Centro Tecnológico Nacional de la Conserva y Alimentación

ALGAE AS AN INGREDIENT IN FOOD PRODUCTS: CTC'S EXPERIENCE

AlgaeCeuticals

Murcia, Spain
6 February 2020

INDEX

Centro Tecnológico Nacional de la Conserva y Alimentación

NATIONAL TECHNOLOGICAL CENTRE FOR THE CANNING AND FOOD- CTC

- CTC is a private non profit research organization with more than 120 associated companies and working for more than 500 companies every year. CTC is recognized by the Spanish Government as Innovation and Technological Centre, Office of Transfer of Research Results and it is declared of Public Use.

- CTC's aim is to promote research, innovation and competitiveness in the agrofood sector.

- CTC is located in Murcia (South East of Spain) with a big presence of agrofood companies and private and public food research centers.

OBJECTIVES

- To promote research, development and innovation in the Agrofood sector
- Consultancy and analytical services
- Training at all levels
- Improve competitiveness in the Agrofood industry
- To solve environmental problems, etc

CTC'S ACREDITATIONS
OTRI- Research Findings Transfer Office. (Spanish Inter-Ministerial Commission for Science and Technology. October 1999. Number 150.
Association declared to be of public interest
Test laboratory accredited by ENAC; accreditation nº 220/LE1206 and 220/LE453
Collaborative body of Hydraulic Administration
Spanish Ministry of Science and Innovation Register of Technology Centres and Innovation Support Centres
Laboratory approved for taking part in fruitmonitoring.com der HTS GmbH
Control Laboratory authorised to carry out physicochemical and microbiological tests by Spanish Agency of Healthcare Products and Medicines
Laboratory authorised to carry out analytical processes by General Directorate for public Health
Centre approved by the Spanish Ministry for the Environment and Rural and Marine Affairs for pesticide testing (EU-Russia Memorandum

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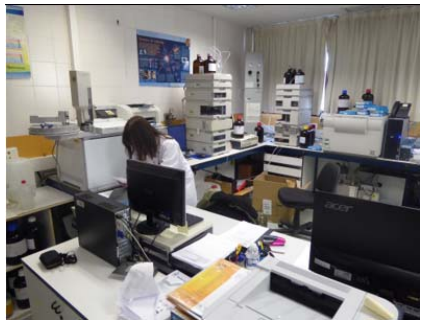
LABORATORIES

Physicochemical lab
(including Quality, Packaging and Sensory lab.)



Instrumental lab (GC and HPLC both MS/MS QQQ, AA, ICP, etc)

Microbiology lab
(including Food Safety lab)

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PILOT PLANT

Retort

Aseptic processing and packaging line

Thermosealing (MAP or vacuum)

Centrifuge / Tangential filtration /Freezing tunnel

II. ECODUNA: CHLORELLA AND SPIRULINA

Ecoduna supplied CTC with 5 kg of Chlorella and 5 kg of Spirulina (both food grade and in powder) and algae aleoresin

Ecoduna provided with the technical sheets

ecoduna eparella

Product Datasheet

Chlorella powder food grade

FOOD GRADE - MADE IN AUSTRIA			
Description	Spray dried biomass of Chlorella	Quality parameters	100% natural, vegan, high in antioxidants, GMO free, allergen free, no additives, no colourings
Ingredients	100% *Chlorella sp.*		
Origin	Austria	Production period	September until March

Physical parameters			
Appearance	Dark-green powder	Smell/taste	Fresh grassy smell
Particle size	25 - 70 µm, fine		
Bulk density	550 - 650 g / L	Residual moisture	≤ 5 %

Nutritional values	per 100 g
Energy	1571 kJ / 375 kcal
Fat	11 g
of which saturates	3,5 g
Carbohydrate	16 g
of which sugars	1,5 g
Protein	46 g
Salt	1,28 g

The nutritional values are based on third party analyses. Values are presented as mean values and can slightly change from batch to batch.

Vitamins	per 100 g	NRV *
Vitamin B12	41 µg	1640 % NRV
Vitamin K1	17,5 µg	23 % NRV
Vitamin B6	0,48 mg	34 % NRV
Vitamin B2	1,6 mg	114 % NRV
Folic acid	1781 µg	891 % NRV
Niacin	14,5 mg	91 % NRV
Vitamin E	17,6 mg	147 % NRV
Ascorbic acid	5 mg	6 % NRV

* Nutrient reference value defined per EU regulation 1169 / 2011

Minerals	per 100 g	NRV *
Iron	192 mg	1370% NRV
Manganese	16 mg	785% NRV
Potassium	1256 mg	63% NRV
Magnesium	495 mg	132% NRV
Phosphorus	2641 mg	377% NRV

* Nutrient reference value per EU regulation 1169 / 2011

Pigments	per 100 g
Chlorophyll *Method: Photometry*	3,9 g
ß-carotene *Method: HPLC*	43 mg

The values are based on continuous analyses and can vary due to the naturalness of the raw material.

purely vegetable · made with Austrian drinking water · high protein · natural Antioxidants · Super Food · GMO-free · no allergen · no additives · no colourings

ecoduna

eparella

Amino acid composition	per 100g
Alanine	3,7 g
Arginine	2,7 g
Aspartic acid	3,7 g
Cystine	0,09 g
Glutamic acid	4,8 g
Glycine	2,7 g
Histidine	0,84 g
Isoleucine	1,7 g
Leucine	3,6 g
Lysine	2,8 g
Methionine	0,7 g
Phenylalanine	2,2 g
Proline	1,5 g
Serine	1,6 g
Threonine	1,9 g
Tyrosine	1,5 g
Valine	2,6 g

Microbiological values	Reference value
Aerobic total plate count	< 10^6 cfu / g
Enterobacteriaceae	< 10 cfu / g
E. Coli	negative / g
Salmonella	negative / 25 g
Yeast/mould	< 30 cfu / g

Heavy metals	per kg	maximum values*
Cadmium (Cd)	< 0,01 mg	max. 1 mg / kg*
Lead (Pb)	< 0,2 mg	max. 3 mg / kg*
Arsenic (As)	< 0,07 mg	-
Mercury (Hg)	< 0,01 mg	max. 0,1 mg / kg*

* maximum values according to EU regulation 629 / 2008 setting maximum levels of certain contaminants in foodstuffs

Polycyclic aromatic hydrocarbons (PAH)	
∑ total PAH	below limit of detection

Others	
Packaging	**10 kg bag** (compound foil PET/ALU/PE) Complies with: • EU regulation 10/2011 on plastic materials and articles intended to come into contact with food • EU regulation 1935/2004 on materials and articles intended to come into contact with food
Transport & storage	Store unopened at room temperature and in dry environment (<65% rel. humidity) Dark storage is recommended
Best before date	24 months. Content should be consumed or processed further within 3 months after opening.

