there are more and more companies that prefer to market products with ecological certification according to consumer demand. For this reason, the use of ecological raw materials is another valuable aspect.

The advantages of organic products could be divided into two main groups: the benefits it brings to the user and the benefits to the environment and the producing communities of these products.

In the benefits for the user we can list a number of advantages: pesticide-free products and chemical fertilizers; high-quality products; foods with a better "more authentic" flavor; products free of synthetic additives contain no potentially harmful chemical elements.

As for the benefit to the environment and the communities that produce them: organic products promote sustainable, rational farming and breeding with short and long term benefits for the consumer and the community.

Citrus by-products can be classified as organic raw materials if their origin is free from the use of chemicals and the rate of growth of the crop has been respected, therefore it has taken place within the environment of organic agriculture and fruits have been obtained with all its natural properties.

Ecological Agriculture is legally regulated in Spain, in particular it is regulated by European legislation, and by the application of the control and certification system established by Council Regulation (EC) 834/2007 of 28 June 2007 on Production and labeling of organic products (and repealing Regulation (EEC) No 2092/91) and by Commission Regulation (EC) No 889/2008 of 5 September 2008 laying down Implementing Regulation (EC) 834/2007.

Regulation (EC) 834/2007, and all its provisions and amendments, stipulates inter alia: the obligation to subject farmers, importers and processors who wish to market Ecological Production products to a control system to ensure that the rules of production are respected and no techniques incompatible with this agrarian system of food management and production are used.

This Regulation provides the basis for the sustainable development of ecological production methods; ensures the effective functioning of the internal market; and ensures fair competition, the protection of consumers' interests and their trust.

The Regulation also establishes common objectives and principles to support the rules it creates concerning all stages of production, preparation and distribution of organic products and their controls; and the use of indications in labeling and advertising that refer to organic production.

2. THE AGRI-FOOD SECTOR

The agro-food sector is considered strategic for the Spanish economy and, especially, for the Region of Murcia.

In order to analyze the sector context, it will be taken into account that it is formed by the AGRICULTURAL COMPONENT (agriculture, livestock and fishing) and the FOOD COMPONENT (food and beverage industry).

In the first place we will do a national analysis, introducing the data in terms of the number of employees, number of companies, turnover and sales evolution, as well as other aspects of interest such as export. And later this data will be analyzed and some more specific ones relative to the Region of Murcia; all this to analyze the importance of the agri-food sector and especially of the sector of preparation and conservation of fruits and vegetables (CNAE 10.3).

2.1. National analysis

In Spain, the Food and Beverage Industry is the first industrial branch, according to the latest INE Industrial Business Survey, at 31 December 2014, accounting for 20.7% of net product sales, 18.4% of employed people and 18.8% of investments in tangible assets. This industry presents a great heterogeneity as it is made up of subsectors of the most diverse nature and whose turnover and employment figures also vary substantially.

On the other hand, it is a key link for the agri-food chain as it transforms more than 70% of agricultural production, which comes from the more than 23 million hectares of agricultural land used (INE. Date of 17 December 2014).

In the agricultural component we can highlight an increase of 6.1% in crop production, mainly due to the increase in prices (13.3%), as indicated in the Renta Agraria 2015 Report prepared by the Ministry of Agriculture, Food and Environment (MAGRAMA). In terms of quantities, most products fell, while fruit grew 1.7% in volume and vegetables remained unchanged in quantity. On the other hand, the 2.4% decline in value in animal production is mainly due to a negative behavior of prices, which fell by 6.8%, while the quantities produced increased by 4.8%.

In addition, the agricultural sector has linked a large auxiliary sector of suppliers of intermediate products and services. The Renta Agraria 2015 Report indicates that intermediate consumption has increased by 2.8% in value. The quantities consumed increased by 2.9% and prices fell by 0.1%. In terms of quantities, there is an increase in volume in feed (6.8%), veterinary expenses (4.7%), financial intermediation services (1.1%), energy (0.2%) and products phytosanitary (0.1%). On the other hand, there were declines in: fertilizers (-4.4%), seeds and seedlings (-1.0%) and agricultural services (-0.5%).

In macroeconomic terms, the food sector is a strong sector that in low cycles is considerably more stable than other industrial sectors. Its excellent behavior during the current recession, both in terms of turnover and employment, is further proof that it is a solid engine for the national economy.

Table 1 shows the main economic variables with a decrease of 0.88% in total industry in 2014 and 0.38% in the food and drink sector compared to the previous year, but an increase in the remaining variables. Specifically, turnover in the food and beverages sector amounted to 105,127,344 thousand euros, an increase of 1.81% over the previous year.

Table 1.- Numbers of the main indicators of the food industry data at 31 December 2014

	INDUSTRY		**Food and Beverage (CNAE 10, 11)**	
	2014	**2013**	**2014**	**2013**
Employed People	1,931,972	1,949,194	353,964	355,323
Net product sales (Thousand euros)	454,966,257	444,363,082	93,395,615	91,450,355
Turnover (Thousand euros)	571,921,638	562,350,692	105,127,344	103,253,717
Net purchases of raw materials (Thousand euros)	261,712,276	256,056,211	57,097,994	55,481,686
Investment in tangible assets (Thousand euros)	18,072,998	17,838,977	3,378,507	3,008,968
Number of companies	188,470	191,075	27,336	27,117

Source: Annual Industrial Survey of Companies 2014 of INE.

In the industry as a whole, 188,470 companies were registered in 2014, 1.36% less than the previous year, while in the food and beverage sector the number of companies increased by 0.80% to a value of 27,336 (Table 1).

In addition, the behavior of the processed food trade has been favorable, compared to data from previous years (Figure 1), with exports rising to 24,067.9 million euros and imports to 17,964.8 million euros (Figure 2). The balance is positive and the coverage rate is higher than in recent years, indicating that we have exported more, currently standing at 134%. According to MAGRAMA data, the most representative products exported in 2014 were olive oil (€ 2,895 million); Preserved vegetables and veg (€ 2,579 million); Pork meat (€ 2,547 million); Wines (€ 2,517 millon) and Miscellaneous food preparations (€ 1,346 million). The most representative imported products in the same period were non-olive oils (€ 1,282 million); Miscellaneous food preparations (€ 1,009 million); Preserved vegetables (€ 976 million); Cheese (€ 920 million) and Sugars and confectionery (€ 891 million).

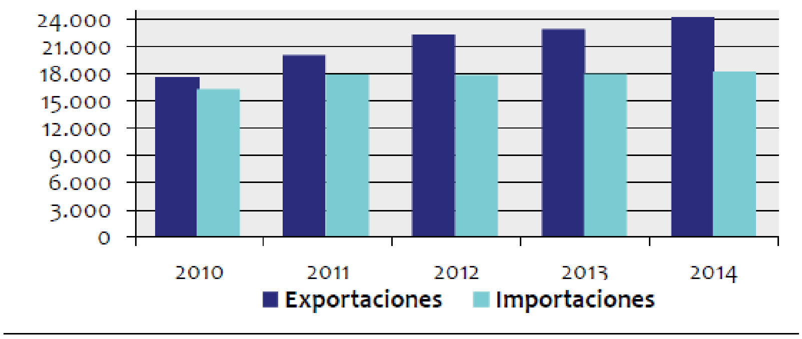


Figure 1.- External trade of the total Agro-food industry in value (millions of euros).
Source: Department of Customs-Special Taxes

ESPAÑA - TOTAL PAÍSES	IMPORTACIONES	EXPORTACIONES	SALDO	TASA
	(M €)	(M €)	(M €)	%
Comercio alimentario total	27.182,7	37.066,2	9.883,5	136,4
Comercio alimentario transformado	17.964,8	24.067,9	6.103,1	134,0
Comercio alimentario no transformado	9.179,9	12.990.2	3.810,3	141,5

Figure 2.- External trade of the food industry in 2014
Source: Department of Customs-Special Taxes

Within the agri-food sector, the meat subsector, bread, pastry and pasta, as well as the fruit and vegetable preparation and preservation sector, which employs more than 50% of the people occupied by this industry, are highlighted (Figure 3).

SUBSECTORES	PERSONAS OCUPADAS		VENTAS NETAS PRODUCTO		COMPRA DE MATERIAS PRIMAS		INVERSIONES NETAS ACTIVOS MATERIALES	
	Número	% Total s/ I.Alim.	Millones €	% Total s/ I.Alim.	Millones €	% Total s/ I.Alim.	Millones €	% Total s/ I.Alim.
Industrias Cárnicas	83.407	23,6	20.079	21,5	13.571	23,8	527	18,8
Transformación de Pescado	18.339	5,2	4.166	4,5	2.754	4,8	94	3,4
Conservas de Frutas y Hortalizas	31.069	8,8	8.247	8,8	4.713	8,3	423	15,1
Grasas y Aceites	11.874	3,4	10.262	11,0	8.794	15,4	170	6,1
Industrias Lácteas	24.340	6,9	8.643	9,3	5.159	9,0	92	3,3
Productos Molinería	5.900	1,7	2.932	3,1	2.180	3,8	43	1,5
Pan, Pastelería, Pastas alimenticias	76.921	21,7	6.567	7,0	2.337	4,1	238	8,5
Azúcar, Chocolate y Confitería	14.524	4,1	3.455	3,7	1.728	3,0	50	1,8
Otros Productos Diversos	30.779	8,7	6.848	7,3	3.349	5,9	289	10,3
Productos Alimentación Animal	11.752	3,3	8.819	9,4	6.770	11,9	138	4,9
Vinos	24.793	7,0	5.844	6,3	2.732	4,8	371	13,2
Otras Bebidas Alcohólicas	9.317	2,6	3.737	4,0	881	1,5	303	10,8
Aguas y Bebidas Analcohólicas	10.949	3,1	3.796	4,1	2.129	3,7	62	2,2
TOTAL INDUSTRIA ALIMENTARIA	353.965	100,0	93.396	100,0	57.098	100,0	2.800	100,0
TOTAL INDUSTRIA	1.931.972		454.966		261.712		15.677	

Figure 3.- Numbers of the main indicators of the food industry by subsectors. Year 2014
Source: MAGRAMA, 2015

In more detail, the fruit and vegetable preparation and preservation sub-sector registered a decrease of more than 10% of the companies, with 1,225 companies remaining in 2014, which occupied 485 more people than in 2013; In particular went from 30,584 people to 31,069 people. These data continue the trend shown in previous years, of adjustment and balance of the sector, which seeks to improve its excessive atomization. In addition, these data were accompanied by an increase in investment in tangible assets reaching € 437 million (Table 2), which shows the progress of the subsector.

Table 2.- Numbers of the main indicators of the sub-sector of preparation of preserved fruits and vegetables (data as of December 31, 2014)

	Preparation and preservation of fruits and vegetables (CNAE 10.3)	
	2014	**2013**
Number of companies	1,225	1,369
Employed People	31,069	30,584
Net product sales (Thousand euros)	8,247,196	7,334,788
Turnover (Thousand euros)	9,071,626	8,178,149
Net purchases of raw materials (Thousand euros)	4,712,837	3,923,359
Investment in tangible assets (Thousand euros)	437,136	245,764

Source: INE (2015)

With respect to turnover and the purchase of raw materials, there is also a positive evolution, with an increase of more than 10% and 20% respectively.

In addition, this subsector is the one that contributes the most representative products exported by Spain in 2014, according to data of the Customs Department and available in MAGRAMA. For frozen or preserved vegetables the value amounted to 421 million euros; for preserved vegetables and vegetables at 155 million euros; and for frozen or preserved fruits to 101 million euros. Also in Figure 4 it can be seen that the coverage rate has increased in recent years, from 230.5% in 2010 to 264.8% in 2014.

	AÑOS				
	2010	2011	2012	2013	2014
Exportaciones (M €)	2.346	2.615	2.783	2.849	3.101
Importaciones (M €)	1.018	1.127	1.148	1.152	1.171
Saldo (M €)	1.328	1.488	1.635	1.698	1.930
Tasa de cobertura (%)	230,5	232,1	242,5	247,4	264,8
Exportaciones (miles t)	2.369	2.519	2.624	2.616	2.921
Importaciones (miles t)	1.034	1.082	1.099	1.062	1.012

Figure 4.- External trade. Import and Export Data
Source: Department of Customs-Special Taxes

At the national level, Cataluña, Andalucia, Castilla and Leon, Comunidad Valenciana, Castilla La Mancha, Galicia and the Region of Murcia, are the ones that contribute most to the net sales of products of the food industry, with more than 76% of the total food industry. However, an analysis of the relative specialization level of each of them - in terms of the food sector's contribution in relation to the industrial relative importance of each Autonomous Communities by billing and employment - places the Region of Murcia between areas in Spain with a higher level of specialization in the food, beverages and tobacco industry.

In addition, net sales of food products put the Region of Murcia in seventh place, according to the latest INE data (Figure 5). Likewise, they place it first in terms of the products of the fruit and vegetable canning subsector with 23% of the national total (Figure 6).

