

Food preservation with MAPAX® packaging.



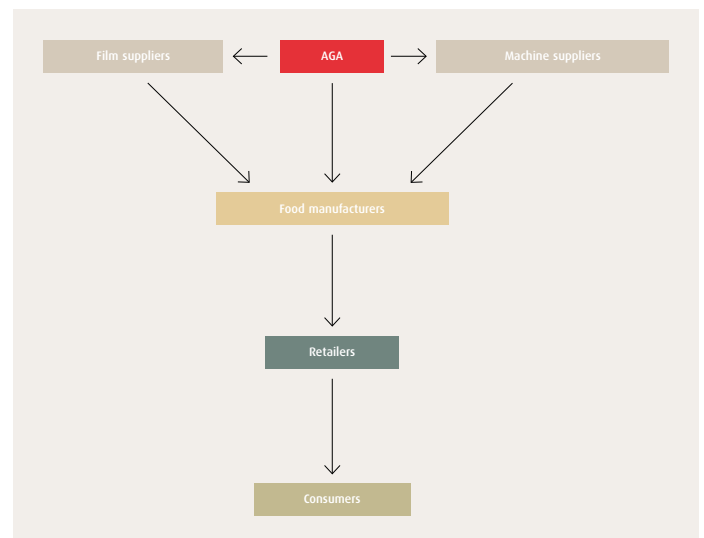
Race Against Time

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 foodstuffs. However, external factors (hygienic conditions while processing, temperature, etc.) also play a role in maintaining product freshness.

In order to prevent this loss of natural freshness and quality, an effective concept of food preservation has been developed – Modified Atmosphere Packaging, or MAP. This means packaging in modified atmosphere – nitrogen, carbon dioxide and oxygen. With the use of natural gases and adequate packaging materials and machines, quality of foodstuffs is maintained and their shelf life is enhanced.

And the winner is... MAPAX®

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 etc.) also pose a threat to the product's freshness. It is therefore of critical importance how the product is handled in the processing stage, on the filling line or during the chilling process prior to packaging. Particular emphasis must be placed on the packaging stage, because the way the foodstuff is packaged is decisive when it comes to prolonging shelf-life and guaranteeing food safety for the consumer.



MAPAX® concept for the industrial infrastructure.

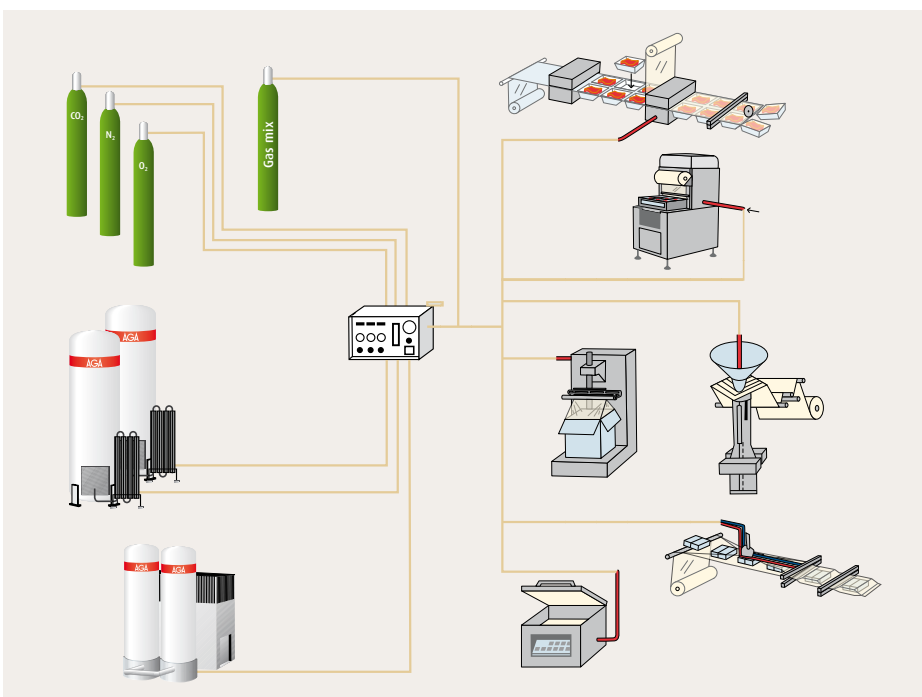
Recommended gas mixtures for dry foods and bakery products

