VOLATILE AROMA COMPOUNDS OF COOKED SUCKLING LAMB MEAT

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Introduction

In the Mediterranean Europe Area, sheep/dairy farms are frequent and, in addition to milk, meat from suckling lambs aged between 25 and 45 days and with a carcass weight lower than 7 kg is largely produced on these farms (Sañudo *et al.*, 1998). Suckling lamb meat is a product in demand because of its high eating quality, which could be partly due to its mild flavour compared to meat from older animals (Martínez-Cerezo *et al.*, 2005).

Volatile compounds in meat have been widely studied for their effects on meat flavour and their potential as tracers of animal feeding system (Vasta and Priolo, 2006). According to the origin, volatile compounds of cooked meat can be divided into three groups, those coming (directly or formed by animal metabolism) from feed ingested by animals and those formed during heating of meat by means of lipid oxidation and the Maillard reaction (Mottram, 1998).

To our knowledge there are no studies dealing with aroma compounds of meat suckling lamb. These studies could be useful to gain a better understanding of the flavour of this distinctive product and for traceability of the feeding diet of suckling lambs (Prache *et al.*, 2005). Considering these facts, the purpose of the present study was to develop an initial approach to determining the volatile compounds of suckling lamb meat.

Materials and Methods

Ten carcasses of Churra breed suckling lambs were randomly sampled in a local slaughterhouse. All lambs had been reared by ewes' milk exclusively. The right-hand pelvic limb of each carcass was boned, then the meat, thus obtained, was homogenised and a portion of 100 g was taken for volatile extraction. A Likens-Nickerson simultaneous distillation-extraction apparatus was used; diethyl-ether was the extraction solvent and a dispersion of the meat in water at boiling temperature was the source of volatiles. The extraction process lasted 4 hours. Then, ether solution with the extracted volatiles was concentrated by distilling in a Kuderna-Danish concentrator (until 1 ml solution) in a 50 ºC water bath. Separation and identification of volatiles were carried out by GC-MS (Hewlett Packard-6890 Series GC system - Hewlett Packard-5973 Inert MSD Mass Selective Detector) equipped with a HP-5MS column (30 m x 0.25mm x 0.25 µm) and He as carrier gas. Four microlitres of the solution were injected (injector temperature was 230ºC, and split mode 50:1). Initial oven temperature was 50ºC which was increased to 95ºC at a rate of 10 ºC min^{-1} and then to 270ºC at a rate of 10ºC min^{-1}. The MS detector was activated after 6 min of injection. Compounds were identified by comparing the mass spectra with those contained in the Willey 275 database and then comparing their Kovacs' Index with those in the literature, if available. Quantification was carried out by area percentage.

Results and Discussion

A total of 68 volatile compounds were detected in suckling lamb meat using this methodology. The most abundant chemical families were carboxylic acids and esters (16 detected, 35% of total area), and aldehydes (16 detected and 30% of total area) (Table 1). The large majority of compounds were previously observed in cooked meats, and an important part of them came from lipids as was also expected for cooked lamb meat (Mottram, 1998; Elmoore *et al.*, 2000; Vasta and Priolo, 2006). The most abundant compounds were fatty acids (*e.g.* tetradecanoic, hexadecanoic, dodecanoic, or octadecenoic acids), feed-ingested fat-soluble volatiles such as 3,7,11,15-tetramethyl-hexadecene (phytene), or lipid-derived compounds originated by thermal degradation (oxidation products, e.g. hexadecanal, octadecenal, and octadecanal).

By comparing our results with those of other studies dealing with lamb volatiles (Elmoore et al., 2000; Vasta and Priolo, 2006), the present data showed elevated presence of medium and long chain acids and esters, higher relative abundance of phytane, and no o lower levels of low molecular weight compounds (e.g. hexanal, short-chain branched fatty acids, propanol, etc). Extraction methodology could account for the observed differences; the Likens-Nickerson simultaneous distillation-extraction apparatus is effective in collecting meat flavour volatiles of the mid- to high-molecular weight range.

With regard to phytene, it seems to be a grass-derived compound (Elmoore et al., 2004) which will be ingested with the ewes' milk by suckling lambs and then retained in the lambs' fat tissues. Based on this fact, it would be beneficial to study the potential use of this compound, as a plant biomarker, as suggested by Prache *et al.* (2005), for traceability of age at slaughter and type of rearing (ewes' milk vs milk-substitute).

Table 1: Volatile compounds detected in cooked suckling lamb (only the most abundant are shown in the table).

Compound *(number of compounds)*	Relative abundance (area %)[&]	Samples[*]	Method of Identification[#]	Observed KI[#]
Hydrocarbons (3)	15.4			
3,7,11,15-tetramethyl-hexadecene	15.2	10	MS+KI	1846
Aldehydes (16)	30.0			
Nonanal	0.4	10	MS+KI	1104
Tetradecanal	0.4	9	MS+KI	1613
Hexadecanal	22.8	10	MS+KI	1818
Octadecenal	3.8	5	MS+KI	1919
Octadecanal	2.7	6	MS+KI	2022
Ketones (4)	4.5			
2-Tridecanone	0.9	6	MS+KI	1498
2-Pentadecanone	2.1	10	MS+KI	1696
2-Heptadecanone	1.4	10	MS+KI	1902
Alcohols and hydroxyketones (5)	1.2			
1-Hexadecanol	0.7	9	MS+KI	1882
Carboxilic acids and esters (16)	35.2			
Decanoic acid	1.2	10	MS+KI	1372
Dodecanoic acid	4.3	10	MS+KI	1572
Tetradecanoic acid	15.3	10	MS+KI	1764
Hexadecanoato metil éster	1.0	8	MS+KI	1926
Hexadecanoic acid	8.5	10	MS+KI	1963
Methyl-octadecenate	0.6	6	MS	2104
Methy-octadecanoate	0.4	7	MS	2129
Octadecenoic acid	3.1	9	MS+KI	2145
Octadecanoic acid	1.3	10	MS	2163
Furan and furanoids (6)	2.0			
δ-Decalactone	0.8	10	MS+KI	1714
γ-Undecalactone	0.8	9	MS+KI	1932
Sulphur containing (8)	6.7			
A sulphur containing compound	1.0	10	MS	1196
A sulphur containing compound	2.6	10	MS	1687
A sulphur containing compound	1.5	10	MS	1747
A sulphur containing compound	1.4	10	MS	1945
Others and unknown (10)	4.1			
Isobuthyl-phtalate	0.7	9	MS	1875
Dibuthyl-phtalate	0.9	6	MS	1969

[&]: Percentage of the area of the peak with respect to the total sum of areas. [*]: Number of samples in which the compound appeared. [#]: MS, coincidence with the mass spectrum of the library; KI, coincidence with Kovats' Index (KI) obtained in literature.

Conclusion

Volatile compounds of suckling lamb meat have been determined. Among them, phytene could be considered for further studies as a potential tracer of feeding system or age.

References

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