SMARTCHAIN
SMART SOLUTIONS IN SHORT FOOD SUPPLY CHAINS

FREEZE-DRYING FOR FOOD PRODUCTS

AZTI

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Dissemination Level		
PU	**Public**	
PP	**Restricted to other program participants**	
RE	**Restricted to a group specified by the consortium**	
CO	**Confidential, only for members of the consortium**	**CO**

1. **Title of the case description**

   FREEZE-DRYING SOLUTIONS FOR FOOD PRODUCTS

2. **Indicate your role in the Smart Food Supply Chain:**

   individual member of the chain: ☐
   chain operator: ☐
   network operator: ☐
   association: ☐
   technical, scientific, or management expert: X
   advisor: ☐
   policy maker: ☐
   other: ..... ☐

3. **Indicate the region (if applicable):** world-wide supplier network

4. WP2 Cross-reference table

Please indicate with an X in the relevant box of the matrix for which needs and the steps / functions of the supply chain the described innovative solution is applicable

		Individual steps of the SFSC							Short food supply chain as whole						
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Needs of the consumers (citizens)	food safety		x		x	x			x	x					
	food quality		x		x	x			x	x					x
	trust														
	ethical aspects														
	accessibility		x		x	x			x	x					
Needs of the chain actors	fair price		x		x	x			x	x					
	increased negotiating power		x		x	x			x	x					
	shared use of available resources														
	product development support		x		x	x			x	x					x
	access to markets and consumers		x		x	x			x	x					x
	access to infrastructure														

1: Farming

2: Primary production

3: Transport

4: Processing and packaging

5: Storage

6: Logistics

7: Sale

8: Product integrity, authenticity, transparency

9: Marketing concepts

10: Food chain management and networking for enhancing cooperation among chain actors

11: Business modelling

12: Policy environment

13: Legal requirements

14: Labelling

5. Short description of the innovative solution

- **Describe the specific need or problem being addressed by the case and please explain what is the novelty of this innovative solution**

  In temporary and perishable products such as fungus/mushrooms and some kind of fruits and vegetables is essential to maintain the quality of them until been consumed. The novelty proposed is the use of freeze-drying to dehydrate them to reduce their water activity to make it possible to preserve them for long periods of time (more than 6 months) and also to make it possible to reach markets that could not be reached if these products would have this high humidity.

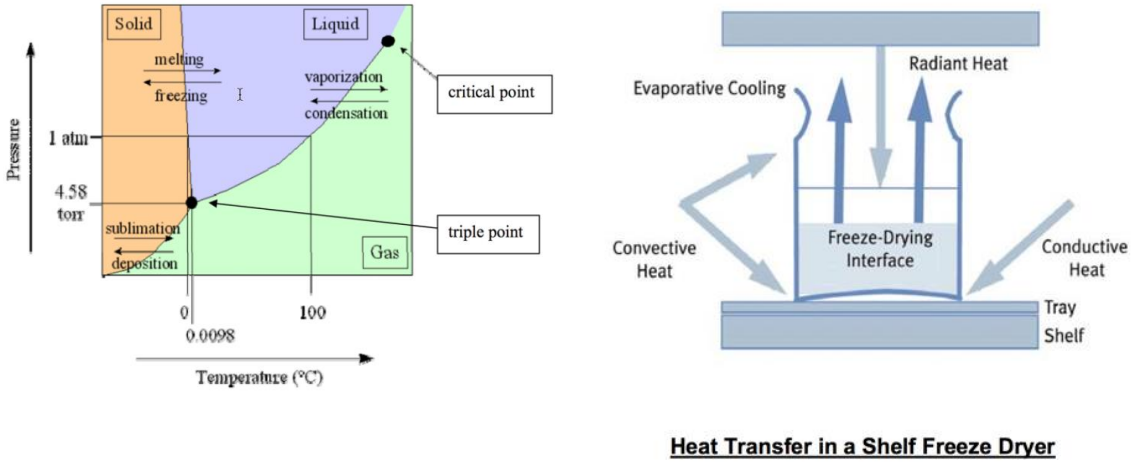
- **Describe the enabling function(s) and the practical benefit(s) - (e.g. for which types of problems and opportunities is used and can it be used, and how)**

  The freeze-drying is able to remove water from fresh products once they have been harvested, the operation can be done in a close area of the field. The final water content of the products can be at maximum of 1% (wet basis). This can be so useful to extend the self-life of fresh products in room temperature conditions. Moreover, this makes possible to access to new markets (exports) that fresh products could not access due to their perishability and to extend the commercial life of these temporary products along the whole year. This technique allows to maintain the quality aspects of the products (sensory, health-related compounds) better than conventional heating drying techniques, maintaining better also the shape and aspect of the product.