The product including packaging and labelling complies with:

- the Austrian Food Safety and Consumer Protection Law (LMSVG)
- the EU regulation 1169/2011 on the provision of food information to consumers
- the EU directive 2002/46/EC on food supplements (NEMV)
- the EU regulation 1924/2006 about nutritional values and health-related claims
- the EU regulation 396/2005 on maximum residue levels of pesticides in or on food and feed of plant and animal origin
- the EU regulation 1829/2003 on genetically modified food and feed
- the EU regulation 1830/2003 concerning the traceability and labelling of genetically modified organisms and the traceability of food and feed products produced from genetically modified organisms
- the EU regulation 1881/2006 setting maximum levels for certain contaminants in foodstuffs

Date:	Version:	Created by:	Checked by:	Released by:	Replaces version:
22.01.2019	V4	MSt	KSt	LNe	V3

ecoduna

eparella

Product Datasheet

Spirulina powder food grade

FOOD GRADE - MADE IN AUSTRIA			
Description	Spray dried biomass of Spirulina	**Quality parameters**	100% natural, vegan, high in antioxidants, GMO free, allergen free, no additives, no colourings
Ingredients	100% *Spirulina sp.*		
Origin	Austria	**Production period**	April until October

Physical parameters			
Appearance	Blue-green powder	**Smell/taste**	Fresh, flowery smell; type specific
Particle size	25 - 70 µm, fine		
Bulk density	550 - 650 g / L	**Residual moisture**	≤ 6 %

Nutritional values	per 100 g
Energy	1550 kJ / 367 kcal
Fat	5 g
of which saturates	3 g
Carbohydrate	23 g
of which sugars	1 g
Protein	54 g
Salt	2,35 g

The nutritional values are based on third party analyses. Values are presented as mean values and can slightly change from batch to batch.

Vitamins	per 100 g	NRV *
Vitamin B12	27 µg	1080 % NRV
Vitamin K1	1205 µg	1607 % NRV
Vitamin B1	1,5 mg	136 % NRV
Vitamin B2	1,7 mg	121 % NRV
Folic acid	200 µg	100 % NRV
Niacin	15 mg	94 % NRV
Vitamin E	5 mg	42 % NRV
Ascorbic acid	12 mg	15 % NRV

* Nutrient reference value defined per EU regulation 1169 / 2011

Minerals	per 100 g	NRV *
Iron	45 mg	321 % NRV
Manganese	3 mg	150 % NRV
Potassium	1320 mg	66 % NRV
Magnesium	210 mg	56 % NRV
Calcium	85 mg	11 % NRV

* Nutrient reference value per EU regulation 1169 / 2011

Pigments	per 100 g
Phycocyanin *Method: Yoshikawa*	8 g
ß-carotene *Method: HPLC*	137 mg

The values are based on continuous analyses and can vary due to the naturalness of the raw material.

ecoduna

eparella

Amino acid composition	per 100 g
Alanine	3,80 g
Arginine	3,70 g
Aspartic acid	4,90 g
Cystine	0,18 g
Glutamic acid	7,30 g
Glycine	2,60 g
Histidine	0,79 g
Isoleucine	3,00 g
Leucine	4,60 g
Lysine	2,50 g
Methionine	1,10 g
Phenylalanine	2,30 g
Proline	2,10 g
Serine	2,50 g
Threonine	2,40 g
Tyrosine	2,10 g
Valine	3,20 g

Microbiological values	Reference value
Aerobic total plate count	< 10^6 cfu / g
Enterobacteriaceae	< 10 cfu / g
E. Coli	negative / g
Salmonella	negative / 25 g
Yeast/mould	< 30 cfu / g

Heavy metals	per kg	maximum values*
Cadmium (Cd)	< 0,01 mg	max. 1 mg / kg*
Lead (Pb)	< 0,02 mg	max. 3 mg / kg*
Arsenic (As)	< 0,04 mg	-
Mercury (Hg)	< 0,01 mg	max. 0,1 mg / kg*

* maximum values according to EU regulation 629 / 2008 setting maximum levels of certain contaminants in foodstuffs

Polycyclic aromatic hydrocarbons (PAH)	
∑ total PAH	below limit of detection

Others	
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Date:	Version:	Created by:	Checked by:	Released by:	Replaces version:
22.01.2019	V4	MSt	KSt	LNe	V3

Ecoduna provided with the nutritional values

CHLORELLA POWDER		SPIRUILINA POWDER	
Nutritional values	Per 100g	Nutritional values	Per 100g
Energy	1574 KJ /375 Kcal	Energy	1550 KJ /367 Kcal
Fat	11g	Fat	5g
Of which saturates	3,5g	Of which saturates	3g
Carbohydrate	16g	Carbohydrate	23g
Of which sugars	1,5g	Of which sugars	1g
Protein	46g	Protein	254g
Salt	1,28g	Salt	2,35g
Vitamin E	17.6mg	Vitamin B12	27µg
Folic Acid	1781µg	Folic Acid	45mg

SPIRULINA

- ✓Important source of ß-carotene (**provitamin A**).
- ✓Source of Vitamin K
- ✓To use the authorised health claims for vitamin A you have to add approximately **526mg** Spirulina per 100g final product to reach 15% NRV

CHLORELLA

- ✓Important source of **vitamin B12**
- ✓Source of iron and folic acid.
- ✓To use the authorised health claims for vitamin B12 you have to add approximately **915mg** Chlorella per 100g final product to reach 15% NRV of this nutrient.

