



LIFE Environment and Resource Efficiency

LIFECITRUS

LIFE14 ENV/ES/000326

B4_Summary report of the National and International demonstration and disclosure initiatives for citrus juice and oil industries, fresh producers and marketers

30 July 2018.





This report collects information on the B4 action raised in the memory of the project “LIFECITRUS-LIFE14 ENV/ES/000326”.

1. INTRODUCTION

First, a general overview of citrus fruits is shown in the field of global production and marketing. Secondly, the most important aspects of the sectoral structure in Spain and Italy are described. Third, the basic features of citrus consumption in Spain are analysed. And in the last section, exports and international markets for these products are analysed.

Global production and marketing of citrus fruits

The cultivation of citrus fruits is very popular in the regions of the world; in fact, the world annual production of citrus fruits exceeds 100 million tons and the production of oranges exceeds 50% according to FAO data for the year 2017. The world production of tangerine is almost 29% of the total production and the production of grapefruit is 5%.

Production in the European Union is estimated at 11.7 million tons and is concentrated in the Mediterranean region. Spain and Italy account for almost 80 percent of the total EU production.

More specifically, Spain is the fifth largest producer of oranges after Brazil, India, Mexico and China. As for mandarin, Spain is the second largest producer after China. And in the lemon, Spain is also the second behind Argentina with nearly 1 million tons.

In terms of marketing, the destination in fresh and the industry are the two sales lines. Spain mainly sells its citrus fruits for the fresh market, while, for example, Argentina allocates more than 75% of the lemon production to its industrialization. Globally, tangerine has its main destination of commercialization in fresh, because only 5% of the total production is destined to the industry of transformation.

Citrus in Spain and Italy

Spain, Italy, Greece and Portugal are the EU's largest citrus fruit (oranges, tangerines and lemons) producing countries. Spain is the largest producer of citrus in the European Union and fifth in the world with an annual production of more than 6 million tonnes over the last decade.

The citrus area cultivated in Spain has been increasing slightly over the last decade, although in 2011 it has experienced a slight decrease of 0.5%. The traditional orientation to the cultivation of the orange tree is maintained, which represents 48.7% of the total surface area of citrus, followed by the mandarin, which occupies 38.1% of the surface and much more distant the lemon tree (12.6%) and the grapefruit (0.6%). Valencia continues to be the producing region with the largest citrus area, accounting for 56.2% of the national total, although the relative weight of the area in Andalusia is growing continuously and already represents 27.1%.

Valencia occupies the first national place in both orange and mandarin, and Murcia in lemon and grapefruit.

The annual production of citrus fruits, as it happens with many other crops, depends mainly on the climatic evolution, oscillating according to campaigns between 5 and about 7 million tons. The production of oranges can range between 2.5 and 3 million tons, tangerine exceed 2 million, lemons have reached maximums of 1 million tons (lemon production is concentrated in the regions of Murcia and Valencia, Malaga and Almeria in Andalusia) and the harvest oscillates between 800,000 and 1.1 million tons with an upward trend in the nearest future and grapefruits are around 50,000 tons.

Italy is the second largest European orange producer after Spain. The annual production of Italy is about 2.6 million tons, where 60% of the production is oranges. Sicily and Calabria are the main citrus-producing areas. 59% of oranges and 50% of tangerines are produced in Sicily. *Tarocco*, *Moro*, *Sanguinello*, *Naveline*, and *Valencia* are the leading orange varieties grown in the country. Moreover, *Ippolito* and *Meli* crops are gaining popularity. *Comune* or *Oroval* and *Monreal* are the leading clementine varieties grown in the country. *Avana* and *Tardivo di Ciaculli* are the chief mandarin cultivars. Sicily is the main lemon-producing area too, accounting for 86 percent of domestic production. *Femminello Commune* (*F. Zagara Bianca*, *F. Siracusano*, and *F. S. Teresa*), *Monachello* and *Interdonato* are the leading lemon varieties grown in the country.

Consumption of citrus fruits

Citrus fruits are highly consumed throughout the world as fresh products and juices. It has interesting characteristics and contains active phytochemicals that can protect health. The European citrus sector is strongly oriented towards the fresh produce market, but citrus fruits can be processed because they depend on the quantity and quality of citrus production. In addition, consumers want a high quality product and therefore the market offers physical and organoleptic quality. Producers and / or exporters work to provide an improved fruit with an adequate caliber for fresh commercialization or industrialization.

