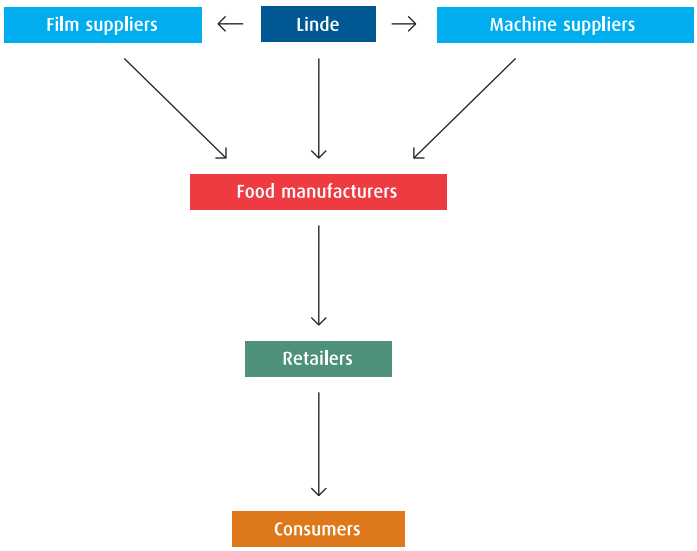
The ultimate combination for freshness. MAPAX® modified atmosphere packaging.

Linde Gas

MAPAX® food preservation.

MAP industrial infrastructure



Winning the race against time

From the very moment fruit is picked, corn is harvested or fish is caught, the race against time begins. From now on, natural deterioration and spoilage (internal factors like water activity, pH-value, type and quantity of product microorganisms) endanger the quality and shelf-life of the foodstuff. However, external factors (hygienic conditions while processing, temperature) also pose a threat to the product's freshness.

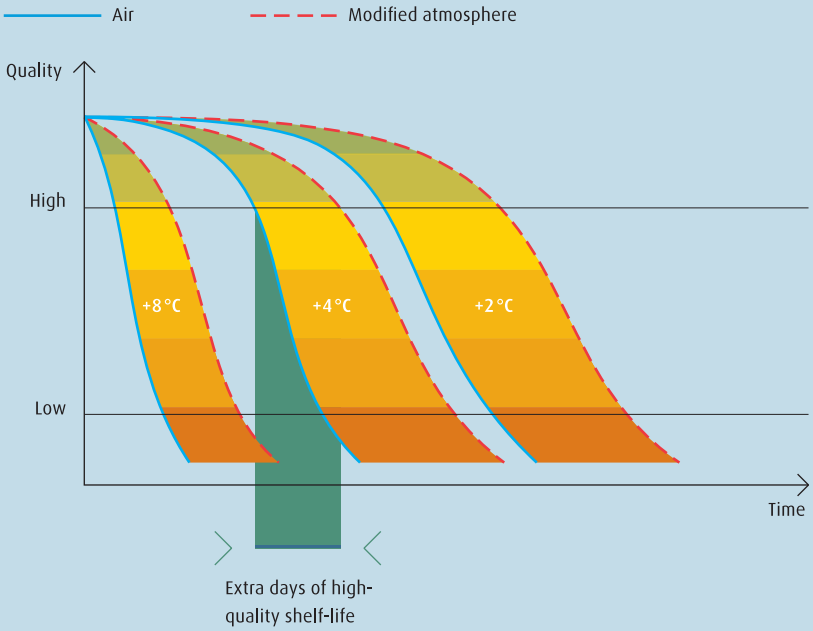
In order to prevent this loss of natural freshness and quality, an effective and intelligent concept of food preservation has been developed – Modified Atmosphere Packaging (MAP). Through the use of natural gases and adequate packaging materials and machines, the quality of foodstuffs is maintained and their shelf-life enhanced.

