E65

WARMED OVER FLAVOR IN MINCED MEAT

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Background

Generally WOF is measured using TBA methodology. This method measures malonaldehyd and other TBA reactive substances. Few studies have used head-space analysis or distillation for determination of the specific volatile substances constituting WOF. Further, results are lacking regarding the influence of temperature, sodium chloride and fat levels on the composition of volatiles.

Objective

Identification of the specific substances responsible for WOF, and the influence of NaCl, fat level and incubation temperature and time on the relative proportions of the compounds. Further, the influence of the usual reheating procedure, on volatiles produced.

Methods

Lean pork meat from the ham and back fat were minced once. Ingredients for meat balls were meat, fat, NaCl and distilled water. The recipe for the meat balls: 4 batches, low salt (1%) with low fat (without added fat) or high fat level (20% added) and high salt (2.5%) with low fat or high fat levels. Meat balls were added (8%) additional water. The meat balls (20g) were heated in a water bath at 100°C for 5 min. The samples were incubated at 5°C and 10°C.

Half of the meat balls were reheated in a microwave oven (600W eff.) for 2 1/2 min before aroma collection, the other half was not reheated. The effect of heating was tested in a second experiment on samples which were heated for 2, 4 or 6 min using microwave oven or using a water bath (90°C) with heating time 5 min, these latter samples were wrapped in alu-foil during heating.

Volatile compounds were collected using dynamic head-space. Two meat balls were minced using a mixer and transfered to a washing bottle. He gas passed through the mince (60ml/min, 30 min), and the volatiles were collected on Tenax TA tubes. These were subsequently desorbed in a Perkin-Elmer ATD 400 autosampler and volatiles were automatically transferred via a heated liner to a HP 5892 SerII GC equipped with a HP 5972 mass detector. The column used was a DB-1701 (J & W Scientific) 30m, 0.25id, 1μ. Volalites were identified using NIST library and a user library of known standards. Statistical analysis was done using Sirius (Pattern Reg.Syst.) for principal component analysis (PCA).

Results and discussion

The composition of the meat balls were 64.0 % water, 6.5 % fat in low fat samples and 21.9 % fat in high samples.

In Table 1. 51 compounds are shown. More components could be identified, but only these which constitute a reasonable proportion of the total WOF are shown.

Table 1. Volatiles in minced meat balls

n-alkanes	**alkohols**	**aldehydes**	**ketons**	**thiols**
pentan	ethanol	acetaldehyd	acetone	methanthiol
hexan	2-me-1-propanol	propanal	2,3-butadion	di-me-disulfid
heptan	1-pentanol	pentanal	2-me-2-pentanon	tri-me-trisul-
octan	2-hexanol	hexanal	3-hydroxy-2-butanon	fid
dodecan	1-hexanol	heptanal	2-heptanon	
tetradecan	1-octen-3-ol	octanal	2,3-octadion	
2-octen	2-ethyl-hexanol	nonanal	cyclohexanon	
	phenol	3-me-butanal	2-nonanon	
		2-me-butanal		
pyrazines		(E)-2-heptenal	**others**	
me-pyrazin		benzaldehyd	dihydro-me-furanon	
2,5-di-me-pyrazin		2-octenal	2-pentylfuran	
tri-me-pyrazin			limonen	
3-eththyl-2,5-di-me-pyrazin			styren	
			5 unknown	

A) Experiment with different salt/fat/temperature levels. Oxidation of lipids during meat ball processing and storage produces aldehydes. The aldehydes constitute the largest proportion of the volatiles produced during storage, simple alkanals generally comprising approx. 70-80 % as shown in Fig. 1. Hexanal is by far the most important of the aldehydes, the other aldehydes comprising only about 10 % each of total aldehydes. It is evident that there is only a small difference in the relative proportion of aldehydes in the different samples apart from day 0. Aldehydes are produced during autoxidation of lipids (Ulrich and Grosch, 1987). Lamikanra and Dupuy (1990) found that the proportion of hexanal increased relative to C5, C7 and C9 during storage of cooked goat meat.

