

## CHARACTERIZATION OF THE HEADSPACE VOLATILE COMPOUNDS IN SALTED DRIED AND SMOKED MEATS FROM DIFFERENT RUMINANTS

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### Background

Salting and drying were first used as common procedures for preserving meats. Nowadays, salted dried meats made from whole meat pieces of pork, beef, goat, venison, horse represent a great variety of products, and their characteristic flavour is one of the key attributes for the consumer. Although these meats are mainly local products, they are now entering several international markets, though they are still limited to high class catering. In order to obtain a quality competitive product is necessary a normalised technology. To aid in this task, scientific assessment is needed to explain the peculiarities of these products.

### Objectives

The objective of this study was to identify the volatile compounds characteristic of salted dried and smoked meats (cecinas) prepared from beef and venison in order to establish its volatile pattern.

### Material and Methods

#### Samples

Two different samples of cecina were purchased from retail shops. Each sample came from a different animal specie: bovine and deer.

#### Analytical procedure

A Purge & Trap concentrator Tekmar 3000 connected to a HP 5890 gas chromatograph coupled to a HP 5972 mass spectrometer were used for the volatile compounds analysis. Six grams of sample were minced and thoroughly mixed with 6 g of Na<sub>2</sub>SO<sub>4</sub>. Eight grams of the mixture were transferred into a 25 mL fritless sparger and were purged under the following conditions: 30 mL/min flow of ultra pure helium was used as a purge gas, purge was 15 min at 30°C controlled by a thermal sleeve. The compounds concentrated in the Tenax trap were thermally desorbed at 220°C for 3 min. A CP-Sil 8 CB low bleed/MS fused silica capillary column (60 m x 0.25 mm i.d., 0.25 µm film thickness) was used with helium as the carrier gas at a flow rate of 1 mL/min. Immediately before the desorption of the trap, 1 µL of an internal standard (130.6 ng/µL 1,2-dichlorobenzene in methanol) were injected into the gas chromatograph. During the desorption period of 3 min, volatile compounds were cryofocused by immersing 15 cm of column adjacent to the heater in a solid CO<sub>2</sub> bath while the oven was held at 40°C. The bath was then removed and chromatography achieved by holding at 40°C for 2 min followed by a programmed rise to 280°C at 4°C/min and held for 5 min. A series of *n*-alkanes (C<sub>6</sub>-C<sub>22</sub>) was analyzed, under the same conditions, to obtain linear retention index (LRI) values for the aroma components. Compounds were identified by first comparing their mass spectra with those contained in the HP Wiley 138 Mass Spectral Database and then comparing the LRI values with either those of authentic standards or with published values. Approximate quantities of the volatiles were estimated by comparing their peak areas with those of the 1,2-dichlorobenzene internal standard, obtained from the total ion chromatograms, using a response factor of 1. Analysis were performed by triplicate.

### Results and Discussion

A total of 115 compounds were tentatively identified when analyzing venison and beef cecina samples by purge and trap coupled to GC/MS. They were classified according to their most likely origin (table 1). Lipid oxidation generated 14 and 18% of the total volatiles of venison and beef cecinas, respectively. Although hydrocarbons were the main volatiles formed via lipid autooxidation in venison cecina, they probably have no significant impact on flavour as they have relatively high odour threshold values (1). Aldehydes are probably the most interesting of the lipid-derived volatiles as they have low odor threshold values (2). Linear aliphatic aldehydes from C<sub>5</sub> up to C<sub>10</sub> were detected in all samples showing hexanal and nonanal the highest levels. Identified ketones were all methylketones. They may be formed from fatty acids by chemical (autooxidation) or enzymatic (β-oxidation) reactions during mould metabolism. This last via could be possible since an important superficial fungal growth (*Penicillium* and *Aspergillus* spp) has been reported in cecinas during the drying phase in a cellar (3). Volatiles compounds from amino acid breakdown accounted for 11 and 25% of the volatiles of venison and beef samples, respectively. The main volatiles in this group were branched aldehydes and their corresponding alcohols, which can be derived from amino acids via Strecker degradation (4) or by microorganisms (5) and have been associated with a ripened aroma in dry hams (6). Several esters were present in the cecinas, but in very small amounts. They arise from the esterification of carboxylic acids and alcohols by microbial enzymes (7). Volatiles from carbohydrate fermentation reached high levels, especially in venison cecina where they accounted for 46% of the total. Several pyridines, pyrazines and furans were detected in the headspace volatiles from all samples. These compounds formed in the Maillard reaction and also reported in heat meats (8) could be originated as a result of the long smoking process (12-15°C, 20 days). As was expected from a smoked meat product, phenolic compounds, cyclopentanone/enones and aromatic hydrocarbons were identified among the volatiles isolated from cecina. All these substances are typical of wood smoke (9, 10, 11).

