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Study of the characteristics of conventional cooked hams and organic cooked hams

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Abstract. Consumers' concern due to the use of additives in the manufacturing of meat product has focused an increasing demand of the organic products. The organic products are primary or manufactured products obtained without the use of chemical products. So, in the organic cooked meat products the use of phosphates is not permitted. However, the use of nitrites is allowed in a lower amount than for manufacturing conventional products due to the role that nitrites exert on the development of colour. The aim of this work was to study the characteristics of conventional and organic commercial cooked hams. Six different commercial brands of cooked hams were analysed: 3 conventional and 3 organics. In each ham the pH, a_w , proximal composition, amount of additives (sodium chloride, nitrites and phosphates) and the colour (L^* , a^* , b^*) were evaluated. The main differences found among the cooked ham analysed were in the protein and fat content. The use of pigs with different genetic or with different feed (conventional or organic) could explain these results. Moreover, differences in the amount of phosphates were detected. The use of different concentration of phosphates in the manufacturing of conventional cooked ham and the use of different raw meats might explain these differences.

Keywords. Additives – Organic products – Cooked ham – Characterization.

Une étude des caractéristiques du jambon cuit conventionnel et du jambon écologique

Résumé. La préoccupation du consommateur à propos de l'inclusion d'additifs chimiques dans les produits à base de viande a entraîné un développement de la demande de produits écologiques. Les produits écologiques sont des produits agricoles primaires ou élaborés, obtenus sans l'utilisation de produits chimiques. Ainsi, dans les produits à base de viande cuits écologiques, l'ajout de phosphates n'est pas permis. Toutefois, l'inclusion de nitrite est autorisée pour favoriser le développement de la couleur, mais en concentrations plus basses que dans l'élaboration des produits conventionnels. L'objectif de ce travail était d'étudier les caractéristiques du jambon cuit commercial écologique et du jambon cuit commercial conventionnel. Pour cela, 6 marques commerciales de jambon cuit ont été analysées : 3 conventionnelles et 3 écologiques. Pour chaque jambon on a déterminé le pH, l' a_w , la composition proximale, la teneur en additifs (chlorures, nitrites et phosphates) et on a réalisé la mesure instrumentale de la couleur. Les principales différences entre les différents jambons analysés concernaient la teneur en graisse et en protéines. L'utilisation de porcs ayant une génétique différente ou recevant une alimentation différente (conventionnelle ou écologique) pourrait expliquer ces résultats. Des différences ont également été détectées dans la teneur en phosphates. L'emploi de différentes concentrations de phosphates pour l'élaboration de jambons conventionnels et l'utilisation de différentes matières premières pourrait être la cause de ces différences.

Mots-clés. Additifs – Produits biologiques – Jambon cuit – Caractérisation.

I – Introduction

Nowadays, the consumers' demand of additives-free and healthy meat products with quality attributes similar to conventional meat products has focused an increasing demand of the organic products. The organic products are primary or manufactured products obtained without the use of chemical products (DOUE, 2008).

The cooked ham is one of the meat products most demanded in Spain. In the manufacture of this meat product, phosphates (E-450, E-451 and E-452) and nitrites (E-249, E-250) are commonly added. Phosphates improve cohesion of meat pieces and binding of water (Keenan *et al.*, 2010) however, this additive is not permitted for manufacturing organic cooked meat products (DOUE, 2008). Otherwise, the use of nitrites (E-249, E-250) is allowed, due to the role that nitrites exert on the development of colour, but in a lower amount than for manufacturing conventional products. The aim of this work was to study the physico-chemical characteristics of conventional and organic commercial cooked hams.

II – Material and methods

Six different commercial brands of cooked hams were analysed: 3 conventional (C1, C2, C3) and 3 organics (O1, O2, O3). In all cooked hams evaluated (3 for each commercial brand), different analysis were carried out. The pH value was determined with a Crison 2001 pH meter (Crison Instrument S.A, Barcelona, Spain) equipped with a punction electrode. Water activity (a_w) was determined using a hygrometer (Aqua-lab CX2, Decagon, Washington, USA). Moisture, protein, fat and ash content were determined according to ISO standards 1442:1997 (ISO, 1997), 937:1978 (1978), 1443:1973 (ISO, 1973) and 936:1998 (ISO, 1998), respectively. Moreover, NaCl (ISO 1841-1:1996), nitrite (ISO 2918:1975) and phosphate content (ammonium molybdate method, BOE, 1995) were analysed. Surface colour was measured using a reflectance spectrophotometer (CM-2600d/2500d, Konica Minolta, Aquateknia S.A., Spain). Colour coordinates were determined in the CIE-LAB system and the results were expressed as lightness (L^*), redness (a^*) and yellowness (b^*). Data sets were statistically analyzed using one-way variance analysis (ANOVA) in order to determine any significant differences. The means were separated by Tukey-honest significant difference test at 5% level. Principal component analysis (PCA) was performed in order to evaluate the influence of the parameters on total variability. Data analyses were conducted using Statgraphics Plus 4.0 statistical package.

III – Results and discussion

The results obtained for pH, a_w and proximal composition are showed in Table 1. Although one of the organic cooked ham brands presented an unusual pH value according to Aymerich *et al.*, (2003), the pH values for the other brands were similar. For a_w , no differences ($p > 0.05$) were detected among the cooked ham brands evaluated. In general, the values obtained for this parameter were similar than those found by Rubio *et al.*, (2009) in cooked ham.