WITH THE ADDITION OF LESS THAN 1G OF SPIRULINA AND CHLORELLA PER 100G/100ML FINAL PRODUCT YOU CAN USE SPECIFIC HEALTH CLAIMS

TYPICAL DOSAGE PER DAY IS VARYING DUE TO DIFFERENT PRODUCT APPLICATIONS BUT NORMALLY IS BETWEEN 1g– 10g.

III.ELABORATION OF NEW FOOD PRODUCTS CONTAINING ALGAE AT PILOT SCALE

- In Algaeceuticals, CTC has started the elaboration of new food products containing algae at lab scale and some of them at pilot scale.

- Product development is a key point for the food industry, from refining an already existing product to developing a completely new one. It is a process with a high risk that often ends in failure.

- Algae are a complicated matrix that gives the food special colours and flavours

DEVELOPED PRODUCTS AT PILOT PLANT SCALE

Pate of mussels and melva with algae.

Onion cream with algae.

Broccoli gazpacho.

Fish soup with algae.

Omelette with algae.

Kiwi jam with algae.

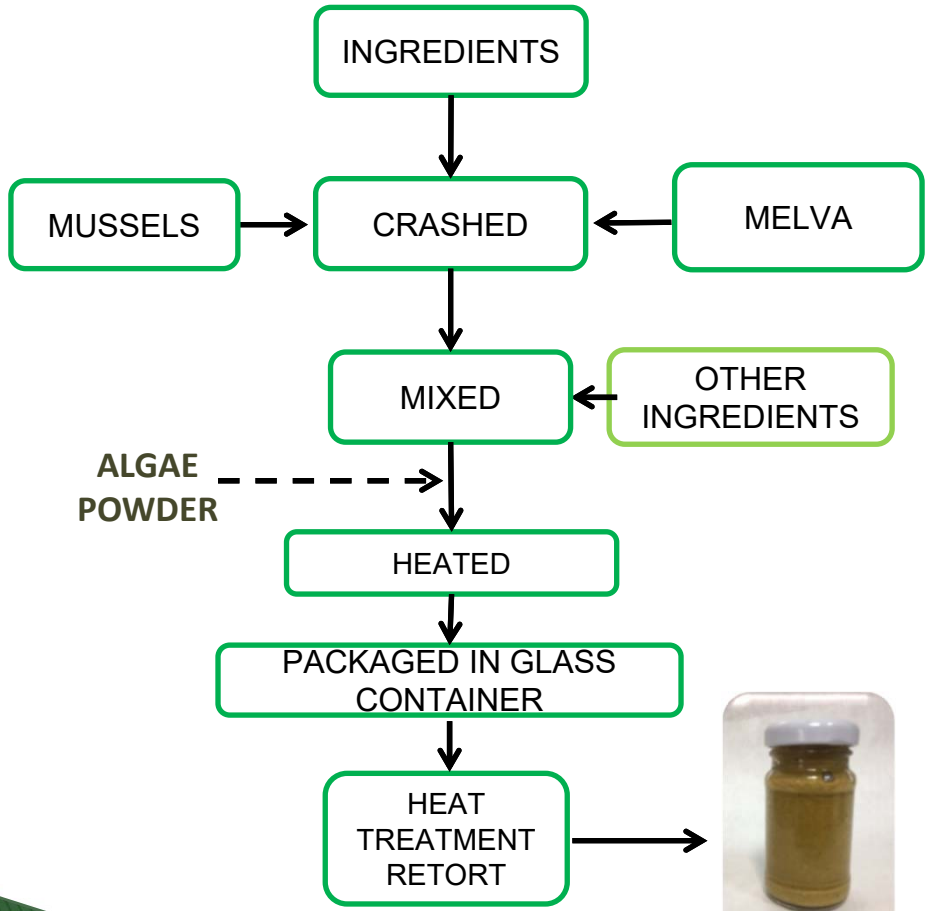
Algae“caviar”.

Soap with spirullina NON FOOD.

Pate of mussels and melva with algae.

