Minced meat packed in high-oxygen modified atmosphere – effects on sensory quality and oxidation products

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Introduction

To meet the consumer demands of increased food safety and quality the retailers have started to pack minced meat in modified atmosphere packaging (MAP) with high oxygen content (80 % O_2 and 20 % CO_2). The high oxygen content gives the minced meat a bright red colour, which is an indication for the consumer that the meat is fresh and has a good quality. The carbon dioxide prohibits the growth of micro-organisms. However, there have been consumer complaints due to lower water holding capacity and meat flavour. The aim of our study was to investigate if the high oxygen pressure in the packages speeds up the oxidative processes in minced meat after different storage times and by that influencing sensory qualities and water holding capacity negatively.

Material and method

Minced meat samples were collected at meat processing company. The samples consisted of trays containing 800g of minced meat with a 10% fat content. A total of 12 repetitions were taken from 5 different batches. For each repetition a day 0 sample was taken by puncturing the plastic directly after packing. Two additional trays from each batch were cold stored at 4°C for 6 or 8 days. pH was measured by mixing 1g of minced meat with 10ml KCl. Samples for chemical analysis were kept in -80°C. Minced meat for sensory analysis was vacuum packed and placed in -20°C.

Sensory analysis: The minced meat was mixed with 0.8 % salt and cooked in an oven as a meat loaf until an inner temperature of 72°C. The samples were weighed before and after cooking and cooking loss was calculated. The samples were stored at 4°C overnight and then served to the sensory panel at room temperature. The panel consisted of 6 trained panellists. The attributes judged were meat odour, meat flavour, juiciness, crumbliness, sweetness and acidity. The scale used was from 1-10, where 1 was low intensity and 10 high intensity. Minced meat samples stored for 0, 6 and 8 days were tested from each batch. A consumer test, with 131 consumers was performed at a local supermarket. The minced meat consisted of a mix from all the batches but with the same treatment (0, 6 or 8 days). The consumer was asked to rank which sample that was best, second best and worst.

Chemical analysis: The lipid oxidation was analysed with the thiobarbituric acid reactive substances (TBARS) method (Miller, 1998). Protein oxidation was measured as carbonyl concentration (nmol/mg protein) according to a modified method after Olivier et al. (1987) using a spectrophotometer. The vitamin E stability was investigated by extracting the antioxidant from the minced meat and then using high performance liquid chromatography (HPLC) as described by Högberg et al. (2002).

Statistics: Data were analyzed using the mixed procedure in Statistical Analysis System (version 9.1, SAS institute Inc., Cary, NC, USA). The statistical model used had the effect of storage day as fixed factor. In addition, panelist and batch were included as random factors in the sensory analysis. The results from the consumer test were analyzed according to Friedman's ranking test.

Results and Discussion

Shelf life and fresh beef meat quality are strongly influenced by initial meat quality, storage conditions and package parameters (Zhao et al., 1994). The chemical analyses showed an increased oxidation of both lipids and proteins with storage time. The measured TBARS values (Table 1) never exceeded the limit that Campo et al. (2006) suggested as unsuitable for human consumption. As the oxidation products increased with longer storage time, the amount of off flavour detected by the sensory panel also increased (Figure 1). The increase in cooking loss was most likely depending on the decrease in pH. The decreasing pH can probably be due to that CO_2 diffuse into the minced meats water phase (Jakobsen and Bertelsen, 2006). In our study minced meat aged 8 days was more acidic, had a higher crumbliness and was less sweet than the

minced meat aged 0 or 6 days. The vitamin E content decreased during storage. The consumer test showed no significant differences in preference between the 0, 6 or 8 day samples. However, there was a tendency of two separate groups, one preferring the day 0 sample and the other the day 8 samples.

Table 1. The effect of storage time for 0, 6 or 8 days on pH, Cooking loss (%), Vitamin-E (α-tocoferol) (mg/g), TBARS (µg/g) and Protein oxidation (nmol/mg protein).

	Treatment				
	Day 0	Day 6	Day 8	S.E.	p-value
pH	5.71[a]	5.72[a]	5.67[b]	0.01	0.0001
Cooking loss	19.95[a]	21.89[b]	23.92[c]	0.56	0.0026
Vit. E (α-tocoferol)	2.43[a]	2.14[b]	1.89[c]	0.87	0.0018
TBARS	0.77[a]	1.21[b]	1.29[b]	0.18	0.0001
Protein oxidation	1.07[a]	1.39[ab]	1.69[bc]	0.28	0.140

Different letters, within row, are significantly different ($p<0.05$).

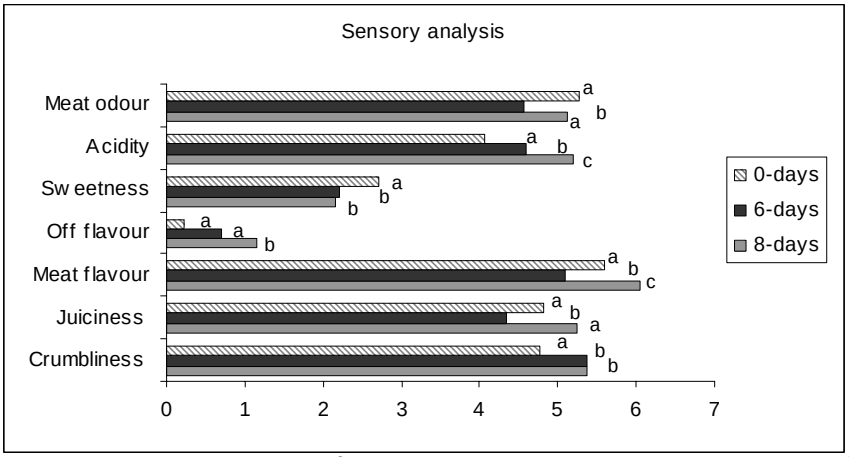

Figure 1. Sensory evaluation of minced meat kept 0, 6 or 8 days in MAP (scale from 1-10 were 1 is low intensity and 10 high intensity). Bars with different letters are significantly different ($p<0.05$).

Conclusions

Chemical and sensory changes appeared during storage of minced meat in modified atmosphere with high oxygen content. The increased amount of oxidation products affected both taste and texture. The changes were, however, small and despite the changes in the minced meat indicated by the chemical and sensory analyses, the average consumer could not notice any quality defects with a longer storage time.

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