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Caroline Thomas, Jean Luc Vendeuvre, Anne-Sophie Guillard, Julie Sudron, Frederic Mercier, Pascal Tournayre, P. Fuchsmann, Katharina Breme, Jean-Louis Berdagué

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C. Thomas[1], J.L. Vendeuvre[1], A.S. Guillard[1], J. Sudron[2], F. Mercier[2], P. Tournayre[2], P. Fuchsmann[3], K. Breme[3] and J.L. Berdagué[2]

[1] IFIP : 7 av. du Général de Gaulle - 94704 Maisons-Alfort Cedex, France ; [2] INRA de Theix : 63122 Saint-Genès Champanelle, France. [3] Agroscope Liebefeld-Posieux ALP-Haras, Suisse.
Caroline.Thomas@clermont.inra.fr

- The aim of this study was to acquire knowledge about volatile sulfur compounds (VSC) of cooked ham, which are poorly described in the literature. That can be explained because the analysis of VSC is particularly difficult. Indeed, VSC are (i) present at trace levels (limited production during cooking at low temperature: T < 70 °C) and they are (ii) very difficult to extract and to detect due to strong retention by the matrix and high chemical reactivity of thiols during analyses.
Industrial and experimental hams were investigated using different types of extraction and detection methods in order to achieve the most exhaustive identification of VSC. These methods were: Solid Phase Micro-Extraction coupled to the bidimensional Gas Chromatography-time of flight Mass Spectrometry (SPME-GCxGC-MStof), Dynamic Headspace coupled to Gas Chromatography-Mass Spectrometry (DH-GC-MS), Head Space-Solid Phase Micro-Extraction coupled to Gas Chromatography – Pulsed Flame Photometric Detection and to Mass Spectrometry (HS-SPME-GC-MSquad/PFPD) or a specific extraction of thiols with mercury salts followed by a GCxGC-MStof analysis. In addition, olfactometry analyses [1] were performed using a multiway olfactometer (GC/8WO-MS) and a "heartcut type" bidimensional Gas Chromatography-Olfactometry device (GC-GC/O-MS).

- Despite a low cooking temperature, a large variety of cyclic or aliphatic VSC are produced in ham during cooking. The different analytical approaches have led to a reliable identification of 39 VSC. The most efficient methods of detection and identification were SPME-GCxGC-MStof and HS-SPME-GC-MSquad/PFPD The specific extraction of thiols with mercury salts allowed to extract important quantities of 2-methyl-3-furanthiol but induces also a dimerisation of this compound into bis(2-methyl-3-furyl) disulfide during chromatography. According to literature [2], most of these substances originate from a Maillard reaction between sulfur containing amino acids (cysteine or methionine) and reducing sugars, or from thermal degradation of thiamine. Aliphatic VSC and furans were mainly produced from Strecker degradation, and thiophene and thiazole from Amadori and Heyns rearrangements.
Olfactometry analyses demonstrated the important role of sulfur odorants in cooked ham and revealed that only seven VSC identified by mass spectrometry were perceived during olfactometry. Among those sulfur odorants, sulfides, methional, 2-methyl-3-furanthiol and methyl 2-methyl-3-furyl disulfide showed very low detection thresholds [3]. Olfactometry tests also showed that pure 2-methyl-3-furanthiol and methyl 2-methyl-3-furyl disulfide have "meaty" odors very similar to the odor of cooked ham.

- Relevant key aroma compounds of cooked ham were identified. Moreover, despite low cooking temperatures, this work showed that a large variety of cyclic and aliphatic VSC are produced in ham during the cooking process. The knowledge of the precursors of these key odorants provides valuable information to optimize the aroma of cooked ham.

Keywords: sulfur compounds, mass-spectrometry, olfactometry, aroma, cooked ham.

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