

Minimising protein oxidation in retail-packed minced beef using three-gas MA-packaging

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INTRODUCTION

Red meat is commonly packed in MAP containing 70-80% oxygen (O₂) to obtain an attractive bloom colour and 20-30% carbon dioxide (CO₂) to extend shelf life. Unfortunately, high oxygen MAP negatively impacts meat sensory attributes including tenderness, juiciness and flavour, and causes premature browning (PMB) during cooking. The objective of this study was to investigate the effect of low oxygen levels using three-gas mixtures (O₂, CO₂, N₂) MAP on shelf life, oxidation markers, and eating quality of minced beef.

MATERIALS AND METHODS

Shelf life & oxidation: Bovine shoulder clod were pre-minced at a Danish deboning plant, using nitrogen for cooling. The meat was then transported to a Danish packing plant, where it was minced finely and weighed out into 500 g per tray and sealed with gas mixtures 1-5, as detailed in Table 1. The samples were stored for 0, 6, 8, 11 and 13 days after packaging.

Table 1. Experimental design for Raw meat evaluation: shelf life, lipid and protein

Cut	Shoulder clod - Minced 2 days after slaughter				
	1	2	3	4	5
Gas mixtures	40% O ₂	40% O ₂	50% O ₂	50% O ₂	80% O ₂
	20% O ₂	40% CO ₂	20% CO ₂	40% CO ₂	20% CO ₂
	40% N ₂	20% N ₂	30% N ₂	10% N ₂	-
Storage conditions	1200 lux, 5° C, for up to 13 days				

oxidation.

Sensory profiling: For the sensory profiling of cooked meat, forequarter muscles (12% fat) were minced 6 days after slaughter, sealed in the gas mixtures 1, 3 and 5, and stored for 6 days at 5°C.

CONCLUSION

It is possible to maintain the shelf life of MA-packed minced beef while reducing the oxygen content from 80% to 50%. Further reduction of the O₂ content to only 40% will also reduce lipid oxidation during storage. However, deviating from the established two-gas high-oxygen packaging practice does not result in any sensory benefits.

RESULTS

- Shelf life: Packing minced beef in 50% O₂ + 40% CO₂ + 10% N₂ will result in the same shelf life as high oxygen MAP (80% O₂ + 20% CO₂). In contrast when using a three-gas mixture with 40% O₂ + 20-40% CO₂, the shelf life will be reduced by 2-4 days at 5°C (Table 2).

Table 2. Cross section of MA-packed minced beef just after opening the package, and the acceptability limit (approx. storage time for threshold score = 2.5) of raw minced beef stored in MAP with different gas mixtures at 5° C.

Gas composition/Day	40% O ₂ + 20% CO ₂ + 40% N ₂	40% O ₂ + 40% CO ₂ + 20% N ₂	50% O ₂ + 20% CO ₂ + 30% N ₂	50% O ₂ + 40% CO ₂ + 10% N ₂	80% O ₂ + 20% CO ₂ + 0% N ₂
Day 6					
Day 8					
Day 11					
Day 13					
Accept limit	8 days	7 days	10 days	11 days	12 days

- Lipid oxidation: Beef packed with 40% O₂ is more stable than samples packed in 50% or 80% O₂. The CO₂ content did not affect the development of lipid oxidation (Figure 1).