In EU-28, oranges and lemons are mainly consumed fresh. Spain's orange consumption is estimated at approximately 20 kg. In Spain, *Navelina* and *Navelate* varieties are consumed fresh and *Valencia Late* varieties are predominantly used in processing. In Italy most oranges and lemons are consumed fresh too. Blood varieties (*Tarocco*, *Moro* and *Sanguinello*) are used primarily for fresh consumption. Late varieties (*Ovale* and *Valencia*) are destined to both processing and fresh markets. *Fino* and *Verna* are the leading lemon varieties grown in Spain, accounting for 70 and 30 percent of the total production, respectively. The *Fino* variety is predominantly used in processing. *Ruby Red* is the main grapefruit variety planted in Spain.

Italians consume large quantities of oranges, but tangerines are highly consumed in fresh too.

The total volume of citrus to processing depends on crop quality and quantity of citrus destined for the fresh market, both domestic and foreign.

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, a shift from fruit juices and nectars to healthier beverages by consumers in major markets, such as Germany and France, has affected volumes considerably.

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).

Fruit juices continue to represent a significant part of the Spanish market in agro-food products. For flavours, orange juice with a volume of 259,804 tonnes is flavour more sold abroad, followed very closely by the grape, with a total of 257,281 tons. In fact, orange juice is the most popular juice in the EU-28.

Lemon juice is consumed less, but can be consumed as such, sweetened with sugar or honey, and can be used in the preparation of slush, sorbets, jams and pastries.

Citrus exports

Spain is a leader in the export of citrus fruits to the EU, it markets more than 90% of its production to other EU-28 countries, but it has competitors that are becoming increasingly entrenched. Spanish citrus sales have competitors to third countries, among which Morocco in tangerines and clementines, Egypt in oranges and Turkey in lemons.

Another problem is that in recent years there has been an increase in extra-EU exports due to the Russian veto, which has forced to seek new customers outside the EU.

Italy also devotes part of its production to exports and mainly exports to Germany, Switzerland, Austria, and France.

2. METHODOLOGY

According to the above-mentioned information, we contacted numerous companies both nationally and internationally, working meetings were organized and demonstrative actions were raised on the floor of LIFECITRUS project.

Representative companies have been encouraged to test their own citrus scraps or to participate in demonstrations at the semi-industrial CTC plant. A total of 58 national and international companies have been contacted throughout this action. These companies are mainly Spanish and Italian, due to the contacts of the project partners. List available in Annex I.

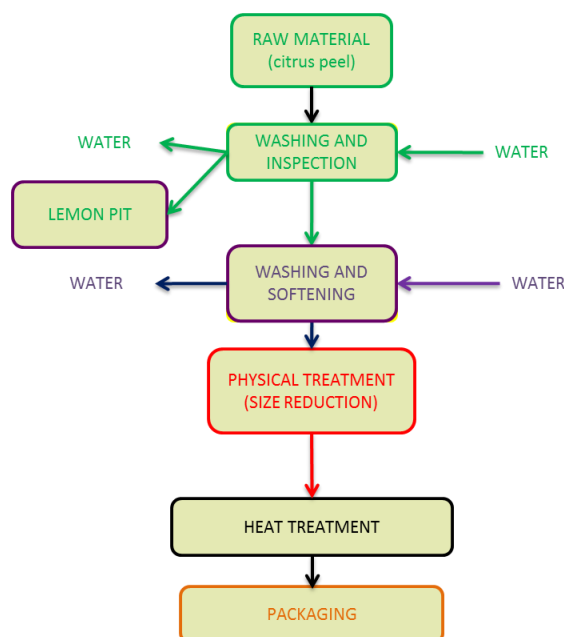
Two workshops were developed in the frame of this action. The first workshop was held within the Fruit Attraction Fair on October 18, 2017, through contact with sales people and technicians from different companies in a particular way. In the end, meetings were held with 6 national and international citrus companies, highlighting contacts from Brazil and Turkey. The second workshop was organized with companies of citrus fruits and other fruits and was held on November 15, 2017 in Rome, at the headquarters of FEDERALIMENTARE Servizi. This meeting was grouped with the meeting of action B5 (with general food companies) to increase public attendance. The following companies related to citrus fruits attended: Orange Fiber and Agrumaria Corleone. From this meeting a positive comment was obtained from Agrumaria Corleone and a possible visit to the demonstration plant was believed, but it could not be finally celebrated.

As a result of the workshops and other dissemination activities, meetings with technicians from 3 national and international companies have been held to plan demonstration activities in the semi-industrial plant. In fact, 4 tests for 2 of them have been done, while tests with the other company (Agrumaria Corleone) weren't scheduled at the end.

3. TESTING AT THE DEMONSTRATION PLANT

4 tests have been done with national citrus commercialization companies and manufacturing high value-added active ingredients that have the by-product because they cannot find a market or because they seek to give it commercial value in other markets.