Brewer *et al.* (1992) studying frozen ground pork also found hexanal to constitute the highest proportion of volatiles.

The proportion of aldehydes in this study does not change irrespective of salt and fat levels and incubation temperature and time. Reheating did not change the realtive composition of the volatiles.

B) The second experiment especially focusing on the effect of reheating time in microwave oven and storage is shown in Fig. 2. It is evident that the amounts of the different aldehydes increase during storage at 5°C for 2 days and more after 7 days. Especially after 7 days the hexanal content increases irrespective of the reheating time in microwave oven. At zero and 2 days storage no difference between microwave- and water bath heating was observed. After 7 days, the water reheated samples showed lower levels of aldehydes compared with the microwave heated samples.
However, there is a considerable difference between the flavor components produced after 7 days, 6 min reheating time compared with 2 and 4 min. Several pyrazines and furanon were produced, but the meat balls were totally dehydrated after 6 min and had a roasted flavor. In the samples which did not change visually during reheating the general picture was that the relative distribution of the components did not change significantly. This was also shown by PCA, which did not give a clear picture (not shown) of different groups of samples related to physico-chemical parameters.

TBA analysis has shown that reheating at moderate temperatures in water bath gives higher TBA numbers with higher temperatures (60-80°C) (Mielche and Bertelsen, 1993), and TBA measures aldehydes especially malonaldehyd a oxidation product. At higher temperatures, Maillard raction products may be produced. However, this methodology does not show the relative proportions of different components. The relative composition of aldehydes in minced meat balls has not been reported before.
Probably due to the methodology used, alkadienals were not found in this study. Konopka and Grosch (1991) found several alkadienals in stored boiled beef using a rather severe distillation procedure.

Conclusion

The study showed that aldehydes constituted the highest proportion of volatiles produced in the minced meat product, often more than 80 %. Hexanal was the most important component, and the relative levels of the different aldehydes did not change significantly. Alkanes, alcohols, ketones were also generally found. Reheating using microwave oven did not generally change the composition of volatiles, as long as the samples were not adversely affected. However, in samples which adversely changed appearence other compounds were produced, related to a roasted aroma.

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Fig.1.Relative composition of aldehydes in meat balls.

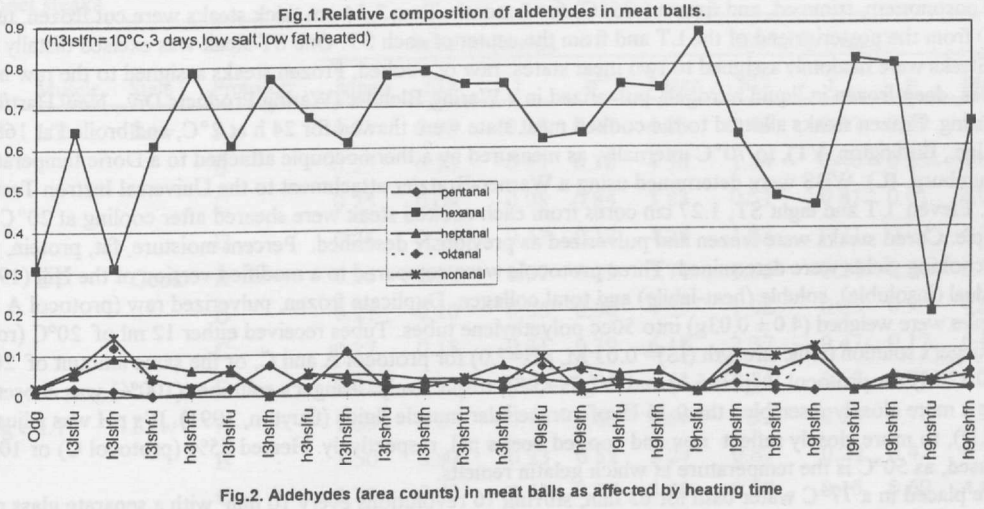

Fig.2. Aldehydes (area counts) in meat balls as affected by heating time