FOR INTERACTIVE COMMUNICATION, CONSUMER CONVENIENCE, IMPROVED MANAGEMENT AND HIGHER FOOD SAFETY



INTELLIGENT PACKAGING



Intelligent packaging (IP) acts as an extension of the communication function of traditional packaging and has the ability to detect, sense and record the changes in the products environment. IP monitors the environmental conditions inside the packaging or in the vicinity of packaging. Using IP the quality of the products and its shelf life can be estimated and decisions made for optimizing the information flow within the food supply chain more efficiently.

The purpose of intelligent food packaging is to monitor and give an indication of the quality of the packaged food and thus guarantee its safety.

TYPES OF INTELLIGENT PACKAGING

Intelligent packaging (IP) does not refer to a single technology, but to a variety of technologies that are able to perform specific functions and thus inform the consumer about the food quality and safety. In general, three types of IP are presented in this leaflet, that are differentiated according to their main function.

Interactive packaging refers to data carrier devices, such as 2D barcodes, radio frequency identification (RFID) and near field communication (NFC), electroluminescence displays and augmented reality for packaging. Data carriers are able to store information regarding storage, distribution and characteristics of the packaged food. They make the information flow more efficiently within the food supply chain. It is also possible to integrate other functions into data carriers to obtain information of the storage conditions (temperature and relative humidity) or food quality information by obtaining microbial data.

Sensors are used in packaging to collect and provide quantitative information about the package and its content. They detect, record and transmit information of the changes in the environment, the condition or the operating history of the packaged food. The sensors monitor specific functionalities, e.g. pH, time and temperature, presence of hydrogen sulphide, oxygen or carbon dioxide.

Indicators can provide visual qualitative or semiquantitative information about the packaged food by means of a colour change (e.g. different colour intensities or irreversible colour change). They can be used to provide information regarding temperature, gas and volatiles presence, pH change and microbiological contamination. In contrast with sensors they cannot provide quantitative information and are not able to store the measured data.

> Want to learn more about Intelligent Packaging?



"Les Macarons" cookie box (Stora Enso)

Interactive packaging

The interactive packaging based on near field communication (NFC) provides allergenic information for customers via NFC tag and mobile phone application. If product contains any potential harmful substances, mobile phone will alert the consumer of their presence. In addition to NFC interaction the package contains also hidden UHF RFID antenna and chip with a tamper evident functionality.



Smart box

Interactive packaging

Printed electronics can be used to produce special effects and anti-theft protection on packaging. Electronic components can be printed directly on a solid board packaging and can provide improved consumer communication and tamper detection.



Freshcode (Kao Chimigraf)

Freshness indicator

Freshcode's innovative colour indicator lets consumers, distributors and packers know the ideal consumption period for filleted and deboned chicken breasts in modified atmosphere packaging (MAP). This intelligent ink gradually changes colour to indicate the level of freshness. The product is no longer suitable for consumption when the label turns fully black.

OxyDot-O2xyDot® (Oxysense)

Oxygen sensor

O2xyDot is used to sense oxygen within a package. An OxyDot is attached inside the package prior the filling and sealing. After the dot is illuminated, the dye absorbs light in the blue region and fluoresces within the red region of the spectrum, and the fluorescence lifetime is measured. Oxygen quenches the fluorescent light from the dye as well as its lifetime. Different lifetime indicate different levels of oxygen.



Cockta can

Temperature indicator

The temperature indicator was produced with functional printing using thermochromic ink. It is used to show the temperature of soda drink. In this case the snowflake becomes clearly visible when its background changes to blue. The colour change occurs within 7-12°C showing when the soda drink is properly cooled.



Keep-it

Time-temperature indicator

Keep-it indicator is a shelf life indicator, which records the temperature at which the packaged salmon is exposed to. When the product is stored cold the intelligent ink in the indicator moves slowly, dark strip is long, meaning that the food is fresh. If the temperature rises, intelligent ink moves quicker and dark strip shortens.



ADVANTAGES	 » IP can help in reducing the food waste, achieving higher food safety, consumer convenience and management along the food supply chain. » IP can help to ensure that the quality of the product is good and to obtain information of the food product (e.g. country of origin, month of harvest, allergens, food composition). IP can show when the packaged food is fresh or whether its shelf life has expired; it can show the food's temperature; it can display the food's temperature history; it can be used to check the effectiveness or integrity of active packaging systems. » IP offers considerable potential as a marketing tool and the establishment of brand differentiation.
THE RIGHT TECHNOLOGY FOR EACH APPLICATION	 > IP can be placed onto secondary and tertiary packaging if the main idea is to have information about shipping or storage conditions. If the aim is to have storage information, distribution and traceability interactive packaging (e.g. RFID) should be used. > IP can be included in the primary packaging if the information is related with the food characteristics (e.g. release of ethylene or bacteria presence) or storage conditions (e.g. temperature). If the main interest of the intelligent packaging is to have information about the shelf life parameters of the food product a sensor or an indicator should be used.
FUTURE DEVELOPMENT	 The enhancement of the known systems using nanotechnology, printed electronics and photonics, that will lead to cheap materials with high capacity to detect and measure changes on food products. Smart packaging, where intelligent packaging won't be used only to control the effectiveness of active packaging systems but also to trigger a desired function of the active packaging, and to release the active compound only if needed. The integration of several functions within only one device and the development of new functions, e.g., systems able to communicate the presence of potential allergens, warnings related to diet management, and error prevention alerts. Internet of everything (IoE) applied to packaging, resulting in an advanced food safety management system (e.g. HACCP) that will be able to monitor food loss and food waste, identify potential hazards and conduct biohazard analysis and recommend controls, critical limits, and appropriate corrective actions when a deviation occurs.

ABOUT ACTINPAK

COST FP1405 ActInPak aims to identify and overcome the key technical, social, economic and legislative barriers to a successful deployment of renewable fibre-based functional packaging solutions such as active and intelligent packaging. Currently, 43 countries are involved in the network, with participants representing 209 academic institutions, 35 technical centers, and 83 industrial partners. For more information, please visit the ActInPak website: www.actinpak.eu

COST (European Cooperation in Science and Technology) is a funding agency for research and innovation networks. Our Actions help connect research initiatives across Europe and enable scientists to grow their ideas by sharing them with their peers. This boosts their research, career and innovation. *www.cost.eu*



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