Making our world more productive

MAPAX® – Best for meat and meat products

Comparison of two different meat packages – one with modified atmosphere packaging and the other one without

Linde's MAPAX® portfolio meets today's food preservation challenges with bespoke gases and mixtures, application expertise and complementary installation, test and safety services.

Bacteria grow easily on fresh meat

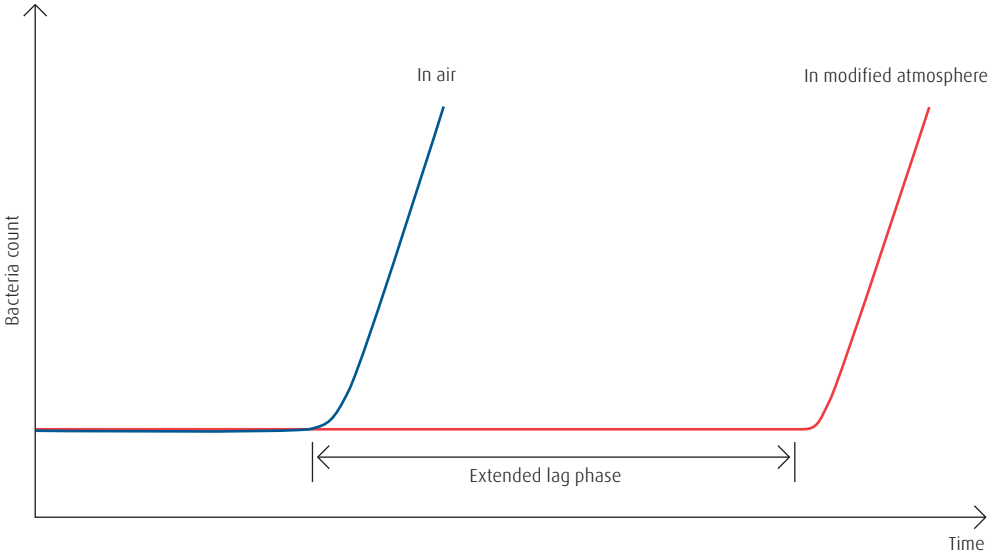
Meat and meat products are particularly susceptible to bacterial growth owing to their high water activity and nutrient content. Meat is sterile to begin with, but when carved up, the surfaces exposed to ambient air provide excellent conditions for the growth of bacteria. Minced meat is naturally even more exposed. For this reason, hygiene and effective temperature control in processing and prepackaging – keeping tools and equipment clean – are vitally important to minimise the contamination of the product with microorganisms.

Red meat requires oxygen

A special problem arises with red meat such as beef with regard to colour changes caused by the oxidation of the red pigment. The atmosphere for fresh meat therefore normally contains high concentrations of oxygen (60–80%) in order to retain the red colour by ensuring high oxygen levels in the meat's myoglobin. Highly pigmented meat such as beef thus requires higher oxygen concentrations than low pigmented meat such as pork. With the right mixtures, the practical shelf-life of consumer-packed meat can be extended from 2–4 days to 5–8 days at 4 °C.

The effectiveness of carbon dioxide

Generally speaking, carbon dioxide has a strong inhibiting effect on the growth of bacteria, of which the aerobic genus Pseudomonas presents the greatest problem for fresh meat.



Bacteria count over time for meat stored in air and in a modified atmosphere at the same temperature. The meat stored in air enters the period of extremely fast growth, the lag phase, well ahead of the meat stored in the modified atmosphere. This is because the CO_2 in the modified atmosphere has dissolved into the surface of the meat, reducing its pH value, inhibiting bacterial growth and thus extending the lag phase, until the point when the inhibiting effects become insufficient to control the bacteria.