- **Describe the method/procedure/technology/solution implemented. (Please explain, whether the innovative method is a product / service / process / marketing or organizational / management innovation) After completing the description, please indicate, whether this innovation is a technological or non-technological one.**

  Freeze-drying is a process that reduces the moisture content in perishable, thermosensitive products in order to preserve their quality. The procedure consists of three principal steps; 1. Freezing the sample below its eutectic temperature to create the desired crystalline structure, 2. Drying, sublimation of the crystals of water, 3. Packaging of dried samples. At the completion of the process, the treated product will have retained its form, volume and original structure-as well as all its physical, chemical and biological properties.

technological [X] non-technological [ ]



1. Figure: The process of freeze-drying (https://www.spscientific.com/freeze-drying-lyophilization-basics/)

Freeze-driers:

2. Figure: Bench Top, Pilot and Production freeze-drier

- **Describe the business, which implemented the innovated solution (size, country, region, location, type of food)**

  This innovation can be used for a small/medium sized business or a multinational company, it is independent of the size of the business to be applied. The size and the capacity of the required freeze-drier depends on the volume of the production and initial and final moisture content of the material to be treated. The innovation proposed only requires electricity and compressed air so the country, region or location is not a limiting factor to be incorporated in the company that would need it.

  The suitable type of food to be processed is that one that has high moisture content, perishable and thermosensitive products (e.g. fruits and vegetable, fungus/mushrooms).

- **Describe the distribution channels of the product(s)**

  After being freeze-dried the new products can be distributed in room temperature all over the world because they will have a very reduced moisture content (less than 1% wet basis) and consequently a high shelf life (more than 6 months). Off course, taking into account that they need a correct packaging in order to avoid breakage due to their light fragility, and to avoid rancidity or rehydration.

- **Describe what makes the innovation work.**
  - this is a drying technology that preserve the quality of the products for a long period of time
  - existing different sizes of machine according to the capacity required
  - uniform drying
  - individual parameter settings for the different products
  - preserve quality and taste
  - substantially longer shelf life
  - save on energy costs comparing to the preservation at frozen conditions
  - freeze-drying is much more effective and modern than the traditional technologies of drying
  - not many workers required to control de process

- **Describe the specific prerequisites for the business related to the implementation of the method and/or related to the location, method, procedure, solution**

a: List the relevant necessary resources (including the estimated cost) for the specific innovation.
Please list the relevant ones only (list is annexed)

MATERIALS:

- fresh vegetable and fruits, fungus/mushrooms, …
- local perishable

HUMAN:

- human resource for operation (1-2 persons, depend on the capacity maybe only with 1 person is enough). The skill for these persons is production because the provider of the know-how (technological center) will develop the procedure/process

TECHNOLOGY:

- Capacity required, because the capacity is related with the size of the machine
- Packaging required

FINANCIAL

- estimated cost: depends on the volume of the production

b: List the relevant necessary capabilities for the specific innovation.
Please list the relevant ones only (list is annexed)

FOOD SAFETY:

- basic skills to comply with the EU food safety regulations
- food safety culture (motivation, responsibility for food safety) and basic skills for the implementation of HACCP

FOOD QUALITY:

- ability to define the target segments of consumers for SFSCs
- ability to define the product characteristics which are (tacit) basic requirements for the target segment(s) of consumers;
- ability to define which product attributes/levels and augmented services represent an added value for the target segments of consumers;

- food quality culture (motivation, responsibility for food quality);
- ability to provide distinguishable quality which meets the needs of the targeted consumer segment;
- ability to access the consumer willingness to pay for specific products of SFSCs.

