FLAVOUR COMPOUNDS RELATED TO MATURITY OF DRIED FERMENTED SAUSAGE

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Background

The flavour profile of dried fermented sausage is very complex, including more than two hundred different compounds from many classes of components (*Berdagué et al., 1993; Stahnke, 1994, 1995a; Mateo & Zumalacárregui, 1996; Henriksen & Stahnke, 1997*). Over the years, there has been a great interest in identifying those aroma and taste compounds that explain different characteristics of the perceived flavour – characteristics such as maturity, acidity, rancidity etc. The methods that have been used to study the relationships are gas chromatography olfactometry (*Stahnke, 1994, 1995b; Stahnke et al., 1999*) and sensory profiling correlated to the volatile profile or the non-volatile fraction (*Berdagué et al., 1993; Stahnke, 1995b; Stahnke et al., 1999; Henriksen & Stahnke, 1997*). Those results have indicated that together with non-volatiles such as amino acids, peptides, lactic acid and salt, volatile compounds arising from amino acid breakdown, sugar catabolism and lipid oxidation are of great importance for the basic sausage flavour. However, the results are scarce and it is still not known with certainty, which components comprise the sensory attributes of various sausage types.

During the production of fermented dried sausage starter cultures from the *Micrococcaceae* family are used together with lactic acid bacteria to accelerate the flavour formation. However, it has never been scientifically shown that any of those cultures enhance the flavour formation even though their aroma producing potential has been demonstrated in pure cultures in model experiments (*Montel et al., 1996; Stahnke, 1999*).

Objectives

The purpose of the present study was to study the sensory effect of the starter culture *Staphylococcus carnosus 833* in commercially produced Italian dried sausages.

Methods

Sausage batches

One control batch and three experimental batches were produced by the Italian factory Negroni in Parma using a standard recipe, but exchanging *Micrococcus varians* (control) with *Staphylococcus carnosus 833* (from INRA, France) in the experimental batches. All the experimental sausages were ripened for a total of 40 days, while the ripening period of the control batches were extended to 70 days. The finished sausages were wrapped in aluminium-foil, vacuum-packed, frozen and sent to MATFORSK, Norway and to the Technical University of Denmark (DTU).

Volatile profile (DTU)

Two sausages from each batch were analysed twice by triplicate analysis. The sausage samples were cut into smaller pieces and minced with water (80g /55g) in a small food processor.

20 g of sausage slurry plus 80g water were weighed into a 125ml wash bottle. The slurry was equilibrated for 30 min. in a water-bath at 42°C, purged with N_2 (50 ml/min.) for 30 min. at 42°C and the volatiles trapped onto 225 mg of Tenax TA®. Triplicate Tenax TA® tubes were made for each sample. Volatiles on Tenax tubes were desorbed by an automatic thermal desorber (ATD400, Perkin-Elmer Ltd.) and injected directly onto a DB-1701 column in a GC-MS system (HP, USA). Desorption temperatures were: tube 200 °C, cold trap 250°C. Temperature programme in the GC was: 35°C, 1 min; 4°C/min to 175°C, 10°C/min to 250°C, 5 min. MS parameters were: Ionisation energy 70eV, scan range 33-300 AMU. Identification was based on MS spectra compared to the NBS75k database and on Kovats retention indices of authentic compounds.

Sensory profile (MATFORSK)

Twelve sausages were evaluated by a standard flavour profile method (ISO6564-1985–E standard), three of each type: control sausages (ripened 40, 55 and 70 days) and sausages added *S. carnosus* (ripened 40 days). Ten tested and trained assessors evaluated the samples twice on a scale from 1 to 9 on a computerised system (CSA Compusense ver 5.38, Canada). A total of 8 odour notes, 3 colour descriptors, 16 flavour notes and 6 texture descriptors were evaluated.