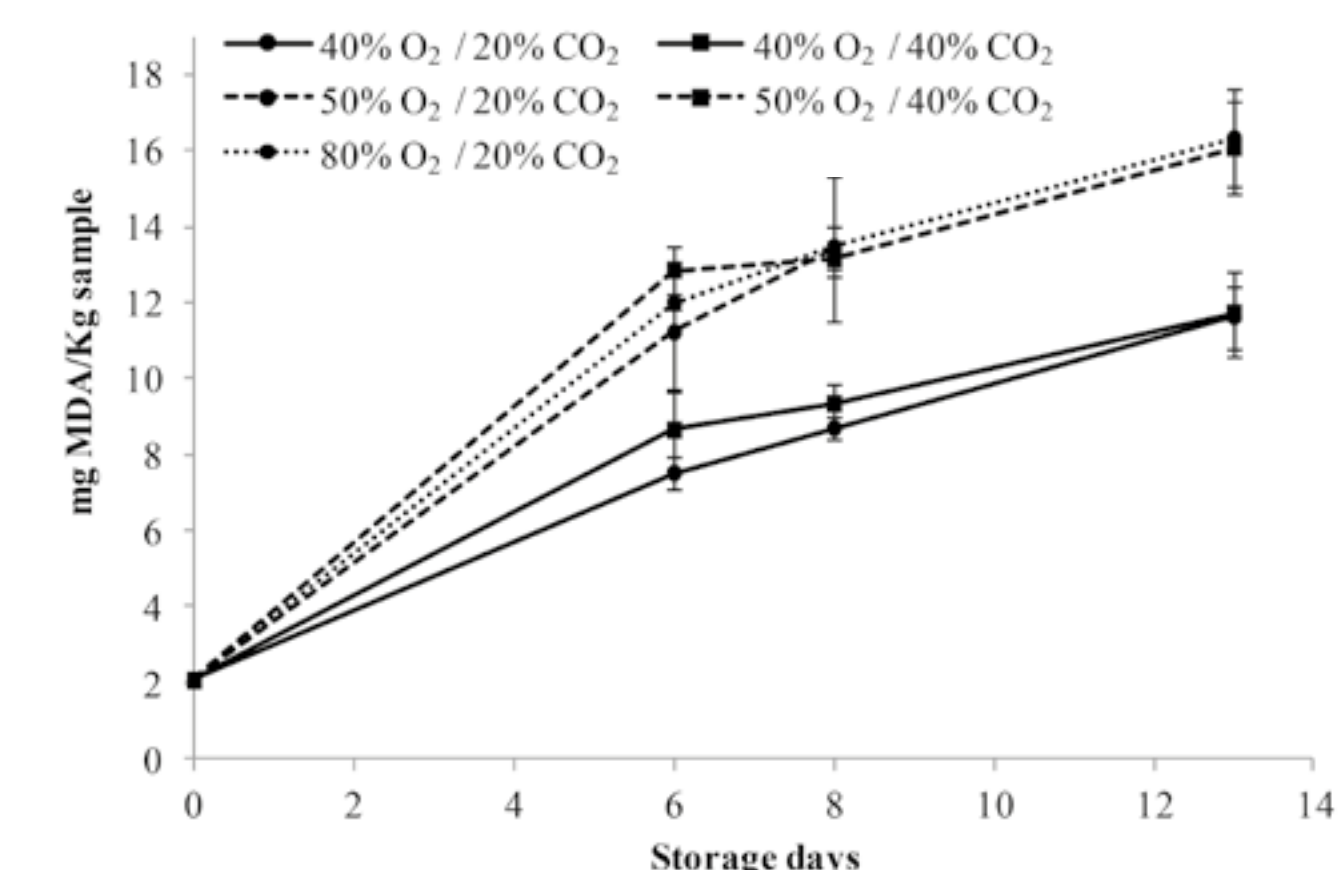


Figure 1. TBARS in raw meat samples from minced beef stored in different MAP gas mixtures for 6, 8 and 13 days at 5°C.

- Protein oxidation: A time-dependent decrease in free thiol groups, irrespective of the gas mixture, was observed during storage (Figure 2).

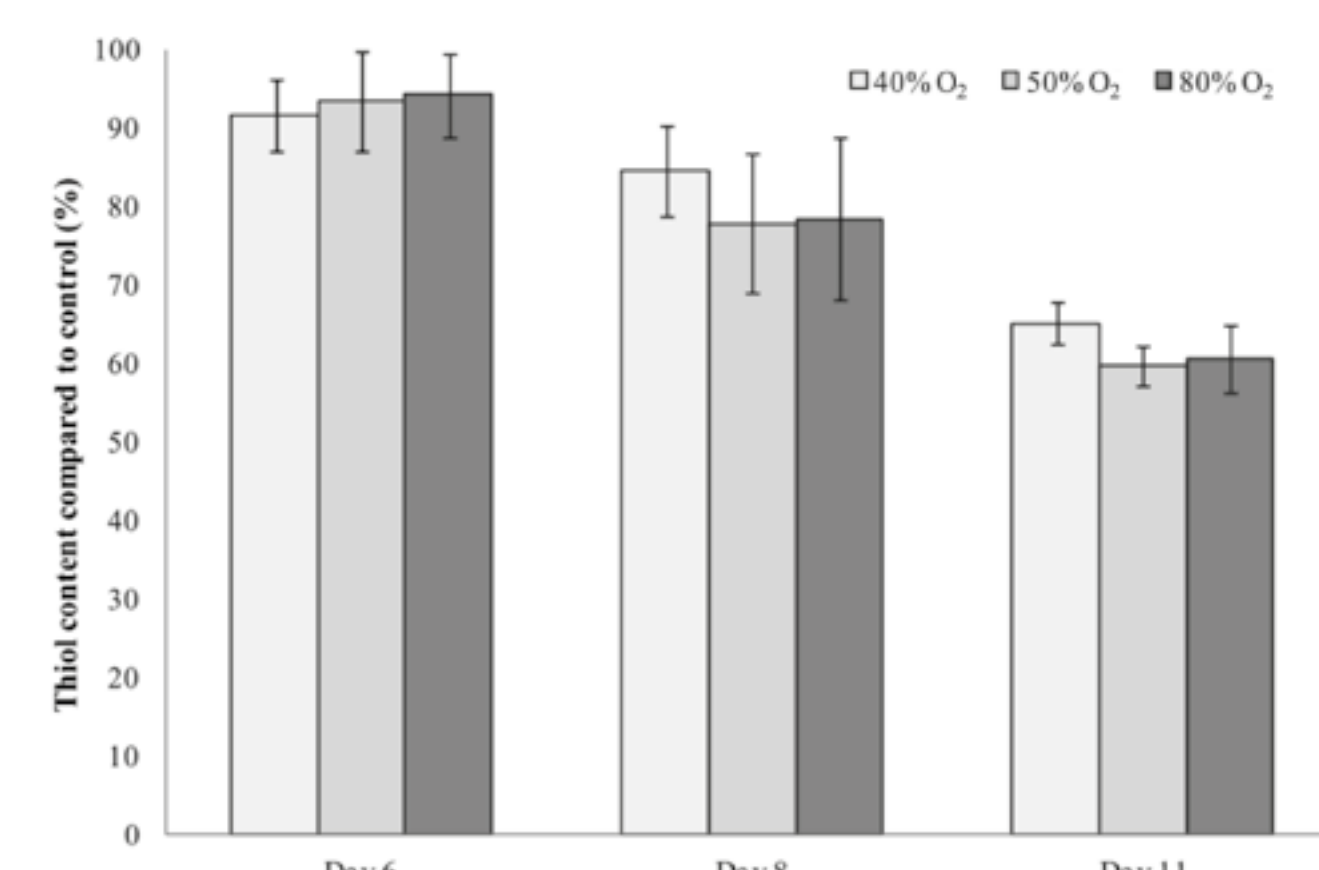


Figure 2. Percentage of free thiol groups in raw meat samples from minced beef stored in different MAP gas mixtures for 6, 8 and 11 days at 5°C.



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