Below is shown the outline of the LIFECITRUS process for obtaining the new ingredient used in the demonstrations.



TEST WITH COMPANY TO PRODUCE THE NEW INGREDIENT. Cítricos El Túnel (clementine and lemon puree)



The company Cítricos El Túnel is located in the Valencian Community and is dedicated to the withdrawal of products (orange, lemon and tangerine) not suitable for export and the purchase and sale of citrus fruits.

This company initially had 50 kg of clementine by-product to evaluate the performance of the LIFECITRUS process equipment in the CTC demonstration plant. Finally, 24 Kg of the new ingredient was obtained. Therefore, the yield was 50%. The characteristics of the new ingredient are indicated in Table 1.

Table 1. Characteristics of clementine puree

	Clementine puree
pH	4.28
Calories (Kcal/100g)	27
Colour (CieLab)	L= 63,87; a= 4,87; b= 46,12
Total fat (g/100g)	0.2
Total carbohydrate (g/100g)	0.3
Total sugars (g/100g)	< 0.05
Proteins (g/100g)	0.9
Dietary fiber (g/100g)	10.3
Sodium chloride (g/100g)	0.04
Hesperidine (mg/Kg)	6849
Moisture (g/100g)	87.8

Results in fresh weight

The feedback for Cítricos El Túnel was a low yield and therefore another test of a greater quantity of by-product was developed to evaluate the performance of the process and offer better results.

The test was repeated with 150 Kg of lemon by-product as raw material of the LIFECITRUS process, which was previously analysed. The new test made it possible to determine that a higher yield of 58% can be achieved and obtain an ingredient with the characteristics indicated in Table 2.

Table 2.- Characteristics of raw material and lemon puree

	Lemon byproduct	Lemon puree
pH	3.28	3.81
Solid solubles (Brix)	8	4.3
Acidity (% citric acid)	1.2	0,19
Colour (CieLab)	L= 71.51, a= 4.63, b= 26.31	L= 68.51, a= 2.92, b= 23.53
Calories (Kcal/100g)	41	26

Total fat (g/100g)	0.3	0.3
Total carbohydrate (g/100g)	5.3	1.9
Total sugars (g/100g)	3.0	< 0.05
Proteins (g/100g)	0.9	0.6
Dietary fiber (g/100g)	6.6	6.5
Sodium chloride (g/100g)	0.07	0.05
Moisture (g/100g)	86.4	90.3
Hesperidine (mg/Kg)	1029	1163
Plaguicidas (mg/Kg)	2-phenylphenol (0.14); imazalyl (0.98); pyrimetanil (0.26); propiconazole (0.021)	2-phenylphenol (0.14); imazalyl (0.92); pyrimetanil (0.2); pyriproxyfen (0.014); propiconazole (0.023)

Results in fresh weight

With these results, the company is interested in finding other suppliers to reach a high quantity of by-product that makes its implementation viable.

TEST WITH COMPANY TO PRODUCE THE NEW INGREDIENT. Grupo Ferrer-Interquim (grapefruit puree)



Interquim is integrated into the Ferrer HealthTech division (Grupo Ferrer) based in Barcelona and is dedicated to the manufacture of active ingredients for the pharmaceutical industry. It has production plants with a high degree of automation: extraction and purification in aqueous medium, extraction and purification with solvents, synthesis and production of active ingredients of vegetable origin and animal nutrition. One of its R & D lines is to obtain products with optimal functionality, so it works with plant extracts and raw materials with interesting compounds.

In the demonstration plant of the project LIFECITRUS has been able to know the results of the use of grapefruit by-product to obtain a new natural ingredient with interesting properties.

It has contributed 400 Kg of grapefruit by-product to evaluate in two tests for its repeatability, using 200 Kg in each demonstrative action. The yield obtained in the grapefruit processing of the first test was 56%. Table 3 shows the characterization of the raw material and the obtained mash.

Table 3.- Characteristics of raw material and grapefruit puree 1

	Grapefruit byproduct	Grapefruit puree 1
pH	3.91	3.61
Solid solubles (Brix)	14.1	6.5
Acidity (% citric acid)	2.3	0.8
Colour (CieLab)	L = 63.31, a= 8.03, b= 34.50	L= 56.55, a= 6.31, b= 41.03
Calories (Kcal/100g)	51	24
Total fat (g/100g)	0.2	0.2
Total carbohydrate (g/100g)	7.8	2.3
Total sugars (g/100g)	6.0	1.5

Proteins (g/100g)	1.0	0.5
Dietary fiber (g/100g)	6.8	5.7
Sodium chloride (g/100g)	0.03	0.04
Moisture (g/100g)	83.7	91.0
Hesperidine (mg/Kg)	< 10	< 10
Plaguicidas (mg/Kg)	imazalyl (0.12); pyrimetanil (0.022); tebufenpyrad (0.045)	imazalyl (0.059); pyraclostrobin (0.012); pyrimetanil (0.019); tebufenpyrad (0.037); thiabendazole (0.016)

Results in fresh weight

In the second demonstration test with the Ferrer Group Company, a previously frozen raw material was used and a yield of 44% was obtained. Table 4 shows the analysis of the obtained puree.

