MULTIVAC White Paper on FRESHSAFE

Shelf life improvement for fruit and vegetables with suitable packaging technology: FRESHSAFE from MULTIVAC

Basic knowledge: metabolic processes with fruit and vegetables

Fresh fruit and vegetables are living products. These products need oxygen to live. This is because their metabolism remains active even after harvesting. The two most important processes in this are respiration and transpiration.

In the case of respiration or breathing, the plants absorb oxygen and give off carbon dioxide, water and heat. In the case of transpiration, which also takes place during the growth process as well as after harvesting, they only absorb oxygen. The consequences are ripening, fermentation, discoloration and then finally spoilage due to decay of the cellular structure, as well as the growth of mould and other undesirable microorganisms.

The ripening gas, ethylene, is one of the materials, which can accelerate the ripening process - and it presents a particular challenge not only in the processing and packaging procedures but also for the consumer at home. It is absorbed as the gaseous phytohormone, ethene, and it stimulates the ripening of fruit by converting stored enzymes into sugar and energy. This means that the fruit becomes sweet but also soft. Ethylene is gaseous and has a stimulating effect on other food in the vicinity.

Many fruits and vegetables basically respire more quickly and can therefore spoil more rapidly. Others respire more slowly and can therefore be kept longer by themselves. The frequency of respiration is however different - and also depends on the season, environmental temperature, region or time of harvesting. Even within the same product variety.

As a basic principle, whole and undamaged products can generally be kept longer than cut product. In the case of vegetables and salads, and in particular with ready-to-eat or cook assortments, which are the focus of current trends, the risk of microbial spoilage is many times higher, because the protective layer, such as the skin for example, is missing from the interface of the product with the atmosphere. Depending on the product variety, harvesting conditions and degree of ripening as well as the processing, packaging material and packaging technology, there can very quickly arise the onset of discoloration, mould and liquid accumulation, even before the best-before date has expired.

Present and future: Challenging requirements in the market

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Food producers and the industry generally, as well as packers, exporters, importers and retailers, face the challenge therefore of finding the best available packaging technology, machines and materials, which can be used to improve the shelf life and quality of the delicate products that can spoil so quickly - and by doing so, they can contribute to optimum food safety and maximum consumer protection.

Packaging machine manufacturers are permanently faced with the task of developing needs-based and state-of-the-art solutions for the market, which are able to create a reliable and economical packaging procedure by achieving the optimum pack result for every product.

All those involved in the process chain - as well as consumers - bear the responsibility for handling resources sparingly, protecting the environment and stemming food waste, which is now running worldwide at around 1.3 billion tons per year. In the case of fruit and vegetables, it is as much as 40 to 55 percent of the cultivated crop - in other words, almost half of all cultivated products spoil and can not be used.

In summary, there are today essentially four great challenges to overcome:

1. Raising the level of food safety and consumer protection
2. Handling resources sparingly
3. Developing and using packaging solutions, which meet current and future trends
4. Reducing food waste

This means that measures for better utilisation of fresh or delicate food have top priority. An important factor in this is the packaging procedure. In addition to protecting the product, packaging contributes to extending the shelf life of packed products and increasing food safety. It is however a matter of using the technology, which is suitable for the particular food, but which is also economically viable for the particular producer, meets his needs and is within his control.

**Current processes: MAP and EMAP**

MAP and EMAP packs have primarily been used up to now for extending the shelf life of fruit and vegetables. In the case of MAP packs (Modified Atmosphere Packaging), the natural atmosphere in the sealed pack is replaced by a modified atmosphere or gas mixture appropriate for the particular product. It usually consists of carbon dioxide, nitrogen or oxygen. Its precise composition is based on the product variety, the storage temperature and the nature of the product, as well as its degree of ripening, state of reduction and many other factors. Due to the reduction or adjustment of the oxygen quantity, the respiratory activity of the food is reduced and the ageing process slowed down. If however oxygen is completely missing from the mixture, fermentation sets in and the product changes very severely in its sensory characteristics.
In the case of EMAP packs (Equilibrium Modified Atmosphere Packaging), a modified atmosphere is created through targeted micro-perforation of the packaging film, which permits an exchange between the pack and the ambient environment. This means that CO2 gets out and O2 gets in. An equilibrium atmosphere prevails in the pack and this also prevents the pack from swelling. A combination of a smaller quantity of oxygen and a larger quantity of CO2 generally delays the oxidation process, which is responsible for discoloration, loss of taste and microbial growth. But even in this case, it is necessary to match the correct composition of the gas mixture as well as the density of the perforation to the particular product and its natural respiration. The formation of ethylene must also be incorporated as precisely as possible into the calculations. This is because the ripening gas is generally also exchanged via the micro-perforation, so that its concentration does not increase too much in the pack. It is only thanks to the interaction of respiration and film permeability, that the inside of the pack creates an atmosphere, which promotes the shelf life of the food.