CC.AA.	PERSONAS OCUPADAS		VENTAS NETAS PRODUCTO		COMPRA DE MATERIAS PRIMAS		INVERSIONES NETAS ACTIVOS MATERIALES	
	Número	% Total s/ I.Alim.	Millones €	% Total s/ I.Alim.	Millones €	% Total s/ I.Alim.	Millones €	% Total s/ I.Alim.
ANDALUCÍA	46.465	13,1	13.124	14,1	9.037	15,8	433	15,5
ARAGÓN	11.041	3,1	3.379	3,6	2.220	3,9	117	4,2
PRINCIPADO DE ASTURIAS	6.859	1,9	1.768	1,9	1.042	1,8	19	0,7
ISLAS BALEARES	3.869	1,1	531	0,6	309	0,5	28	1,0
CANARIAS	9.385	2,7	1.137	1,2	512	0,9	27	1,0
CANTABRIA	6.123	1,7	1.227	1,3	524	0,9	23	0,8
CASTILLA Y LEÓN	35.529	10,0	9.370	10,0	5.420	9,5	293	10,5
CASTILLA-LA MANCHA	21.748	6,1	6.468	6,9	4.125	7,2	172	6,1
CATALUÑA	75.723	21,4	21.261	22,8	13.195	23,1	526	18,8
COMUNIDAD VALENCIANA	29.792	8,4	7.994	8,6	4.845	8,5	269	9,6
EXTREMADURA	9.519	2,7	2.112	2,3	1.417	2,5	152	5,4
GALICIA	26.817	7,6	7.158	7,7	4.753	8,3	151	5,4
COMUNIDAD DE MADRID	20.081	5,7	4.458	4,8	1.793	3,1	125	4,5
REGIÓN DE MURCIA	18.394	5,2	5.732	6,1	3.543	6,2	175	6,3
COMUNIDAD FORAL NAVARRA	12.245	3,5	2.685	2,9	1.412	2,5	98	3,5
PAIS VASCO	12.837	3,6	3.352	3,6	2.153	3,8	123	4,4
LA RIOJA	7.280	2,1	1.609	1,7	783	1,4	68	2,4
TOTAL INDUSTRIA ALIMENTARIA	**353.965**	**100,0**	**93.396**	**100,0**	**57.098**	**100,0**	**2.800**	**100,0**
TOTAL INDUSTRIA	**1.931.972**		**454.966**		**261.712**		**15.677**	

Figure 5.- Numbers of the main indicators of the Food Industry by Autonomous Communities. Year 2014

Source: MAGRAMA, 2015

VENTAS NETAS (% sobre TOTAL sector)	OCUPADOS POR C.A. (% sobre TOTAL sector)	VALOR AÑADIDO (% sobre TOTAL sector)
REGIÓN DE MURCIA (23 %)	ANDALUCÍA (19 %)	COM. VALENCIANA (19 %)
COM. VALENCIANA (18 %)	REGIÓN DE MURCIA (19 %)	ANDALUCÍA (18 %)
ANDALUCÍA (18 %)	COM. FORAL DE NAVARRA (13 %)	COM. FORAL DE NAVARRA (17 %)

Figure 6.- Percentage of sales, occupancy and added value of the fruit and vegetable preservation subsector compared to the total sector.

Source: Annual Industrial Survey of Companies 2014 of INE

2.2. Regional analysis. Murcia

In the Region of Murcia, the food industry traditionally has had a great influence within the industry of the Region, with a contribution to the regional GDP of more than 20% because, as already indicated, sales turnover in total of the food industry in 2014 was 5,732 million euros (Figure 5) and the regional GDP of that year of 26,808 million euros.

Regarding the number of regional companies, according to data from the latest INE Industrial Business Survey, the food and beverage branches have 1,037 companies in the Region of Murcia in 2015, of which almost 50% have less than 2 employees.

On the other hand, Figure 7 shows the main indicators of the subsectors of the regional food industry, where the fruit and vegetable canning subsector stands out due to its higher volume of net product sales and greater number of people employed.

SUBSECTORES	PERSONAS OCUPADAS		VENTAS NETAS PRODUCTO		COMPRA DE MATERIAS PRIMAS		INVERSIONES NETAS ACTIVOS MATERIALES	
	Núm.	% Total s/ I.Alim.	Millones €	% Total s/ I.Alim.	Millones €	% Total s/ I.Alim.	Millones €	% Total s/ I.Alim.
Industrias Cárnicas	5.106	27,8	1.211	21,1	723	20,4	34	19,5
Transformación de Pescado	361	2,0	87	1,5	67	1,9	1	0,3
Conservas de Frutas y Hortalizas	5.815	31,6	1.881	32,8	959	27,1	47	26,8
Grasas y Aceites	254	1,4	991	17,3	937	26,4	4	2,3
Industrias Lácteas	472	2,6	106	1,8	68	1,9	2	1,4
Productos Molinería	100	0,5	51	0,9	40	1,1	1	0,5
Pan, Pastelería, Pastas alimenticias	1.464	8,0	73	1,3	26	0,7	11	6,3
Azúcar, Chocolate y Confitería	1.192	6,5	198	3,4	84	2,4	15	8,3
Otros Productos Diversos	2.258	12,3	548	9,6	301	8,5	21	12,2
Productos Alimentación Animal	428	2,3	310	5,4	252	7,1	1	0,7
Vinos	556	3,0	133	2,3	46	1,3	33	18,7
Otras Bebidas Alcohólicas	313	1,7	124	2,2	28	0,8	5	3,0
Aguas y Bebidas Analcohólicas	75	0,4	20	0,3	11	0,3	0	0,1
Total Ind. Alimentaria Murcia	**18.394**	**100,0**	**5.732**	**100,0**	**3.543**	**100,0**	**175**	**100,0**
Total Industria Murcia	**61.213**		**17.878**		**11.946**		**649**	

Fuente: Datos elaborados por la S. G. de Fomento Industrial e Innovación (D. G. de la Industria Alimentaria del MAGRAMA), en base a la Encuesta Industrial Anual de Empresas 2014 del INE (Datos a 31-XII-2014).

Figure 7.- Numbers of the main indicators of the food industry by subsectors in the Region of Murcia. Year 2014
Source: MAGRAMA, 2015

Within the Region of Murcia, the fruit and vegetable preservation subsector reached a production figure of 1,971 million euros, almost 35% of the regional food industry and 10.1% of industrial GVA at basic prices (www.carm.es/econet). Therefore, the manufacture of canned vegetables and juices in the Region of Murcia is an activity with a very important specific weight in the whole economy and regional employment, and is well positioned in the national market and in the international markets more demanding.

In the year 2014, exports of fruit and vegetable preserves in the Region of Murcia amounted to 449.95 million euros, which represents 4.31% of total regional exports and 17.73% of national canned exports, according to ICEX data for olives, canned vegetables, fruit preserves, jams and juices. More specifically, exports were 188,876.33 tonnes of juices, 109,562.73 tonnes of preserved fruits, 69,786.10 tonnes of vegetable preserves, 22,771.28 tonnes of jams and 12,156.52 tonnes of table olives and for oil mills. In general, the trend of the sector has been favorable for the Region of Murcia, with an increase with respect to 2013 of 4.71%.

From these data it is shown that the fruit and vegetable canning sector in the Region of Murcia is a highly structured industrial subsector, with a presence in foreign markets. In addition, in the Region of Murcia is configured what is called a cluster since there are two specific circumstances:

- A high degree of productive specialization in relation to any other geographical area of the regional and even national territory.

- The existence of companies with traction capacity or other activities, through the relations of purchases of productive inputs, the capacity to induce innovative impulses and the transfer of knowledge to other sectors.

Its productive fabric is characterized by its fragmentation and because it is mostly made up of small and medium-sized enterprises concentrated largely in the region of Vega del Segura and the Northwest. In summary, the fruit and vegetable preservation industry is characterized by its cluster structure in the Region of Murcia, due to a concentration of related companies in this geographical area, which generates employment for 5,815 people (latest data available in CREM for 2014).

3. MARKET RESEARCH PUREE PRODUCT FROM CITRUS BYPRODUCTS

3.1. Characterization of the agri-food market

The agri-food market is a pillar of the Spanish economy. This market is characterized on the one hand by a commercialization of products for Spanish households, and is defined by population and average expenditure per inhabitant. Thus, it is possible to say that it is a market segmented by the rents of the consumers that according to their personal characteristics valued of different form the different attributes of the commercial signs: convenience, proximity, quality, assortment, price, etc.

In addition, other markets are moving around, such as packaging and industrial machinery for the sector. Therefore, we can talk about the market of products such as fresh fruits and vegetables, as well as their processed, as well as drinks, packaging and machinery for food industry.

It is a global market where the consumer population is the key factor. In Spain, during the year 2015, total expenditure on food amounted to 99,037 million euros according to MAGRAMA data. At home, spending on food and drink amounted to 67,043 million euros, while in the extradomestic area reached 31,994 million euros. It can be said that during 2015 there was an increase in spending (Figure 8), which was due to the increase in prices, despite a decrease in consumption. This is indicative of the fact that consumers are willing to pay more for products even if they are less volume.

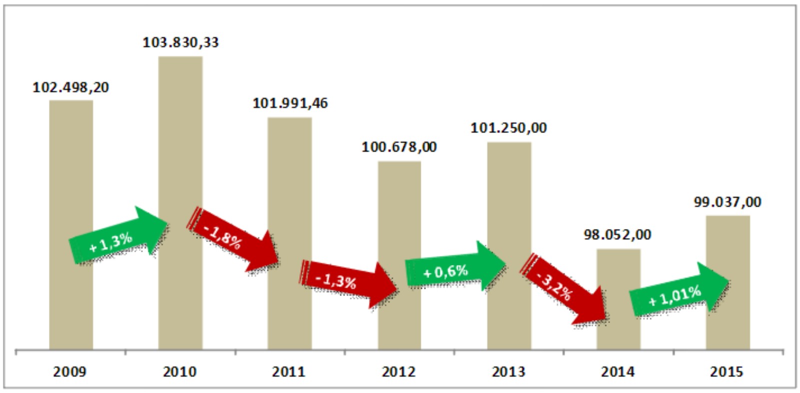


Figure 8.- Evolution of spending on food in Spain (million euros).
Source: Informe del consumo de alimentación en España 2015 (MAGRAMA)

With regard to the distribution of food expenditure by channels, household expenditure accounted for 67.7% of the total, with supermarkets and self-services being the preferred purchasing channel for food products, while the remainder corresponded to consumption outside the home with preference for restaurants with table service.

According to the National Statistical Institute of Spain (INE), the food and beverage sector is home to 27,336 companies (more recent data -2014), about 6,500 more companies than in 2010 due to the increase produced as well as the incorporation registration of those companies without employees. Figure 9 shows the evolution of the number of companies in the last 5 years.

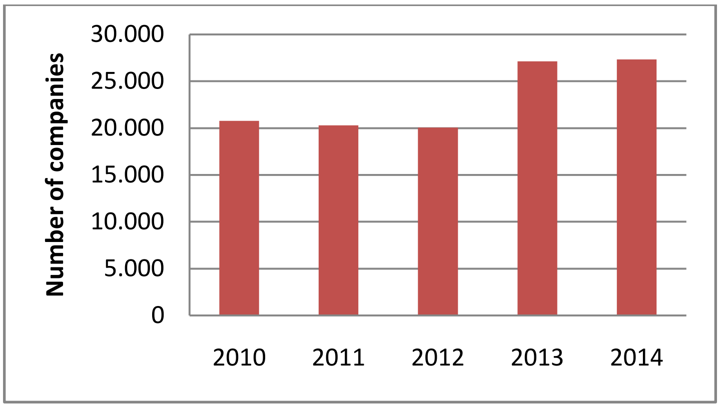


Figure 9.- Evolution of the number of companies in the food and beverage sector in Spain
Source: Annual Industrial Survey of Companies 2014 of INE

Among the main food and beverage companies are Coca Cola, Danone and El Pozo Alimentación, the latter located in the Region of Murcia.

In the Region of Murcia there are 1,402 establishments in the food and beverage sector (according to data from the Regional Statistics Center of the Region of Murcia - CREM, most recent 2012), with a high percentage of establishments in the subsector manufacturing bakery products and pasta, followed in the second place by that of processing and preservation of fruits and vegetables (known as cannery).

In the case of the Cannery sector, special attention is given to companies involved in the processing of vegetables (vegetables, fruits or both), which include activities related to the "Manufacture of preserved fruit and vegetables", but also other food products such as prepared dishes as well as sauces. In all, all the companies included in this classification are 150 (according to data from INE's business directory for 2015), representing more than 10% of companies in the food and beverage industry in the Region of Murcia. In summary, the agri-food sector, which is the largest in the Region of Murcia, is a traditional sector in the economy of Murcia, and an important generator of employment through SMEs, since about 93% of companies have less than 200 employees.

On the other hand, the Murcia agri-food sector, in addition to the incomes it obtains in the market, through the provision of food to the population, also plays a fundamental role in fixing this population to the rural environment, in the conservation of environmental values , Landscape, cultural and gastronomic, and in social and territorial cohesion. All this makes it a strategic sector for the regional economy and fundamental for the generation of employment, wealth and welfare for the population.

According to the sector report 2015 of CESCE, one of the pillars of the good evolution of the Spanish food and beverage industry is the continuous increase of exports. Specifically, they rose by 5.9% in 2014 to reach 24,018 million euros (compared to a 1.5% increase in 2013) and had an average growth in the last five years of 8.4%.

Including non-processed products (horticultural products) in food and beverages, exports reached 38,269 million euros in 2014, compared to 36,367 in 2013, an increase of 5.2%. This increase makes Spain the eighth largest food exporter in the world and the sixth in the EU-28, where it has a market share of 7.3%.

The data reflect the growing trend of Spanish exports, which cut distances with other countries, such as Germany (15.9%), the Netherlands (15.4%), France (13.4%), Italy (8.2%) or Belgium (7.9%).

According to the FIAB, the main destination markets for Spanish food and drink exports are the European Union (68.7%) (led by France, Italy, Portugal, United Kingdom and Germany), United States (5 , 1%), China + Hong Kong (3.6%) and Japan (2.4%); Thus consolidating the identified priority markets for the sector. The main products exported are those from the meat industry and its derivatives, beverages and oils.

Going to external markets, however, poses a major challenge for the food and beverage industry, speaking of a highly atomized sector in which most companies are small.

Because of the great importance of the fruit and vegetable preserves subsector in the Region of Murcia, known as the processed vegetable, mainly the fruit of bone, artichoke, and pepper, is included here a brief analysis of the current situation of this Important subsector.

• The vegetable processing sector is a mature sector, with very low margins and strong competition from third countries that are more competitive in cost.

• Strategy based on cost leadership.

• Seasonality in the manufacture of certain products (peach, apricot ...).

• Difficulties in the marketing of the products in the position of strength of supermarkets and large chains. Strong weight of the white mark on this channel.

• Absence of culture oriented cooperation between companies belonging to very close sectors (competition). Good level of cooperation of companies with technology centers and universities.

• In general terms, the products are of good quality, but with low brand differentiation.

• High degree of flexibility in the sector, especially in SMEs.

• The generation of new products is mainly given by large companies.

• Some presence of the products abroad.

3.2. Objective

This report has been developed in order to gather information on the target population for a new product, in such a way that it could guide decisions regarding its introduction in the market and its willingness to buy.