Table 4.- Characteristics of grapefruit puree 2

	Grapefruit puree 2
pH	3.43
Calories (Kcal/100g)	29
Total fat (g/100g)	0.6
Total carbohydrate (g/100g)	2.3
Total sugars (g/100g)	0.8
Proteins (g/100g)	1.3
Dietary fiber (g/100g)	4.6
Sodium chloride (g/100g)	0.037
Moisture (g/100g)	90.9
Hesperidine (mg/Kg)	934
Plaguicidas (mg/Kg)	chlorpyrifos (0.028); imazalyl (0.97)

Results in fresh weight

In the two demonstrations, the same yield was not obtained and this was due to the storage time in freezing. The yield decreases due to the greater amount of leachates that appear when the raw material is fed to the LIFECITRUS process. The analysis does indicate a similar characterization for the two purees, although with a higher content of hesperidin in the second grapefruit puree obtained.

In conclusion, the company has quantified a low amount of hesperidin and a variable yield to develop a new ingredient, so it should continue working on processing and standardization.

4. CONCLUSION

Finally, in Action B4, with 4 demonstration actions, 800 Kg of citrus by-products have been processed and the following conclusions have been obtained:

1. The new ingredient requires high water consumption and its implementation is not viable when the production of by-products or quantities of discards is not enough.
2. Companies participating in the demonstrations prefer to evaluate the new ingredient privately.



In summary, the innovative ingredient is interesting for national companies, but it is not yet in the market and there is no demand that benefits its implementation. The manufacturer of active ingredients may be interested in the assessment of hesperidin.

The replicability of the process at national and international level has been tried, but there is still no positive feedback and companies prefer a new private project and test to advance.



Annex I

ALBAFRUITS	TORRES HERMANOS Y SUCESTORES, S.A.U.	NICO FRUIT
NOVASANCO	BENIHORT-COOP. AGRÍCOLA "SAN ISIDRO" DE BENICARLÓ	GRUPPO VILLARI
PERALES Y FERRER	GARCÍA BALLESTER	VALDIVERDURA
MANIPULADOS HORTICOLAS SAN ANDRÉS	FRUTAS TONO	FRUTTA SANA
VITALGRANA	MEDITERRANEAN FRESH FRUIT & VEGETABLE EXPORTERS' ASSOCIATION	PANNITTERI
AGRICONSA	AGROINVER ZAPATA, S.L.	AZIENDA TROMBINO
AGRISOL	EXPLORACIONES AGRARIAS LA JAIRA, S.L.	AZIENDA SAVA AGRI
AGROFRESH EXPORT CONSORTIUM	EXPLORACIONES AGRICOLAS DE CITRICOS, S.L.	CONSORZIO COA EXPORT
ART-FRUITS GROUP	FINCA CARMINA, EXPLORACIONES Y SERVICIOS, S.L.	COOPERATIVA GOEL
ASOCIACIÓN NARANJA DE VALENCIA	GIL RODRIGUEZ, DAVID	CONFAGRICOLTURA
ASSO FRUIT ITALIA SOC. COOP. AGR.	GIMENO PEREZ, ELOY	ZUEGG SPA
BEST FRUIT	MARTINEZ GARCIA, FRANCISCO ISIDORO	POLENGHI GROUP
BRIO FRUITS	MATEO TORRES, MARIA DE LOS REMEDIOS	AGRICONSULTING SPA.
BRUÑO	VELASCO CALLAU, MARIA CARMEN	INTERQUIM (GRUPO FERRER)
CAÑAMAS HNOS, S.A.U	CITRICOS FERISAN, S.L.	SURINVER
CINATUR GROUP	CITRIMOGI, S.L.	CÍTRICOS EL TÚNEL
CITRIBER	AGRUMARIA CORLEONE SPA	
CITRICOS COX SAT	AIIPA ASSOCIATION	
COPAL	ORANGE FIBER SRL	
EXQUISITE FRUITS	GIULIANO SRL	
FONTESTAD, S.A./MAYORISTAS DE CITRICOS EN MADRID	EON SRL	