INPUT FOR R+D:

- ability to develop new products, processes, packaging, preservation techniques, systems and access to new markets, including in other categories;
- access to innovative technologies
- access to local input for R+D covered by other aspects

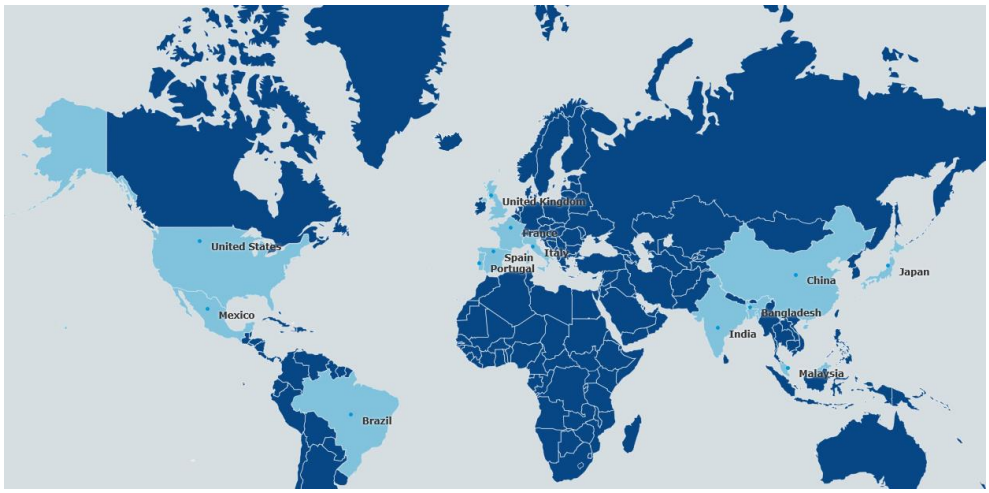
ACCESS TO MARKETS: AND MARKET SUCCESS:

- effective promotion, customer service, efficient and innovative sales methods;
- ability to understand consumer's needs;
- ability to organise logistics efficiently and to exploit innovative solutions and distribution channels,
- ability to develop and implement new business models for ensuring access of consumers to products and augmented services, develop the market accessibility for the suppliers.
- stock control;

- **The method/technology was established by**

  NAME: TELSTAR
  ADDRESS: Estrada Consiglieri Pedroso, 66, Queluz de Baixo, 2730-053, Barcarena, Lisboa, Portugal

  DEALER AND SERVICE POINTS: USA, Mexico, Brasil, Spain, Portugal, UK, France, Italy, India, Bangladesh, China, Japan, Malaysia



APPLICATION AREAS:

The innovation is applicable to those products that want to be preserved along the time at room temperature without losing in their palatability and chemical and physical properties.

The freeze-drying retains the physical structure of the food product and preserves it for re-hydration at a later date. Conventional drying methods also have a major disadvantage as the high temperatures used can cause chemical or physical changes. Changing the taste or texture of a food product could make it inedible or less palatable which would be very undesirable.

Coffee was one of the first freeze dried food products to be produced, but now vegetables, fruits, meats, fish, dairy products, herbs and food flavourings can be also successfully freeze dried.

6. Describe the results, achievements and typical failures

- New products development
- Better structure, less bacteria growth, longer shelf life.
- Saving energy compared to the maintenance of frozen products
- Availability of the products the whole year
- Stability in the prices of the products due to the stability in the supply
- Increase the market, access to far markets

7. Summarize what makes the case to a good practice for the members of the SFSCs (e.g. lessons learned)

The innovation proposed make possible to increase the shelf life of fresh products or even create new products that nowadays do not exist. So, this means that the companies incorporating it could reach new markets (farther markets as well as new customers due to the development a new products) and increase the sales of perishable fresh food or seasonal products (deseasonalise sales). Moreover, this technology offers a high-quality final products.

8. **Aspects, methods for transfer of methods for other SFSC members**
   This technology is applicable to various SFSC members, so an aspect that could be taken into account could be to construct a shared platform in which some member could access to the technology in order to share cost of the inversions (e.g. agro-food cooperatives).

9. **Recommendations for members of other SFSCs for further applications**
   Freeze-drying can be used for small businesses where it is necessary to improve the quality of dried products and to preserve fresh products.

   The capacity of the freeze driers maybe is not probably 100 % used for one company (depend of the necessities of each one) but they can associate to share the technology in order to increase the profit obtained, even if one of them alone find the business profitable. Collective financing, scheduled operation can be effective for the small businesses. Small and high capacity equipment are available.

