# SMART LABELS TELL CONSUMERS HOW FRESH THEIR FOOD IS

## IQ-FRESHLABEL improves food quality and safety through intelligent labels

### The Project: Optimisation of technologies and new biosensors

Consumers ask for transparency and food safety. Now, 'intelligent labels' on food packages provide important information. The labels change their colours - from green to red or from blue to white - when the freshness is waning. Has the temperature of frozen fish been too high for too long? If so, the label changes from green to orange or red. Has a MAP-packed chicken lain too long outside the chilled shelf? Then a label on the pack will detect it: the dark blue colour starts to fade. The current 'best before' regulation in the EU, informing consumers of the possible expiry date, is a rather conservative approach. A lot of unnecessary waste, in supermarkets as well as in households, is caused because products are thrown away at the 'best before' date although, properly stored, food products are edible after this date.

The optimisation of existing smart label technologies and the development of new biosensors, measuring the real state of freshness, is therefore the goal of the project named IQ-FRESHLABEL.

### The Product: Smart labels for food packaging

Improper handling of products along the cold chain – especially exposure to high temperatures during production, transport, and storage - results in decreased sensorial quality and premature spoilage of food. Deterioration in flavour, increased microbial growth, and subsequent altered oxygen concentration in the packaging are some of the indicators of the quality loss and spoilage of chilled or frozen foods. The principle of the technology behind smart labels is to correlate changes in quality with time and temperature in a visual colour signal. The project is the successor of two projects funded under the 6th Framework Research Program of the EU, FRESHLABEL and CHILL-ON.

So far four types of smart labels have been developed or optimised:

- Eye- and machine-readable oxygen sensor (prototype). The sensor is based on a two-step process in which the active material of the sensor is activated with UV light and subsequently the O2 concentration is detected by straightforward luminescence technology. The sensor (a label) changes from a 'non luminescent' state (no oxygen) to a luminescent state (oxygen detected) according to the concentration found. The luminescence is a sign of decreasing freshness;


- Aluminium time temperature integrators (TTIs) for chilled MAP poultry products (produced by FreshPoint Quality Assurance Ltd.). The TTI contains a layer of aluminum, giving an initial silver colour to the label. To activate the TTI it is necessary to stick a reactive label over it. With time and temperature, the silver layer dissolves to indicate the corresponding decrease in quality of the product. The background colour of the label (yellow) becomes visible. When the label is totally yellow, the food product is bad;
- Enzymatic time temperature integrators (TTIs) for frozen products (produced by Vitsab International AB). The TTI comprises two small pouches: on the one side with enzymes and on the other side with substrate. The device is activated by pressing on the pouches and mixing enzymes and substrates. The initial colour of the label is green. Over time, and according to temperature variation, the colour changes to orange/red to indicate the decreased quality of the food product;
- Photochromic time temperature integrators (TTIs) for frozen products (produced by BIZERBA).

The TTI is printed with intelligent ink containing organic crystals that change colour according to the accumulated temperature history of the product. The crystals are activated by UV radiation. The initial colour is dark blue. The colour fades to pale blue according to time and temperature variation to indicate the decreased quality of the product.

## The end users: Food producers, retailers, packaging industries, consumers

Supply chain: SMEs and producers of chilled and frozen food, packaging and distribution over long distances.

Retailers: offering specific information about food quality on products; avoidance of food spoilage and waste by precise detection methods; avoidance of quality defects

Consumers: assurance of safe and fresh food, objective information and transparency over the whole supply chain and avoidance of spoilage of edible food.

## The inventors: Industry, research and technology organisations, academia

Technologies behind enzymatic, aluminium, and photochromic TTI belong to project partners Vitsab International AB and FreshPoint Quality Assurance Ltd., both companies being smart labels producers. The collaboration with RTD performers Rheinische Friedrich-Wilhelms-Universität Bonn, National Technical University of Athens and ttz Bremerhaven has enabled the validation of smart labels for chilled and frozen food products along the cold chain.

In addition, the RTD performer Universität Bayreuth has developed, together with Yoav Eichen, a brand new technology as base for an oxygen sensor. The sensor is based on a two-step process in which the active material of the sensor is 'sensitised' with UV light and subsequently the 02 concentration is detected by straightforward luminescence.

To support optimal design of smart labels and their short-term uptake and implementation, RTD performers Valtion teknillinen tutkimuskeskus VTT and Taloustutkimus Oy have conducted socioeconomic impact analysis of chain's stakeholder and consumer acceptance.

The IQ-FRESHLABEL project has 17 project partners including research institutions, industry associations and SMEs.

## Development stage: Prototypes and/or ready for market

The readable oxygen sensor is at prototype stage, whereas the three other labels - enzymatic, photochromic, aluminium Time Temperature Integrators - are developed and ready for market.

IPR (Intellectual Property Rights) are currently under definition.

## Policy impact: Food safety policy

The IQ-FRESHLABEL project aims to influence the research and legislative areas in food labeling and packaging. Currently 'best before' dates are the only legally required assurance of desired properties of food products. These, however, are not always a satisfactory measure of quality. The smart labels could therefore bring a paradigm shift in food safety policy.

## Next steps: Acceptance tests and consumer education

Flexible tools for the determination of the economic impact of the implementation of TTIs are still to be developed and tested. There are still some hurdles to overcome before the product can be available on the market: acceptance of food chain stakeholders and consumers, education of stakeholders and consumers about the use and utility of the labels. Consumers have to be trained, or informed via extra labeling, about the different meanings of the colour-changing pouches and strips. Tests of consumer and retailer acceptance are underway. Standardisation questions may arise.


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