Product	Gas mixture	Gas volume	Typical shelf-life	Typical shelf-life	Storage temp.
		Product volume	Air	MAP	
Pre-baked bread	100 % CO ₂	50–100 ml	5 days	20 days	20–25 °C
		100 g prod.			
Cakes	50 % CO ₂ + 50 % N ₂	50–100 ml	15 days	60 days	20–25 °C
		100 g prod.			
Coffee (ground)	N ₂ or CO ₂	50–100 ml 100 g prod.	4 weeks	24 weeks	20–25 °C
Milk powder	100 % N ₂	50–100 ml 100 g prod.	12 weeks	52 weeks	20–25 °C
Peanuts	100 % N ₂	50–100 ml 100 g prod.	12 weeks	52 weeks	20–25 °C

Recommended gas mixtures for dairy products

Product	Gas mixture	Gas volume	Typical shelf-life	Typical shelf-life	Storage temp.
		Product volume	Air	MAP	
Hard cheese	80–100 % CO ₂ + 0–20 % N ₂	50–100 ml	2–3 weeks	4–10 weeks	0–2 °C
		100 g cheese			
Hard cheese (sliced,grated)	40 % CO ₂ + 60 % N ₂	50–100 ml	2–3 weeks	7 weeks	0–3 °C
		100 g cheese			
Soft cheese	20–60 % CO ₂ + 40–80 % N ₂	50–100 ml	8 days	21 days	0–3 °C
		100 g cheese			
Yogurt	0–30 % CO ₂ + 70–100 % N ₂	50–100 ml	10–14 days	22–25 days	4–6 °C
		100 g prod.			

MAPAX® offers various gas delivery options.



Recommended gas mixtures for fish and seafood

Product	Gas mixture	Gas volume	Typical shelf-life		Storage temp.
		Product volume	Air	MAP	
Raw fish	40–90 % CO ₂ +	200–300 ml	3–5 days	5–14 days	0–2 °C
	10 % O ₂ + 0–50 % N ₂	100 g fish			
Smoked fish	40–60 % CO ₂ +	50–100 ml	15 days	30 days	0–3 °C
	40–60 % N ₂	100 g fish			
Cooked fish	30 % CO ₂ +	50–100 ml	7 days	30 days	0–3 °C
	70 % N ₂	100 g fish			
Prawns (peeled, cooked)	40 % CO ₂ +	50–100 ml	7 days	21 days	4–6 °C
	60 % N ₂	100 g prod.			

Recommended gas mixtures for meat and meat products

Product	Gas mixture	Gas volume	Typical shelf-life		Storage temp.
		Product volume	Air	MAP	
Raw red meat	60–80 % O ₂ +	100–200 ml	2–4 days	5–8 days	2–3 °C
	20–40 % CO ₂	100 g meat			
Raw light poultry	40–100 % CO ₂ +	100–200 ml	4–7 days	16–21 days	2–3 °C
	0–60 % N ₂	100 g meat			
Raw dark poultry	70 % O ₂ +	100–200 ml	3–5 days	7–14 days	2–3 °C
	30 % CO ₂	100 g meat			
Sausages	20–30 % CO ₂ +	50–100 ml	2–4 days	2–5 weeks	4–6 °C
	70–80 % N ₂	100 g prod.			
Sliced cooked meat	30 % CO ₂ +	50–100 ml	2–4 days	2–5 weeks	4–6 °C
	70 % N ₂	100 g prod.			