The market study aims to quantify the number of individuals, companies and other economic entities generating a demand that justifies the implementation of a specific program of production of goods or services, its specifications and the price that customers would be willing to pay for them. For this reason, the methods for the market study basically consist of the determination and quantification of supply and demand.

Although the quantification of supply and demand can be easily obtained from secondary sources of information, it is always advisable to research the primary sources themselves, since they provide direct, updated and more reliable information than any other type of data source. The general objective of this research is to verify the real possibility of penetration of the product in a determined market.

When talking about primary sources, the customer or user of the product is referred to and proceeded by means of the approach and direct conversation with him. If the evaluation of a new product is interested in detecting what it would like to buy and what are the current problems in supplying similar products or services, there is no better way of knowing it than asking the interested parties directly through a questionnaire or survey.

3.3. Product description

It is a puree rich in alimentary fiber with gelling capacity, which can be substitute for the so-called hydrocolloids for application in the food industry.

Hydrocolloids or gums are a broad group of long chain polymers which are characterized by their property of forming viscous dispersions and / or gels when mixed with water. What characterizes hydrocolloids is that they contain a large number of hydroxyl groups, through which hydrates and retains a lot of water by forming hydrogen bonds. In addition, they have a wide range of functional properties, including, among others, the thickener, gelling agent, emulsifier, stabilizer, etc. The main reason for the widespread use of hydrocolloids in the food industry is their ability to modify the rheology of food systems. Hydrocolloids include pectins, but also alginates, carrageenans, agar-agar, xanthan gum, ...

This puree is obtained by the treatment, without chemicals, of citrus by-products, using water as a washing agent and physical steps for its size adaptation.

In this way the use of natural ingredients is promoted, betting on clean labels.

3.4. SWOT Analysis

The main objective of a SWOT analysis is to help an organization find its critical strategic factors, once identified, used and supported in organizational changes: consolidating strengths, minimizing weaknesses, taking advantage of opportunities, and eliminating or reducing threats.

Once described the threats, opportunities, strengths and weaknesses of the organization we can build the SWOT Matrix, matrix that allows us to visualize and summarize the current situation of the future company.

Weaknesses	Threats
- Need for investment to acquire equipment - Lack of experience - No previous knowledge - Possibility of local market. Poor clientele	- Bad economic situation - It is conditional on the success of citrus processing companies - Substitute products with a long history in the market - Unknown product - Non-existent sales channel - Competition between citrus processing industries - Rejection by consumers of products with the new ingredient
Strengths	**Opportunities**
- Adapting to new needs - Implementation in a Region with high quantity of by-products that can feed into the process - Commercial experience (because it is a diversification of products) - Innovative aspect - Possibility of entering the market of Ecological Products	- First to introduce this product in the market, so there is no price competition - Existence of a demand for the food industry - A new customer market will open - New environmental regulations. Concern for the environment - Recovery of a by-product - Good image of the main product when not generating waste - Trained technical staff

3.5. Supply analysis

The supply is the quantity of goods or services that a certain number of producers are determined to make available to the market at a certain price.

For the proposed product there is no similar one on the market, it is a new product, which can be a substitute, for example, of pectin in the preparation of preserves and other foodstuffs.

3.5.1. Pectin

Pectin is a very important additive in food, used in the processing of fruits, vegetables and in the pharmaceutical industries. Approximately 35,000 tonnes of pectin are produced annually in the world.

Pectin is a natural product present on the cell wall of all the higher plants, which can be extracted for use in the production of good quality jams from fruit having a low pectin content.

Pectin for food use is defined as a polymer containing at least 65% of galacturonic acid units. The acid groups may be free or methylesterified salts of sodium, potassium, calcium, or ammonia. In some commercial pectin there may also be amide groups present.

The proportion of galacturonic acids found in the methylester form is termed "degree of esterification" (DE) or "degree of methoxylation" and is mentioned as a percentage. The degree of esterification affects pectin behavior. High methoxyl (MH) pectins are defined as those with an ED equivalent to or greater than 50, while low methoxyl (LM) pectins have an DE of less than 50.

An easy to handle pectin should have the following characteristics: good dispersability, high dissolution rate and maximum solubility.

Commercially, pectin is derived from fruit waste, particularly from waste and by-products from the manufacture of juices (apple and citrus).

The manufacturing processes are based on hydrolysis, separation and recovery. The protopectin is hydrolyzed in dilute, hot acid medium, thereby removing not only pectin but also other products such as neutral polysaccharides and gums. The insoluble matter is then separated by pressing and filtration. The transparent pectic extract is precipitated in alcohol. The fibrous coagulum obtained by successive washes is then purified with hydroalcoholic solution. The fibrous pectin is pressed, dried under vacuum, ground and then screened. The degree of final esterification depends on the temperature, pH and duration of the acid treatment. Therefore, strongly methylated pectins or weakly methylated pectins can be obtained. The weakly methylated and chemically modified pectins (amidated pectins) can also be obtained by an ammoniacal treatment which leads to a de-esterification and an amidation in the acid function. Amidated pectins are used in food technology if their degree of amidation is less than 25%.

In summary, its obtaining consists of five main steps:

• Hydrolysis

• Separation of liquids and solids

• Purification

• Recovery

• Standardization

The fruit has a very high esterification degree of pectin. During the acid hydrolysis used to extract it, some of these esters are converted to the free acid form, or saponified. High methoxyl pectins with different degrees of esterification are obtained by careful control of this process. On the other hand, the low methoxyl pectins can be obtained by acidic or alkaline hydrolysis.

However, the extraction of these commercial pectins requires high energy consumption. Large amounts of hot water and distillation systems are needed to recover the alcohol used. Also the drying of the obtained product consumes remarkable amounts of energy.

The pectin solutions are stable under acidic conditions (between pH 3.2 and 4.5), even at high temperatures. They are also stable for several hours at room temperature under more alkaline conditions, but rapidly degrade at high temperatures.

High methoxyl pectins form thermostable gels when the pH is low (less than 3.5) and the sugar concentration is high (dry matter content greater than 60%). The pH and dry matter content, rather than the strength of the gel, affect the rate of gelation.

Gel formation is not the only function of pectins: high methoxyl pectins are excellent stabilizers of sour milk beverages. High methoxyl pectins can provide a wide variety of textures and rheological properties, depending on the calcium concentration and the calcium reactivity of the pectin chosen. Also, high methoxyl pectins are very attractive viscosifiers for carbonated drinks.

On the other hand, pectin is a soluble dietary fiber that prevents cardiovascular diseases, since it induces a significant improvement of the lipid situation, as a result of the effect of reducing bad cholesterol (LDL) and promoting the increase of good (HDL).

The new product presents the advantages of commercial pectin, but energy costs are reduced because its processing allows obtaining a puree with the characteristics suitable for use in the food industry.

3.5.2. Competitors

In short it can be said that the competitors of this new product are the producers of pectin and marketers.

The main producing countries of pectin at world-wide level are:

- Mexico
- Colombia
- Germany
- Brazil
- U.S
- Belgium
- Spain
- China
- Denmark
- Argentina
- Italy

However, among the world's largest producers of pectin, the members of IPPA (International Pectin Producers' Association) include Cargill, CP Kelco and Naturex, among others.

Cargill provides food, agriculture, financial and industrial products and services for the whole world. In particular, it is one of the main suppliers of texturants and emulsifiers in the global food and beverage market, as well as in the pharmaceutical and cosmetic markets. With more than 150,000 employees in 70 countries, Cargill offers specific solutions that provide texture for different food applications, based on a wide range of ingredients such as: hydrocolloids, emulsifiers, lecithins, cultures, starches, soy flour and functional systems.

CP Kelco is one of the leading producers of pectin and its brand of pectin GENU® is currently well positioned in the market for its gelling and texturizing properties. GENU® pectin is a naturally occurring polysaccharide present in the structure of fruits and vegetables. Its main raw material is citrus peel, although CP Kelco also produces pectin derived from sugar beet.

Naturex produces special natural ingredients for different industries: the food and beverage industry, nutrition and health and personal care. It is based in France, but also has commercial offices around the world. The pectin produced by Naturex can be used in jams, jellies, spreads, fruit blends for baked and dairy products, beverages, confectionery, frosting and desserts. Naturex pectin is extracted from apples and citrus fruits.

Danisco was founded in 1989 and is headquartered in Denmark. Currently, it is one of the most important producers of inputs for the food industry. The pectin produced by Danisco is a stabilizer highly recognized in the industry, it is extracted from specific citrus peels according to the functionality that will be fulfilled. Danisco's pectin is developed in such a way that it reduces the production time of the products for which it is an input and therefore allows its customers to reach the final consumer faster.

Danisco markets pectin under the Grindsted® brand. Thanks to its extensive knowledge of the functionality of pectin, Danisco offers a large number of pectins designed for specific applications.

At the national level the AFCA (ASSOCIATION OF MANUFACTURERS AND MARKETERS OF ADDITIVES AND FOOD COMPLEMENTS) encompasses companies competing with the product, such as CEAMSA. This company produces and supplies a complete range of high quality carrageenans and pectins to the food industry as a whole. Its production plants are located in Spain and the Philippines, and are based on proprietary technology.

Among its products is also Ceamfiber, a purified natural fiber obtained from the citrus peel with a great technological functionality in a wide variety of applications. This fiber mainly contains insoluble food fiber with a high capacity of water retention and absorption of oil.

Finally, at the regional level, Premium Ingredients specializes in the design, production and marketing of powdered mixtures of functional ingredients for the food industry. Since 1997, it has been dedicated to the design and improvement of food ingredients and powdered products, with a continuous commitment to innovation. In addition, it has specialized in the manufacture of ingredients for cheese, dairy products and beverages, in addition to covering other applications such as confectionery, baking products, sauces and many other powder formulations. Among its network of collaborators is CP Kelco.

3.5.3. Substitutes

There are other substances that have similar characteristics to pectin and thanks to their gelling properties, stabilizers or thickeners could substitute this product. These other substances include: alginates, carrageenans, agar-agar, xanthan gum, gum tragacanth, locust vean gum, guar gum, gelatin, chitosan, glycerin, furcellan, starches and other cellulose derivatives. These are mostly derived from plants or algae. It should be noted that starch is the most common natural substitute, but its gelling properties are limited.

3.6. Demand analysis

Demand is understood as the quantity of goods and services that the market requires or demands in order to satisfy a specific need at a certain price.

A similar product has not yet been found on the market, so the demand for the new puree to use as a food ingredient is unknown. The information was obtained by selecting a population and a sample taken from potential customers of the product.

Population: In order to establish the possible acceptance of the product has been established as a study area the fruit and vegetable processing sector of the Region of Murcia. The choice was made based on the fact that they are potential consumers of the product since they use additives of similar characteristics for the preparation of preserves, jams, concentrates and beverages.

The geographical distribution of the consumer market is at the international, national and regional levels, but due to the location of the project, the selection of the target population was reduced at the local level to guarantee a response and the linkage of regional companies to the development of new markets.

3.6.1. Sample size

We selected 15 companies, potential consumers of the product, which are detailed below:

CTC

Abellan Biofoods, SL

Alcurnia Alimentación,SLU

Coato, S. Coop

Conservas y Frutas, SA

Marín Montejano, SA

Hero España, SA

La Vega del Mar Menor,SL

Marín Giménez Hnos, SA

Panarro Foods, SL

Hida Alimentación, SA

Aliminter, SA

José Sandoval, SL

Lorusso y Saez, SL

AMC, SA

All are located in the Region of Murcia, except one located in Almería that has shown a high interest for the project from the beginning.

3.6.2. Questionnaire

1. Gender
    a) Female b) Male

2. Age
    a) 18 - 30 b) 31 - 50 c) 51 - …

3. Education
    a) Primary education b) General Certificate of Secondary Education c) Certificate of Higher Education d) University Degree

4. Do you buy products with gelling properties, thickeners and stabilizers for your company?
5. What ingredients do you buy?

6. How often do you buy them?

7. What was the election for the purchase of these ingredients?
    a) Regular supply offer b) Other:

8. Would you like these ingredients to be natural?
    a) Yes b) No

9. Do you know of any company that supplies natural ingredients with gelling and thickening capacity? If yes, please indicate which.

10. Would you prefer to purchase natural ingredients with similar properties to the current ingredients, in addition to other properties as your source of fiber?

11. Would you be interested in the ecological certification of this product?

12. Value from 1 to 10 your preference of the new product with ecological certification

After the application of the survey, a detailed question-by-question analysis was performed, showing the results and percentages of the answers obtained.

Knowledge of these data will serve to draw conclusions, which are fundamental to the viability of the product.

3.6.3. Results of the questionnaire

In the first place, it is noteworthy to indicate that the profile of the respondents is mostly women between 31 and 50 years old with university studies.

Of the people surveyed, 85.7% purchased for their company products such as pectin, starch, carrageenan, guar gum, xanthan gum, citric acid, ascorbic acid, and calcium chloride, but in any case the consumption of pectin.

The purchase frequency is either every month, or they make an annual purchase and store the product. No information was obtained on the choice of purchase, but most do not use an offer from a regular supplier.

Regarding the preference for the purchase of products with gelling capacity, all respondents said they would like them to be natural, but most (85.7%) do not know any supplier of natural ingredients with gelling ability and thickening. Only a positive result has been obtained and this indicates that the company Naturex works with natural ingredients.

Finally, it can be said that all respondents would be willing to buy natural ingredients that could replace the current commercial pectin, and even the ecological qualification of a substitute product is of interest to 71.4% of the respondents. Specifically, the ecological rating obtained an evaluation superior to 8 of 10 for more than 70% of the respondents.

3.7. Conclusions

In conclusion to this study it can be said that the inclusion in the market of a new ingredient with gelling capacity, which can substitute for pectin, is of interest to the fruit and vegetable preservation companies of the Region of Murcia.

Fruit and vegetable preservation companies are potential consumers of the puree product obtained in the LIFECITRUS process. In the Region of Murcia are located 150 companies, of relative importance for the regional economy.

On the other hand, from market research it can be observed that the potential consuming companies of the puree product show a lack of knowledge about other currently marketed natural ingredients, which could be substitutes for pectin. This fact guarantees the success of the placing on the market of an ingredient such as the puree proposed once its characteristics and properties are disclosed.

