Food packaging is becoming increasingly active and intelligent: new techniques in the war against food decay

The industry is constantly developing new packaging techniques that actively modify the ambient air of food products. As a result, packaging is becoming increasingly refined. “Smart Packaging”, as it is known, has been gaining in popularity over the last few years. It slows decay substantially, improves the control of freshness, and ultimately prevents food wastage (see ‘Multiple functions of packaging’). Here’s a sample of some of the most recent leading innovations.

Traditional packaging is very passive when it comes to protecting food. It forms a barrier to the outside world without any further intervention and indicates only the expiry date. Since the nineties, however, more and more refined packaging techniques have been emerging. They are known as “Smart Packaging”. The European Directive 1935/2004/EC differentiates between intelligent and active packaging.

Active packaging conditions

Active packaging conditions the air in the packaging to slow down the (bio)chemical degradation processes and to steer the behaviour of microorganisms. Some examples are airtight packaging filled with a specifically composed gas mixture (Modified Atmosphere Packaging or MAP) or air permeable systems with controlled conditioned air (Equilibrium Modified Atmosphere Packaging or EMAP). Certain types of packaging decrease the influence of harmful substances by evacuating them or by neutralizing them chemically. All of these packaging systems actively affect the product during its entire storage life to postpone decay or loss of quality as long as possible.

Intelligent packaging informs

Intelligent packaging aims to inform. It goes much further than indicating the storage life. For instance, it informs if the packaging has been damaged or if the product was not cooled sufficiently at a certain stage in the logistics chain. Time-Temperature Indicators (TTIs) are a form of intelligent packaging that focus on temperature variations. Premature decay is often due to unforeseen interruptions in the cooling chain.

The industry is developing increasingly refined packaging systems to improve the storage life of fresh food products and to avoid food spillage.

Intelligent packaging such as TTIs refines storage life information by taking into account temperature variations or other incidents.

Active packaging techniques such as MAP or EMAP condition the food’s ambient air to slow down the (bio)chemical degradation processes and to steer the behaviour of microorganisms.
Food packaging is becoming increasingly active and intelligent: new techniques in the war against food decay

The heart of the OnVu label becomes paler as the ambient temperature accumulates. This indicates gradual decay.

Label’s fading colour indicates decay

The industry firmly believes in Time-Temperature Indicators or TTIs to detect weak links in the cooling chain. Such labels indicate visually whether a product has been subject to unforeseen temperature swings and to what extent this has damaged the product.

German company Bizerba sells the OnVu system, a label with blue ink based on organic crystals. The label is activated by UV light during the packaging process. This colours the label dark blue. The colour gradually becomes paler under the influence of the accumulated ambient temperature. The fading colour intensity provides a good indication of the extent of decay. However, the label of each product and each packaging requires specific conditioning. For instance, a label for fish in normal aerobe packaging requires a lower UV dose for activation than a label for the same fish in MAP packaging. The latter is better protected. It is also possible to tailor the packaging to the product by changing the composition of the ink.

Enthusiasm versus conservatism

The OnVu pilot project in the Mexican Superama chain was welcomed enthusiastically. Research pointed out that the label made customers more aware of their part in the cooling chain when taking their merchandise home as well as when storing it at home.

‘Some customers even asked if they could purchase the labels for their own use,’ says Rob Dieu, Sales Manager Industrial Applications for Bizerba Belgium. ‘It is an understandable request, but unfortu-

An OnVu label trial revealed that customers became more aware of the part they play in the entire cooling chain.
MAP packaging consists of airtight trays filled with a modified mixture of O₂, N₂, and CO₂.

MAP slows the growth of bacteria; meat stays fresh for longer

Fresh food products such as fish, high-fat meat and prepared meals cannot be stored for a long time without taking special measures. In the nineties, the industry developed a technique that practically doubles storage life: Modified Atmosphere Packaging or MAP. MAP is an attractive alternative to vacuum packaging. It consists of airtight trays filled with a modified mixture of O₂, N₂, and CO₂. This gas mixture does not influence the quality of the food in a negative way; it simply slows down the microbial activity. At the same time, it ensures that the product stays aesthetically appealing. For instance, red meat remains juicy red in MAP packaging whereas in vacuum packaging its colours change to a darker purple.

Costs cannot increase

Initially, MAP was mainly used for fish, afterwards for fresh meat products as well. Today, MAP is used increasingly for products such as cheese and prepared meals. The technique can be applied in a number of ways," says Christian Vlasselaer, Managing Director at Multivac, manufacturer of packaging machines. 'The only variable is the composition of the gas mixture.' Nevertheless, some economical considerations influence the choice of packaging. MAP packaging is more expensive than traditional packaging with an air permeable stretch foil. It requires not only more complex and flexible machinery because, for example, the trays must always have the same dimensions, but also larger machinery because the gas mixture requires more space. In addition, there can be no contact between the meat and the foil. 'That is why we always allow "head space," explains Christian Vlasselaer. 'We try to limit it as much as possible to constrain transport and other costs.'

Limiting the head space even further

Adjusted techniques mean the head space can be reduced further. There are, for instance, systems that first package the meat tightly in an air permeable foil to prevent it from moving around. Another technique uses a foil consisting of two air permeable layers and an airtight top layer. The layer in the middle always contains oxygen.

MAP technology helps reduce the amount of preservatives in food.
EMAP conditions the air underneath permeable foil

Because fruit and vegetables remain physiologically active after harvesting, they cannot be packaged in airtight MAP. In order to offer these products a longer storage life, the industry has developed the Equilibrium Modified Atmosphere Packaging (EMAP). In most cases, these are small trays with a limited but easy-to-control permeability.

Harvested fruit and vegetables need to be able to respire (take up oxygen) and transpire (releasing vapour and warmth). If not, they would quickly die. On the other hand, respiration stimulates the metabolic activity that leads to decay. That is why the product cannot come into contact with too much or too little oxygen and the surroundings cannot be too humid or too dry. Likewise, the CO₂ concentration needs to be kept within certain boundaries to avoid the product turning brown, which is a frequent problem with cut vegetables.

Designing EMAP packaging to prolong storage life as much as possible is a balancing act. Modified foil or small cavities ensure controlled air permeability. Often, the air inside the packaging is conditioned with a mixture of O₂, CO₂ and N₂ that has been tailored to the product’s specific needs. Well-designed EMAP packaging is able to prolong storage life by 25% and even up to 300%.

Taking into account practical limitations

Smart Packaging has its limits. Lots of new techniques require more complex packaging machines and more expensive materials. This risks increases the cost of packaging. The industry needs to limit the total amount of packaging materials it uses and avoid compromising recyclability, without incurring substantial mark-up costs compared to traditional packaging.

For additional information:

- On innovative packaging: www.pack4food.be
- On the OnVu system: www.bizerba.com
- On MAP applications: www.multivac.com
- On packaging recyclability: www.pack4recycling.be