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Physico-chemical and sensorial characteristics evolution of vacuum packaged Iberian dry-cured ham stored at refrigerated temperature

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Abstract. Two groups of five dry-cured hams from Alentejano pig breed submitted to a post-salting cure of 12 months were studied. One of the groups was processed through craft methods at Barrancos (small city of south-east Alentejo region, Portugal) and the other one in a Portuguese meat plant. Equal groups of slices and unitary portions weighing about 250 g were vacuum packed and stored at 7℃. Physico-chemical analysis (pH, a_w, chlorides, total volatile basic nitrogen, thiobarbituric acid index and colour (L*, a*, b*) and sensorial evaluation (colour, off colour, aroma, off aroma, tenderness, succulence, taste, off taste, salt intensity and global evaluation) were carried out before packaging (time 0) and after 2, 5 and 8 months of storage. Statistical analysis consisted in analysis of variance considering the factors "process" (artisanal and industrial), "sample presentation" (portions and slices) and "storage time" (0, 2, 5 and 8 months). Physico-chemical analysis exhibit differences, mainly for "process" factor and sensorial evaluation for "storage time" factor. However, results evidence desirable evolution of the samples during storage time. These study allow to conclude that under refrigeration (7℃) is possible to store vacuum packaged high quality dry-cured ham during, at least, 8 months.

Keywords. Alentejano dry-cured ham – Quality – Storage time – Vacuum packaged.

Évolution des caractéristiques physico-chimiques et sensorielles du jambon de porc Alentejano réfrigéré et conservé sous vide

***Résumé**. Deux groupes de cinq jambons de cochon Alentejano avec 12 mois de maturation après salage ont été étudiés. Un des groupes a été traité selon un processus artisanal à Barrancos (sud-est du Portugal) et l'autre groupe a été transformé dans une unité industrielle. Des portions unitaires d'un poids approximatif de 250 g et des tranches de 1 mm d'épaisseur du même poids ont été emballées sous vide et entreposées à 7℃. Les analyses suivantes ont été effectuées : anal yses physico-chimiques (pH, aw, chlorures, azote basique volatil total, index d'acide thiobarbiturique, et couleur (L*, a*, b*) et sensorielles (couleur, couleurs étranges, arôme, arôme étrange, tendreté, teneur en jus, saveur, saveurs étranges, intensité de la salaison et évaluation globale) avant l'emballage (temps 0) et après 2, 5 et 8 mois de conservation. Le traitement statistique consistait en une analyse de la variance en considérant les facteurs "processus" (artisanal et industriel), "mode de présentation des échantillons" (portions et tranches) et "temps de conservation" (0, 2, 5 et 8 mois). L'évaluation physico-chimique a montré qu'il y avait des différences et l'analyse sensorielle a montré des différences, en particulier pour le facteur "temps de conservation". Cependant, les résultats ont montré une tendance positive dans les échantillons au cours de la conservation. Cette étude nous permet de déduire qu'il est possible de conserver des jambons de qualité emballés sous vide et maintenus à une température de 7℃ pendant au moins 8 mois.*

***Mots-clés.** Jambon de porc Alentejano – Qualité – Conservation – Emballage sous vide.*

I – Introduction

Traditional quality products process should be based on scientific and technological support in order to develop poor regions. Recently the production of dry cured ham of Alentejano pig bread

increased a lot after a long period of low production due to the reduction of pig production. Due to the high nutritional quality of products that are processed with this specific raw material, the dry cured ham has nowadays a high commercial value that obliges to a high sensorial quality standard. Attributes such as color, fat infiltrated proportion, aroma, textures, and taste are, among other, the most important for consumers and that support the decision of buy the product. Dry cured ham is an expensive food product so the market offers deboned pieces packaged in vacuum conditions. So it´s an interesting and practical objective to study the evolution of deboned packaged ham portions in order to determine their shelf life.

The specific aim of this work is to evaluate the physic-chemical and sensorial characteristics evolution of dry cured ham portions after 12 months of cure, some obtained by artisanal process and others by industrial process, all of them deboned and vacuum packaged, sliced or cute in small portions, and stored at 7ºC along 8 months.