Table 1. pH, a_w and proximal composition in cooked ham (conventional and organic)

		pH	a_w	Moisture (%)	Protein (%)	Fat (%)	Ash (%)
Conventional	C1	^b 6.2	0.972	73.3	^b 18.9	^{ab} 2.9	3.3
	C2	^b 6.5	0.982	73.4	^b 18.6	^{ab} 3.6	3.5
	C3	^b 6.2	0.972	75.1	^a 17.1	^{ab} 5.0	4.3
Organic	O1	^b 6.2	0.973	74.4	^a 17.5	^b 4.6	3.2
	O2	^a 5.1	0.973	73.1	^b 19.0	^{ab} 2.1	2.9
	O3	^{ab} 5.6	0.979	74.9	^c 20.5	^a 1.4	2.8

^{a,b,c} Means within the same column with different letters differ significantly ($p < 0.05$).

With regard to proximal composition, differences for the protein and fat content ($p < 0.05$) were found among the commercial brands analysed. A higher variability was observed for organic

cooked ham in these parameters. The use of raw meat from pigs with different genetic, fed with different diets or slaughtered at different age could affect the composition of raw meat and consequently the composition of meat products (García-Rey *et al.*, 2004). Authors as Cheng, *et al.* (2005) indicated that cooked ham has a moisture, protein and fat content around 65-71%, 21-24% and 1-2%, respectively.

In the Table 2 are showed the results obtained for the content of additives. No differences ($p > 0.05$) were detected for the amount of NaCl. For the nitrite content, it is important to point out that although the maximum amount of nitrites allowed for manufacturing conventional and organic products is different (150 ppm and 80 ppm, respectively), no differences ($p > 0.05$) were found among brands since nitrite is a highly reactive compound at the pH of 5.5-6 (Marco, *et al.*, 2006). As it was expected, some differences were found for the phosphate content ($p < 0.05$) between conventional and organic brands of cooked ham. The conventional cooked hams showed the highest values for this parameter. The intrinsic value of phosphates that meat has is around 4500 and 5000 ppm (Flores, 2001) and, in Spain, the maximum amount of phosphate permitted is 5000 ppm. Therefore, the use of different concentration of phosphates in the manufacturing of cooked hams might explain the differences found in this study. On the other hand, taking into account that in the manufacture of organic cooked ham the addition of phosphate is not allowed, the differences among the three commercial organic brands may be due to the use of different raw meat.

Table 2. Additives content and colour values obtained in cooked ham (conventional and organic)

		NaCl (%)	Nitrites (ppm)	Phosphates (ppm)	L*	a*	b*
Conventional	C1	1.7	2.1	^c 7058	65.9	7.6	^b 9.0
	C2	2.0	3.3	^a 5018	59.8	8.1	^a 5.8
	C3	2.0	1.5	^d 9742	60.4	10.1	^{ab} 6.5
Organic	O1	2.1	3.3	^a 5087	59.8	9.9	^{ab} 8.0
	O2	1.4	5.5	^a 4968	63.4	9.1	^{ab} 7.8
	O3	1.7	4.6	^b 5772	54.6	12.1	^b 8.6

a,b,c,d Means within the same column with different letters differ significantly ($p < 0.05$).

Considering colour, only were found differences for b* ($p < 0.05$) among the conventional commercial cooked hams. The use of different sorts of ingredients and additives in the manufacture of this product or even the use of different raw material, could explain these differences. The L*, a* and b* values were within the range reported by the others authors with regard to this product (Casiraghi *et al.*, 2007)

Finally, the parameters evaluated were subjected to PCA in order to determine the relationships between the different cooked hams. The plot of the two first principal components (Fig 1) explained 71.78% of the total variance. The first component (PC1) explained 47.92% of the variance. The loading plot for PC1 showed that a_w, a* values, protein and nitrite had a positive loading, whereas the rest of the parameters evaluated had a negative loading. The second PC (PC2) described 23.6% of the variance, where only L* and b* values and phosphate content had a positive loading. The samples distribution on the two first PC plot did not allow clearly separate the two groups. However, differences between them became apparent with respect to PC1. Conventional cooked hams were located on the negative side of the PC1, whereas organic cooked hams were grouped on the positive loading of the PC1. The conventional cooked hams may be distinguished by its phosphate content.

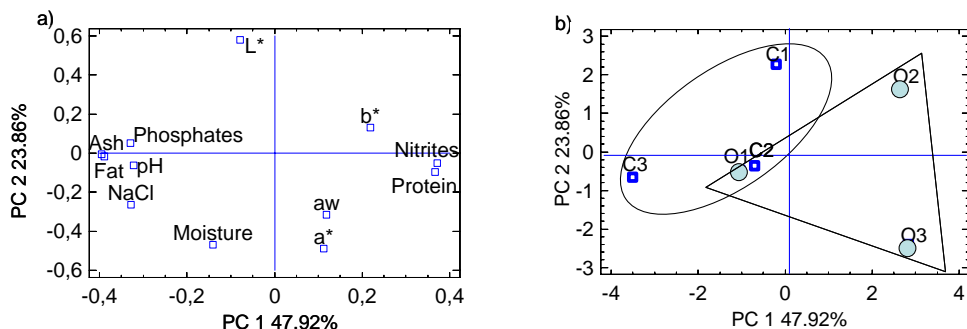


Fig. 1. Loading plot (a) and score plot (b) after principal component analysis of characteristic of cooked ham analysed, conventional (C1,C2,C3) and organic (O1,O2,O3).

IV – Conclusions

On basis of these results, the physico-chemical parameters evaluated did not allow establish clear differences between conventional and organic commercial cooked hams.

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