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HEADSPACE VOLATILES OF VARIOUS FERMENTED SAUSAGE PRODUCTS

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BACKGROUND: Berdague et al. (1993) attributed volatile compound origins in the manufacture of fermented sausages to lipid oxidation (60%), fermentation (27%), proteolysis (6%) and other sources (7%). Their research and that of Kemner and Nielsen (1994) confirm that starter cultures contribute a characteristic "flavor profile" even though lipid oxidation products predominate due to the effects of aerobic dehydration.

OBJECTIVE: The objective of this study was to evaluate overall volatile flavor compounds among various types of fermented sausages.

METHODS: Thirty-three products representing 8 types of fermented, dry sausages were analyzed for volatile headspace compounds using a Tekmar Model 7000 Headspace Autosampler interfaced to a Hewlett-Packard Model 5890 series II Gas Chromatograph. A 2.0g sample was sealed in a 9mL headspace vial and heated at 100°C for 20 minutes after which a sample of volatiles was automatically injected onto a 30m fused silica capillary column DB-5 (J&W Scientific) maintained at -20°C. The column was programmed from -20°C to 250°C at 10°C/min and then held for an additional 5 min. The FID signals were stored and integrated using a Hewlett-Packard Chemstation. Volatiles were tentatively identified on the basis of reference standards. Confirmation of volatile identities was accomplished on a Hewlett-Packard Model 5987 GC-MS. Volatiles were introduced into the GC-MS with a OSC-1 purge and trap unit (Tekmar). Spectra were identified primarily by comparing with published spectra.

RESULTS AND DISCUSSION: The 8 fermented product categories found in the market area within 175km of Clemson, SC, had moisture contents ranging from approximately 62% for Lebanon bologna, a nondried, fermented product, to 26-28% for chorizo and pepperoni, which are fully dried, fermented products. Of the total volatiles separated for each product category, approximately 35% were identified. Berdague et al. (1993) identified 78 of 86 compounds in their study of flavor compounds produced in dry sausages not containing spices or flavoring materials. Seasoning volatiles likely were some of the constituents separated in our commercial products.

Of the 58 compounds listed in Table 1, 21 were identified. Twelve compounds appear in every product category while 42 appear in at least 5 of 8 product types. For summer sausage, Genoa, Italian, and hard salamis, chorizo and pepperoni, 3 compounds represented from 63.8-91.8% of the total area of the volatiles. Acetaldehyde was greater in 3 of the products (30.4-40.7%) and pentane was the second in total area for the other 3 products (35.8-63.6%). The third largest component was either diethylether (4.2-12.0%) or hexane (8.2%). For Lebanon bologna and pork roll, pentane and acetaldehyde were predominant followed by unknown C (Lebanon bologna) or unknown H (pork roll). While these compounds had greater contributions to the total peak areas within products, thresholds for flavor contribution were not considered and in many cases are unknown. Most of the identified compounds in Table 1 are likely the result of lipid oxidation. Aldehyde, ketone, alcohol, alkane, sulfur, ether, ester and aromatic compound classes are represented in the identified volatiles.

CONCLUSION: From 8 types of fermented sausages, 58 volatiles appeared frequently within one or more product types. Even with diversity involving seasoning, fermentation, heating, and drying variables, many volatiles were present in at least 5 of the 8 product types.

REFERENCES:

BERDAGUE, J. L., MONTEIL, P., MONTEL, M. C. and TALON, R. 1993. Effects of starter culture on formation of flavour compounds in dry sausage. Meat Sci. 35:275-287.

KEMNER, M. B. and NIELSEN, H.-J. S. 1994. Aroma production from meat starter cultures. 40th ICoMST Proc. The Hague, Netherlands.

Table 1. Separated headspace volatiles found in various fermented sausages.

Compounds[1]	Retention Time[2]	Lebanon Bologna	Pork Roll	Summer Sausage	Genoa Salami	Italian Salami	Hard Salami	Chorizo	Pepperoni
acetaldehyde	3.04	x	x	x	x	x	x	x	x
unknown F	3.38			x	x	x	x	x	x
unknown C	3.40	x		x	x	x	x	x	x
pentane	4.62	x	x	x	x	x	x	x	x
diethyl ether	5.24	x	x	x	x	x	x	x	x
unknown H	5.30	x	x	x					
unknown J	5.58	x		x	x	x	x	x	x
unknown K	6.07					x	x	x	x
unknown N	6.88	x	x	x	x	x	x	x	
unknown O	7.04	x		x	x	x		x	x
butanal	7.70	x	x	x	x	x	x	x	x
hexane	7.88	x	x	x	x	x	x	x	x
ethylacetate	8.62	x		x	x	x			x
unknown V	8.83	x		x					
unknown X	9.13	x		x	x	x	x		x
unknown Y	9.33	x	x	x	x	x	x	x	x
unknown AA	9.57	x	x	x	x	x	x	x	x
1-heptene	10.16	x		x	x		x		x
pentanal	10.37	x	x	x	x		x	x	x
unknown AL	11.21	x		x	x	x	x	x	x
dimethyl disulfide	11.66	x		x		x	x	x	x
unknown AP	11.81				x	x	x		x
1-pentanol	12.14	x		x			x		x
unknown AS	12.42			x		x	x		x
unknown AT	12.62	x				x	x		x
hexanal	12.80	x	x	x	x	x	x	x	x
unknown AY	13.60	x		x					
1-hexanol	14.47			x		x	x		
2-heptanone	14.67			x					x
heptanal	15.00	x	x	x			x		x

Compounds[1]	Retention Time[2]	Lebanon Bologna	Pork Roll	Summer Sausage	Genoa Salami	Italian Salami	Hard Salami	Chorizo	Pepperoni
unknown BH	15.15	x		x	x				
unknown BL	15.71	x		x	x	x	x		x
unknown BM	15.91	x		x	x	x	x	x	x
unknown BO	16.28	x		x		x			
benzaldehyde	16.41	x	x	x	x	x	x	x	x
unknown BR	16.57	x							
1-heptanol	16.70	x		x	x	x	x	x	x
pentylfuran	16.84	x		x	x	x	x	x	x
octanal	17.28	x	x	x	x	x	x	x	x
2-ethyl-1-hexanol	17.43	x		x	x	x	x	x	x
unknown BW	17.54	x		x	x	x		x	
unknown BY	17.66	x		x	x	x	x	x	x
unknown BZ	17.77	x		x	x	x	x	x	x
unknown CA	17.86	x		x	x	x	x	x	
unknown CB	18.01	x		x	x	x	x		x
1-octanol	18.30	x		x	x	x	x	x	
unknown CE	18.86	x		x	x		x	x	x
nonanal	18.98	x	x	x	x	x	x	x	x
unknown CH	19.56	x		x	x	x		x	
unknown CI	20.55	x		x		x		x	
unknown CJ	20.80	x		x					x
unknown CM	22.26		x	x	x	x	x		x
unknown CN	22.41	x		x	x	x			x
unknown CO	23.40	x		x	x				
unknown CQ	24.67	x		x	x	x	x	x	x
unknown CR	25.64			x	x	x	x		x
unknown CT	31.32						x		x
unknown CW	31.90	x		x	x	x		x	x

[1] Named compounds were identified using comparison of retention time (RT) to that of known standards with verification by mass spectrometry (MS).
[2] Retention time in minutes.