II – Materials and methods

1. Sample preparation

Two groups of five hams of Alentejano pig bread with 12 moths of cure were considered to design this research work. One group was processed in a traditional production, region Barrancos, Alentejo, Portugal. Another group was processed in a modern factory. Sample preparation consists on obtained portions of 250g and slices of 1mm thick all of them packaged at vacuum conditions and stored at 7ºC. Samples were analyzed before being packaged (day 0) and at 2, 5, and 8 moths of storage.

2. Physico-chemical analysis

pH according to NP-3441 (1990), measured with a digital pH meter PTI-9; a_w (Rotronic Hygroscop DT, was measured with a probe WA-40); chlorides according to NP-1845 (1982); total volatile basic nitrogen-ABVT- according to NP-1848 (1987); thiobarbituric acid index-TBA- according to NP-3356 (1987); colour coordinates L*, a*, b* (Minolta CR-210b), were measured on the surfaces of the portions and on the surfaces of the slices.

3. Sensorial evaluation

A panel of 18 panelists evaluated samples made of 1 mm thickness slices. A descriptive quantitative method was used in order to obtain a quantification of different attribute, on structured scale from 0 to 100.

4. Statistical analysis

Statistical analysis consisted in analysis of variance considering the factors "process" (artisanal and industrial), "sample presentation" (portions and slices) and "storage time" (0, 2, 5 and 8 months). For mean comparison LSD test, was used for $p<0,05$.

III – Results and discussion

There were no significant differences on pH values between samples of artisanal ham and industrial ham (Table1). The highest value of pH was observed at the first day of analysis (time 0). This fact can be justified by the action of microaerophilic lactic acid bacteria, that can be responsible by the lower pH values exhibited by the sliced ham (5.76 for sliced samples and 5.92 for portion samples). The higher development of the lactic acid bacteria can be due to the larger specific surface and so a bigger quantity of substrate available for the bacteria. It was observed that the artisanal ham presented higher values of chlorides due to higher water loose during cure process, without environmental control, also was observed lower a_w values (0.874)

than the industrial ham (0.907). During storage period a_w values increased from 0.839 at day 0 until 0.892 after 8 months of storage. This change can be justified by the water released from proteolysis.

Table 1. Means and standard deviation for physic-chemical results

	Process		Sample presentation		Storage time (month)			
	Artisanal	**Industrial**	**Portions**	**Slices**	**0**	**2**	**5**	**8**
pH	5.88 ±0.4	5.82 ±0.2	5.92a ±0.3	5.76b ±0.3	6.08a ±0.08	5.74b ±0.03	5.83bc ±0.04	5.87b ±0.02
a_w	0.874a ±0.004	0.907b ±0.04	0.899 ±0.004	0.900 ±0.004	0.839a ±0.007	0.914c ±0.004	0.894b ±0.003	0.892b ±0.004
Chlorides (%NaCl)	4.9a ±0.1	4.5b ±0.1	4.8 ±0.1	4.6 ±0.1	4.9a ±0.1	4.3b ±0.1	4.8a ±0.1	5.0a ±0.1
ABVT ($mgNH_3/100g$)	230.41a ±14.31	101.34b ±1.97	172.71 ±16.39	156.79 ±12.72	205.67 ±41.15	128.22 ±9.63	165.56 ±15.99	183.95 ±20.27
TBA(mg malonic aldehyde/kg)	0.53a ±0.05	1.40b ±0.27	0.79 ±0.15	1.22 ±0.28	1.33 ±0.49	0.64 ±0.10	0.69 ±0.18	1.47 ±0.43
L*	42.6 ±0.8	41.1 ±1.1	44.2a ±0.9	38.7b ±0.6	39.9 ±1.1	44.9 ±1.1	40.0 ±1.1	41.5 ±1.5
a*	10.8 ±0.5	10.8 ±0.6	9.1a ±0.4	13.1b ±0.4	12.0 ±0.4	12.0 ±0.7	9.7 ±0.7	10.0 ±0.9
b*	5.6a ±0.3	4.2b ±0.4	3.7a ±0.3	6.4b ±0.2	4.2 ±0.6	5.5 ±0.4	4.0 ±0.5	5.4 ±0.6

For each factor and for each physic-chemical variable. different letters represent significantly different means for $p<0.05$.