10. **More information is available at (web), if it is relevant**
    https://www.telstar.com/

Annex

1. Checklist for necessary resources (tangible and non-tangible):

- materials (access to: raw materials/ ingredients - including volume, land – including size, packaging materials
- human: labour force: size, knowledge & skills (production, technical, marketing, managerial, ICT, financial, etc.)
- technology: patents, know-how, trademarks, copyrights, trade secrets
- infrastructure, equipment, facilities, - size, minimum volume of production/sales, IT infrastructure
- information, reputation, brand, trust
- financial*

  *: estimated cost:

  0 - 10 000 Eur
  10 001 - 50 000 Eur
  50 001 - 100 000 Eur
  100 001 - 300 000 Eur
  300 001 – 1 000 000 Eur
  1 000 000 Eur above –

- other specific necessary resources for the application of the specific innovation

2. Checklist for the necessary capabilities

- **food safety:**
  - basic skills to comply with the EU food safety regulations
  - ability to understand what makes the product safe (the key controls, which ensure the safety of the product – biological, chemical and physical hazards, providing the safety shelf life of perishable products)
  - food safety culture (motivation, responsibility for food safety) and basic skills for the implementation of HACCP

- **food quality:**
  - ability to define the target segments of consumers for SFSCs
  - ability to define the product characteristics which are (tacit) basic requirements for the target segment(s) of consumers;
  - ability to define which product attributes/levels and augmented services represent an added value for the target segments of consumers;
  - food quality culture (motivation, responsibility for food quality);
  - production experiences which help to provide the expected quality reliably, uniformly;
  - ability to provide distinguishable quality which meets the needs of the targeted consumer segment;
  - meeting (local) legal requirements, application of the labelling rules;
  - ability to access the consumer willingness to pay for specific products of SFSCs.

- **trust:**
  - ability to ensure product integrity, authenticity and transparent information for the consumers (including systems, tools);
  - ability to access external trust enhancers (third party certification, internal certification system, participatory guarantee systems);
  - application of the labelling rules and branding (mandatory and voluntary);
  - ability to meet third party certification requirements

- **ethical aspects**
  - ability to understand consumer needs for ethical behaviour related to the specific product(s) of the SFSCs;
  - culture for ethical food production and supply;
  - ability to implement necessary measures to ensure ethical food production and supply;
  - ability to access the consumer willingness to pay for products meeting ethical aspects

- **accessibility to consumers:**
  - ability to organize logistics efficiently and to exploit innovative solutions and distribution channels;
  - efficient, innovative sales methods;

	- ability to develop and implement new business models for ensuring access of consumers to products and augmented services;
• **fair price:**	- collecting marketing information; - ability to enhance and maintain cooperation among chain actors including the combined use of available complementary resources, capabilities, competences of SFSCs actors, networking, understanding the principles of food value chain management; - ability to define, develop or maintain unique quality of products and augmented services; - ability to develop and implement new business models; - ability to access the consumer willingness to pay for fair price
• **increased negotiation power:**	- collecting marketing information; - ability to enhance and maintain cooperation among chain actors including the combined use of available complementary resources, capabilities, competences of SFSCs actors, networking, understanding the principles of food value chain management, cooperation culture; - ability to define. develop or maintain unique quality of products and augmented services; - ability to develop and implement new business models;
• **shared use of available resources:**	- ability to enhance and maintain cooperation among chain actors including the shared and combined use of available complementary resources, capabilities, competences of SFSCs actors, networking, understanding the principles of food value chain management, cooperation culture; - the level of value chain management culture; - ability to access the consumer willingness to pay for food with reduced environmental impacts

- **input for R+D:**
  - ability to monitor, research, evaluate, and understand the needs and wants of customers and consumers;
  - ability to develop new products, processes, packaging, preservation techniques, systems and access to new markets, including in other categories;
  - access to innovative technologies; distribution and marketing solutions and methods. management systems;
  - access to local input for R+D covered by other aspects

- **access to markets: and market success**
  - effective promotion, customer service, efficient and innovative sales methods;
  - ability to understand consumer's needs;
  - ability to organise logistics efficiently and to exploit innovative solutions and distribution channels,
  - unique value propositions;
  - ability to develop and implement new business models for ensuring access of consumers to products and augmented services, develop the market accessibility for the suppliers.
  - stock control;
  - ability to access to required raw materials within a restricted geographical area

- **access to infrastructure:**
  - ability to use existing own infrastructure in a focused way to serve consumer needs or to combine it with complementary infrastructures of other SFSC actors, cooperation culture;

- **management:**
  - to implement management systems for vision, planning, implementing), coordinating, controlling, monitoring, continuously;
  - improving; ability to motivate, authorize staff;

- **production, processing:**
  - management system, production experience, specific controlling, monitoring, continuously;
  - willingness to consider and ability to evaluate the adoption of TECI and NTI in the current production processes;
  - any additional specific resources necessary for the application of the specific innovation.