Finally, it is known that the creation of a citrus bark processing plant in the Region of Murcia is technically feasible because it has the raw material that is wasted, but it is necessary to continue working to raise awareness of the fruit processing companies of the need for the separation of waste and the use of waste. On the other hand, the economic viability of the project must be demonstrated.

4. CITRUS FRUIT IN THE ECOLOGICAL AGRICULTURE

4.1. Introduction

Organic production is a sustainable system for growing healthy food. It respects the natural resources and makes a rational use of the field, improving the natural fertility of the soil. No synthetic chemicals or genetically modified organisms are used.

The growing interest in the environment has led to a closer approach to the so-called organic or ecological agriculture, since this way of producing not only supposes cultural practices respectful of the environment, but also better meets the requirements on food health, which are becoming more and more worrying to consumers.

It can be said that the alternative model of ecological production as a European bet contributes to a saving of operating costs, with more added value of agricultural products for their high quality differentiated, better preservation of the natural environment and its biological diversity, providing food safe totally, very important to improve the health and life expectancy of Spanish and European citizens.

IFOAM establishes eleven fundamental principles and practices on which ecological production systems are based:

1. It produces food of high quality nutritious and in sufficient quantity.

2. Work with ecosystems instead of trying to dominate them.

3. It encourages and intensifies the biological cycles within the agricultural system, which includes microorganisms, flora and fauna of the soil, plants and animals.

4. It maintains and increases the fertility of soils in the long term.

5. Maximizes the use of renewable resources in locally organized agricultural systems.

6. Work within a closed system with respect to organic matter and nutrients.

7. Provide livestock with living conditions that allow them to perform all aspects of their innate behavior.

8. Avoid all forms of contamination that may result from agricultural techniques.

9. It maintains the genetic diversity of the agricultural system and its environment, including the protection of the habitats of wild plants and animals.

10. It allows farmers to have a satisfactory income and perform a rewarding job in a healthy work environment.

11. Considers the broader social and ecological impact of the agrarian system.

Organic farming is regulated with a series of standards and certifications that guarantee the origin of the food and the organic production.

The regulation of organic farming in Europe is based on Council Regulation (EEC) No 2092/91 of 24 June 1991 on organic production of agricultural products and indications referring thereto on agricultural products and foodstuffs.

In the European Union, organic, biological and ecological names for agricultural and livestock products intended for human or animal consumption are considered synonymous. Its use is protected and regulated by the Community Regulations R. (CE) 834/2007 and R. (EC) 889/2008.

4.2. Organic farming in the world and Europe

The organic market is growing day by day all over the world. The latest data analyzed in 2014 indicate that organic farming is practiced in 172 countries. Since 1999, about 100 countries have been incorporated, as shown in Figure 10.

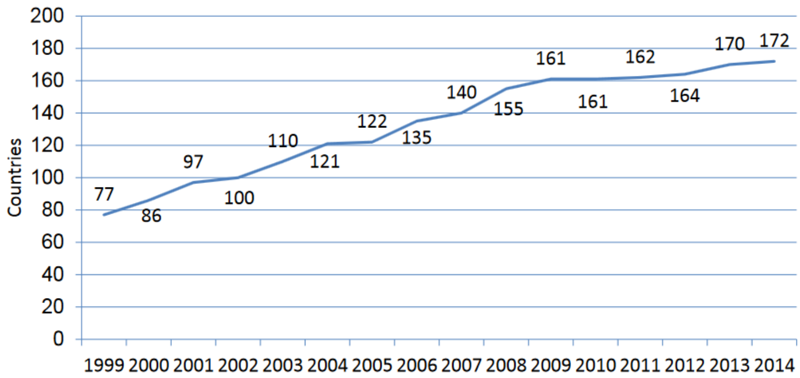


Figure 10.- Number of countries with organic farming data

Source: FIBL-IFOAM Surveys 1999-2016

In addition, in 2014, 43.7 million hectares were devoted to organic crops (500,000 more than in 2013), accounting for 0.99% of the total world agricultural land. This global certified organic agricultural area (SAEC) has quadrupled from 11.0 to 43.7 million hectares between 1999 and 2014.

The number of producers grew to 2.3 million organic farmers: 40% in Asia, 26% in Africa and 17% in Latin America. The tenth place is the first European country, Italy, with 48,662 producers.

The regions with the largest areas of organic agricultural land are Oceania (17.3 million hectares, 40 percent of the world's organic agricultural land) and Europe (11.6 million hectares, 27 percent). Latin America has 6.8 million hectares (15 percent) followed by Asia (3.6 million hectares, 8 percent), North America (3.1 million hectares, 7 percent) and Africa (1.3 million hectares, 3 percent). The countries with the most organic agricultural land are Australia (17.2 million hectares), Argentina (3.1 million hectares), and the United States (2.2 million hectares).

In 2014, sales of certified organic food - fresh and processed - reached a figure of € 80 billion, concentrating almost exclusively on developed countries. In round numbers, the US share is raised to one third and the EU share to 30%.

In general, the demand of the ecological market is based on a consumer with a well-informed agent profile and with an important purchasing power, which justifies that the most developed countries are those where the demand is significantly greater. Thus, the United States, Canada and Europe, virtually monopolize the entire demand for organic products on the planet.

The United States continues to lead the way in food and beverage consumption, with an expenditure of 27.1 billion euros, followed by the Top 10 by Germany (7.91 billion euros), France (4.83 billion euros, China (3.70 billion), Canada (2,523 million), United Kingdom (2,307 million), Italy (2,145 million), Switzerland (1,817 million), Sweden (1,402 million) and Austria (1,065 million). Of 998 million euros (data 2012), since, despite being among the first in ecological area, it has an internal consumption of bio food of barely 1% of the agri-food total and a very low per capita expenditure.

Europe is positioned as the second consumer and producer of organic products worldwide. With 11.6 million hectares, it is the second continent with the largest area for organic farming and accounts for 27% of the world total. It is verified that there has been a growth of sales of organic products of 7.6% during 2014, reaching 26,100 Million €. Germany and France account for half of sales, followed by the UK and Italy. The highest rate of growth has been experienced by Sweden, with a 45% increase in 2014. Denmark is the world's leading country with the highest percentage of bio product consumption, with 7.6% of total sales of food.

On the other hand, the world average per capita consumption of organic food stood at a modest € 11 in 2014. Switzerland leads the ranking with € 221, followed by Luxembourg, Denmark, Sweden, Liechtenstein, Austria, Germany, USA, Canada and France. Spain ranks 12th in terms of sales volume, with a share of 1.25% in the world total, down nine more posts per capita: € 21.

In the specific case of Germany, according to the Ecobarometer 2013, a representative study carried out regularly by the Federal Ministry of Food, Agriculture and Consumer Protection (BMELV), it is young people who are increasingly turning to organic products. Consumers under the age of 30 are the age group that most often acquires these types of products. 22%

of the Germans surveyed buy exclusively or frequently these products; 52% purchase them occasionally. The quality and taste of the products is highly valued by this consumer, but also the sustainability of the production processes and the reliability of the control systems. German consumers opt for organic products especially in the case of fruit and vegetables, followed by eggs, dairy products and bakery products. According to the respondents, the main arguments for the purchase of organic products are regional origin, followed by animal welfare and a possible lower environmental impact.

4.3. Organic farming in Spain and its market

During the last years the sector of production, processing and ecological marketing in Spain has experienced an upward trend. The Spanish organic production market is one of the most dynamic in the world and has established itself as the leading European producer.

In the year 2014 in Spain the area devoted to organic farming reached more than 1.66 million hectares. The distribution of the ecological surface at national level shows the concentration of production in Andalucia, which with 51.32%, agglutinates more than half of the area destined to ecological production. They follow Castilla-La Mancha with 17.11%, Cataluña with 6.36% and Extremadura with 4.85%. Table 3 shows the detail.

Table 3.- Area of ecological agriculture (2014)

SUPERFICIE DE AGRICULTURA ECOLÓGICA (ha). Año 2014				
Comunidad Autónoma	Calificada en primer año de Prácticas (a)	Calificada en conversión (b)	Calificada en agricultura ecológica (c)	SUPERFICIE TOTAL (a+b+c)
ANDALUCÍA	70.279,6365	22.584,7338	760.629,8685	853.494,2388
ARAGÓN	3.530,5900	2.123,1900	47.507,2100	53.160,9900
ASTURIAS	687,4765	643,6175	14.832,1494	16.163,2434
BALEARES	771,7127	1.433,5530	23.235,6775	25.440,9432
CANARIAS	391,0832	465,7419	8.325,6453	9.182,4704
CANTABRIA		222,0000	3.445,6283	3.667,6283
CASTILLA-LA MANCHA	7.483,8700	11.080,7000	266.034,9800	284.599,5500
CASTILLA Y LEÓN	4.987,2508	1.925,9803	21.850,4750	28.763,7061
CATALUÑA	22.898,1789	9.002,6169	73.905,0385	105.805,8343
EXTREMADURA	16.528,3562	15.635,4900	48.547,8150	80.711,6612
GALICIA	315,5698	473,5607	12.747,2737	13.536,4042
MADRID	429,7329	1.627,4363	6.289,4517	8.346,6209
MURCIA	2.139,9400	1.780,3100	53.619,9000	57.540,1500
NAVARRA	9.060,1200	969,1850	54.514,7840	64.544,0890
LA RIOJA	200,2349	334,7898	3.905,2435	4.440,2682
PAÍS VASCO	358,3600	454,8200	2.061,1900	2.874,3700
COMUNIDAD VALENCIANA	1.279,7899	2.095,6984	47.541,5067	50.916,9950
TOTAL NACIONAL (ha)	141.341,9023	72.853,4236	1.448.993,8371	1.663.189,1630

Source: Agricultura Ecológica. Estadísticas 2014 (MAGRAMA)

For types of crops we can comment on permanent crops, where olive groves, nuts and vineyards stand out, but where citruses are also found. Spain is the fifth world power in the ecological cultivation of citrus fruits.

The total area for organic farming of citrus was about 7020 ha (Table 4), with about 47% dedicated to orange growing (especially in Andalucia and Valencia) and 32% to lemons and limes (especially in Andalucia and Murcia). The rest is for the cultivation of mandarins. In any case, citrus fruits represent only 1.43% of the permanent crops behind the olive grove, nuts, vineyards and others.

Table 4.- Area of ecological agriculture by type of crop (2014).

SUPERFICIE DE AGRICULTURA ECOLÓGICA (ha) POR TIPO DE CULTIVO CULTIVOS PERMANENTES. AÑO 2014									
Comunidad Autónoma	Frutales	Bayas cultivadas	Frutos secos	Plataneras y subtropicales	Cítricos	Viñedos	Olivar	Otros	TOTAL (cultivos permanentes)
ANDALUCÍA	972,0699	130,5578	36.552,7340	885,1862	4.187,6308	757,7869	58.004,4517	124.067,5450	225.557,9623
ARAGÓN	304,5100		1.571,4310	17,2600		790,1700	2.348,5100	18,9000	5.050,7810
ASTURIAS	142,8148	28,3438	35,1574	6,5901	0,8784	0,4714		0,0380	214,2939
BALEARES	101,4766	0,1200	3.128,7926	58,8500	59,3278	454,7235	573,2324	221,8507	4.598,3736
CANARIAS	193,7207	0,0150	36,1639	402,8588	50,0529	645,0556	53,6520	123,6502	1.505,1691
CANTABRIA	0,4100	17,9500	4,5000						22,8600
CASTILLA-LA MANCHA	216,2100	1,6500	16.776,1200	7,9000		47.142,7800	62.222,0900		126.366,7500
CASTILLA Y LEÓN	23,6450	2,9200	86,7912	1,0300		2.173,3155	168,5600	3,5700	2.459,8317
CATALUÑA	476,2900		2.435,5000	40,0200	117,7000	9.471,6388	6.624,4000	345,0200	19.510,5688
EXTREMADURA	716,5120	1,4300	1.654,6500	575,0200	19,3500	2.265,5810	31.537,2080	0,5600	36.770,3110
GALICIA	250,8371	5,8568	966,1882	0,9177		75,5456	2,3638		1.301,7092
MADRID	5,0512	2,4525	33,7895	4,9969		436,4992	3.322,2135		3.805,0028
MURCIA	416,3600		24.415,8900	67,9000	1.381,0500	10.539,5900	3.006,7800	17,2800	39.844,8500
NAVARRA	123,7300	1,0100	199,5700	18,3300		947,6600	469,5800	2,3200	1.762,2000
LA RIOJA	60,8349		800,3670	1,6103		762,6216	639,7080		2.265,1418
PAÍS VASCO	165,0700	8,7500	15,3600	7,2000	0,2100	432,7200	16,7400	1,6000	647,6500
COMUNIDAD VALENCIANA	401,8789	0,2068	5.932,6023	213,9300	1.203,5936	7.484,6658	3.401,1544	2,8154	18.640,8472
TOTAL NACIONAL (ha)	**4.571,4211**	**201,2627**	**94.645,6071**	**2.309,6000**	**7.019,7935**	**84.380,8249**	**172.390,6438**	**124.805,1493**	**490.324,3024**

Source: Agricultura Ecológica. Estadísticas 2014 (MAGRAMA)

Sales of organic products in Spain increased 5.42% in the period between 2011 and 2013, reaching a total volume of consumption of 1,018 million euros according to the latest data offered by the Ministry of Agriculture (MAGRAMA).

4.4. Organic farming in Murcia

In the year 2014, the total area of organic farming in the Region of Murcia was 57,540 ha (1381 ha corresponded with the cultivation of citrus and 2,592 ha with the cultivation of fresh vegetables). The largest area, 35,000 ha, corresponded to the cultivation of nuts and vineyards.

The Region of Murcia has a large distribution of organic crops within each of the regions. In the Altiplano area there is a greater area dedicated to organic farming, with 33% of the total. There, vineyards (59%), almonds and other nuts (19%) are the most cultivated products, followed by olive and herbaceous crops. In the field of Cartagena prevail the vegetables (42%), followed by the nuts (31%) and the citrus (21%). In the Northwest, arable crops (46.4%) and nuts (36.8%) stand out. And in the Vega del Segura, the Guadalentín Valley and the region of the Rio Mula, the fruit trees acquire a greater relevance, although also the almond tree plantations abound.