Recommended gas mixtures prepared foods and catering

Product	Gas mixture	Gas volume	Typical shelf-life		Storage temp.
		Product volume	Air	MAP	
Pizza	30–60 % CO ₂ +	50–100 ml	1 week	3 weeks	2–4 °C
	40–70 % N ₂	100 g prod.			
Pasta	30–60 % CO ₂ +	50–100 ml	1 week	3 weeks	2–4 °C
	40–70 % N ₂	100 g prod.			
Sandwiches	30 % CO ₂ +	50–100 ml	2 days	10 days	2–4 °C
	70 % N ₂	100 g prod.			
Ready meals	30–60 % CO ₂ +	50–100 ml	4 days	21 days	2–4 °C
	40–70 % N ₂	100 g prod.			

Recommended gas mixtures for fruits and vegetables

Product	Gas mixture	Gas volume	Typical shelf-life		Storage temp.
		Product volume	Air	MAP	
Lettuce	5 % O ₂ + 5–20 % CO ₂ +	100–200 ml	2–5 days	5–8 days	3–5 °C
	75–90 % N ₂ or	100 g prod.			
	80 % O ₂ + 20 % N ₂				
Fresh salad mix	5 % O ₂ + 5–20 % CO ₂ +	100–200 ml	2–5 days	5–8 days	3–5 °C
		100 g prod.			
Salad mix	75–90 % N ₂	100–200 ml	2–5 days	6–11 days	3–5 °C
	80 % O ₂ + 20 % N ₂	100 g prod.			
Pre-peeled potatoes	40–60 % CO ₂ +	100–200 ml	0.5 hours	10 days	3–5 °C
	40–60 % N ₂	100 g prod.			

MAPAX® packaging benefits.

Better Shelf Life

MAPAX® solutions for packaging keep food from spoiling the natural way. MAPAX® solutions for packaging provide both producers and customers with the following benefits:

- significantly extended shelf life
- fresh and delicious produce
- reduced spoilage and returns

Better Logistics

oods protected with MAPAX® solutions for packaging can be delivered less frequently and over longer distances. This enhances planning flexibility and logistics. Starting from raw material positioning

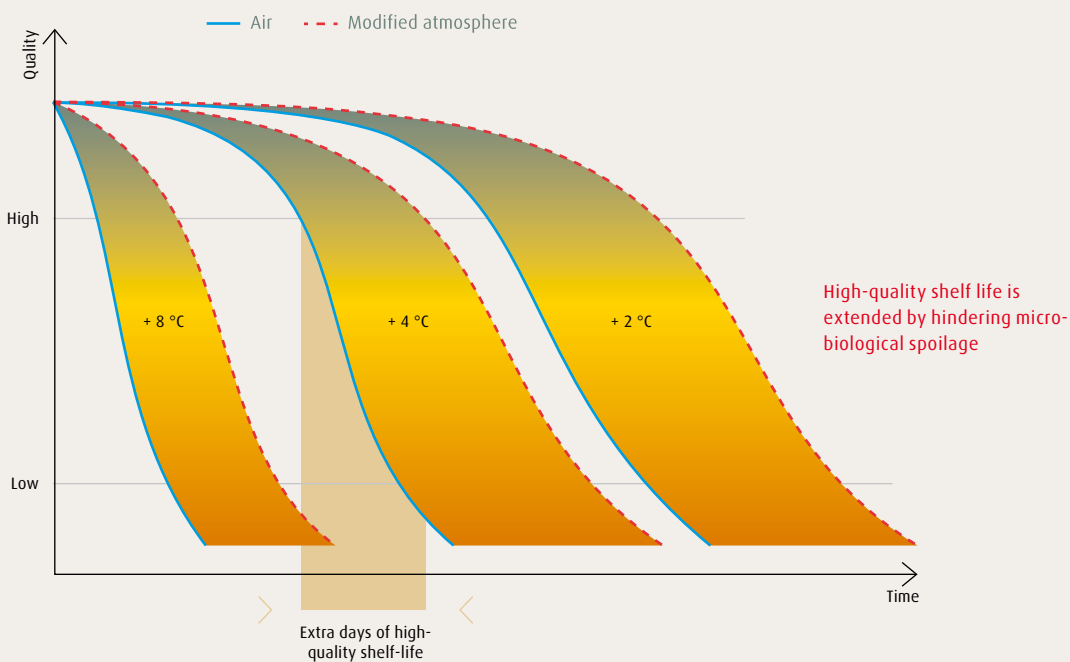
and finishing with transportation of produced goods, MAPAX® solutions offer the following benefits