The future belongs to MAPAX®

MAPAX® from Linde Gas is a tailor-made MAP programme based on the necessary data relating to foodstuffs, gases and packaging. It relies on close cooperation between the suppliers of the packaging material, the packaging machines and the gases. The purpose of this collaboration is to meet the demands for an efficient and cost-effective packaging of foodstuffs, with consistent product quality throughout the entire distribution chain: from the packaging itself to the attractive display in the chilled-food counter.

Moreover, by using the advantages of MAP technology and applying them to a variety of specific needs, food manufacturers are able to develop new products for new markets.

High-quality shelf-life is extended when microbial deterioration is inhibited



MAPAX® benefits.

Improved preservation

The MAPAX® solution successfully inhibits the deterioration of foodstuffs in a natural way. With significant gain for manufacturers and clients, the MAPAX® concept:

- radically extends shelf-life
- keeps products fresh and appetising
- ensures fewer returns through spoilage

Improved distribution

Goods protected by the MAPAX® technology can be delivered less frequently and across longer distances. This enhances planning flexibility and rationalises the workflow. From the delivery of raw materials to the transporting of manufactured goods, the MAPAX® solution:

- reduces preservative requirements
- extends time and geographical boundaries
- rationalises logistics

Improved marketing

If packaged with the MAPAX® technology, products gain days if not weeks of high-quality shelf-life. They are longer available to consumers and may include more delicate raw materials. Thus, the MAPAX® system:

- allows the creation of new dishes and products
- allows highly attractive and marketable packaging

MAPAX® solutions.

All in one – MAPAX® functions everywhere

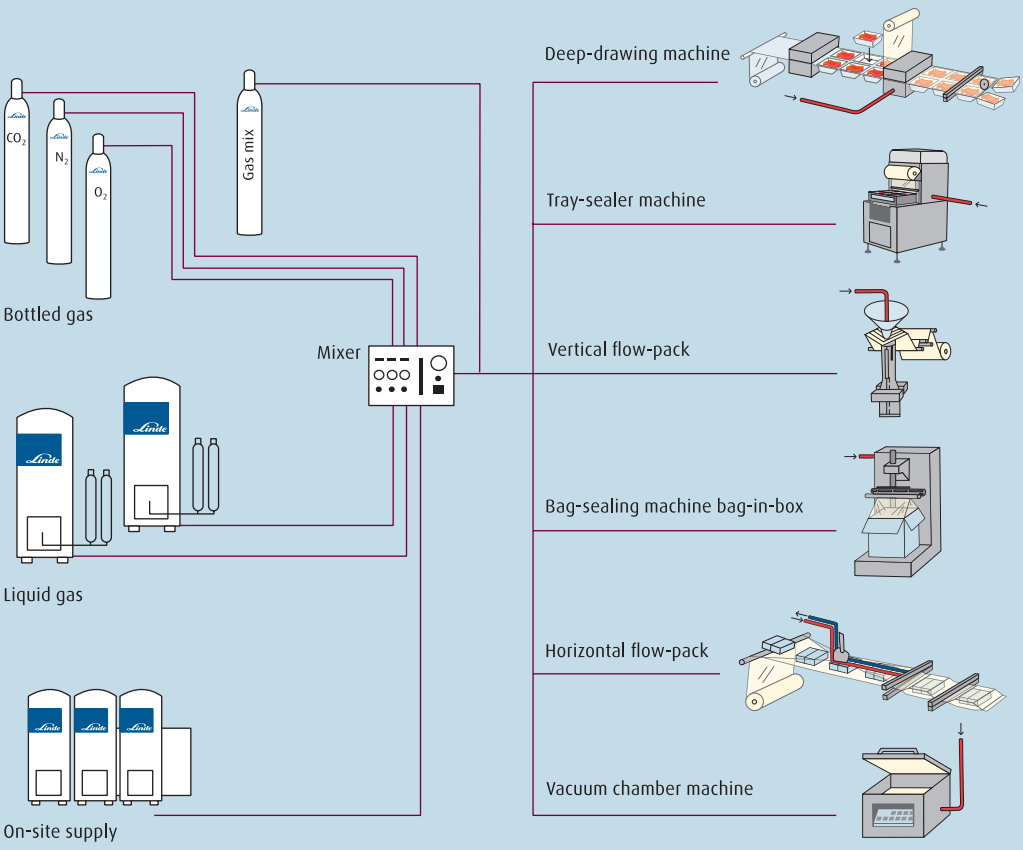
MAPAX® takes the following considerations into account:

