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EVOLUTION OF THE VOLATILE COMPOUND PROFILE OF COOKED MEAT DURING THE AGEING OF SQUABS

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I. INTRODUCTION

In Spain, meat from young pigeons, typically sourced from hunting activities, is often consumed in specialized restaurants. The ageing process usually takes place while the bird is intact, with feathers and without evisceration (treatment called “faisandage”). During this process, chemical changes occur in the meat, primarily affecting proteins and fats. These transformations can lead to the release of volatile compounds during cooking, which in turn influence the meat's sensory profile However, the evolution of both desirable and undesirable volatile compounds in pigeon meat remains unclear, have not been fully elucidated. The aim of the study was to explore the evolution of volatile compounds of squabs cooked meat at different stages of ageing.

II. MATERIALS AND METHODS

Thirty whole squabs (*Columbia livia*) were slaughtered and transported under chilled conditions to the “Estación Tecnólogica de la Carne” (Guijuelo, Salamanca, Spain). They were hung and stored in a cooling chamber at 0–4°C. Five squabs per day were selected for analysis at 0, 7, 12, 17, 21 and 27 days. At each sampling point, the squabs were dressed, with feathers removed, internal organs carefully extracted and the heads severed. Then breast muscle was extracted and volatile compound analysis was performed. Cooked meat (150°C/15 minutes) was analysed using solid-phase microextraction in headspace mode followed by gas chromatography–mass spectrometry (SPME-HS-GC-MS). Volatile concentrations were quantified based on peak areas and expressed as a percentage of total identified compounds. Their sensory contribution was assessed using Odour Activity Values (OAV) [1]. Data were analysed by one-way ANOVA, with ageing time as the factor, and significant differences ($P<0.05$) were further examined using the Duncan test.

III. RESULTS AND DISCUSSION

Some of the most relevant volatile compounds, expressed as a percentage of the total identified compounds, are presented in Table 1. These volatiles originate mainly from lipid oxidation, amino acid degradation, and Maillard reactions during cooking, although several are already present in aged raw meat and further modified by heat. Hexanal, a marker of lipid oxidation and the major aldehyde in fresh meat, remains stable over the ageing period and 2,4-decadienal—a product of polyunsaturated fatty acid (PUFA) oxidation and characterized by a high odour activity value (OAV)—was only detected after 21 days of ageing. Aliphatic hydrocarbons such as heptane and octane, primarily generated through thermal processes, increased markedly toward the end of the ageing period. Aliphatic alcohols, particularly hexanol and 3-methyl-1-heptanol, followed a similar trend.

Ketones are considered major contributors to meat aroma due to their relatively high concentrations. Sulphur-containing compounds and pyrazines, derived from sulphur-containing amino acids and from the degradation of lysine and arginine, respectively, were present in lower concentrations but exhibited extremely low OAVs, making them sensorially significant. Sulphur compounds, furans, and carboxylic acids increased up to intermediate ageing stages and declined thereafter. Benzeneacetaldehyde, by contrast, showed a progressive increase from day 12 of ageing onward. This temporal pattern—an increase at intermediate ageing stages followed by a decline—reflects the interplay between active proteolysis, lipid oxidation, and Maillard reaction precursors, initially promoting the formation of aroma-active volatiles. Over extended ageing, however, these compounds may volatilize, degrade, or convert into secondary products. Microbial activity and interactions with other meat components can also influence their stability and concentration.

In general, the dynamic behaviour of volatile compounds during ageing has a significant impact on the aroma profile after cooking. Heat promotes both the release and transformation of existing volatiles and initiates new pathways, such as Maillard reactions and thermal degradation of lipids and amino acids, which further define the sensory attributes of cooked aged meat.

Table 1 –Most relevant volatile compounds in squabs breast muscle expressed as a percentage of the total identified.

Volatile compound (%)	Ageing time						*P value*
	0 days	7 days	12 days	17 days	21 days	27 days	
[1]Σ Aliphatic aldehydes	51,2a	47.2ab	46.5ab	49.2bc	44.2cd	43.2d	0.050
Hexanal	29.15	21.49	22.68	21.86	22.03	21.38	0.110
2,4 Decadienal	-	-	-	-	-	0.284	0.001
3-Methyl-butanal	5.349	7.896	6.090	8.488	6.945	5.542	0.332
Benzeneacetaldehyde	0.156c	0.280c	0.554a	0.307b	0.455a	0.555a	0.035
[1]Σ Aliphatic hydrocarbons	2.529b	3.640b	3.304b	1.676b	3.429b	10.997a	0.000
Heptane	0.454b	0.739b	0.850b	0.780b	1.061b	4.333a	0.002
Octane	1.117c	2.016bc	2.148bc	3.015ab	1.225bc	4.223a	0.027
[1]Σ Aliphatic ketones	5.560	6.007	7.406	8.371	7.898	10.343	0.147
[1]Σ Aliphatic alcohols	7.033	6.099	7.925	7.044	7.769	9.147	0.216
1-octen-3-ol	3.679	3.748	4.952	3.824	4.625	4.963	0.140
Hexanol	0.534b	0.400b	0.506b	0.461b	0.657b	1.428a	0.046
3-methyl-1-heptanol	-	-	-	-	0.454a	0.413a	0.002
[1]Σ Pyrazine	0.150b	0.152b	0.163b	0.140b	0.152b	0.240a	0.002
[1]Σ Sulphur compounds	2.280b	1.805b	2.053b	4.853a	2.098b	1.310b	0.024
Dimethyl sulfide	0.412a	0.225bc	0.160c	0.123c	0.464a	0.173c	0.013
Dimethyl disulfide	0.584	0.892	1.103	2.188	0.909	0.687	0.098
[1]Σ Alkyl furans	26.239	32.210	30.119	23.575	27.660	22.451	0.308
2-pentyl-furan	0.111b	0.146b	0.158b	0.168b	0.258a	0.1201b	0.020
Carboxylic acids	1.622	1.414	1.455	2.296	2.145	2.639	0.089
Butanoic acid	0.693	0.383	0.209	0.209	0.190	0.823	0.401
Hexanoic acid	0.929b	1.031b	0.813b	3.06a	1.366b	1.663b	0.011

1: Σ refers to the total concentration of all identified compounds in each chemical group.
a, b, c: different superscripts indicate significant differences between ageing time (P<0.05).

IV. CONCLUSION

Meat ageing is a dynamic process that alters the volatile profile, significantly affecting the aroma of cooked meat. 2,4-decadienal appears after 21 days, and benzeneacetaldehyde increases from day 12. Sulphur-containing compounds, with low concentrations but strong sensory impact, peak at intermediate stages, highlighting the complex interplay of lipid oxidation, proteolysis, and Maillard reactions during ageing and cooking.

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