Probably due to environmental conditions during cure process, more favorable to proteolytic process, were found ABVT values higher in artisanal ham than in industrial ham (230.41 mg NH_3/100g for artisanal ham and 101.34 mg NH_3/100g for industrial ham). Although the higher temperatures during the artisanal cure process, oxidation degree was significantly inferior (0,53 mg of malonic aldehyde) when compared with the values obtained for industrial ham (1,40 mg of malonic aldehyde). Considering that pig nutrition was similar for animals used in both processes and that antioxidant quantity used at the ham preparation were also similar, the differences in TBA values could be caused by a strong contamination by moulds, probably lipolytic, during the cure process and a light exposure of industrial ham at the end of that process. Colour coordinates L* a* b* didn´t show significant differences during storage time, and sliced ham always present different values when compared with portions, for all the coordinates, L* with 44.2 for portions and 38.7 for slices, a* with 13.1 for slices and 9.1 for portions, and b* with 6.4 for slices and 3.7 for portions. So the sliced ham seems to change more than portions.

About the results of sensorial evaluation (Table 2) it could be observed that values obtained for colour after 5 and 8 months of storage (66 and 67 points respectively) were significantly higher than those at 0 and 2 months (56 and 54 months respectively). Aroma attribute was classified with significantly superior values for artisanal ham (58 points) than industrial ham (53 points) probably due to intensive proteolytic and lipolytic phenomena occurred in artisanal ham. Sliced ham had better classification than portions for the attributes tenderness and taste. Taste was better after 6 or 8 months of storage (62 and 60 points respectively) than at time 0 and 2 months of storage (52 point for both). Global evaluation was almost similar for artisanal ham

and industrial ham (55 and 57 points respectively). However there were noticeable differences between slices and portions for global evaluation with higher values for the first samples, slices. On the other hand time storage improved sensorial global evaluation of ham with (58 points after 8 storage months and 50 points for time 0). Panel noticed strange colours, strange aromas and strange taste but always at low levels. Storage time never caused the increasing of those undesirable attributes. Aroma and strange taste can be related to the presence of acetaldehyde and pentane (results not shown in this work).

Table 2. Means and standard deviation for sensorial results using a scale from 0 to 100

	Process		Sample presentation		Storage time (month)			
	Artisanal	**Industrial**	**Portions**	**Slices**	**0**	**2**	**5**	**8**
Colour	60±2	63±1	62±1	61±2	56a±2	54a±2	66b±1	67b±2
Strange colours	5±1	6±1	6±1	5±1	7ab±1	8b±1	5ab±1	3a±1
Aroma	58a±1	53b±1	53a±1	60b±1	48a±5	50a±3	62b±2	59b±1
Strange aromas	5±1	3±0	4±1	3±1	7a±2	4ab±0	3b±0	3b±1
Tenderness	58±1	58±1	55a±1	62b±1	55ab±0	53b±1	62c±2	61bc±3
Suculence	52±1	49±1	48a±1	52b±1	43a±1	45a± 1	57b± 2	51c± 1
Taste	58±1	56±1	56±1	59±1	52a±1	52a±2	62b±2	60b±2
Strange taste	8±1	4±1	7±1	5±1	10±2	6±1	5±2	6±3
Salt intensity	50±1	43±1	47±1	45±1	43ab±4	42b±2	48ac±2	50c±2
Global evaluation	55±1	57±1	54a±1	59b±1	50a±1	52a±1	61b±1	58b±3

For each factor and for each physic-chemical variable. Different letters represent significantly different means for $p<0.05$.

IV – Conclusions

Physico-chemical parameters were different for artisanal and industrial hams. The different sample presentation didn´t influence a lot the physic-chemical parameters and, considering a practical point of view, the changes observed along the storage time weren't also very expressive.

The sensorial panel didn't notice important differences between the artisanal and industrial hams, neither between sliced ham and portions, however panelists preferred samples stored for a long time. Colour, aroma, tenderness, succulence, flavor became better with the permanence inside the package.

To storage portions and slices of dry cured ham of Alentejano pig bread in vacuum conditions at cold temperature (7ºC) is possible for at least 8 months, without noticeable changes in desirable attributes.

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