Statistical analysis

Both the volatile and the sensory profiles were analysed

Table 1. Volatiles detected in Italian dried sausage

Component[a]/ origin	Component[a]/ origin
amino acid breakdown	*Lipid microbial breakdown*
2-methylpropanal	2-pentanone
3-methylbutanal	2-hexanone
2-methylbutanal	2-heptanone
3-methyl-1-butanol	2-heptanol
2-methyl-1-butanol	2-octanone
3-methyl-3-buten-1-ol	? 1-octen-3-ol
3-methyl-2-buten-1-ol	3-octanol
? 2-ethyl-1-hexanol	*Lipid autoxidation*
Benzaldehyde	Pentanal
phenylacetaldehyde	1-pentanol
? 2-propanone (acetone)	Hexanal
4-methyl-2-pentanone	1-hexanol
3-methyl-2-pentanone	Heptanal
Dimethyldisulfide	Octanal
Sugar catabolism	Nonanal
2-butanone	Decanal
2-butanol	*Secondary reactions*
2,3-butandione (diacetyl)	Ethyl acetate
3-hydroxy-2-butanone (acetoin)	Ethyl octanoate
? Ethanol	Benzonitrile
? 1-propanol	

[a] Numerous alkanes, terpenes and benzenes were identified in all minces, but not included in this table (see text). ? The origin is not certain or the compound may also arise from elsewhere.

individually by principal component analysis (PCA) in Unscrambler (ver 7.5, CAMO ASA, Norway).

Results and discussion

Table 1 shows the total number of volatiles used in the data analysis and their proposed origin. More volatiles were present, but they either arose from added spices or contaminants and were not of interest for the present experiment.

Figure 1 shows a bi-plot from the PCA analysis on the volatiles from Table 1. The plot explains a total of 64% of the variation in the data set and separates the samples into two clusters – a cluster on the right containing control sausages added *M. varians* (ctrla-ctrb2) and a cluster on the left containing sausages added *S. carnosus* (31a-33b). The control sample ctr2b is somewhat different from the other controls due to lower amounts of some of the compounds, however the difference is not as great as it may seem since the y-axis (PC2) explains only 11% of the variance. The variance between the experimental sausage samples is similar.

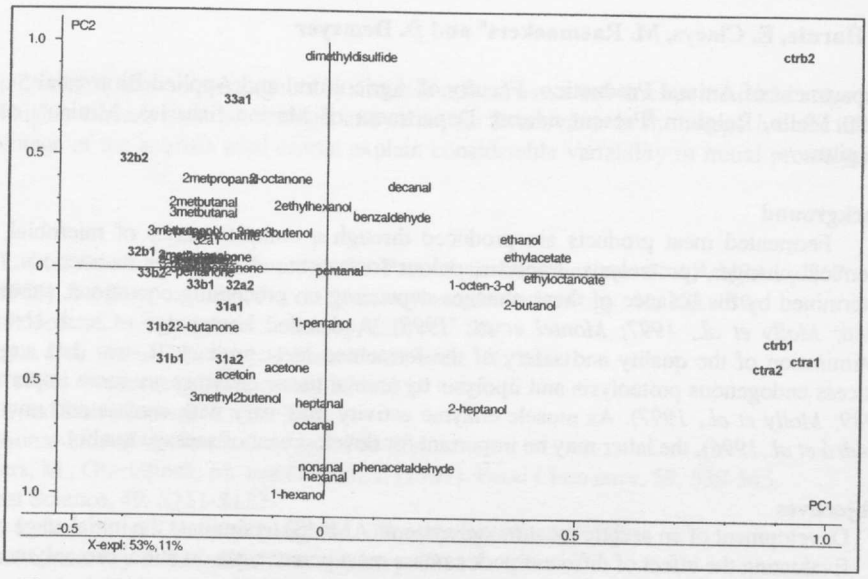

Figure 1. Bi-plot from the PCA-analysis on the volatile profile. See explanation in text.