On the other hand, the number of industries related to vegetable production in organic farming in the Region of Murcia was 201 for those engaged in the processing of canned fruits and vegetables, most of which are Manipulation and packaging of products Fresh fruit and vegetables and only 41 are dedicated to the production of canned, semi-preserved and vegetable juices.

In the national total, the Region of Murcia is in the fourth place, in terms of the number of industries, behind Andalucia, Cataluña, Castilla-La Mancha and Comunidad Valenciana, and representing about 8% of national companies.

4.5. Producers / Operators

It was reported that there are almost 2.3 million organic producers in the world. According to the data obtained, more than three-quarters of the producers are in Asia, Africa, and Latin America. The country with the most organic producers is India, followed by Uganda and Mexico (see Figure 11).

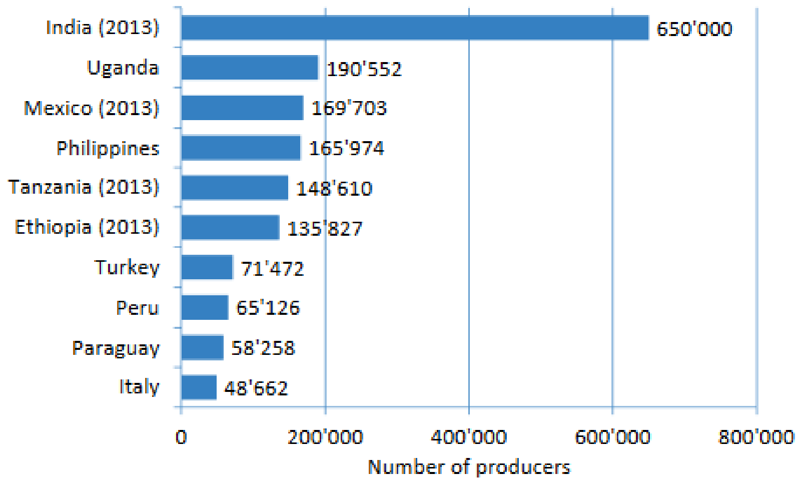
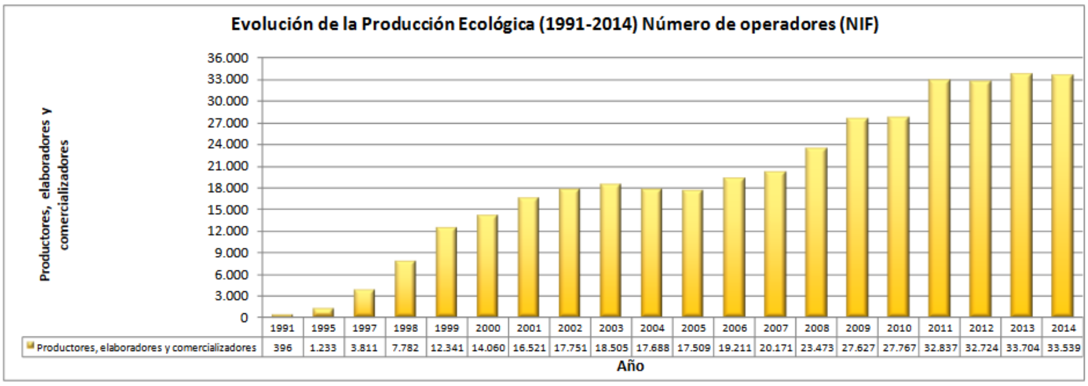


Figure 11.- The ten countries with the largest numbers of organic producers 2014

Fuente: FiBL survey 2016

With regard to the number of operators operating in this sector in Spain, except for the years 2003 and 2005, when their number dropped slightly, these have continued to increase and their growth has been closely linked to this. Figure 12 shows the evolution of the number of operators between 1991 and 2014.



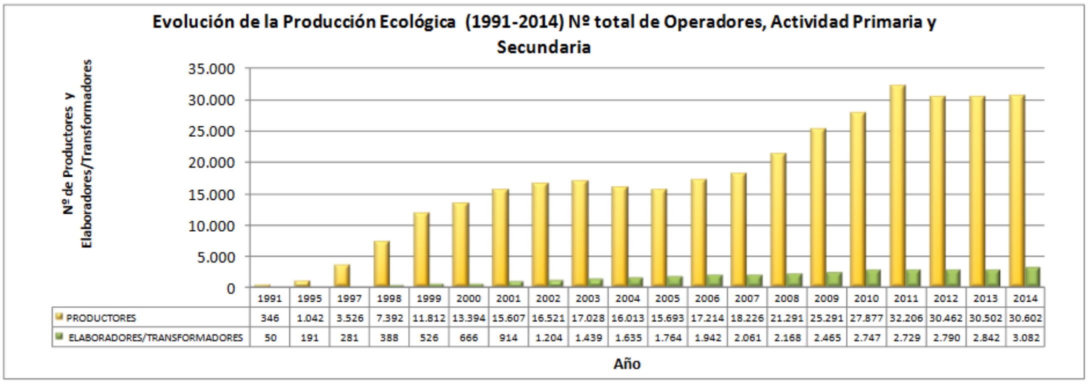


Figure 12.- Number of Spanish operators in organic production (1991-2014)

Source: Agricultura Ecológica. Estadísticas 2014 (MAGRAMA)

About the number of operators at the level of Spanish Autonomous Communities, the Region of Murcia is placed in 5th position, after Andalucia, Castilla La Mancha, Extremadura and Castilla Leon, with more than 2,300 producers in primary activity and the rest in secondary and tertiary (Table 5).

Table 5.- Number of operators in organic production by Autonomous Community (2014)

Nº DE OPERADORES POR ACTIVIDAD DE AGRICULTURA ECOLÓGICA. AÑO 2014													
COMUNIDAD AUTÓNOMA	PRODUCTORES AGRARIOS				D	E	F	G	COMERCIALIZADORES				TOTAL
	A	B	C	TOTAL					H1	H2	H3	Total	
ANDALUCÍA	7.821	1.129	1.033	9.983	4	471	25	13	115	1		116	10.612
ARAGÓN	638	3	26	667		110	1	5	13			13	796
ASTURIAS	124	213	27	364	3	66			2	134	5	141	574
BALEARES	283	1	221	505		74			5	41		46	625
CANARIAS	918		44	962	1	105				56		56	1.124
CANTABRIA	86	104	20	210		54							264
CASTILLA-LA MANCHA	6.291	13	117	6.421	1	303			21		1	22	6.747
CASTILLA Y LEÓN	500	14	43	557		105			6		1	7	669
CATALUÑA	1.541	10	559	2.110		839	51	17	262	7		269	3.286
EXTREMADURA	2.801	52	92	2.945		87			36			36	3.068
GALICIA	303	157	22	482	46	93	2	1	14			14	638
MADRID	246	16		262		83	17	(s/d)	12			12	374
MURCIA	2.295	1	1	2.297		177	2		58			58	2.534
NAVARRA	380	53	53	486	1	76					16	16	579
LA RIOJA	238	7	2	247	1	60				4		4	312
PAÍS VASCO	258	36	39	333		74	1		4	22		26	434
C. VALENCIANA	1.721	27	23	1.771	1	305	28	31	87	23	9	119	2.255
TOTAL NACIONAL	26.444	1.836	2.322	30.602	58	3.082	127	67	635	288	32	955	34.891

NOTA: El número de operadores se ha contabilizado una vez por cada una de las actividades económicas.

A: Productores Agrícolas B: Productores Ganaderos C: Productores Agrícolas y Ganaderos D: Entidades de Producción Acuícola
E: Elaboradores/Transformadores F: Importadores G: Exportadores H1: Mayoristas H2: Minoristas H3: Otros Operadores

Source: Agricultura Ecológica. Estadísticas 2014 (MAGRAMA)

4.6. Interest in an organic raw material

In general, it can be said that the quality of the organic product is greater than that of the conventional one, without this supposing to undervalue the benefits of the latter. They are foods that are subject to less risk in their production and are more natural and safe and are less likely to cause allergies, poisoning and other disorders that may arise because of the different substances used for food processing conventional. Its nutritional contribution is more complete than the conventional one and its effects in the organism will always be positive. They contain a higher concentration of proteins (meat and vegetables), higher vitamin content (fruits and vegetables), higher mineral content (in fruits, vegetables, cereals and legumes) and higher antioxidant substances (fruits, vegetables and olive oil) and thus contributing to improve human defenses and resistance to diseases due to their balanced nutritional content.

To produce healthy food must be operated with an agricultural system in balance. When inputs (fertilizers, phytosanitary products, livestock drugs, etc.) are added to the agricultural practice in excess or unsafe because of the contaminations and toxicities they can cause, they alter the biochemistry of the plant and, therefore, the quality of the food.

In conventional plant cultivation, the use of certain plant protection products (pesticides), at inappropriate doses or applied indiscriminately, can lead to the appearance of residues in food, which pose a risk due to the toxic effects that can cause both the consumer and the environment.

Especially worrisome is the use of pesticides products that have cumulative properties, that is to say that taken in the doses to which they are applied do not have repercussions, but they are not eliminated of the organism, with which we will always have incorporated them in our organism and secondly, repetitions in the ingestion raise the level of the accumulated toxin being able to be seriously injurious.

In Europe the legislation on the use of these products is demanding, but its implementation is not guaranteed and the laws of other countries from which many foods come to our markets, imported by large companies or that come to us through commercial agreements of EU cooperation with other countries, it being public knowledge that the phytosanitary controls that are carried out on them do not exist or are very lax.

Laboratories attached to the EU agri-food framework publish annually the results of continuous analytical checks to control the presence of chemical residues in food, resulting in a significant percentage of food containing levels of contaminants above the established limits.

Residues of pesticides, potentially toxic substances, in foods of plant origin, especially fruits and vegetables, but also in processed products, are a matter of concern for consumers.

The issue of pesticide residues in citrus fruits is particularly worrisome because of the lipophilic character of most (not all) of the molecules used as citrus pesticides, these substances readily penetrate into the cell walls of oils essential that cover the bark of the citrus fruits and are blocked and retained there, so that their persistence is greater than they would be in other types of plant products.

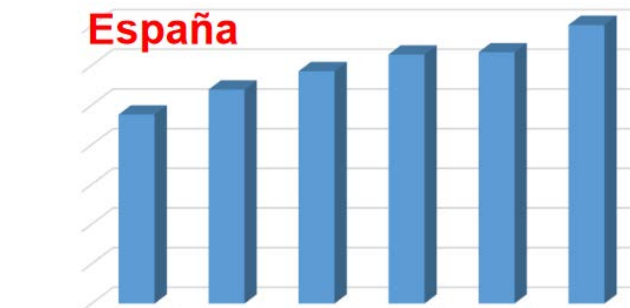
A case of interest is citrus, which receive the application of pesticides and fungicides so that they do not deteriorate during long journeys and storage periods. This causes your skin to concentrate a high pollutant load of toxic compounds, such as imazalil.

Taking into account the use of citrus skin, it is advisable to use organic raw material to avoid possible products toxic to consumers.

4.7. Area and market of organic citrus

Citrus fruits, originating in Asia, are grown in subtropical and tropical regions, being considered the fruit of greater production and commercialization worldwide, above bananas and apples. This genus includes fruits as well known as orange, mandarin, lemon, lime or grapefruit, with recognized medicinal and nutritional properties, given its high content of sugars, ascorbic acid (vitamin C) and citric acid, which give it its characteristic flavored farmer as much appreciated in fresh as in juices or accompanying other foods and drinks.

It is not a novelty that we are betting on organic farming. Ecological citrus are those that come from an agricultural process, without the presence of synthetic products, such as pesticides, herbicides or artificial fertilizers. Figure 13 shows the evolution of the surface of organic citrus in Spain.

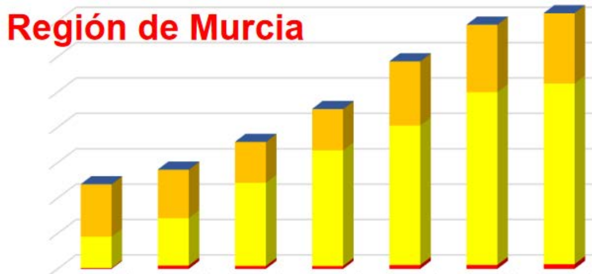


	2009	2010	2011	2012	2013	2014
Cítricos	4763	5391	5856	6275	6332	7020

Figure 13.- Area in hectares for the cultivation of organic citrus in Spain

Source: CAERM, 2015

Andalucia seems to have opted for the cultivation of organic citrus to judge by the area dedicated to this purpose, 4,187 hectares in 2014, representing 60% of the area of organic citrus of the national aggregate and 5.2% of the total citrus grown in Andalucia. The area under organic citrus cultivation has increased fivefold since 2001. Most of this area corresponds to organic orange cultivation. For its part, the Region of Murcia is the second in area of organic citrus cultivation with 1,381 hectares in 2014, representing about 20% of the area of organic citrus in Spain. This region has also significantly increased its area dedicated to organic citrus since 2009, which was only 479 hectares (MAGRAMA). In Figure 14, it can be seen from data from the Ecological Agriculture Council of the Region of Murcia (CAERM) that the area of organic citrus cultivation has continued to increase and in 2015 the total number of hectares destined to this crop reached 1446 hectares.



	2009	2010	2011	2012	2013	2014	2015
Otros cítricos	1	2	1	2	1	0	0
Mandarinas	42	46	47	53	90	93	99
Naranjas	255	227	184	180	272	289	299
Limones	176	268	470	654	788	977	1021
Pomelos	5	19	16	16	22	22	27

Figure 14.- Area in hectares for the cultivation of organic citrus in the Region of Murcia

Source: CAERM, 2015

As regards fresh organic citrus, the European Union market is mainly supplied by the member countries of this bloc. Italy is the largest supplier of organic citrus. Italy is really strong in citrus with more than 21,900 hectares, highlighting the cultivation of orange with almost 11,000 hectares of which almost 2,900 hectares are in the period of conversion (data 2012). Ecological citrus are located in the southern regions with Sicily with almost 11,000 hectares and Calabria with 8,600 hectares. In addition to oranges, Italy covers almost 7,000 hectares in clementines and almost 3,900 hectares of lemon, very present in Sicily.

