

Effect of packaging, freezing and thawing of ground beef on the quality of beef patties

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Abstract

Retail stores often offer discounts on purchases of large amounts of meat. Some of the meat is prepared the same day, and some is stored for later use. This study evaluates the effect of retail packaging, freezing and thawing on the quality of beef patties. Loosely ground beef was retail-packed in: (1) highly permeable wrap, and (2) high oxygen MAP. The meat was subsequently refrigerated at 4°C and frozen early (wrap = 10 hours, MAP = 2 days) and late (wrap = 24 hours, MAP = 7 days) in the shelf-life. After storage (-18°C), the meat was thawed on the kitchen counter (10 hours), in the refrigerator (24 hours) or in a microwave oven (300W). Patties were formed (125g), tempered (approx. 15°C) and fried on a pre-heated pan (160°C) to a core temperature of 75°C. Patties made from beef packed in MAP had reduced meat flavour and juiciness, while cooking loss, rancid flavour, warmed-over flavour (WOF), sour taste, rubbery texture and premature browning (PMB) increased compared with wrap. Meat frozen late had an increased rancid flavour and WOF (MAP only) and resulted in a longer chewing time, more rubbery texture and reduced juiciness. Thawing in a microwave oven reduced cooking loss (MAP only), WOF, rancid flavour, sour taste and PMB compared with other methods.

Introduction

When consumers experience poor appearance and eating quality of meat, it is often the butcher, the retail store or the meat company who are blamed. Retail stores often offer discounts on purchases of large amounts or several packages of meat. Some of the meat is prepared the same day, and some is stored in the refrigerator and/or freezer for later use. Several studies have shown that the quality of beef decreases when it is packed in high oxygen modified atmosphere both in relation to eating quality (Tørngren, 2003; Clausen & Madsen, 2005) colour stability (Grobbel *et al.*, 2008) and premature browning (PMB) (Hunt *et al.*, 1999; John *et al.*, 2004; Tørngren & Madsen, 2005). Besides packaging in high oxygen MAP the freezing and thawing processes will also affect PMB (Van Laak *et al.*, 1996; Sonderberg & Hoffman, 2004; Hunt *et al.*, 1999). This study evaluates the degree to which consumers can influence the quality of beef patties when they freeze and thaw retail-packed ground beef in the domestic kitchen.

Objective

This study evaluates the effect of retail packaging and the freezing and thawing of ground beef on the eating quality and PMB of beef patties.

Material and methods

Loosely ground beef (10-12% fat) was portioned into 250 g trays and packed under two different retail headspace conditions: (1) highly permeable film (wrap) (21% O₂, 79% N₂), and (2) high oxygen modified atmosphere packaging (MAP) (70% O₂, 20% CO₂). The meat was subsequently refrigerated at 4°C and frozen early (wrap = 10 hours, MAP = 2 days) and late (wrap = 24 hours, MAP = 7 days) in the shelf-life. Before freezing, the meat was either frozen in the retail packaging or repacked into freezing bags. After approx. 4 weeks' storage (-18°C), the meat was thawed on the kitchen counter (10 hours, 20°C), in the refrigerator (24 hours, 5°C) or in a microwave oven (300W, 10 min). The trial design is shown in Figure 1.

Sensory analysis: The meat was formed into patties (125g) and tempered to approx. 15°C before being fried on a pre-heated pan (160°C) to a core temperature of 75°C. The patties were cut and served in pieces measuring 2½ cm x 3 cm. Samples were evaluated on a 15-point unstructured scale anchored at the extremes (0 = low intensity and 15 = high intensity) by an 8-member trained sensory panel. The textural attributes were: rubbery texture, chewing time, chewiness and juiciness. The odour attributes were: fried beef odour, sour odour, and rancid odour. The taste and flavour attributes were: fried meat flavour, WOF, rancid flavour, sour taste and sourish taste.

Cooking loss: Patties were weighed before and after cooking, and the cooking loss was calculated.

PMB: The meat was formed into patties (125g) and tempered to approx. 15°C before being fried on a pre-heated pan (160°C) to core temperatures of 55°C, 65°C and 75°C.

Data were analysed using mixed models (SAS 8.2, 1999-2001). The model included the packaging method, freezing, repackaging and thawing as fixed effects, and the assessors as random effects. Non-significant interactions were deleted from the model. Least squares (LSmeans) were calculated and separated using probability of difference. Levels of significance: $p > 0.05 = \text{ns}$, $0.05 > p > 0.01 = *$, $0.01 > p > 0.001 = **$, $p < 0.0001 = ***$.

Results & discussions

The *retail packaging* method had the biggest influence on quality, as it affected the textural properties, cooking loss, flavour and PMB of beef patties. Patties made from beef packed in MAP had decreased juiciness and chewiness along with longer chewing time, intensified rubbery texture (Figure 1) and increased cooking loss. Furthermore, MAP resulted in an altered flavour profile with decreased fried beef flavour and increased rancid flavour, WOF and sour taste. As expected, PMB increased when the meat was packed in MAP compared with meat packed in wrap (Figure 4).

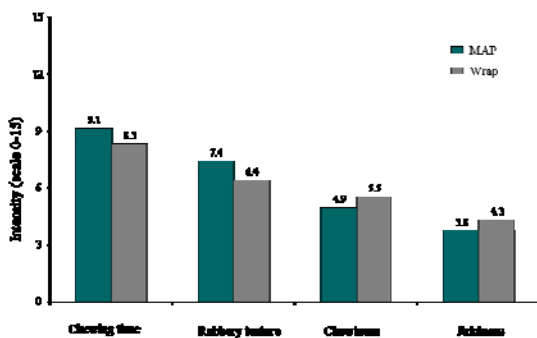


Figure 1. Effect of packaging on textural attributes.