The difference between both processes lies in the fact, that with MAP packs a static atmosphere is artificially created by means of inert gases, while in the case of EMAP a precisely calculated exchange of atmosphere, which is matched to the product, takes place via the micro-perforation, and the modification is actively created by the respiration of the product itself.

**EMAP with perfection: FRESHSAFE from MULTIVAC**

With the FRESHSAFE process, MULTIVAC offers an innovative packaging system with an integrated perforation station for thermoforming packaging machines and traysealers, in which the upper web is perforated during the packaging procedure. This means that standard film can be run - and no stock of perforated film is therefore required.

The small perforations are generally created by the proven needle roller system. But in future it will be increasingly possible to use laser technology as well. The more expensive laser perforation is particularly recommended for automation solutions, in which it is necessary to make a rapid adjustment of the film permeability to the products to be packed.

Thanks to the cost-effective needle perforation system, all current upper webs can be perforated to the individual permeability that is required. This results in a noticeable extension of shelf life and a reduction in waste product. Thanks to the use of lower-cost standard films and permanent savings on servicing, there is a rapid return on investment since such a system is amortised very quickly.

**Practical examples of FRESHSAFE**

MULTIVAC offers the right solution for all the different requirements of the market - for thermoforming packaging machines, traysealers and even chamber machines. Economical entry-level models as well as fully automatic solutions for large batches are available.
The use of the fully automatic T 800 traysealer enabled a Dutch mushroom processor to enter a new market segment. In order to bring fresh and sliced mushrooms to wholesale markets and retail chains throughout Europe, and to ensure that they arrived as fresh as possible at the consumer, the company needed a reliable packaging solution, which would retain the quality of the delicate products and allow them to be presented attractively at the point of sale. This meant that a pack had to be found, which would take the development process of the mushrooms into account. This is because mushrooms contain large quantities of water, which vaporises during the respiration process. The consequence is that they lose their freshness, their appetising appearance and of course some weight. Consumers also recognize from the discoloured dark-brown or black gills and the shrivelled dry surface, whether the mushrooms are still worth buying.

The company tested the various types of pack in MULTIVAC’s Innovation Center at Wolfertschwenden. Only FRESHSAFE was able to really convince the customer. When comparison tests were performed, the shelf life of the mushrooms, which were packed with this technology, doubled from four to eight or nine days. This gave the supply chain much more room to manoeuvre - and it offered the mushroom processor the opportunity of bringing sliced and whole mushrooms to retailers and therefore directly to the consumer.

Since the T 800 could be integrated in a complete, end-to-end packaging line and also use very cost-effective standard film, the packaging procedure was not only efficient but also very economical. The inline perforation with needles enables different packs to be produced, since the permeability of the upper web can be matched to the particular pack size, product, weight and storage temperature. The film does not therefore have to be changed every time a change is made to another format or product. Another benefit: the sealed trays can not simply be opened in the supermarket by the consumer for visual examination of the content before purchasing. This also contributes to better protection.

Summary

With the FRESHSAFE process, MULTIVAC offers an innovative packaging procedure, which contributes to a significantly extended shelf life for delicate food products, and which is also very economical thanks to the use of standard films. FRESHSAFE is suitable for thermoforming packaging machines, traysealers and chamber machines. The packaging concept can even be used on compact entry-level machines such as for example the R 105 thermoforming packaging machine, as well as on the T 300 traysealer, which is designed for small to medium-sized batches, and on the space-saving C 200 chamber machine.