As for the price, compared with conventional production, organic production, by its very nature, is more expensive on the basis of conventional criteria of measurement. The reality is that organic products are more expensive due to:

- Lower crop productivity by not using conventional inputs or intensive cultivation methods.

- Higher costs of some ecological inputs.

- Higher labor cost by increasing working hours and specific tasks: biological control, irrigation, thinning, weed removal, pruning ...

- Increased risk of crop loss (up to 30% FAO estimates)

On the other hand, while in Spain and Italy the consumption of organic citrus is a minority, in the rest of European countries their demand is constantly increasing; since its use is more and more frequent in the kitchens of the North of the Continent that demand a fruit healthier and respectful with the environment. Germany is one of the countries with opportunities detected for the commercialization of bio products, which follow the preferences and channels of conventional products. Spain is the first citrus supplier with a 76% quota, so the German market is of great interest to organic citrus producers.

Finally, in addition to its content, the bark of oranges and lemons ecological has gained great importance as its use is increasing in sectors such as catering or baking for being healthier to avoid toxic waste by not using massively chemical fertilizers and pesticides.

This situation is causing Spanish producers and distributors of citrus, mainly Andalusia, Valencia and Murcia, are increasingly betting on organic production as a strategy to increase their sales and expand their international markets.

SAT "CITRICOS DEL ANDARAX", which is located in Almería (Andalucia), is the first Spanish producer and exporter of organic citrus fruit with a volume of 14,000 tons of which 6,000 tons are directed to the fresh market (data 2012). The strength of the company is the family of oranges in which they add about 13,000 tons, leaving the rest for mandarins and lemons. The company's partners total some 500 productive hectares located in Andalucia - Almería, Córdoba, Granada and Huelva.

The volume of fresh citrus is destined for export, Germany being the most important market, although the company has diversified the portfolio from 2007-2008 to the Nordic and Eastern

European markets, such as Slovenia. On the other hand, SAT "CITRICOS DEL ANDARAX" destines more than 55 percent of its production to the industry business. Specifically, they develop a line of fresh organic juice for Spain and France. The company has its own processing plant in which they develop a line of juices with clientele between the Spanish supermarket chains, Horeca channel, hospitals and schools.

The Murcia citriculture has a great social and economic weight within the regional agri-food economy. It is, therefore, a strategic sector that generates more than 35,000 jobs and is, undoubtedly, one of the most important business activities for the Murcia countryside. In the Region of Murcia there are prestigious companies dedicated to the production and commercialization of organic citrus.

Toñifruit has been a company dedicated to the production of ecological citrus for 4 generations. They started there in the 19th century to grow lemon trees in an artisan way and today combine modern cultivation techniques, with the craftsmanship of the ancestors, to create an ecological production of the highest quality. Its cultivated area of citrus is located in the Valley of Guadalentín, a perfect environment for cultivation, where they take care of every detail of the planting to guarantee the best product. In the process of harvesting, they select the best fruits and organic citrus fruits at the optimum time of ripening. All this with a short time to the destination, so that they arrive with all their properties and with the taste of freshly caught fruit to the consumers. Through proprietary brands such as "So Goods" or "Mr Good Nature", Toñifruit sells organic products with which it works, such as orange or ecological clementine. In addition, according to data from 2012, Toñifruit leads the supply of organic lemon in Spain and is one of the big European operators adding more than 3,500 tonnes of organic lemon among the varieties Fino, Verna and Rodrejo. The company exceeds 2,000 tonnes of the Fino variety, which starts to be sold at the end of September. The link between this company and the lemon is total.

Camexa is another leading company in its sector dedicated to the production of ecological mandarins. Among its unique and exclusive varieties are late mandarins such as the Nadorcott or the Gold Nugget. All seeded and harvested from February to April. The Gold Nugget variety is a mandarin specialty gourmet, with limited production and zero seeds. Nadorcott, excellent orange-red, has good juice content and peeling facility.

Da Luna Plantaciones Ecológicas, a young business organization, created in 2008 with the purpose of carrying out an agro-ecological transformation of family farms. In Da Luna they put a lot of emphasis on spontaneous vegetation. In their plantations they have created a privileged environment, shelter for wild birds and small mammals and vertebrates of all kinds.

Finally "El Lomo trading", company dedicated exclusively to the production and commercialization of organic citrus. With farms situated in the Guadalentín Valley, they are distinguished by their commitment to quality and the introduction of new varieties that lengthen the supply cycle. Its aim is to offer citrus, unique in appearance and flavor. Among its most popular varieties is "Newhall", a smaller orange, with a deep orange color in both its bark and pulp, and good odor and flavor.

It is noteworthy that the value chain of citrus fruit includes a rather atomized producer sector against highly concentrated and organized buyers and a poorly transparent market. In the case of the Region of Murcia it can be said that the commercialization of Murcia citrus is very professionalized and very well managed. Below we can summarize its main features:

- The commercialization of citrus fruit is carried out in more than 60% through the large distribution chains.

- 30% of the sales volume is sold through retailers and small chains of fruit shops.

- 10% is sold only through importers.

- More than 60% of commercial operations in citrus are carried out with closed prices, while 40% are sales with consignment prices.

- The citrus sector has not managed to consolidate the concentration of supply so there is an offer so dispersed and atomized.

5. COST-BENEFIT ANALYSIS OF THE INNOVATIVE LIFECITRUS PROCESS

5.1. Cost-benefit analysis. Considerations

The citrus peel should be presented, for consumption, at a competitive cost that would be alternative to the use of pectins and at the same time revalorize the raw material.

To determine if it is economically feasible to make the citrus puree, the technique of Cost Benefit Analysis (CBA) was used. This technique is an important tool in the decision-making process; indicates that a problem or situation is valued and considered deeply to choose the best path to follow according to different alternatives and operations.

The CBA is related to the economic viability of a project on the basis that all benefits must be greater than costs. Thus, the benefits of each alternative are compared to their costs, using the following expression:

Net Profit = Total Benefits – Total Costs

If the total benefits are greater than the total costs, the economic viability of the project will be discussed and it will be better in the alternative that shows the highest net profit. First, it was taken into account that the raw material used has a zero cost because it is expected to revalue it from the generating company itself.

Second, production costs due to services in the productive area (water, electricity and gas), as well as costs associated with labor and consumables, were calculated. In addition, the cost of amortization of the investment was taken into account.

On the other hand, the generation of wastewater is the most significant environmental aspect of the activity of companies in the vegetable processing sector, both because of the high volumes generated and because of the pollutant load associated with them. Therefore, it has been taken into account the cost of purification of the waters to comply with the parameters of discharge in the area under study.

Finally, to determine the benefits, the pectin used in the formulation of jams was considered as the selling price, but taking into account the percentage of pectin that citrus puree may have.

5.2. LIFECITRUS process

To obtain a purée of citrus peel, the following process was carried out on a pilot scale.

First, the seeds present are removed by inspection and manually, along with foreign parts. Once the seeds and foreign parts have been removed, a reduction in the size of the raw material is carried out for the effectiveness in the subsequent washing.

The cleaved and washed citrus peel is initially subjected to extraction for the removal of water-soluble compounds. The solid phase must continue in the process and for this a separation of the aqueous phase is necessary. A decanter is used, which employs centrifugal force for separation. The liquid phase is discarded as waste water.

Subsequently, the solid phase is reduced in size to a puree-like product. This product is heat treated for enzymatic inactivation and bagged for storage.

The associated costs and benefits of the placing on the market of a puree product from the citrus bark are described below. The calculations have been made for the design of an industrial plant provided by an engineering company.

5.3. Costs of the production of a product from citrus peel

The Region of Murcia is one of the largest exporters of lemon in the world, in addition to include fresh processing companies also includes juice companies and citrus concentrates. These companies generate citric by-products that can be valued at the company itself to obtain a new natural ingredient.

Therefore, we have taken as a reference the location of a citrus peel processing line in an example industry of the Region of Murcia, but more specifically in the city of Murcia for presenting foci of generation of the byproduct in its surroundings.

5.3.1. Investment and maintenance costs

The line has been designed to process and pack lemon rind, and consists of the following sections:

- Line of reception and processing of product.

  - Washing the peel
  - Reduced size
  - Inspection of the product through artificial vision
  - Centrifugal separation by decanter
  - Reduced size (microcutter)
  - Cooking

- Sterilization and packaging

    • Aseptic filler

The capacity of the designed line has been selected according to a production of 6 tons / hour, since it has been considered an example citrus juice industry that works 3,600 hours / year and that can generate about 20,000 tons per year of by-products.

The budget received is 1,340,000 € for the total of the necessary equipment and will be an investment contributed by an example company of the sector of elaboration of citrus juices.

The life of the equipment has been considered for 7 years under normal operating conditions with adequate maintenance. Thus, the annual amortization is intended to be 191,428.57 € / year.

On the other hand, the annual cost of maintenance and operation has been considered 6% of the initial investment.

No costs for land, civil works or similar have been taken into account. This study focuses on the installation of a production line in an existing company and that has the necessary means for the implementation of this process.

5.3.2. Personal costs

Because the citrus peel processing line has been planned for an existing industry, the need for a high number of workers is not anticipated. It is considered that 3 operators are sufficient to control the process.

The hour-person cost is € 12, carrying a work shift of 8 hours a day.

5.3.3. Production costs

In the processing of the citrus peel requires water for the washing stages, as well as consumption of electricity and energy for the operation of the equipment.

On the one hand, water consumption has been established at approximately 20 m^3 / tonne processed due to the washing and cleaning stages of the equipment. The cost of m^3 of drinking water in the city of Murcia has been taken with a value of 1.36 € / m^3.

On the other hand, the discharges produced in the processing line have to be treated in a wastewater treatment plant. According to previous studies carried out by the CTC, the cost of treatment of waste water treatment can be in the average value of 2.4 € / m^3, considering a biological treatment of waste water.

The industrial waters produced by the agro-food industry contain contaminants that in many cases exceed the parameters established by the legislation. They usually have high organic loads, which is characterized by their high levels of Chemical Oxygen Demand (COD) and Biological Oxygen Demand (BOD). This problem causes the need to reduce levels of pollutant load, in order to comply with the parameters imposed by the legislation. In particular, it has been demonstrated that biological treatment is required because of the characteristics of these waste waters. This type of treatment is already implemented in industries such as the example considered.

As for the rest of consumption, according to the line designed, the electrical consumption of the equipment used has been estimated at 175 kWh for the whole line, with a unit cost of 0.12 € / kWh.

The energy cost is due to the consumption of natural gas to obtain steam. It has been estimated that the equivalent consumption of kWh will be 2,300 kWh in a boiler of 6,000 kg of steam. The unit cost considered is 0.042 € / kWh.

5.3.4. Packing costs

The citrus peel, for its use, should be transformed into a non-perishable product, packaged in industrial containers such as aseptic bags, widely used today for pulps, concentrates and fruit purees.

Because the process efficiency has been estimated at approximately 60%, the output flow required to be packed is 3.6 tonnes / hour. For this purpose metal containers of 200 kg capacity and aseptic single barrier bags will be used. It requires a total of about 65,000 containers per year, with a unit cost of 11.7 € / container.

5.4. Benefits of the preparation of a pectin source product

Pectin is a natural product present in the cell wall of all higher plants and is used by the food, cosmetic and pharmaceutical industries for their gelatinizing, thickening and stabilizing properties.

The key structure of all pectin molecules is a linear chain of α-D-galactopyranosyluronic acid units linked by glycosidic bonds (1-4) to which variable contents of methyl ester groups are attached.

Its industrial extraction began at the beginning of the 20th century and has acquired great importance, especially in the food industries: they are the main gelling agent used to restore certain texture degraded by conservation treatments and to allow their presentation in a form appropriate to their good maintenance and use (they have the unique property of forming gels extendable in the presence of sugar and acid, and also in the presence of calcium ions).

The commercial pectin is obtained from fruit waste, particularly waste and by-products from the production of juices (apple and citrus). These raw materials are used because they produce high quality pectin, contain large amounts (about 25% pectic substances) and are available in sufficient quantities to be commercially viable. In any case, citrus by-products are mostly used. Specifically, companies engaged in the industrialization of citrus fruits to produce juices or other products, generate a percentage of waste near 50% of the weight of the original whole fruit in the form of bark (consisting mainly of albedo and flavedo), seeds, membranes and skins from the juice vesicles, which can be used.

When we speak of citrus we refer to the genus *citrus*, which contains three species and numerous cultivated hybrids, including the most widely marketed fruits, such as lemon, orange, lime, grapefruit and mandarin, with various varieties depending on the region where each of them is cultivated.

On the other hand, pectin is found in fruits under an insoluble form known as protopectin, which is easily converted into the soluble form by gentle hydrolysis. This pectin solution can be precipitated with alcohol, then washed and dried, obtaining pectic acids (pectins). In summary, the commercial pectin extraction method is a traditional technique of extraction with acids and precipitation with alcohol, where the raw material must be conditioned to improve the extraction reducing its size.

With the indicated process, acid hydrolysis, it is possible to obtain pectin that meets the market requirements, that is: percentage of methoxyls, degree of gelation, equivalent weight and percentage of galacturonic acid. The process has a good economic performance, which makes it an alternative for the by-products of the production of citrus juices.

In any case, this method generates a series of environmental problems that has resulted in high costs of wastewater treatment, and closure of factories in countries such as the USA.

An important challenge for the food industry is to achieve natural resources to develop high added value foods using environmentally friendly techniques. The proposal of the LIFECITRUS project is to obtain a citrus concentrate with puree appearance, where extraction techniques that require the use of chemical reagents are not used. In addition, the process uses technologies known by the vegetable processing sector, for easy implementation. And to this is added the energy cost savings of the drying stage.

It cannot be forgotten that the final characteristics of the pectin depend on the vegetable or fruit from which it is being extracted and the conditions of this, as well as the methods used for the extraction and transformation. Therefore, the purée obtained has been tested as a substitute for pectin in the production of jams.

The procedure consisted in the formulation of different strawberry jams with 100, 150 and 200 grams of citrus puree in the recipe of 1 kilogram, which were compared with a jam which in its recipe included 6 grams of pectin commercial powder. Subsequently the texture results were evaluated and the 150 g puree / kg marmalade was selected as the appropriate dose.