The *freezing process* did not affect the quality of patties made from beef packed in wrap. However, patties made from meat packed in MAP changed flavour and texture (Figure 2). Fried beef flavour decreased when the meat was frozen late in the shelf-life. Sour taste, WOF and rancid flavour were minimized when MA-packed ground beef was frozen early. Furthermore, patties made from meat frozen late in the shelf-life were less juicy ($p=0.0185$), had a more rubbery texture ($p=0.0261$) and had a longer chewing time ($p=0.0107$) compared with meat frozen early (data not shown). Results concerning repackaging are indistinct, and would probably have had more influence on the quality changes if the freezing period had been longer than 4 weeks.

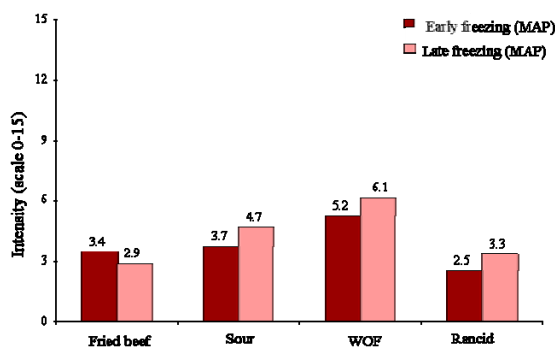


Figure 2. Effect of freezing on the flavour attributes of patties made from MA-packed ground beef.

The *thawing process* had no influence on the texture of beef patties, but influenced the cooking loss of meat packed in MAP (data not shown), the flavour profile and PMB. Beef packed in MAP had a lower cooking loss when it was thawed in a microwave oven (300W) compared with on a kitchen counter (10h, approx. 20°C) or in a refrigerator (24h, 4°C). Furthermore, thawing in a microwave oven resulted in reduced WOF, rancid flavour and sour taste, while fried beef flavour was the same when compared with the other thawing processes (figure 3). PMB was greatly influenced by the thawing process (Figure 4). When thawing in a refrigerator, the internal colour appeared well-done both for beef packed in wrap and MAP, this PMB is minimized without repacking before freezing (not shown). When thawing on the kitchen counter or in a microwave oven, the wrap-packed meat retained its red colour, while meat packed in MAP appeared well-done. However, MA-packed meat thawed on the kitchen counter had a slightly pink internal colour. This is in

agreement with Sonderberg & Hoffman (2004), who found that thawing in a refrigerator increases the amount of patties with an intense degree of PMB.

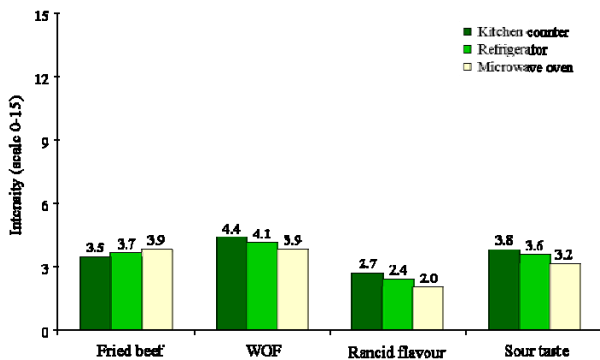


Figure 3. Effect of the thawing process on the flavour and taste attributes of beef patties.

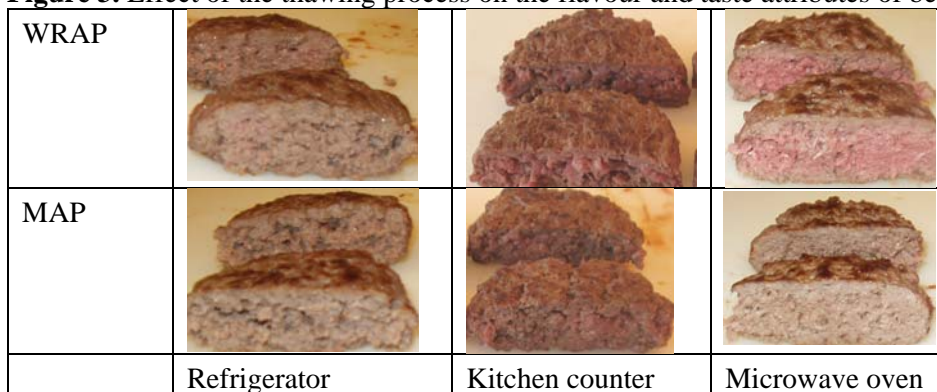


Figure 4. Internal colour of patties (core temperature = 55°C). Rows: Retail packaging in wrap and MAP, columns: Thawing process.

Conclusions

- Packaging in modified atmosphere decreases juiciness and meat flavour, while cooking loss, PMB, rancid flavour, sour taste, rubbery texture and WOF are increased.
- When MA-packed meat is frozen early in the shelf-life, sour taste, WOF and rancid flavour are minimized, while the fried meat flavour is retained. When meat is frozen late in the shelf-life rancid flavour and WOF increased (MAP only) and resulted in a longer chewing time, more rubbery texture and reduced juiciness. The quality of meat packed in wrap is not influenced by the freezing time.
- The thawing process affects flavour, cooking loss and PMB. Thawing in a microwave oven decreases cooking loss (only MAP), WOF, rancid flavour and sour taste, but increases PMB of MA-packed ground beef. Beef packed in MAP should be thawed on the kitchen counter in order to minimize PMB, while meat packed in wrap should be thawed in a microwave oven or on the kitchen counter. Thawing in a refrigerator increases PMB both for meat packed in wrap and MAP.

Acknowledgements

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