PE7.04 Umami flavor evolution in calf meat aged 1 to 3 weeks at 1ºC conditioning 46.00

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Abstract— IGP Ternera de Extremadura calf meat is defined by their excellent sensory properties. The flavour attributes and tenderness are the main conditioners of the acceptability by meat consumers. Umami flavour and flavour intensity are an important part of the meaty aroma and it seems to be improved by the umami related compounds like 5'nucleotides, amino acids and volatile compounds. The evolution of umami flavour in aged calf meat was studied. Umami related compounds increase with conditioning but the duration of the refrigerated storage must be controlled and cannot exceed 14 days duration to avoid the development of non-wished flavours. Meat sensory changes were also studied. The conditioning, as it was expected, has caused an improvement of calf meat sensory properties, mainly in flavour attributes.

Index Terms— calf meat, flavour enhancers, umami, sensory evaluation.

I. INTRODUCTION

MEAT is a food that has been consumed by mankind since ancient times. At the moment it is one of the basic kind of food that has been included in the people's diet because of its nutrition contributions like source of proteins, high absorption iron and essential amino acids. However, in western countries the meat consumption is determined by the pleasant sensations when eating it and not by its nutritive properties. In Spain, calf meat has a high consume and it is very appreciated by consumers. The causes of that good appreciation are its excellent sensory properties. The sensory traits that most affect consumer acceptability of beef are tenderness and flavour [1]. It has been recognized that the low molecular weight water soluble compounds, like free aminoacids and ribonucleotides, are important precursors of the characteristics aroma of cooked meat [2]. The 5'nucleotides have their origin in ATP degradation in foods [3,4] and are involved, mainly inosine monophosphate [5] (IMP) in a synergistic effect with glutamic acid and other amino acids, in the umami flavour development [6]. Umami is defined as a succulent or savory sensation that is obtained when eating some foods like mushrooms, parmesan cheese, asian foods or cooked meat. It is considered as the fifth basic taste sensation [7], with sweet, sour, salty and bitter. In other way, ageing of meat has been used to improve quality [8]. This improvement is determined by the proteolysis action during the refrigerated storage. It is known that the concentration of flavours precursors in meat can be affected by post-mortem conditioning [9]. Consequently, it seems necessary to study the evolution of the umami related compounds during the aging and the sensory changes that could happen in meat.

II. MATERIALS AND METHODS

A. Samples Ten pieces of I.G.P. Ternera de Extremadura 12-14 months calf meat were used in this study. The piece used is called "espaldilla" and it's conformed by the muscles triceps brachii, infraspinatus, deltoids and teres minor. Each piece was divided into three parts that were stored at 1ºC one, two and three weeks respectively.

B.Nucleotide analysis The nucleotides were extracted and analyzed by an HPLC method similar to that reported by Watanabe et al. [10].

C. Amino acids analysis The amino acids were extracted and analyzed by an HPLC method similar that reported by Ruíz et al. [11].

D.Volatile compounds analysis. The volatile compounds were extracted by headspace-SPME and were analyzed by a GC-MS method similar that reported by Ruiz et al. [12]

E. Sensory evaluation Calf meat slices were assessed by a trained panel of 15 members, using a quantitative-descriptive analysis. Seven traits about sensory characteristics of calf meat called hardness, chewiness, juiciness, pastyness, umami, flavour intensity and flavour after taste were studied using the FIZZ Network (version 2.20, Biosystemes, France) program. A 10-cm unstructured scale was used, the extremes being "very low" and "very high". The 6mm slices were roasting for 30 seconds at 215ºC in a contact grill before be analyzed by

judges. All sessions were done at 20–22 °C in a six-booth sensory panel room equipped with white fluorescent lighting. The whole panel participated in each session, the panelist order being randomized. Three meats from three different groups were successively evaluated in each session. The sample order was randomized too.

F. Statistical Analysis Statistical analyses were performed by means of the general linear models procedure of the SPSS statistical software (V.15.0). Data was evaluated by a two-way analysis of variance (ANOVA). Differences were considered significant at p≤0.05. When the effect of any of the factors was significant, differences between groups were analyzed by Tukey's post hoc test.