- the handling and processing of the product
- the types and quantity of microorganisms
- the level of hygiene
- the delay before packaging
- the temperature
- the properties of the packaging material, e.g. permeability
- the free gas volume of the package
- the gas mixture
- the residual oxygen level

Intensive research and know-how

Linde Gas works closely with food research institutes in many countries, e.g. SIK (Sweden), VTT (Finland), Campden (UK). In the laboratories of SIK, for example, various simulations are carried out to determine the potential hazards from microorganisms. Such studies provide the information necessary for determining safe shelf-life periods. Because experts at Linde Gas know exactly how different bacteria are affected by the combination of temperature/atmosphere and other parameters such as permeability, they offer MAPAX® solutions that will ensure maximum microbiological security for each foodstuff.

MAPAX® – a complete menu of solutions





MAPAX® results.

Comparison of shelf-life for products packed in air and with MAPAX® respectively

Food	Typical shelf-life in air	Typical shelf-life with MAPAX®
Raw red meat	2–4 days	5–8 days
Raw light poultry	4–7 days	16–21 days
Raw dark poultry	3–5 days	7–14 days
Sausages	2–4 days	2–5 weeks
Sliced cooked meat	2–4 days	2–5 weeks
Raw fish	2–3 days	5–9 days
Cooked fish	2–4 days	3–4 weeks
Hard cheese	2–3 weeks	4–10 weeks
Soft cheese	4–14 days	1–3 weeks
Cakes	several weeks	up to one year
Bread	some days	2 weeks
Pre-baked bread	5 days	20 days
Fresh cut salad mix	2–5 days	5–10 days
Fresh pasta	1–2 weeks	3–4 weeks
Pizza	7–10 days	2–4 weeks
Pies	3–5 days	2–3 weeks
Sandwiches	2–3 days	7–10 days
Ready meals	2–5 days	7–20 days
Dried foods	4–8 months	1–2 years

MAPAX® gas atmospheres.

Preservation the natural way

MAP is a natural shelf-life-enhancing method that is growing rapidly on an international scale. It often complements other techniques, such as high-pressure and microwave methods or oxygen absorption. The correct gas mixture in MAP maintains high quality by retaining the original taste, texture and appearance of the foodstuff.

The gas atmosphere must be chosen with due consideration of the particular foodstuff and its properties. For low-fat products with a high moisture content, it is especially the growth of microorganisms that has to be inhibited. On the other hand, should the product have a high fat content and low water activity, oxidation protection is most important.

Carbon dioxide – most important

Carbon dioxide is the most important gas in the field of MAP technology. Most microorganisms such as mould and the most common aerobic bacteria are strongly affected by carbon dioxide. The growth of anaerobic microorganisms, on the other hand, is less affected by this gas atmosphere. Carbon dioxide inhibits microbial activity by effectively dissolving into the food's liquid and fat phase, thereby reducing its pH-value, and by penetrating biological membranes, causing changes in permeability and function.