### Conclusion

Headspace of cecina is a complex mixture of volatile compounds. This product shows a greater variety and richness in volatiles if compared with dry hams (4,6) and dry fermented sausages (12, 13).

### Acknowledgments

This research was funded by the Universidad Complutense de Madrid (UCM) with the project PR48/01-9879.

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**Table 1.** Volatile compounds identified in the headspace of salted dried smoked meats.

LRI <sup>1</sup>	Compound <sup>2</sup>	Mean concentration (ng/100 g)		Method of identification <sup>3</sup>
		venison cecina	beef cecina	
	<b>Lipid oxidation</b>	2440	2377	
	<i>Alcohols</i>	396	563	
	<i>Aldehydes</i>	380	578	
	<i>Ketones</i>	461	744	
	<i>Hydrocarbons</i>	1178	432	
	<i>Furans</i>	25	60	
	<b>Amino acid catabolism</b>	1859	3235	
551	2-methylpropanal	72	102	MS+LRI
629	2-methylpropanol	170	392	ms+lri
654	3-methylbutanal	818	1429	MS+LRI
662	2-methylbutanal	186	419	MS+LRI
727	dimethyl disulfide	53	42	MS+LRI
740	3-methylbutanol	412	682	MS+LRI
744	2-methylbutanol	72	105	MS+LRI
752	3-methyl-2-pentanone	56	47	ms+lri
972	benzaldehyde	15	10	MS+LRI
984	dimethyl trisulfide	5	7	ms+lri
	<b>Fermentation</b>	7825	1749	
649	acetic acid	160	15	ms
587	2,3-butanedione (diacetyl)	2809	251	ms+lri
604	2-butanone	446	383	MS+LRI
666	1-hydroxy-2-propanone	32	78	ms+lri
711	3-hydroxy-2-butanone (acetoin)	4205	539	MS+LRI
503	ethanol	80	391	ms+lri
591	2-butanol	93	92	MS+LRI
	<b>Microbial esterification</b>	72	122	
531	methyl acetate	10	8	ms+lri
615	ethyl acetate	45	85	MS+LRI
709	ethyl propanoate	7	9	MS+LRI
724	methyl butanoate	4	6	MS+LRI
756	ethyl-2-methylpropanoate	nd	6	MS+LRI
849	ethyl-3-methylbutanoate	6	8	MS+LRI
	<b>Smoke</b>	1797	2365	
	<i>Phenolic compounds</i>	108	662	
	<i>Cyclopentanone/enones</i>	121	1199	
	<i>Aromatic hydrocarbons</i>	1568	504	
	<b>Spices</b>	1669	0	
	<b>Unknown origin</b>	1482	3079	
	<i>Pyridines</i>	52	288	
	<i>Pyrazines</i>	13	55	
	<i>Furans</i>	133	871	
	2-Propanone	1072	813	MS+LRI
524	2-Propanol	212	1052	MS+LRI
	<b>Total volatiles</b>	<b>17144</b>	<b>12927</b>	

<sup>1</sup> Linear retention index on a CP-Sil 8 CB low bleed/MS column.<sup>2</sup> Information about origin obtained from references 7, 8, 9, 10, 11, 13, 14, 15, 16, 17, 18.<sup>3</sup> MS+LRI, mass spectrum and LRI agree with those of authentic compounds; ms+lri, mass spectrum and LRI in agreement with the literature; ms, mass spectrum agrees with spectrum in the HP Wiley 138 Mass Spectral Database.

nd: not detected