

Less Wastage with Smart Packaging

Packaging protects food products from damage and spoilage en route from manufacturer to consumer. Integrated sensors in packaging can monitor whether the packaged product continues to meet pre-determined quality criteria. Two examples are Wageningen University's innovative microchip for fish packaging and Sensor Spot's MAP packaging indicator.

are working on packaging that can trace what happens to perishable products on their way from the factory to the supermarket. We expect smart packaging to start playing an ever greater role in quality control within the supply chain."



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Twenty-five percent of all food produced on the planet is wasted, according to a recent report by the United Nations Food and Agriculture Organization (FAO). A large percentage of these losses occurs in the supply chain. Deterioration is one of the main reasons for destroying food. However, a great amount of food is destroyed unnecessarily, simply because a random sample has shown signs of spoilage. This leads to the destruction of an entire batch. By monitor-

ing food product quality in the supply chain more accurately, these kinds of unnecessary losses can be prevented.

Food products are very sensitive to loss of quality during storage, handling and transportation. For several years now, Jenneke Heising has been researching smart packaging at Wageningen University's department Food Quality & Design. "Once you know where the problems originate, you can take measures and prevent waste. That is why we

From Active to Interactive

Right now, there are three types of smart packaging. The first one is *active packaging*, which affects the quality of the packaged product. Examples are the use of materials that absorb fluids, such as a meat pad, and the integration of a non-toxic antimicrobial substance, such as garlic oil, into the packaging material.

The second type of smart packaging is *intelligent packaging*, which uses a sensor to monitor and collect data on the quality of the packaged products. There are two types of sensors: one is integrated into the packaging and monitors the gas composition inside the package, while the other registers temperature and time and indirectly collects information about the packaged product.

The recorded temperatures and times are used to calculate the expected changes in the quality of the packaged product.

The third and final type of smart packaging is *interactive packaging*, which monitors the quality of the product and generates a signal that should lead to a particular response. The latter part of this solution is still in its infancy.

Wageningen University Food Quality & Design has developed a prototype for →



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intelligent packaging for fish products, Heising explains. "When fish deteriorates, it produces various volatile compounds, such as TMA (trimethylamine). This compound is water-soluble and affects the water's conductivity. Sensors can measure these changes in conductivity and produce an electrical signal. Our sensor is integrated in a gel that is part of the packaging. Research has shown that there is a clear correlation between the sensor's signals and the freshness of the fish. We are now trying to figure out which substances are responsible for that effect and how exactly we should interpret this information."

Sensor Spot

Sensors on packaging need not be electronic. A much simpler, but equally effective solution is to use indicators. Sensor Spot, a company based in Wijchen, the Netherlands, has developed a smart control system for Modified Atmosphere Packaging (MAP), consisting of a luminescent dot that lights up when exposed to oxygen. With the help of a special reader, it can determine whether the packaging is still airtight.

"The great thing about this technology is that it is simple, reliable and very cheap," says Mark Giesbers, Chief Legal Officer at Sensor Spot. "Packaging that includes a Sensor Spot costs only marginally more than packaging without a Spot." Giesbers argues that much food waste can be avoided. "Every year, the food industry destroys many thousands of pre-packaged batches of cold cuts, cheese and other

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chilled products. The packaging of these products is filled with nitrogen to prevent the food products from coming into contact with oxygen. If the packaging is not airtight, because of faulty sealing or punctures, the products will spoil. Therefore, samples are taken to check the gas composition. If a package is found to contain too much oxygen because of a leaky sealing or a puncture, the whole batch is destroyed. That is unnecessary wasting of

food and a great cost factor for businesses." Giesbers estimates that two to ten percent of MAP packages are destroyed based on random checks. Adding a cheap oxygen indicator like the Sensor Spot makes it possible to check each individual package for quality.

Read-out System

The Sensor Spot provides accurate information about the quality of the gas in the packaging. The technology is simple: the packaging includes an indicator which can be read with an electronic reader using special software.

The sensor itself is a luminescent spot. A new printing technology is used to place this spot on the inside of the packaging foil, which is then laminated to ensure that the sensor is not in direct contact with the food product. The bottom layer is permeable so oxygen molecules in the packaging can reach the sensor. However, the sensor material cannot permeate the foil in the other direction. The packaged products pass a read-out system that includes a camera. The read-out system's software is set to recognize whether an acceptable oxygen level has been exceeded. The cameras can be installed at the end of the packaging line, at a distribution center or a point of sale.

Products like cheese and cold cuts can be screened immediately after packaging. Bread cannot, however, because it continues to release a small amount of oxygen after packaging, changing the gas composition inside. Read-out systems must therefore be adjusted to particular products," Giesbers explains.

Recouping Investment

The development of active and intelligent packaging is definitely going to continue in the coming years, says Eef de Ferrante, Managing Director of the Active & Intelligent Packaging Industry Association

(AIPIA), a worldwide association promoting high tech packaging solutions based in Utrecht, the Netherlands. "Smart packaging is an emerging market. There are initiatives all over the world. True, integrating this technology makes packaging more expensive, but those few extra cents per unit pay themselves back very quickly. After all, a lot less product is wasted. And also, the price of electronics is rapidly dropping. Another development is to use smart packaging as a marketing tool, for example, beer or soda cans with a sensor that shows whether the contents are still cold." Heising also believes there is a great future for smart packaging. "Right now, sensors have to be applied separately in or on packaging. That is expensive. The future is in electronics that can be printed directly onto

the packaging foil. That will reduce costs tremendously. Right now, the technology is mainly useful for retailers to monitor the quality of premium products such as fish and meat throughout the supply chain. For supermarkets it is not yet possible to adopt

sensor. "Our sensor may be able to transmit data by smartphone. The packaging could then tell the consumer how fresh the fish in an individual package is, as it were. This will enable consumers to avoid nasty surprises at home." Heising is convinced that

in a number of years most fresh food packaging will become smart:

'Those few extra cents pay themselves back very quickly'

these solutions, because consumers would have to learn to deal with a changing use-by date. It will take quite a bit of research to reach that point."

In the longer term, Heising sees promising opportunities for Wageningen UR's fish

"It will not happen overnight, but just think how fast technological developments go."

• FLORENTINE JAGERS OP AKKERHUIS



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