III. RESULTS AND DISCUSSION

The ATP degradation products content (table 1) is similar to that previously reported [13] with a exception, the lower IMP content. This nucleotide is the first ATP degradation product and there is a big accumulation before slaughter [5,10,14]. After that, IMP will breakdown to other compounds like Inosine and Hypoxantine [4,10,15]. The low IMP level in our study is caused by conditioning. 5'nucleotides, mainly IMP, and some amino acids are involved in umami flavour development and have taste enhancers properties [14]. The umami related amino acids content (table 1) is similar to that reported for aging beef [15]. Umami compounds content are bigger at calf meat prolonged aging. IMP increase until the 14th day of conditioning but other studies [10,13] have reported a linear decrease of this compound over 10 days of storage. Other umami related compounds like glutamic acid, adenosine monophosphate, adenosine diphosphate, phenylalanine and tyrosine increase too. Unami flavour will improve with meat conditioning due to the raising of the associated compounds. Nevertheless, after 14 days, Hypoxantine will begin to increase and reach its top content after 21 days. This compound is related with loose of fresh meat flavour and off flavors developments [4]. Calf meat flavour improvement seems to be confirmed because volatile compounds identified also increases with conditioning. The most quantity family of volatiles is ketones and its components (table 1) have been reported with pleasant buttery odours in beef [17]. The sensory traits also changes with conditioning (table 2). Umami taste's sensory evaluation seems to increase but there is not statistical difference between storage groups. However, flavour attributes have received better scores at longer conditioning obtaining the best results at 21 days. Other sensory trait that has statistical difference is hardness. That texture attribute decreases with conditioning. It is an important event because tenderness is one of the porperties most appreciated by consumers and it is associated by them with high quality meat. In fact, the conditioning causes improve calf meat quality because enhance flavour and increase tenderness but it must not surpass the 14 days of refrigerated storage as it would increase the risk of appearance of associated disagreeable off-flavours with the hypoxanthine content.

IV. CONCLUSION

The umami-related compounds, mainly glutamic acid and IMP, raise with aging at refrigerated storage, causing sensorial changes in the meat and enhancing flavour attributes. However, the optimal time of conditioning of meat seems to be two weeks long otherwise non-wishes compounds like hypoxanthine could increase and that could be associated with off-flavour odours development.

ACKNOWLEDGEMENT

Jorge Tovar thanks the Junta de Extremadura for its support. Jorge Tovar thanks the IGP Ternera de Extremadura for its contribution supplying the calf meat pieces.

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Table 1. Concentrations of umami related nucleotides (mg/100gr) amino acids (mg/100g) and volatile compounds (AAU x 10^6) in calf meat during post-mortem conditioning at 1ºC

	Conditioning time (days)		
	7	14	21
adenosine 5' diphosphate (ADP)	16,32 ± 2,66	16,50 ± 2,39	18,20 ± 2,57
adenosine 5' monophosphate (AMP)	12,83 [a] ± 2,24	13,36 [ab] ± 2,45	15,64 [b] ± 2,22
inosine	42,13 ± 4,12	45,14 ± 7,43	42,80 ± 5,06
inosine 5' monophosphate (IMP)	16,74 [a] ± 2,07	20,02 [b] ± 3,07	16,95 [ab] ± 3,04
hipoxanthine + guanosine 5' monophosphate (GMP)	91,94 ± 13,14	89,16 ± 9,01	94,37 ± 11,77
glutamic acid	4,03 [a] ± 0,38	4,33 [a] ± 0,45	5,29 [b] ± 0,49
phenylalanine	3,30 [a] ± 0,39	3,99 [b] ± 0,43	5,26 [c] ± 0,35
tyrosine	2,08 [a] ± 0,21	3,16 [b] ± 0,33	3,07 [b] ± 0,33
2,3 butanedione	38,41 [a] ± 9,54	38,13 [a] ± 17,41	60,92 [b] ± 22,98
2 butanone- 3 hidroxy	262,21 [a] ± 55,58	265,83 [a] ± 86,27	403,64 [b] ± 106,83
2 heptanona	1,69 [a] ± 0,71	1,74 [a] ± 0,81	7,34 [b] ± 2,30

Values are means of 20 replicates ± standard errors of the means.
Different letters inthe same row indicate significant difference at p≤0.05.

Table 2. Sensory evaluation of calf meat during post-mortem conditioning at 1°C

	Conditioning time (days)		
	7	14	21
hardness	4,53 [a] ± 0,87	3,43 [b] ± 0,77	3,17 [b] ± 0,82
chewiness	4,68 ± 0,79	4,38 ± 0,68	4,34 ± 0,69
juiciness	4,36 ± 0,77	4,52 ± 0,46	4,20 ± 0,57
pastyness	3,70 ± 0,50	3,61 ± 0,70	3,83 ± 0,42
umami	3,93 ± 0,44	4,06 ± 0,28	4,08 ± 0,57
flavour intensity	4,12 [a] ± 0,58	4,32 [ab] ± 0,50	4,78 [b] ± 0,50
persistency	4,00 ± 0,52	4,12 ± 0,45	4,46 ± 0,56

Different letters inthe same row indicate significant difference at p≤0.05.

Figure. 1. Change (%) of umami related compounds (inosine monophosphate and glutamic acid), sensory traits (umami and flavour intensity) and ketones (2,3 butanedione) in calf meat during post-mortem conditioning at 1°C