It is noteworthy that the difference between the two required a different amount of cooking water. In particular, the recipe with citrus puree required less water to cook the strawberry.

The selling price of the commercial pectin used is approximately 12.5 € / kg, but due to the results obtained in the evaluation of the jams it can be said that the citrus puree used corresponds to a pectin concentration of only 4%. The selling price of the mash has to be adjusted to the percentage it contains, since a greater amount of mash is required to obtain the same result in a product that uses commercial pectin powder. Considering a 4% pectin content, the selling price of the citrus puree could be 0.5 € / kg.

Finally, the puree of citrus is a natural ingredient that can be incorporated in the elaboration of different food products avoiding the use of chemical additives. The use of this product as a substitute for pectin used so far gives the product a completely natural character and releases it from the use of preservatives "E" in the product.

5.5. Results of the cost-benefit analysis

According to the data previously discussed, the total cost associated with the citrus peel processing line is detailed below. The calculation of the unit cost has been determined for an estimated production of 12,960 tonnes per year.

Type of cost		Annual cost (€/year)	Unit cost (€/tonne product)
Amortization (7 years)		191,428.57	14.77
Maintenance and operation		80,400	6.20
Personal		51,840	4.00
Production		2,057,850	158.78
	Water consumption	587,520	45.33
	Waste water	1,036,800	80.00
	Electric consumption	75,600	5.83
	Energy consumption	357,930	27.62
Packing		758,160	58.5
TOTAL		3,139,678.57	242.26

On the other hand, the benefits obtained are 6,480,000 € / year due to the estimated production of citrus purée per year and the unit price of sale determined at 0.5 € / kg (when comparing its gelling power with a pectin used In the making of a jam).

Finally, it can be said that the project is economically interesting since the net profit of the project is positive and has a value of 3,340,321.43 € / year.

5.6. Conclusion

By-products from the citrus processing industry can be valued within the industry itself through a technically feasible process.

In addition, it can be said that the placing on the market of a natural substitute for pectin generates a new line of industrialization, which has been evaluated economically in a positive way. The price of commercial powdered pectin has been determinant to obtain a positive result as a net profit.

6. FEASIBILITY STUDY OF THE LIFECITRUS PROCESS

6.1. Introduction

In order to evaluate the economic viability of the LIFECITRUS process, a study has been carried out and the costs associated with the values of the main parameters of interest have been considered. In the first place it is necessary to know the type of by-product and then establish a diagram of the process.

6.1.1. Citrus byproducts

The Region of Murcia has an important industry in the citrus processing sector with a large volume of production at the national level. This volume entails the generation of large quantities of waste resulting from the processing of citrus fruits, which lack economic value and its elimination is a cost that has an impact on the increase in the final price of the products.

This residue is the fruit discarded by low quality, but especially it consists of the parts of the fruits without commercial value (skin / crust) that are removed during the process of transformation. Their current management through direct use in animal feed classifies them as by-products, but this solution is not compatible with advanced scientific and technical criteria.

The following analysis shows the citrus by-product analysis for both lemon and orange and mandarin, which are the main processed raw materials.

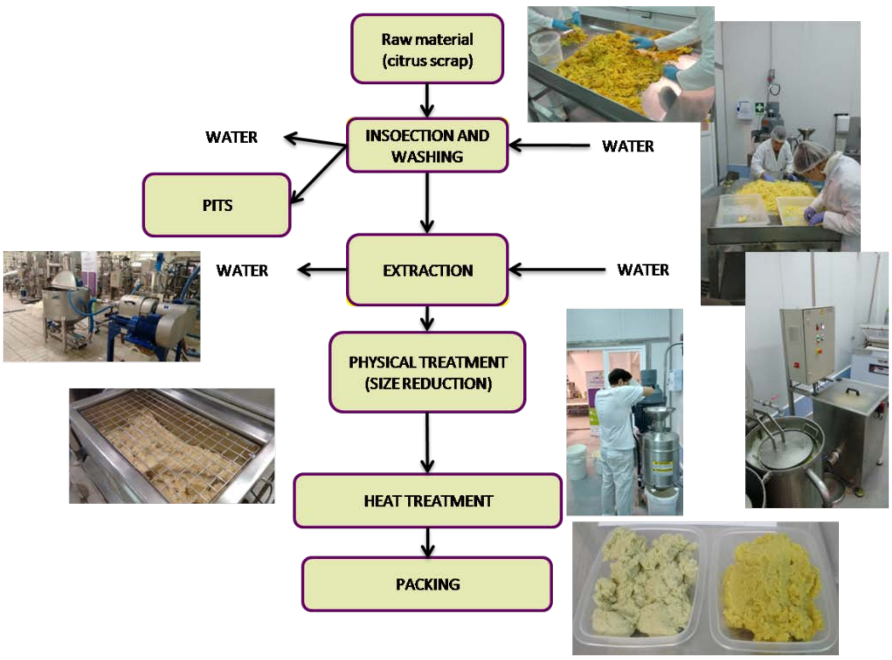
LEMON BYPRODUCT Parameter	Value
Physiochemical	
pH	3.54
º Brix	7.1
Acidity (% citric acid)	0.9
Texture	0
Colour	Max: L= 71.84; a= -5.65; b= 29.25 Min: L= 71.17; a= -5.88; b= 26.04 Medium: L= 71.53; a= -5.80; b= 27.62
Moisture (%)	87
Crude fiber (%)	2.3
Fat (%)	<0.1
Essential oils (mL/100g)	0.5
Dietary fiber (%)	6.7
Instrumental	
Pesticides (mg/Kg)	2-PHENYLPHENOL (0.69); CHLORPYRIFOS (0.01); IMAZALIL (1.57); PYRIMETHANIL (0.87); PROCHLORAZ (0.031); TEBUFENPYRAD (0.036)
Hesperidin (mg/Kg)	1,235
Microbiological	
Aerobic plate count (cfu/g)	48,000
Mold and yeast counts (cfu/g)	3,500

ORANGE BYPRODUCT Parameter	Value
Physiochemical	
pH	3.18
º Brix	14
Acidity (% citric acid)	0.9
Texture	0
Colour	Max: L= 74.61; a= -5.02; b= 64.24 Min: L= 74.61; a= -5.02; b= 64.24 Medium: L= 74.61; a= -5.02; b= 64.24
Moisture (%)	78.4
Crude fiber (%)	3.3
Fat (%)	<0.1
Essential oils (mL/100g)	1.3
Dietary fiber (%)	7.3
Instrumental	
Pesticides (mg/Kg)	2-PHENYLPHENOL (1.34); CHLORPYRIFOS (0.052); CHLORPYRIFOS -METHYL (0.013); IMAZALIL (2.5); PYRIMETHANIL (0.43); THIABENDAZOLE (0.51)
Hesperidin (mg/Kg)	95
Microbiological	
Aerobic plate count (cfu/g)	150,000
Mold and yeast counts (cfu/g)	2,200

MANDARIN BYPRODUCT Parameter	Value
Physiochemical	
pH	3.37
º Brix	11.2
Acidity (% citric acid)	0.91
Texture	0
Colour	Max: L= 68.68; a= -3.21; b= 60.38 Min: L= 68.01; a= 1.49; b= 57.15 Medium: L= 68.28; a= 2.22; b= 59.29
Moisture (%)	84.4
Crude fiber (%)	3.6
Fat (%)	0.3
Essential oils (mL/100g)	0.27
Dietary fiber (%)	6.5
Instrumental	
Pesticides (mg/Kg)	CHLORPYRIFOS (0.015); CHLORPYRIFOS -METHYL (0.011); IMAZALIL (1.83); Lambda-CYHALOTHRIN (0.011); PYRIMETHANIL (0.023); PYRIPROXYFEN (0.016)
Hesperidin (mg/Kg)	9,839
Microbiological	
Aerobic plate count (cfu/g)	560
Mold and yeast counts (cfu/g)	<10

6.1.2. Process Flow Chart

The flow chart considered for the LIFECITRUS process is shown below.



6.1.3. The product obtained. Puree of citrus bark

In the processing of the by-product of citrus, according to the process described above, a purée of citrus bark is obtained rich in pectin which provides a wide range of possibilities. This puree stands out for its high gelling power, which makes it a substitute for commercial pectin in the use as a thickener in jams, preserves and other preparations.

The citrus puree is a natural ingredient that can be incorporated in the elaboration of different food products avoiding the use of chemical additives. The use of this product as a substitute for pectin used so far gives the product a completely natural character and releases it from the use of preservatives "E" in a new product.

6.1.4. Previous data

In order to determine the profitability of the project we have to evaluate the different costs of the project and the exploitation of the activity developed for its implementation in the Region of Murcia, as follows:

The cost of investment in equipment has been estimated at 1,340,000 euros where the line has been designed to process and pack citrus bark, and consists of the following sections:

- Line of reception and processing of product

  - Washing the peel
  - Reduced size
  - Inspection of the product through artificial vision
  - Centrifugal separation by decanter
  - Reduced size (microcutter)
  - Cooking

- Sterilization and packaging

  - Aseptic filler

The cost of raw material has been estimated at 12 euros / tonne, to which is added a transport cost of 4 euros / tonne. In total the cost is 16 euros / tonne. This cost is due to the non-implementation of the processing line in the same citrus processing company; it has decided to implant in an agri-food company that demands ingredients and that can commercialize this natural ingredient.

This study has considered the use of natural gas for the boiler required in the system, for which an average value of market prices has been taken. On the other hand most of the equipment works with electricity, reason why also has been taken an average price of market for the electrical cost.

It is also important to emphasize the importance of the cost of water since the consumption of water in the production of mashed citrus fruit is high. The price of m^3 of water in the Region of Murcia is different in each municipality and therefore it has been necessary to determine the location of the process, which in this case has been the municipality of Murcia. Additionally we have estimated a cost of treatment of this water as wastewater.

On the other hand, we estimate that this production process requires a workforce of three people, to which we have assigned a cost of 12 euros / hour.

We have determined funding for 100% of the investment needed in equipment, and we have established a repayment term of 7 years. The financial cost has been estimated at a rate of 5.5%.

We have distributed the costs of the equipment in 10 years, for which we incorporate a cost of repayment of 10% per year.

We have estimated a cost of sales of 4 euros per tonne as well as a marketing cost that we estimate will imply a cost to sales force of 5% over the sales figure obtained.

Finally we have determined that this new activity developed by the company produces an increase of its general expenses, which we have estimated at 5% of the income generated by it.

Expenses for land, civil works or similar have not been taken into account. This study focuses on the installation of a production line in an existing company and that has the necessary means for the implementation of this process.

In order to take the raw data, an average company in the Region of Murcia has been established with a production of 6 tonnes / hour, which is about 20,000 tonnes / year, which is within the average values of the citrus processing industries In Murcia.

It should also be noted that the product obtained is a purée of citrus with high content of pectin but logically it will require a greater amount of puree than the pectin chemically synthesized. The selling price of the commercial pectin used is approximately 12.5 € / kg, but due to the results obtained in the evaluation of previous studies in the elaboration of foods such as jams, it can be said that the citrus puree used Corresponds to a pectin concentration of only 4%. The selling price of the mash has to be adjusted to the percentage it contains, since a greater amount of mash is required to obtain the same result in a product that uses commercial pectin powder. Considering a 4% pectin content, the selling price of the citrus puree could be 0.5 € / kg.

These and other fixed starting data are detailed below:

PREVIOUS DATA	VALUE	UNIT
Raw material required	21.600	tonne / year
Hours annual work	3.600	hours
Hourly production	6	tonne / hour
Electrical consumption in plant equipment	175	Kw/h
Performance in citrus bark processing	60	%
Amount of puree to be obtained	12.960	tonne / year
Loan payable on ...	7	years
Loan interest	5,5	%
Amortization of investment	10	%
Staff needed	3	people

Also take into account the price of each of the elements that have an impact on the final price of the product:

PRICE	VALUE	UNIT
Pectin price*	12.500	€/t
Puree price	500 menos 25 %	€/t
Raw material price	12	€/t
Raw material transport price	4	€/t
Electricity price	0,14	€/Kwh
Water prices in Murcia **	1,36	€/m^3
Natural Gas price	0,035	€/Kw
Price Package (Can + aseptic bag)***	11,70	€/Envase
Manpower price	12	€/hora/persona
Cost of wastewater treatment	2,4	€/m^3

* Price of pectin varies depending on the type, an average price of low methoxy pectin is taken.
** Total price of supply plus sewage system and sanitation fee for Murcia.
***Aseptic bag: € 2.7; Can: € 12 real value - € 3 residual value = € 9.

6.2. Equipment

Once the optimal flow chart for the citrus bark processing has been determined, the equipment needed to implement this system must be found. Once contacted with suppliers have budgeted all the equipment that is needed. All necessary equipment is listed below.

6.2.1. Line of product reception and processing

6.2.1.1. Washing raft with elevator

The mission of this machine is to carry out a first cleaning of the by-product to eliminate possible residues and a subsequent continuous distribution thereof by a lifting system in which draining also occurs.

Thus, the bark is discharged into the tank manually. In the upper area, air is introduced into the assembly, so that the bubbling produced improves the washing process. The air is produced by a turbine driven by a motor of 7.5 HP. In the raft there is an evacuation system that prevents the capacity of the tank from being exceeded.

Once the washing has been performed, by means of a bucket elevator with double swan neck, showers and discharge hopper, the bark is passed to an inspection tape where the debris is carried out.

The elevator consists of a system of showers to clean the product with clean water. The water that escapes from the elevator is also directed towards the tank of the filtration system for the disposal of waste and recovery by recirculation to the raft. It has a waterwheel in the part superior of the raft to help the exit of the material, as well as of lateral guides along its length.

6.2.1.2. Inspection

Located behind the lift system. The conveyor will locate an operator who will introduce the nonconforming product through the bore holes.

For the removal of water and debris, a hopper has been placed under the inspection zone which will direct said by-products to a container located at the exit.

The debris is eliminated by operators through a debris collection belt and from there they will go to a system of disposal of this type of waste.

6.2.1.3. Bucket elevator to cutter

Once the inspection has been carried out, by means of a bucket elevator with double swan neck, showers and discharge hopper, the bark passes to the platform where its size is reduced.