It is quite clear that the control sausages are different from the sausages added *S. carnosus*. This is especially due to (i) higher amounts of compounds from breakdown of leucine, isoleucine and valine (see Table 1), (ii) higher amounts of methylketones from β-oxidation of fatty acids and breakdown of leucine and isoleucine, and (iii) lower amounts of ethanol and straight chain ethyl esters in the *S. carnosus* samples. On the other hand the amount of aldehydes from lipid autoxidation and the corresponding alcohols are similar in both sausage types. This is also true for the compounds dimethyldisulfide and benzaldehyde/phenylacetaldehyde arising from methionine and phenylalanine, respectively.

Figure 2 shows a scores plot from the PCA-analysis on the sensory results of the sausages. The plot shows that sausages added *S. carnosus*, ripened for 40 days lie in between control sausages ripened for 55 days and control sausages ripened for 70 days. I.e. addition of *S. carnosus* instead of *M. varians* seems to accelerate ripening with more than two weeks in the present time span. The sensory descriptors responsible for pulling the more ripened sausages towards the right are especially maturity odour and flavour, cheesy flavour, bitterness, salty taste and the texture parameter hardness. Compared with the plot in Figure 1, the sensory results indicate that maturity is strongly related with the volatile compounds present in higher amounts in the samples added *S. carnosus*. I.e. aroma compounds arising from breakdown of amino acids and β-oxidation of fatty acids seem to be important for the degree of maturity in fermented dried sausage.

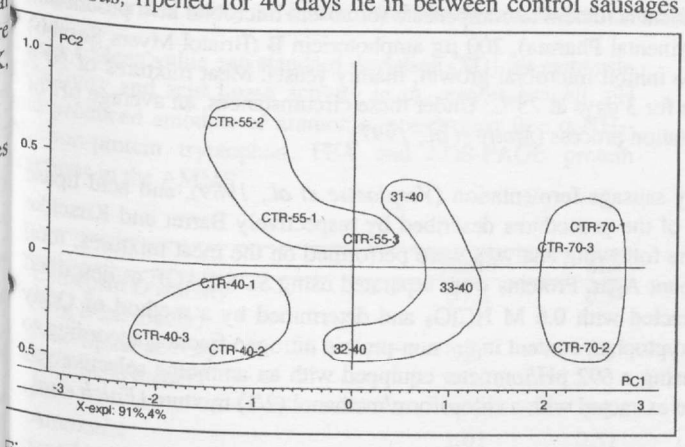

Figure 2. Scores-plot from the PCA-analysis on the sensory profile. The control sausages were evaluated at 40, 55 and 70 days of ripening, the batches added *S. carnosus* at 40 days of ripening.

Conclusions

Fermented dried sausages added *S. carnosus* instead of *M. varians* contained higher amounts of flavour compounds arising from breakdown of leucine, isoleucine and valine and higher amounts of methylketones. This corresponded with accelerated maturity.

Acknowledgements

This study was carried out with the financial support of the Commission of the European Communities, within the project: Control of bioflavour and safety in Northern and Mediterranean fermented meat products', FAIR CT97-3227.

Literature

Berdagué, J.L.; Monteil, P.; Montel, M.C. & Talon, R. (1993). Meat Sci., 35, 275-287.
Henriksen, A.P. & Stahnke, L.H. (1997). J. Agric. Food Chem., 45, 2679-2684.
Mateo, J. & Zumalacárregui, J.M. (1996). Meat Sci., 44, 255-273.
Montel, M.C.; Reitz, J.; Talon, R.; Berdagué, J.L.; Rousset, Akrim S. (1996). Food Microbiology, 13, 489-499
Stahnke, L.H. (1994). Meat Sci., 38, 39-54.
Stahnke, L.H. (1995a, b). Meat Sci., 41, 193-209, 211-223.
Stahnke, L. H. (1999). Lebensm.-Wiss. u.-Technol., 32:357-364.
Stahnke, L. H.; Sunesesn, L. O. & De Smedt, A. (1999). Proceed. 13th Forum for Appl. Biotechn., 22-23 September, Gent, Belgium.