CHARACTER IMPACT AROMA COMPOUNDS IN FERMENTED SAUSAGE

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Background

The aroma profile of fermented sausage is very complex, including more than two hundred different compounds from many classes of components (e.g. 1,2,4,6). In order to be able to control flavour development in the industry it is essential to know which of those compounds are of more interest, their origin and their regulation. Over the years, there has been a great interest in identifying the aroma compounds of most importance; the results have been scarce, though. The components that make up the sensory perceived aroma profile of different sausage types are still not known.
Quite recently a new method was taken into use in order to detect compounds of high aroma value in fermented sausages. This method, gas chromatography olfactometry, has been used with great success in other fields on many different product types such as beef meat, coffee, popcorn, mushrooms etc. (3). The results indicated that some of the compounds in the aroma profile of fermented sausage are of utmost importance to the overall flavour profile, while others seem to be of little or no significance (4,5). Some of the influential compounds were aldehydes arising from fatty acid or amino acid degradation and their corresponding acids, ethyl esters, diacetyl and many others. Those results were obtained from model sausages produced without spices and with an aroma sampling method (dynamic headspace collection) putting to much weight on the more volatile compounds in the profile. In this study, gas chromatography olfactometry was applied on a Spanish Revilla using static headspace collection.

Objective

The purpose of the present study was to detect aroma compounds of major aroma value in a Spanish fermented sausage by gas chromatography olfactometry (GC-O) of static headspace.

Methods

Effluent sniffing (GC-O)

A Spanish fermented sausage, an Revilla, was purchased in a local retail store in Spain, brought back to Denmark, wrapped in alu-foil, vacuum-packed and frozen at -30°C. At the day of analysis, the sausage was cut into smaller pieces, frozen in liquid nitrogen (1 min.) and minced in a small domestic food processor until a fine sausage powder was obtained (30 sec). 30 g of sausage was weighed into a glass flask and closed with a membrane stopper. After equilibration at 25°C for 1 hour, 10 mL of headspace was withdrawn and injected into the cold trap (-30°C) of an automatic thermal desorber (ATD 50, Perkin-Elmer Ltd.). The sample was desorbed from the cold-trap (300°C) and transferred split-less onto a DB-1701 (J&W Sci., USA) capillary column in a GC (HP5890, series II). Temperature programme in the GC was: 35°C, 10°C/min to 175°C, 10°C/min to 250°C, 5 min. The sample was separated on the column and the eluted volatiles sniffed at the end of the column via a sniffer port (ODO-1, SGE, Inc., USA) connected to the column through a heated hose. The effluent from the column was mixed with purified, humidified air (60 mL/min) prior to reaching the nose. Nine untrained employees and students were used as sniffing panel. During sniffing the subjects expressed when they could detect an odour and the perceived odour impression. Their findings were written down by a technician.

Identification (GC-MS)

Headspace volatiles from 30 g of frozen minced sausage were collected on a Tenax tube by dynamic headspace sampling. Collection parameters were: equilibration time: 30 min at 37°C, purge temperature: 37°C, flow rate: 100 mL nitrogen/min, purge time: 30 min. 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 (HP5890II/5972). Desorption temperatures were: tube 200 °C, cold trap 250°C. Temperature programme in the GC was: 35°C, 1min; 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.

Results and discussion

Table 1 shows the number of odours detected by the subjects, the perceived odour impression and the compounds responsible for the odours. The odour of compounds in parenthesis has not been verified by authentic compounds or by literature data. As the subjects in the panel gave different descriptions of the odour notes, more than one description is listed in some cases. Except of compound no. 15, only compounds detected by two or more subjects were included giving a total of 39 sensed odours. This number is smaller than in