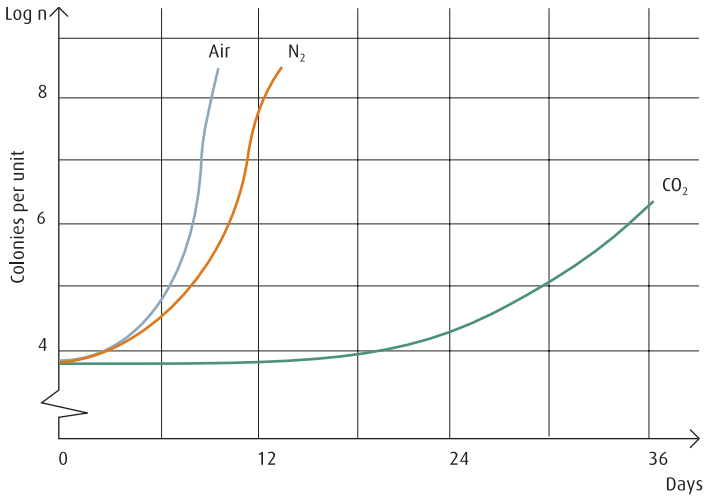
Nitrogen – inert and stabilising

Nitrogen is an inert gas. It is primarily used to replace oxygen in packaging and thereby prevents oxidation. Owing to its low solubility in water, nitrogen also helps to prevent package collapse by maintaining internal volume.

Oxygen – mainly bad, sometimes good

For most foodstuffs, the package should contain as little oxygen as possible to retard the growth of aerobic microorganisms and reduce the degree of oxidation. However, there are exceptions. Oxygen helps to preserve the oxygenated form of myoglobin, which gives meat its red colour. Oxygen is required for food and vegetable respiration.

Bacterial growth on pork in different atmospheres at +4 °C



Linde food grade gases: BIOGON®*.

A gas supply adapted to every application

"Food grade gas" is a specific definition for gases used as a processing aid and/or additive in order to ensure that international standards are complied with. BIOGON® products by Linde Gas conform to food grade regulations, e.g. the EC directive 96/77/EC on food additives within the EU countries and the FDA guidelines in the USA. The BIOGON® gases N_2 and O_2 are separated from the atmospheric air. CO_2 is taken from natural wells or as a byproduct of, for instance, fermentation processes (wine, beer) or ammonia production. Sometimes it may be more effective and practical to produce nitrogen on site using PSA (pressure swing adsorption) or a permeable membrane plant. If a PSA/membrane system is used, a back-up gas supply system is recommended.
Microorganism growth can also be inhibited to a certain extent with the help of other gases authorised for foodstuffs, such as nitrous oxide, argon or hydrogen. Each of the gases has its own unique properties that affect its interaction with the foodstuffs. The gases are used in mixed atmospheres, in suitable proportions or by themselves: either premixed, as individual gases in cylinders under high pressure or as liquids in insulated tanks for subsequent mixing at the packaging machine.

Common examples of Linde Gas food mixtures

Examples	Gas components (%)		
	O_2	CO_2	N_2
BIOGON® N			100
BIOGON® C		100	
BIOGON® O	100		
BIOGON® NC 20		20	80
BIOGON® NC 30		30	70
BIOGON® OC 25	75	25	
BIOGON® O C N 25 09	66	25	9

Names may vary from country to country.

*In some countries, BIOGON® is available under the tradename TRESARIS™.
TRESARIS™ is a trademark of the Linde Group.

Getting ahead through innovation.

With its innovative concepts, Linde Gas is playing a pioneering role in the global market. As a technology leader, it is our task to constantly raise the bar. Traditionally driven by entrepreneurship, we are working steadily on new high-quality products and innovative processes.

Linde Gas offers more. We create added value, clearly discernible competitive advantages, and greater profitability. Each concept is tailored specifically to meet our customers' requirements – offering standardised as well as customised solutions. This applies to all industries and all companies regardless of their size.

If you want to keep pace with tomorrow's competition, you need a partner by your side for whom top quality, process optimisation, and enhanced productivity are part of daily business. However, we define partnership not merely as being there for you but being with you. After all, joint activities form the core of commercial success.

Linde Gas – ideas become solutions.

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