PLANTA PILOTO CTC Centro Tecnológico Nacional de la Conserva y Alimentación

FLOWCHART



INGREDIENTS
Mussels (50%)
Melva
Olive oil
Paprika
Salt
Algae powder(1%)*

**Except in control*

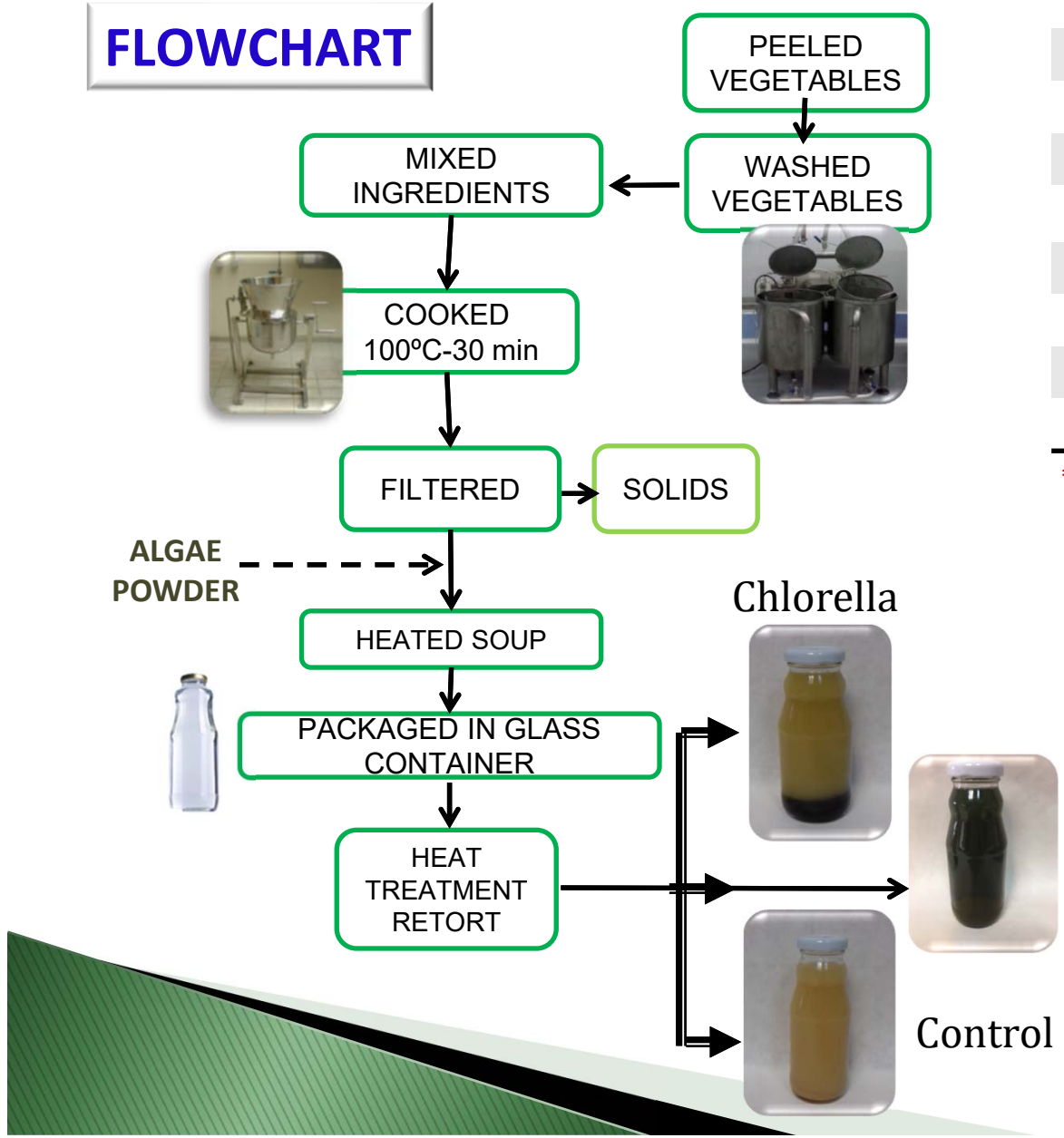
Before heat treatment

Chlorella Spirulina Control

$F_0 \geq 4$ min

Fish soup with algae.

FLOWCHART



INGREDIENTS
Water
Fish (Cod+snuff)
Potatos
Tomatos
Salt
Olive oil
carrot
onion
Species
Algae powder(1%)*

**Except in control*

$F_0 \geq 4$ min

Kiwi jam with algae (60 Brix)

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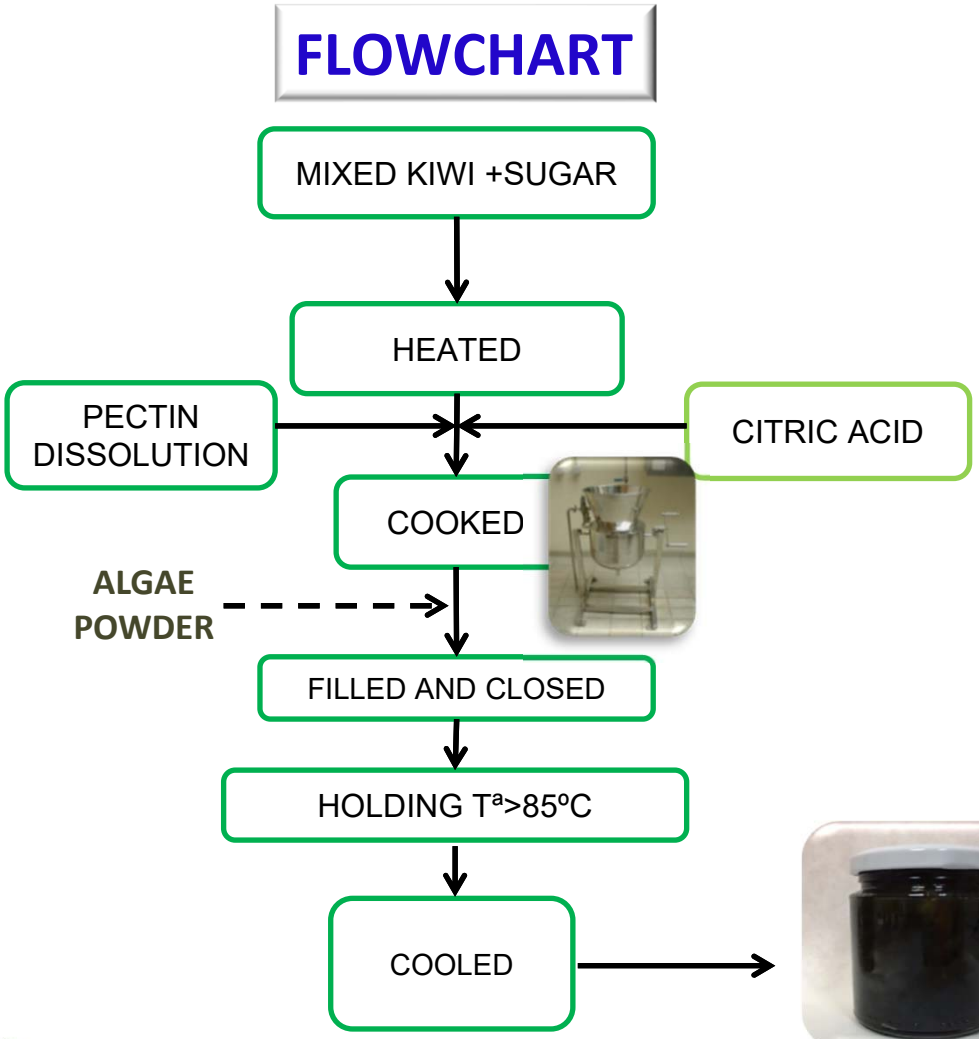


INGREDIENTS
Kiwi pulp(60%)
Sugar
Pectin LM104AS
Citric acid
Algae powder (0,6%)*

**Except in control*

Spirulina Chlorella Control

SPANISH OMELETTE WITH ALGAE.