previous studies using dynamic headspace sampling of aroma components instead of static sampling (4,5). However, a profile obtained by static sampling is more representative of the odour actually sensed when evaluating the odour of a product.
Most of the identified odours have previously been detected in sausages without spices, indicating that they arise from the carbohydrates, proteins and lipids in the mince. However, the compounds allyl-1-thiol, methylthiirane, allylmethylsulfide and α-pinene (no. 4, 6, 7 and 19) seem to arise from the added spices. Allylmethylsulfide and allyl-1-thiol are present in garlic (6) and α-pinene is a major constituent of different peppers (7). Methylthiirane has to our knowledge not been previously identified in any food but the structure indicates that it arises from a ring closure of allyl-1-thiol. However, the most remarkable about methylthiirane and allyl-1-thiol is their odour notes. The subjects in the sniffing panel were quite specific in describing their notes. Both compounds had a distinct salami-like or cured odour. Allyl-1-thiol was present in the highest amount and was detected by all nine subjects; methylthiirane was just present as a trace and only detected by three subjects. Allyl-1-thiol has also been detected in other sausage types, both by GC-O and by GC-MS (results not shown), and by GC-MS in Spanish Chorizo (6).
The identity and salami odour of methylthiirane has been verified by sniffing a purchased methylthiirane standard and by mass spectrum and retention indices. Allyl-1-thiol has only been identified by its mass spectrum since it has not been possible to purchase the compound. However, according to the chromatogram and mass spectra the compound was present as an impurity in the methylthiirane standard and the odour note and retention index fitted the sausage results.

Conclusions

A Spanish Revilla was evaluated by gas chromatography olfactometry (GC-O) and by gas chromatography-mass spectrometry (GC-MS). The analyses revealed the presence of two compounds having a distinct salami-like or cured note. The compounds were identified as allyl-1-thiol and methylthiirane, but the identity of allyl-1-thiol still needs to be verified properly.

Literature

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Table 1. GC-O analysis of Spanish Revilla

Odour no.	RT-index	odour note	number of subjects who detected dour	compound	Odour no.	RT-index	odour note	number of subjects who detected odour	compound
1	469	cabbage, faeces	5	methanethiol	21	1055	cabbage	5	dimethyltrisulfide
2	482	white glue	8	acetaldehyde	22	1083	mushroom	7	1-octene-3-ol
3	534	sharp, sulphur	8	?	23	1088	onion, rubber	3	?
4	641	**salami, cured meat**	9	**allyl-1-thiol**	24	1092	dry weeds	2	?
5	686	butter, caramel	9	diacetyl/2-butanone	25	1095	orange, spicy	6	octanal
6	701	**salami, onion**	3	**methylthiirane**	26	1150	nettles, rotten flower	5	?
7	745	strong garlic	9	allylmethylsulfide	27	1170	mushroom,	4	?
8	788	vinegar	7	acetic acid	28	1184	sulphur, wet soil	4	?
9	879	sharp, onion	7	?	29	1188	honey	2	benzeneacetaldehyde
10	886	green, vegetables	4	hexanal	30	1199	jerusalem artichoke, burned plastic	6	?
11	912	cooked meat	3	(x-pyridinamine)	31	1211	roses, sweet, clover	3	?
12	920	chutney, sweet	6	(ethyl-2-hydroxypropionate)	32	1229	sulphur, garlic	2	?
13	947	rubber, burned	2	?	33	1236	smoked, bandage	5	2-methoxy-phenol
14	967	cheese	9	butanoic acid	34	1267	fresh, green field	3	?
15	991	pelargonium	1	(heptanal)	35	1290	old books, library	2	?
16	1001	popcorn	4	?	36	1300	roses, soap	4	(naphtalene)
17	1017	cheese	5	3-methylbutanoic acid	37	1340	smoked, car tire	5	2-methoxy-4-methyl-phenol
18	1030	popcorn, fungi	4	?	38	1384	deepfried	3	(2-t-decenal)
19	1033	curry, spice, paprika	5	(α-pinene or 3-carene)	39	1401	onion, synthetic	3	?
20	1050	cooked potato	5	methional					