IDENTIFICATION OF VOLATILE COMPOUNDS IN SLOW AND FAST CURED BACON

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SUMMARY

Volatile compounds of two different bacon products were identified by headspace gas chromatography-mass spectrometry and further characterised by headspace gas chromatography-olfactometry in order to compare the impact of production technology and subsequently naturally occurring microorganisms on bacon aroma. The bacon was stored for 21 days at 4°C before analyses.

59 compounds were detected of which 43 could be identified in the bacon. Of these compounds one was alkane, one terpene, five were aromatic, seven aldehydes, nine ketones, fifteen alcohols, two pyrazines, one sulfide and two were chlorinated. Eleven of the unidentified compounds had structures similar to methyl branched alkanes and and aromatic hydrocarbons.

Olfactometric analyses showed that 3-methylbutanal had an odour of 'cheese', while octanal was 'chemical', pentan-2-ol 'green' and 1-octen-3-ol 'mushroom'. None of these odours could be associated with bacon aroma.

It could be concluded, that microorganisms residing in the brine used for slow curing are responsible for the appearance of some of the observed compounds.

Introduction

Through the past decades the production techniques of bacon has changed from the slow curing proces in which bacon is cured in tanks with recycled cover brine to the fast curing proces in which bacon is cured by multineedle injection of brine directly into the meat. However, consumers claim that fast cured bacon lack the characteristic flavour of traditional slow cured bacon. In order to find an explanation on these findings a comparative study of volatile compounds in slow and fast cured bacon was undertaken.

Materials and methods

Bacon preparations: Backs from Danish Grade A1 pigs (castrated mail pigs or gilts) with ultimate pH ranging from 5.5 to 5.8 were obtained from a Danish slaughterhouse. Backs for slow curing were injected with 17°Be bacon brine to an increase af 11 % and subsequently cured four days in 24°Be bacon brine (recycled brine). After curing bacon was drained 12 h at 5 °C. Backs for fast curing were injected with 21°Be bacon brine to an increase of 19 %. After 5 min dripping backs were Cryovac-packed. Both processes were performed at 5°C. All bacon was stored 21 days at 5°C after which samples were taken. Samples were stored vacuum packed in a high oxygen barrier emballage at -20°C. Samples were analysed in duplicates.

Headspace Gas chromatography-mass spectrometry. While still frozen a representative part of the sample was cut out and blended for 10 s. The frozen minced meat was transferred to an extractor as described by Berdagué et al. (1993). Volatile compounds were then purged into a Tenax trap (Tenax GC mesh 60-80) with a He flow rate of 137 ml·min^{-1} for 1 h at ambient temperature in an automated dynamic headspace system (Platine DCI). Injection of volatile compounds into a Hewlett-Packard 5890 series II gas chromatograph coupled to a Hewlett-Packard 5971 A Mass Selective Detector was achieved by flash heating the trap for 1 min at 250°C. The chromatographic conditions were; a nonpolar DB-5 capillary column (Supelco; 60 m x 0.33 mm i.d.; film thickness 0.1 µm); oven temperature 35°C for 4 min and then ramped fra 40 to 220°C with a slope of 3°C/min with a final holding time at 5 min. The column flow rate was 1 ml·min^{-1}. Mass spectra were obtained by electron impact ionization (70 eV) with a scan range from 40-300 amu.

Headspace gas chromatography-olfactometry. Sample preparations and chromatographic conditions were as described above, but a 30 m capillary column was used with a flow rate of 0.53 $ml \cdot min^{-1}$. Humidified make up gas (air) was used in the sniffing port.

Results and discussion

A total of 59 compounds were detected in the two bacon products of which 43 could be identified. Of these compounds were one alkane, one terpenoid, five aromatic hydrocarbons, seven aldehydes, nine ketones, fifteen alcohols, two pyrazines one sulfide and two chlorinated compounds (tab. 1).

In general the content of volatile compounds in the two bacon products was low and contained essentially the same volatile compounds. Most of the identified compounds are normally found in cured pork (Grey and Pearsson, 1984; Mottram et al., 1984 and Rhamarathnam et al., 1991), although 2- and 3-methylbutanal, propan-2-one, propan-2-ol and hexan-2-one are not reported in these investigations.

From table 1 it can be elucidated that volatile compounds present in slow cured bacon but not in fast cured, were 2- and 3-methylbutanal, o-xylene, benzaldehyde, octanal, butan-2-one, pentan-2-ol, propan-1,2-diol and 1-octen-3-ol. Two compounds were observed in fast cured but not in slow cured bacon, namely heptanal and n-pentanol.

The presence of 2- and 3-methylbutanal in the slow cured product indicates that microorganisms may be important for the flavour formation in slow cured bacon, as it is well known that microorganisms are able to synthesize 2- and 3-methylbutanal in cheese (Hemme, 1982) and on synthetic substrates (Lee et al., 1979). In addition, as the only difference in the processing technology between the two examined products is, that slow cured bacon is cured with a recycled brine (40-50 years old) in which extremely halotolerant microorganisms reside (Gardner, 1980; Andersen and Hinrichsen, 1991) and fast cured bacon is cured with sterile brine, microorganisms in the recycled brine may be responsible for production of 2- and 3-methylbutanal in slow cured bacon.

It could be expected that both propan-2-one and propan-2-ol reside in the headspace of cured pork as these compounds are ordinary products from the catabolism of carbohydrates and lipids (Gotschalk, 1985; Belitz and Grosch, 1988). The reason that propan-2-one and propan-2-ol has not been reported in earlier studies could be that the used gas chromatographic techniques omit the resolution of these two very volatile compounds either by masking of a solvent peak or by breakthrough of the compounds on the adsorbent used for trapping of volatiles in the headspace.

Many methylbranched alkanes and aromatic compounds were isolated from the bacon samples.

Olfactometric analyses of the bacon products showed that it was possible to detect odours as cheese, butter and mushroom. In addition it was possible to detect odours, which could not be assigned to a chromatographic peak. Among these odours were creamy cheese, butyric acid, fruity and plastic (results not shown). None of the registered odours could be associated to the characteristic smell of high quality bacon. However, from table 1 it appears that the odours of compounds found in slow cured bacon but not in fast cured are quite potent odours. 3-Methylbutanal with the odour of 'cheese', octanal was 'chemical', pentan-2-ol 'green' and 1-octen-3-ol 'mushroom'.

Conclusion

The production technology of bacon is significant to the content of volatile compounds in bacon. Among differences the content of 3-methylbutanal, pentan-2-ol and 1-octen-3-ol seems to be important in the aroma of slow cured bacon. Microorganisms residing in the brine used for slow curing are responsible for the appearance of some of the observed compounds, which during storage giving rise to a cheese odour. However, more research is needed in order to confirm the actual role of microorganisms.

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