FLOWCHART

PEELED POTATO AND ONIONS

WASHED

FRIED

LIQUID EGG + **ALGAE POWDER**

PACKED IN PLASTIC BAG

VACUUM

HEAT TREATMENT RETORT

118ºC

$F_0 \geq 4$ min

Spirulina

Clhorella

INGREDIENTS
Potatos (60%)
Onions
Egg
Olive oil
Salt
Algae powder (7,5%)

Onion cream with algae.

FLOWCHART

PEELED ONION+GARLIC

WASHED

MIXED INGREDIENTS

CRASHED

ALGAE POWDER

HEATED SOUP

FILLED IN PLASTIC TRAY

VACUUM PACKED

HEAT TREATMENT RETORT

INGREDIENTS
Onions (60%)
Olive oil
garlic
Paprika
Salt
cumin
parsley
water
Algae powder (1%)*

**Except in control*

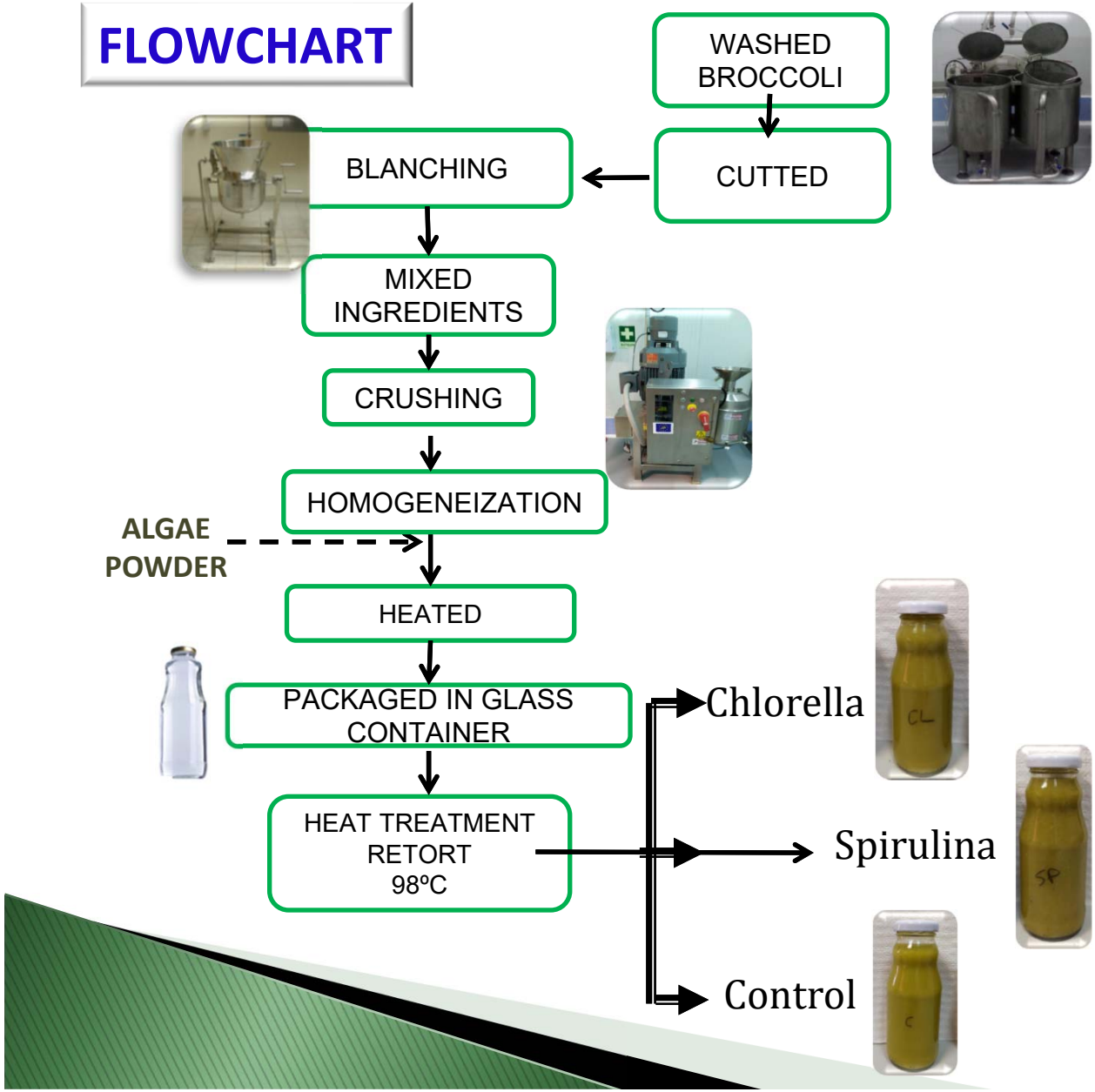
Control

Chlorella

Spirulina

BROCCOLI GAZPACHO WITH ALGAE (SPANISH COLD SOUP)

FLOWCHART



INGREDIENTS
Water
Broccoli
Tomato
Vinegar
Salt
Olive oil
Garlic
Oregano
Algae powder(0,5%)*

**Except in control*

Spirulina spherifications.

