

BIODEGRADABLE PACKAGING WITH NATURAL INDICATOR SUBSTANCES

innovative solutions for Short Food Supply Chains

Campden BRI Hungary

December 2019



Project code: 773785

Project acronym: Smart Food Supply Chains

Internal template:

Template for good practice cases

Work package number: T2

WP leader: CBHU

Work package title: Technological and non-technological innovations

Document issued by:

Delivery month:

Version:

Document language: ENG

Dissemination Level		
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

Biodegradable packaging with natural indicator substances

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): world-wide 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														
	food quality														
	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

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

Increasing demand for intelligent packaging materials are “materials and articles that monitor the condition of packaged food or the environment surrounding the food.

- **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)**

Curcumin, as well as the extract of grape peel, have been examined as a pH indicator used in relation to their ability to monitor the deterioration of the quality and freshness of fish. These two substances were characterized by sensitivity to volatile chemicals corresponding to spoilage of food products. The colorimetric sensor with curcumin very clearly changed color from yellow to orange during the deterioration of the quality and freshness of cod. The authors proposed curcumin and grape skin extract as effective colorimetric indicators of freshness of food in an intelligent package.

- **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.**

An indicator is a substance that displays the presence or absence of another substance or the degree of reaction between two or more compounds via changes in its characteristics including color variation. Changes in milk, which expressed in titratable acidity (TA) and pH, could be used as the main sign of spoilage in milk. The pH indicators are those which the color of their solutions changes under different pH values. These compounds are called acidbase indicators. Carrot is among the most popular vegetable. The purple color of the vegetable is due to the presence of anthocyanins in the outer part of the plant. Anthocyanins of black carrot (ABC) are water-soluble pigments with high color stability at different pH levels due to the presence of acylated groups. One of the most common problems with the preparation and the use of colorimetric indicators is their low color stability. ABC was used as an anthocyanin-rich pigment to construct a colorimetric pH indicator in a chitosan matrix prepared by the sol-gel method. The microscopic and spectral properties, color response efficiency, swelling and stability of the indicator were characterized. The fabricated indicator was also used to monitor spoilage in pasteurized milk.

technological

non-technological

- **Describe the business, which implemented the innovated solution (size, country, region, location, type of food)**
- **Describe the distribution channels of the product(s)**
- **Describe what makes the innovation work.**

Freshness indicators are materials which provide real-time information on the quality of food influenced by microbial and chemical activities. The reaction between the metabolites resulting from the growth of microorganisms and indicators changes the color of the indicator, then helps the consumer to get visual observation/information about the freshness of the product.

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

6. Describe the results, achievements and typical failures

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

An anthocyanin-based indicator was successfully developed using chitosan and cellulose with the aim of monitoring spoilage of milk without using sophisticated instruments. The advantages of the fabricated indicator were the usage of food grade biomaterials (carrot anthocyanin, chitosan, and cellulose). The ABC improved swelling and solubility in water

properties of chitosan-cellulose paper. The fabricated indicator displayed different responses to pH buffers and showed the highest color changes when exposed to acidic pH. The indicator entirely distinguished fresh pasteurized milk from spoiled milk according to the color changes from blue to violet rose color observed in the indicator by the naked eye

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

9. Recommendations for members of other SFSCs for further applications

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

Cellulose/chitosan pH-responsive indicator incorporated with carotenanthocyanins for intelligent food packaging:

<https://sci-hub.tw/https://doi.org/10.1016/j.ijbiomac.2019.06.148>

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.