- less requirements for storage
- longer shelf life and extended geographical coverage
- more efficient logistics

Better Marketing

Days, if not weeks, of high-quality shelf life are gained by using MAPAX® solutions. Products are available to the consumers for longer and may contain more sensitive materials. Thus, MAPAX® enables the following:

- creating new foodstuff and products
- attractive and commercial packaging



MAPAX® solutions.

All-in-one MAPAX® solution take into consideration:

- 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:

AGA 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. As AGA experts have know-how dealing with how different bacteria are affected by the combination of temperature/atmosphere and other such parameters, they can offer MAPAX® solutions that ensure maximum microbiological security for each foodstuff.

MAPAX® gas environments.

Storage in the Natural Way

Modified Atmosphere Packaging (MAP) is a method of extending shelf life in the natural way, and its use is on the rise. It often complements other technologies such as high-pressure and microwave methods or oxygen absorption. The correct gas mixture in modified-atmosphere packaging 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 important to inhibit the growth of microorganisms. Gases with higher carbon dioxide content are the solution. On the other hand, should the product have a high fat content and low water activity, oxidation protection is the most important. In such a case, the primary gas mixture component is nitrogen.

Carbon Dioxide – The Essential Packaging Gas

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. The gas thereby reduces foodstuffs' pH-value, and by penetrating biological membranes it causes changes in permeability and function. Excessive CO₂ content causes the package to shrink due to gas solvation into the product.

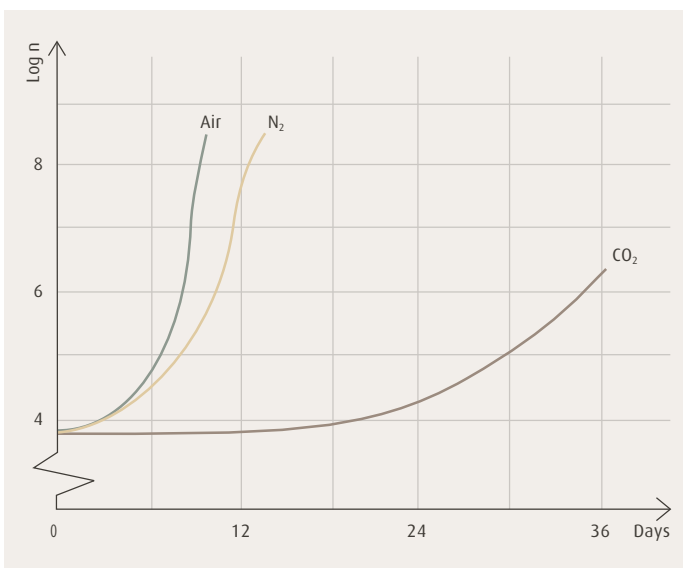
Nitrogen – Inert and Stabilizing

Nitrogen is an inert gas. It is primarily used to replace oxygen in packaging and thereby prevents oxidation. Owing to its low solubility in products, nitrogen also helps to prevent package collapse, thus assuring good appearances.

Oxygen – Mostly Bad, Sometimes Good

For most foodstuffs, the package should contain as little oxygen as possible (less than 1%) 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.