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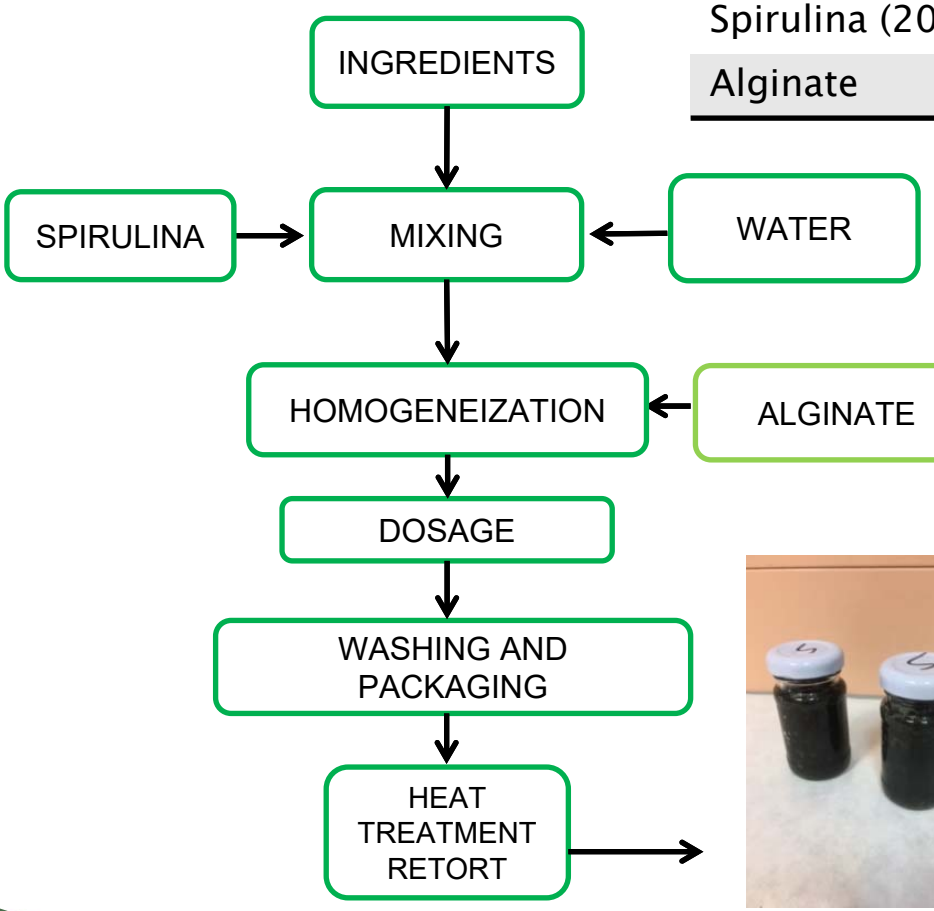
FLOWCHART

INGREDIENTS
Water (79%)
Spirulina (20%)
Alginate



Spirulina

$F_0 \geq 4$ min

Chlorella spherifications.

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FLOWCHART

INGREDIENTS
Water (79%)
Chlorella (20%)
Alginate

INGREDIENTS

CHLORELLA → MIXING ← WATER

↓

HOMOGENEIZATION ← ALGINATE

↓

DOSAGE

↓

WASHING AND PACKAGING

↓

HEAT TREATMENT RETORT →

Chlorella

$F_0 \geq 4$ min

Algae oil spherifications.

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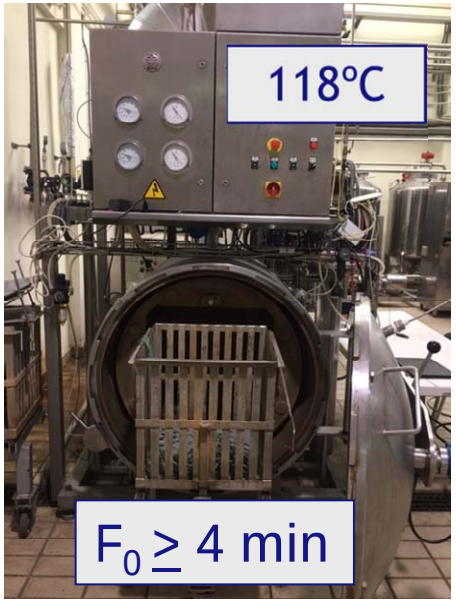
FLOWCHART

INGREDIENTS
Water (74%)
Algae Oil (25%)
Alginate

Algae oil spherificantions.



INGREDIENTS

ALGAE OIL → MIXING ← WATER

HOMOGENEIZATION ← ALGINATE

ADJUST TO PH 7

DOSAGE

WASHING AND PACKAGING

HEAT TREATMENT RETORT →

Algae spherifications

Spirulina spherifications.

Chlorella spherifications

Algae oil spherificantions.

Soap with spirullina (NON FOOD).

INGREDIENTS
SODIUM HYDROXIDE
WATER
OLIVE OIL
FLAVOUR
SALT
CUMIN
PARSLEY
WATER
Algae powder (2%)*

**Except in control*

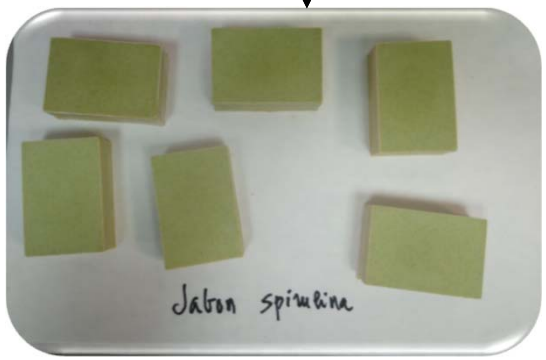
MIXED INGREDIENTS AT 40ºC

↓

EMULSIFIED PRODUCT

↓

ADDITION OF ESSENTIAL OIL AND ALGAE



ANALYSIS IN PROCESS

ANALYSIS

MICROBIOLOGICAL ANALYSIS

- **STABILITY TEST** Stability control according to French Standards **AFNOR NF V08-401**