6.2.1.4. Cutting machine

The product from the elevator feeds two cutters (Urschell or similar) that make the 8x8mm cubes. From these it is discharged in a tape that leads to the machine of artificial vision.

6.2.1.5. Inspection of the cubes

After the cutter and prior to the centrifugal separation an artificial vision equipment is available to eliminate the impurities of the product. This equipment delivers in a small balance tank, prior to the decanter.

6.2.1.6. Centrifugal separation

The product is mixed with water in the tank and from it is passed through a centrifugal decanter that separates the liquid phase from the solid.

The liquid phase is discarded and the solid is passed to the next stage.

6.2.1.7. Microcutter (Comitrol)

In this equipment the product is reduced to puree by means of a microcutter type Urschell Comitrol (or similar).

6.2.1.8. Cooking

Puree is heated suddenly in the cooking equipment. This equipment consists of a heating module by recirculation. The product is recirculated at a rate of 10-20 times the input capacity so that, when entering the cold product is mixed with the hot producing an immediate temperature rise.

The average residence time of the equipment is 15 minutes at an adjustable temperature from 55 to 95 °C. From this equipment it is sent directly to the Sterilizer, where a deaerator is available at the beginning of the equipment.

6.2.2. Sterilizer

The product is received in the deaerator, which acts as a balance tank.

The balance tank regulates the product inlet in the process line, so that there is always a minimum quantity that can be pushed towards the heat treatment section. Some of the components of this equipment are:

- Automatic valves: product inlet, product pump feed, rinse and drain water inlet, CIP solution inlet, return solution CIP, return product from the sterilizer.
- Manual valves: balance tank drainage.
- Proportional level indicator: continuous measurement of the product level in the tank.
- Level Indicators: Maximum and minimum levels in the tank.
- Cleaning sphere: diffusion of the CIP cleaning solution inside the tank.
- Manway: maintenance operations, inspections of the interior of the balance tank.
- Mirrors: Visual inspections.
- Temperature probe.
- The capacity of the tank is approximately 1000 liters.

At the outlet of the deaerator, a positive displacement pump feeds a high-pressure piston pump and moves the product to the sterilizer. The flow rate can be regulated by means of a frequency inverter in both the helical and the piston pumps.

6.2.2.1. Heat treatment

Each of the heat treatment sections (preheating, heating, pre-cooling, cooling 1 and cooling 2) include corrugated tube (three tube) annular space exchangers.

a. Heating section.

After the balance tank, the product is driven to the heating section where it will be heated to the sterilization temperature (85-105 ° C, depending on the product).

In order to avoid very large thermal leaks between the product to be heated and the working fluid, superheated water will be used as the heat transfer medium. In turn, the water temperature will increase when it is circulated through a corrugated heat exchanger, called a water heater. In this case the steam will be the heating fluid.

The superheated water circuit consists of a centrifugal pump to drive the heating water, as well as the necessary safety features such as: pressure relief valve, expansion vessels (whose mission is to absorb the volume increase of the water due to the elevation of its temperature, as well as to prevent hydraulic blows (water hammer) in the line); a container specially designed to allow the separation of water and air present in the installation, with a valve for the purging of this air.

The steam installation will have the necessary elements (steam filter, manual stop valve and steam pressure gauges). The temperature control shall be carried out by means of a temperature modulating valve and the control loop shall be PID (proportional-integral-derivative) type. Also, to prevent steam from entering the condensate line, a float trap will be installed.

At the exit of the heating section, a temperature probe (pT-100) will be installed to control the product outlet temperature towards the maintenance section.

b. Maintenance section.

Once the product has reached the sterilization temperature it is necessary to maintain it at that temperature for a certain time (maintenance time, between 60-90 seconds). To this end, after the heating module is the so-called maintenance tube, calculated so that all the particles of the product have the design residence time and the loss of load of the product flow is the minimum.

After the maintenance section, a temperature probe (pT-100) will be placed to control the process.

c. Cooling section.

After the maintenance section, the product must be cooled before being sent to the aseptic lung. The cooling consists of two sections.

- Cooling section 1 uses tower water at 26-28 °C as the heat transfer medium. At the exit of the cooling section, a temperature probe (pT-100) and a sanitary thermometer will be installed to control the process. The service area includes automatic shut-off valve, manual shut-off valve, expansion vessel and safety valve.
- The cooling section 2 uses glycolised water (-5 °C) as the heat transfer medium. A temperature probe (pT-100) and a pressure sensor will be installed at the exit of the cooling section for process control. Two-way modulating valve, manual shut-off valve, expansion vessel and safety valve are included in the service area. The temperature control will be PID type.

d. Hot deflection and Sterilization Cooler.

After the heating section, a three-way high-pressure valve will be placed as safety, so that when the product has not completed the heat treatment (insufficient temperature), it will divert the product to the beginning of the line from where it can be re-processed or recovered in drums.

In the return line to the balance tank a heat exchanger will be installed, responsible for cooling the product, so that when it returns to the initial balance tank, there is no sudden or flash evaporation. In this application the service fluid is tower water.

After the sterilization cooler is placed a pressurizing valve that will keep the line pressurized, thus preventing the product from boiling inside the heating section.

6.2.3. Aseptic filler

The aseptic filler will be of two filling heads for fruit concentrate in bags of 230 liters without palletizing.

The filling speed is directly dependent on the speed at which the process pump is driving the product from the heat treatment section.

The most important elements that constitute the aseptic filler are:

- Two automatic filling heads. Made of steel they have a filling mouth of 1 ", in which the bag is placed to package the product (previously sterilized). The filling heads perform vertical movement to fill the bags by means of an electric motor installed on each filling head.

- Two conveyor belts for roller inlet on pallet. In each filling line there is a motorized roller belt.
- Two heavy belt / roller conveyors. Under each automatic spindle there is a heavy-duty conveyor belt. The tape has four load cells to control the filling process of each drum, when the bag is full it sends a signal to the control system and prints the label with the production data.
- A conveyor belt of rollers. In each filling line there is an exit roller belt.
- Sanitary steam circuit SIP (sterilization in place). For sterilization of the product circuit, steam seals and filling heads during production. Each head has a condensate outlet tube to prevent them from falling on the product bags.
- Product circuit and product valve. A 3-way diverter valve is provided at the product inlet connection to the filler, which is intended to control the passage of product to the filler, or in case the filler is not ready or the product Does not meet the requirements to be packaged, will divert production to the return cooler of the plant or to the aseptic deposit.
- Compressed air circuit. The compressed air is distributed for the actuation of valves and the pneumatic cylinders in charge of the different movements of the head.
- CIP (cleaning in place) and return circuit. The product circuit and the filling heads are designed for CIP cleaning. The cleaning and sterilization cycle is activated from the control system of the equipment. For the return and recirculation of CIP an accessory with flexible hose is included that connects to the circuit.
- Support structure. Stainless steel structure for the support of filling heads and electro-pneumatic valves.
- Equipment for weighing and labeling of drums. Four electronic cells weigh the contents packed in each aseptic bag, sending a signal to the control system, which, once the filling is complete, prints a label with all production data.
- Control system. The filler control system is integrated into the control panel of the sterilizer assembly. In the structure of the filler includes a box with printer and another with the keypad required to handle the filler.

Its operation consists of:

1. Sterilization of the product (the product is already sterilized from the heat exchange zone).

2. Separate sterilization of the container (container is already purchased sterilized).

3. Sterilization of all the zones in contact with the product by steam injection, during a time parameterized in the control system (SIP)

4. Maintenance of the asepsis of the packaging, the product and the place of packaging by steam, steam seals and injection of sanitary steam.

5. Introduction of the product cold or at room temperature in the container or container without allowing any contamination.

6. Watertight seal of filled container.

7. Once the production is finished the aseptic filler is ready for chemical cleaning (CIP).

The estimated cost of the equipment and installation are as follows:

EQUIPMENT REQUIRED TO OBTAIN CITRUS PURES IN THE PROPOSED INSTALLATION	COST (€)
Washing	55,000
Cutter	115,000
Inspection (artificial vision)	225,000
Centrifugal separation by decanter	150,000
Reduction of size	65,000
Cooking	125,000
Sterilization	375,000
Aseptic filling machine	230,000
Initial investment	**1,340,000**

6.3. Economic study

Once we know the cost of all the equipment to be used in the plant, the cost of the raw material, as well as its transportation, energy, financial, general and marketing costs, we can determine the expenses that go To have in this project.

In addition, on the other hand, the amount of citrus mash to be obtained and the gelling power of this citrus is known. The price of pectin in the market is also known. This way we can calculate the annual savings that would be obtained by replacing the use of this pectin by the use of the citrus puree.

With all these data it will be possible to determine the time necessary to recover the initial investment and if it is a viable or non-viable project and if it is a long or short term project.

The following describes all the expenses derived from obtaining citrus puree:

	AMOUNT (€)	
SALES REVENUE		**4,860,000**
EXPENSES		
Raw material	259,200	
Raw material transport	86,400	
Personnel cost	129,600	
Energy	446,098	
Electrical costs	88,200	
Natural Gas costs	357,898	
Water costs	587,520	
Wastewater treatment cost	1,036,800	
Packaging cost	758,160	
Amortization	134,000	
Loan interest	39,642	
Transportation of finished product	51,840	
Marketing expenses	243,000	
Overheads	243,000	
TOTAL ANNUAL COSTS	**4,015,259**	
ANNUAL BENEFIT	***844,741***	

UNIT COST (tonne puree)	309.82
SALE PRICE (tonne puree)	375.00
Net profit by tonne	*65.18*

To determine the unit cost of both the citrus puree itself and the content of gelling elements, the relationship between the total annual costs and the amount obtained annually has been taken. The cost has been made both on the basis of the gelling power that the puree has in comparison to the pectin as to the amount of this. In order to better compare prices, commercial pectin has always been related to the equivalent gelling power of citrus puree.

The unit cost of the citrus mash that is manufactured is logically lower, since in a certain amount of citrus puree there is only a percentage of pectin.

6.3.1. Amortization

At the estimated annual profit of 844,741 euros, we must subtract the corporation tax, which estimated at 25% reaches the figure of 211,185 euros, leaving the result after tax at 633,556 euros. Given that the required investment is 1,340,000 euros, this investment will be amortized with net profits in the term of 2.11 years.

6.3.2. Estimate of cash flows

To calculate the cash flows of the investment we start from two basic parameters:

- 100% financing of the investment at an interest rate of 5.5% and a term of 7 years, a financial operation that generates monthly payments of € 19,255.86, or € 231,070.32 per year.
- The cash flows obtained per year correspond to the net profits (after tax) plus the provisions to the amortization of the fixed assets. During the first 7 years, these loans amounted to € 633,556 and € 134,000 respectively, and from the eighth year onwards, with the end of the loan, these benefits are increased by the amount corresponding to loan interest, which amounts to an annual average of € 39,642, increasing the profit after taxes to 673,197 euros.

This is the cash flow table corresponding to the first 10 years of activity:

CASH FLOW						
	Cash generated by the activity			Expenditure	Flows generated	
Year	Annual benefit	Amortization	Total	Loan payment	Year	Accumulated
1	633,556	134,000	767,556	-231,070	536,485	536,485
2	633,556	134,000	767,556	-231,070	536,485	1,072,970
3	633,556	134,000	767,556	-231,070	536,485	1,609,456
4	633,556	134,000	767,556	-231,070	536,485	2,145,941
5	633,556	134,000	767,556	-231,070	536,485	2,682,426
6	633,556	134,000	767,556	-231,070	536,485	3,218,911
7	633,556	134,000	767,556	-231,070	536,485	3,755,397
8	673,197	134,000	807,197	-231,070	576,127	4,331,524
9	673,197	134,000	807,197	-231,070	576,127	4,907,651
10	673,197	134,000	807,197	-231,070	576,127	5,483,777

6.3.3. Profitability Parameters

In order to analyze the suitability of the investment, it is necessary to estimate three fundamental parameters, EBITDA, IRR and NPV.

EBITDA (Earnings Before Interest, Taxes, Depreciation, and Amortization) is one of the best known financial indicators, and essential in any fundamental analysis of a company. It represents the gross operating profit calculated before the deductibility of financial expenses.

The Internal Rate of Return (IRR) is the rate of interest or profitability offered by an investment. That is, it is the percentage of profit or loss that an investment will have for the amounts that have not been withdrawn from the project.

The Net Present Value (NPV) is to update the charges and payments of a project or investment and calculate their difference. To do so, it brings all the cash flows to the present moment by discounting them at a given interest rate. The NPV is going to express a measure of project profitability in net absolute terms, that is, in number of monetary units.

In both cases we get some really attractive data:

The **EBITDA** obtained from the activity amounts to 1,018,382 euros per year, which represents 76% of the cost of the investment required in equipment.

We have estimated the **NPV** of the investment with a discount rate equivalent to the cost of the loan, 5.5%, updating the flows corresponding to the projected period, which is 10 years, obtaining a net present value of the investment of 4,177,346.78 euros.

Finally, in order to calculate the Internal Rate of Return, we must point out that the estimated profit has been based on the assumption that no contribution of own capital will occur, so that in that case any yield obtained would generate a rate of return infinite. However, we will calculate the cost of the equipment (€ 1,340,000), that is, assuming that the investor makes a contribution of funds equivalent to the cost of these fixed assets. Calculation of the IRR from an annual benefit of 673,197 euros per year, a figure obtained from an exercise in which financial costs are no longer supported. Under these conditions the IRR of the investment amounts to 49.33%.

We also draw attention to the great capacity of return of the investment that this project presents, whereas if we measure it in terms of cash flows, we observe how in the case where the investment was financed with own funds, it can be financed in just 1.66 years, while an initial investment of 1,340,000 euros produces an effective cash flow generation of 807,197 euros (net profit from taxes plus depreciation of fixed assets, without financial expenses).

6.4. Conclusions

Obtaining citrus purees as a substitute for commercial pectin is highly profitable.

The location of the recovery plant can be a fundamental factor. The implementation of the company together with the companies supplying raw material would save all the costs of travel and transportation. The cost of the supply water could also be reduced.

7. FINAL CONCLUSIONS

Finally, it can be said that the application of a natural substitute for pectin generates a new line of industrialization, in addition to an environmentally sustainable process.