

Evaluating effective microorganisms for post-harvest fungal contamination

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Template for good practice cases

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

1. Title of the case description

Microorganisms as a tool to control vegetables rot

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:
- advisor:
- policy maker:
- other:

3. Indicate the region (if applicable):

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						
	food quality		X		X	X			X						
	trust														
	ethical aspects														
	accessibility														
Needs of the chain actors	fair price														
	increased negotiating power														
	shared use of available resources														
	product development support														
	access to markets and consumers														
	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

The developed solution is based on previous applications and results obtained by the University of Bologna.

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

The analysed case study (Arvaia, Bologna) reported an important concern regarding the food safety of some vegetables that have an important period of storage in the cold store after the harvest (fennels, chicory and cabbage head). During the storage, these vegetables are perishable and fungal rots shorten their shelf life; losses are caused by pathogens such as species of *Alternaria* and *Penicillium* spp., which start deteriorating the inner part. The solution provided is the development of a microbial inoculum that will naturally promote the health of plants by antagonizing a range of plant pathogens. The use of these antagonistic microorganisms, to control plant-pathogenic bacteria and fungi is receiving increasing attention, as they may represent a sustainable alternative to chemical pesticides and antibiotics. Arvaia was very interested in develop this solution in its vegetables.

- **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 microbial inoculum provides:

- 100% organic, not dangerous for the health
 - Flexible for many type of vegetables
 - Post-harvest action against spoilage and rot
 - Easy to use
 - Food safety and quality increase
- **Describe the method/procedure/technology/solution implemented. (Please explain, whether the innovative method is a product / service / process / marketing or organisational / management innovation) After completing the description, please indicate, whether this innovation is a technological or non-technological one.**

- The product consists in a lyophilized or alive bacterial inoculum based on a Lactobacillus strain that has been already used against fungal contamination.

The bacterial supplementation can be performed twice, both in field during the vegetable growth and before the storage. Lactobacilli are eco-friendly, probiotic bacteria whose production required only a substrate for the growth and a bio-reactor or glass flasks.

technological X non-technological

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

The described solution can be used in the SFSC where farmers have long preservation time before selling vegetables; in particular, it is useful for farmers with high production, working in organic way where no fungicides are allowed.

Describe the distribution channels of the product(s)

All the farmers interested in the innovation

- **Describe what makes the innovation work.**

The described product allows maintaining more fresh vegetables/fruits, thus postponing the effect of spoilage due to fungal contamination during storage; consequently, vegetables appearance look better and more attractive for consumers.

- **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: bio-reactors for the microorganism production or, simply, glass flasks

HUMAN: · human resource for operation

FINANCIAL: costs related to the microorganism production (max: 10.000 euro: dependent from the size of the bio-reactors and microbial medium for the growth)

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

The basic knowledge of food safety and quality and good handling capabilities

6. Describe the results, achievements and typical failures

- Higher quality of vegetables with less quantity to select and eventually to throw away because of visible damaged and unhealthy
- A failure can occur if the microorganisms do not induce a resistance against the spoilage fungi

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

- “Organic” solution which also confer and added value to the product (Lactobacilli are probiotic bacteria for an healthy gut microbiota) and consumers eating vegetables treated with these microorganism can probably ingest also the bacteria
- The solutions can be apply to other vegetables and fruits

8. Aspects, methods for transfer of methods for other SFSC members

- Safer and more quality of the products and nutraceutical aspect

9. Recommendations for members of other SFSCs for further applications

- The solution can be offered to reduce the wide spread of fungicides and other chemicals

10. More information is available at (web), if it is relevant

Gaggia et al., 2013 - *New Biotechnology* 30(6), 695-704; Baffoni et al., 2015 - *BMC Microbiology* 15:242)

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.