Recommended gas mixtures for meat and meat products

Product	Gas mixture	Gas volume / Product volume	Typical shelf-life Air	Typical shelf-life MAP	Storage temp.
Raw red meat	60–80% O_2 + 20–40% CO_2	100–200 ml / 100 g meat	2–4 days	5–8 days	2–3 °C
Minced meat	80–100% O_2 + 0–20% CO_2	100–200 ml / 100 g meat	<24 h	3–4 days	2–3 °C
Raw light poultry	40–100% CO_2 + 0–60% N_2	100–200 ml / 100 g meat	4–7 days	16–21 days	2–3 °C
Raw dark poultry	70% O_2 + 30% CO_2	100–200 ml / 100 g meat	3–5 days	7–14 days	2–3 °C
Sausages	20–30% CO_2 + 70–80% N_2	50–100 ml / 100 g prod.	2–4 days	2–5 weeks	4–6 °C
Sliced cooked meat	30% CO_2 + 70% N_2	50–100 ml / 100 g prod.	2–4 days	2–5 weeks	4–6 °C

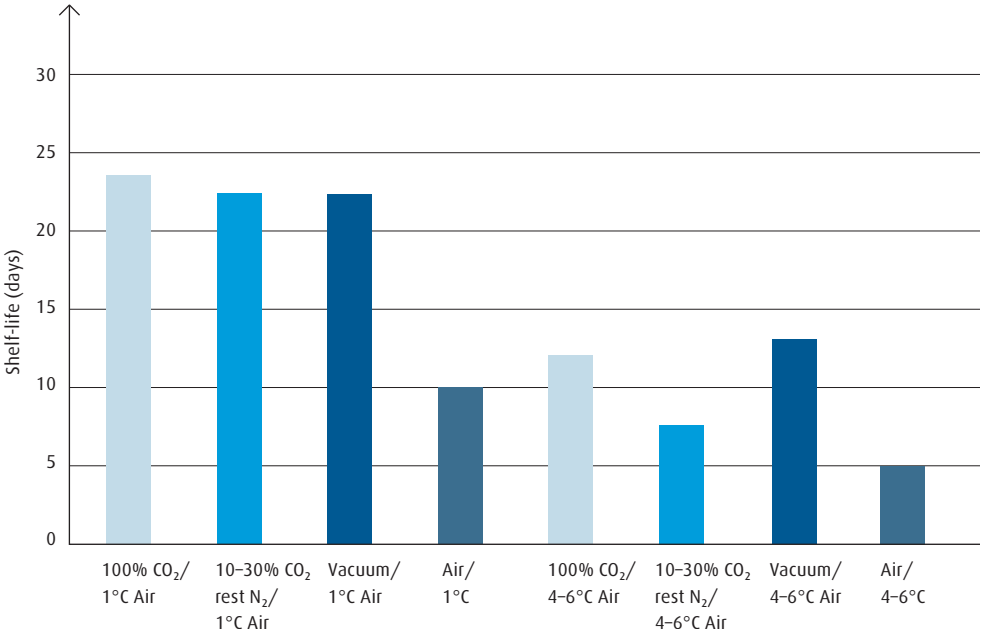
Poultry

Poultry is very susceptible to bacterial spoilage, evaporation loss, off-odour, discolouration and biochemical deterioration. The sterile poultry tissue becomes contaminated during the evisceration process. The practical shelf-life of gas-packed poultry is about 16 to 21 days. The head-space volume should be nearly as large as the product volume. In contrast to red meats, poultry does not undergo irreversible discolouration of the meat's surface in the presence of O_2. The spoilage of raw poultry is mainly caused by microbial growth, particularly growth of the Pseudomonas and Achromobacter species. These aerobic spoilage bacteria are very effectively inhibited by CO_2 in modified atmosphere packaging (MAP). Levels of CO_2 in excess of 20% are required to significantly extend the shelf-life of poultry. Package collapse and excessive drip could be a problem for raw poultry, so if higher levels of CO_2 are used, the gas/product ratio should also be increased. Where package collapse is not a problem (e.g. bulk or master bags), 100% CO_2 is recommended. In both retail and bulk modified atmospheres, N_2 is used as an inert filler gas.

Meat products have different microflora

Deterioration of meat products is most commonly caused by microbial spoilage. Due to the processing operations, for instance marinating, drying, smoking, fermentation, curing and cooking, the microflora in meat products differ from those in raw meat and the spoilage mechanisms are thereby different. This affects the gas composition used in the package. In order to prevent the products from going off, the concentration of carbon dioxide is usually low (20–50%).

Microbiological shelf-life of chicken at different atmosphere/temperature combinations



MAPAX packaging of chicken

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