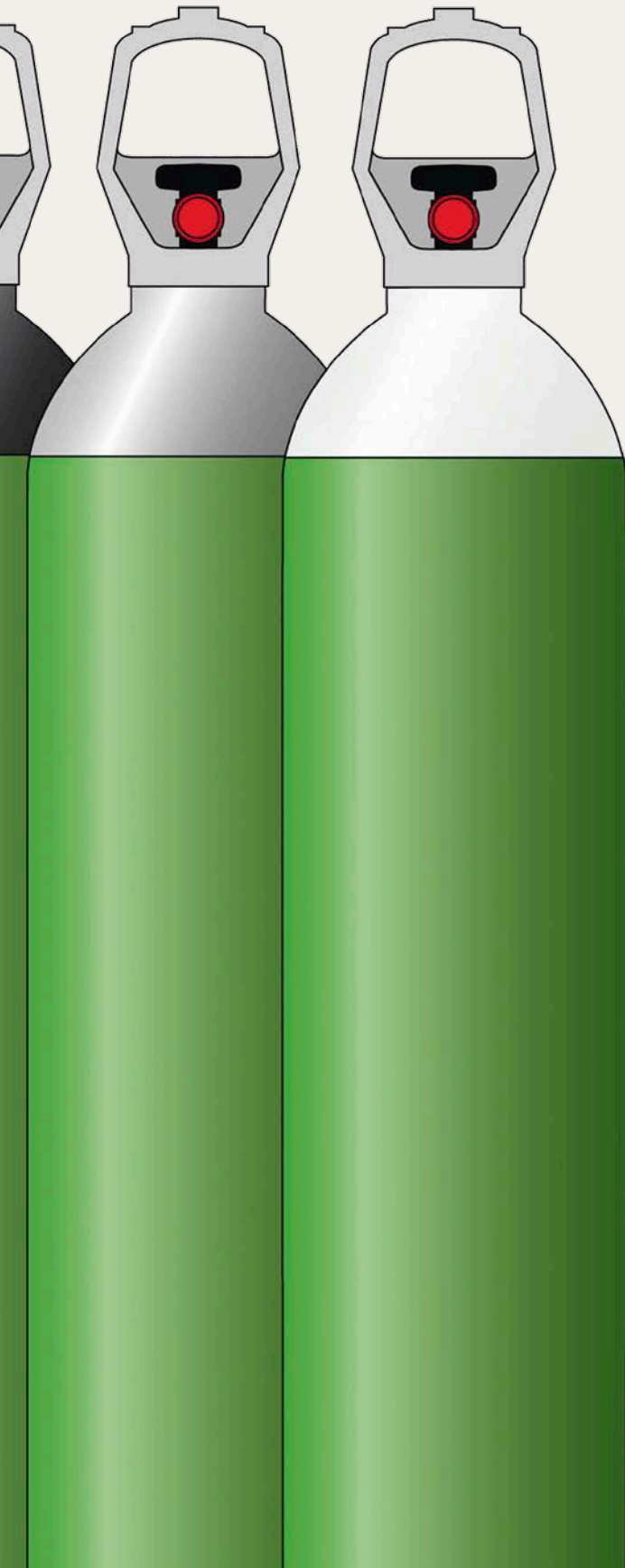
Colonies per unit.



Bacterial growth on pork in different atmospheres at 4 °C



AGA BIOGON® food grade gases.



Gas Supply Adapted To Various Applications

„Food-grade gases“ is a specific definition for gases used as a processing aid and/or additive in order to ensure that international standards are complied with. AGA BIOGON® food grade gases 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. BIOGON® food grade N₂ and O₂ are separated from atmospheric air. CO₂ is taken from natural sources, fermentation processes (wine, beer) or as byproducts of ammonia production. Sometimes it may be more effective and practical to produce nitrogen on-site using PSA (pressure swing adsorption).

If a PSA 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 foodstuff-approved gases such as nitrous oxide, argon or hydrogen.

Each of these gases has its own unique properties that affect its interaction with the foodstuffs. Gases are used in mixed atmospheres from cylinders or by themselves (nitrogen, oxygen, carbon dioxide). In the latter case, gases are extracted from cylinders and are mixed in a gas mixer before packaging.

Examples of AGA 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® NCO 10 10	10	10	80

Names may vary from country to country.

Getting ahead through innovation.

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

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

AGA – ideas become solutions

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