NUTRITIONAL ANALYSIS

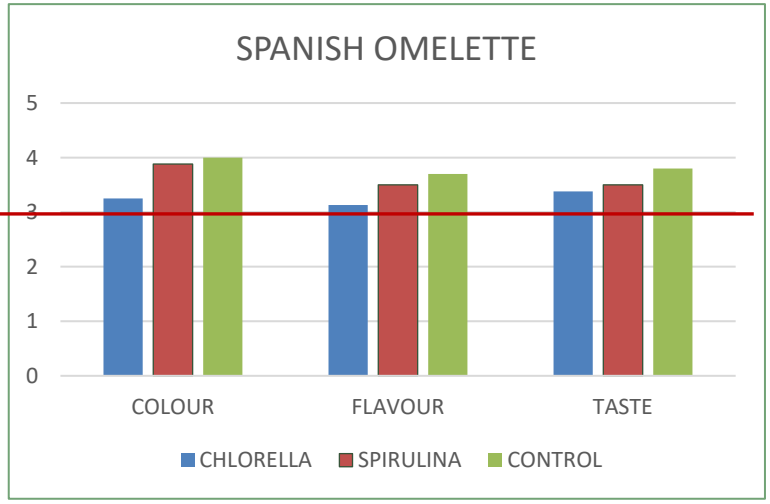
Regulation (EU) No 1169/2011 of the European Parliament on food information provided to consumers

SENSORIAL ANALYSIS

- **TEST CONSUMERS OF ACCEPTANCE AND PREFERENCES. UNE-ISO 6658:2008. Sensory analysis of food. Methodology. General guide**

Analysis Sensorial omelette

0 Very bad
1 Bad
2 Medium
3 Acceptable
4 Good
5 Very good



ATTENDING THE RESULTS, THERE ARE NO SIGNIFICANT DIFFERENCES BETWEEN THE THREE SAMPLES, OBTAINING ALL VALUES GREATER THAN THE ACCEPTABILITY LIMIT

EXAMPLE TEST SENSORIAL ANALYSIS

PROYECTO ALAGAECEUTICALS
Análisis sensorial

CUESTIONARIO TORTILLA

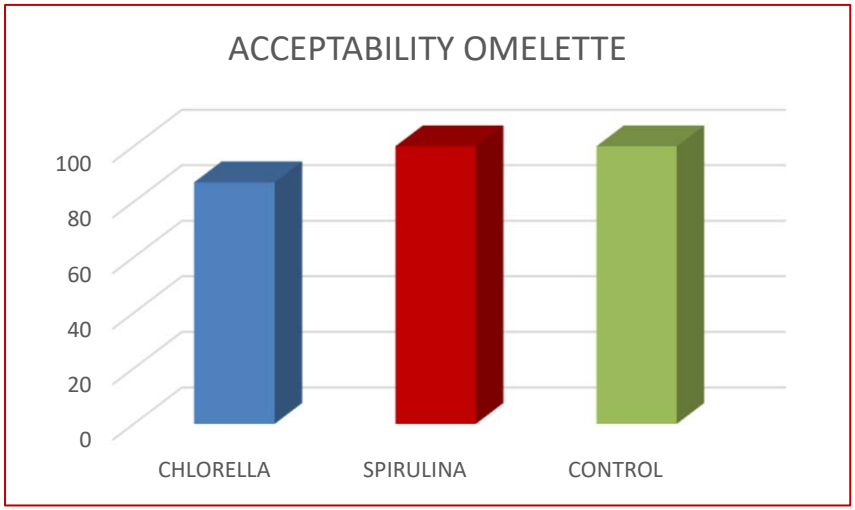
Se presentan tres muestras de TORTILLA, valora marcando con una cruz cuánto le agradan del 1 al 5, teniendo en cuenta lo siguiente:

1 Me desagrada mucho **2** No me gusta **3** No me agrada ni me desagrada **4** Me gusta **5** Me gusta mucho

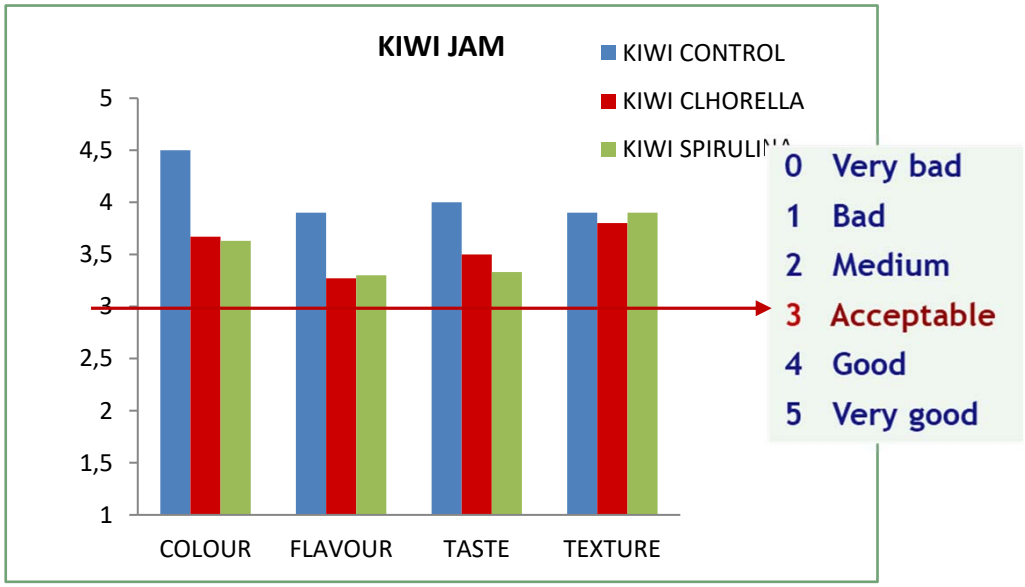
	850					575					354				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
OLOR															
COLOR															
SABOR															
VALORACIÓN GLOBAL															
¿Cuál te gusta más y porqué?															
COMENTARIOS															

En Molina de Segura a:

MUCHAS GRACIAS



Analysis Sensorial jam



PROYECTO ALAGAECEUTICALS

Análisis sensorial

CUESTIONARIO MERMELADA KIWI

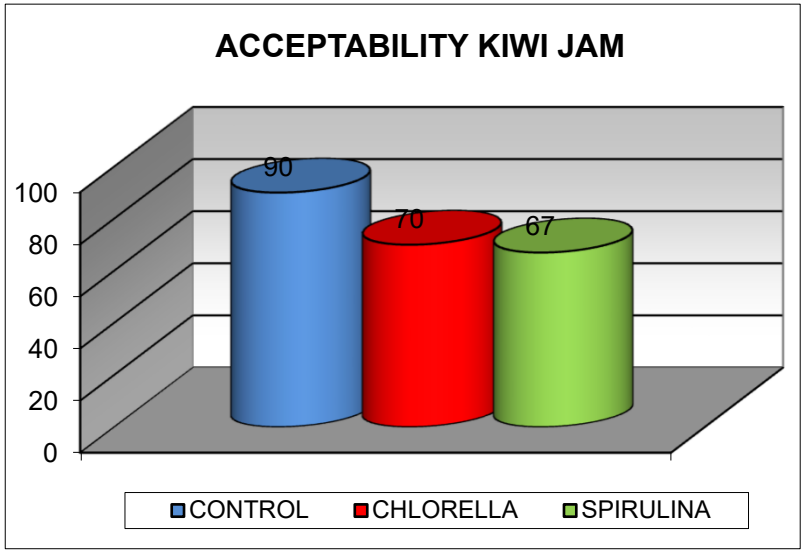
Se presentan tres muestras de MERMELADA, valora marcando con una cruz cuánto le agradan del 1 al 5, teniendo en cuenta lo siguiente:

1 Me desagrada mucho **2** No me gusta **3** No me agrada ni me desagrada **4** Me gusta **5** Me gusta mucho

	650					145					240				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
OLOR															
COLOR															
SABOR															
VALORACIÓN GLOBAL															
¿Cuál te gusta más y porqué?															
COMENTARIOS															

En Molina de Segura a:

MUCHAS GRACIAS

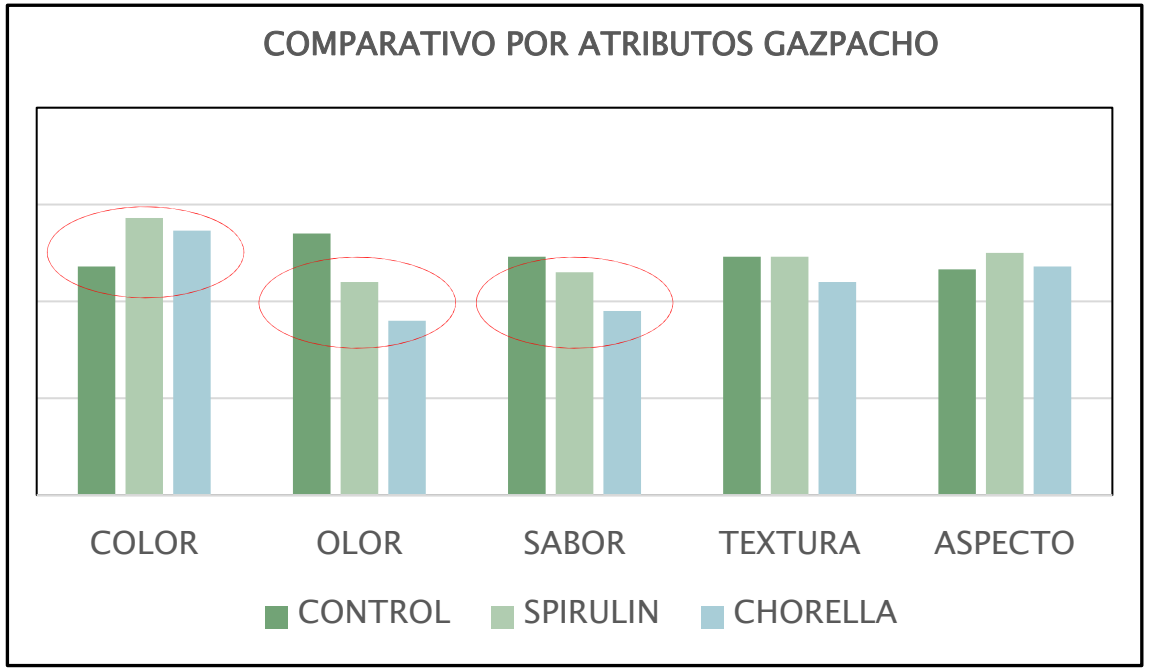


MICROBIOLOGICAL ANALYSIS BROCCOLI GAZPACHO

STABILITY TEST BROCCOLI GAZPACHO	
PARÁMETRO	**RESULTADO**
Caracteres organolépticos testigo	Sin variación
Caracteres organolépticos a 32ºC	Sin variación
Estado del bote testigo	Sin deformación
Estado del bote a 32ºC	Sin deformación
Incubación 7 días a 32ºC	Sin alteración
pH testigo	4.06
pH muestra incubada a 32ºC	4.12
R (máx. 100) a 32ºC	< 100

These results indicate that the heat treatment achieved is sufficient and that the samples are commercially stable at room temperature.

Sensorial Analysis Broccoli Gazpacho



ATTENDING THE RESULTS, the GAZPACHOS OF BROCOLI have obtained a higher than acceptable evaluation (minimum of 3) in all the evaluated attributes.

Nutritional Analysis Broccoli Gazpacho

DETERMINACION	RESULTADO	UNIDAD
Ácidos grasos saturados	0	g/100 g
Azucares totales	1,0	g/100 g
Fibra alimentaria	3,0	g/100 g
Cenizas totales	0,4	g/100 g
Cloruro sódico	0,07	g/100 g
Grasa	0,2	g/100 g
Hidratos de carbono	8,9	g/100 g
Humedad	95,9	g/100 g
Proteínas	1,2	g/100 g
Valor energético (kcal)	14	kcal/100 g
Valor energético (kj)	58	kJ/100 g
VITAMINA C	157	mg/kg
CLOROFILA A	108,7	mg/kg
CLOROFILA B	32,5	mg/kg

Centro Tecnológico Nacional de la Conserva y Alimentación

David Quintin dquintin@ctnc.es