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INFLUENCE OF HAM WEIGHT, PACKAGING METHOD AND STORING ON WHITE FILM DEVELOPMENT ON CARSO DRY-CURED HAMS

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BACKGROUND AND OBJECTIVES

White film and sometimes white crystals on surfaces of vacuum packed, dry-cured hams are phenomenas very often seen on this type of product but usually rejected by consumers. The composition of white film is controversial, but it is generally excepted that the main component of white film is tyrosine (Toldrá et al., 1990), which is formed during ripening of ham due to endogenous protease activity (Arnau et al., 1989; Arnau et al., 1994). Many authors have discussed an influence of ham's ripeness (Toldrá et al., 1997) and storing temperatures (Arnau et al., 1994; Vuk et al., 1998) on development of this defect, but there are almost no evidences in the literature about ham's weight and packaging influence on white film development.

The aim of our work was to investigate an existence of correlation between ham weight (ripeness), methods of packaging and storing parameters and white film formation on Carso dry-cured hams.

MATERIAL AND METHODS

Two groups (thick and thin slices) of Carso dry-cured hams, each contained 14 hams, of two different weights (seven light 4-6 kg and seven heavy hams above 6 kg, in each group) were selected for our work, after they were aged for one year. Six 2-cm thick slices (thick group) or 2-mm thick slices (thin group) which consisted of three muscles (*Biceps femoris, Semimembranosus* and *Semitendinosus*), were cut perpendicular to the femur from each ham. Before the storing three slices from the same ham were vacuum packed and three were packed in nitrogen atmosphere. Each of three slices from the same ham and packed in the same way was then stored for 29 days at different temperatures: 8-10°C, 14-16°C and 20-22°C. After storing slices were sensory evaluated by four-member sensory panel (scored by scale from 1 to 5) for white film intensity ; where score 1 means absence of white film and score 5 means heavy white film, and white crystal presence, where score 1 means absence of white crystals and score 5 means unacceptable level of white crystals presence.

Table 1 Comparison of mean values (analysis of variance, Duncan's test) of frequency of white film, white crystals intensity and tyrosine content in thick slices of dry-cured hams with various white film intensity (of various weight, packaging methods and storing temperatures)

weight	light hams											
packaging	vacuum											
storing temperature (°C)	8-10				14-16				20-22			
white film intensity	no w.f.	moder.	inten.	F	no w.f.	moder.	inten.	F	no w.f.	moder.	inten.	F
white film frequency	1	4	2		2	4	1		1	6	0	
white crystals (1-5 points)	1	1,2	1	1,5	1	1,3	1	1,9	1	1,5	-	2,9
tyrosine $_{a.s.}$ (µmol/g d.m.)	20,08	35,17	$45{,}03^{1,2}$	3,1	22,58	$34{,}28^{1}$	$50{,}71^{1,2}$	$19{,}3^{***}$	23,19	36,18	-	2,9
packaging	nitrogen atmosphere											
white film frequency	0	4	3		1	6	0		2	5	0	
white crystals (1-5 points)	-	1,4	1	3,5	1	1,4	-	2,2	1	1,7	-	$10{,}2^{**}$
tyrosine $_{a.s.}$ (µmol/g d.m.)	-	27,84	47,75	$18{,}2^{**}$	21,98	38,22	-	$5{,}0^{*}$	22,55	38,51	-	$13{,}5^{**}$
weight	heavy hams											
packaging	vacuum											
white film frequency	2	5	0		2	5	0		0	7	0	-
white crystals (1-5 points)	1	1,2	-	2,8	1	1,2	-	2,2	-	1,2	-	-
tyrosine $_{a.s.}$ (µmol/g d.m.)	23,60	31,49	-	$5{,}1^{*}$	22,38	33,15	-	$14{,}4^{**}$	-	29,40	-	-
packaging	nitrogen atmosphere											
white film frequency	1	5	1		1	6	0		0	7	0	-
white crystals (1-5 points)	1	1	1	0,2	1	1,1	-	0,5	-	1,6	-	-
tyrosine $_{a.s.}$ (µmol/g d.m.)	24,23	28,14	$45{,}55^{1,2}$	$5{,}5^{*}$	22,99	33,66	-	3,2	-	29,39	-	-

Legend: a.s. = after storing; d.m. = dry matter; no w.f. = without white film (score 1); moder. = moderate white film (scores 1,5 to 2,5); inten. = intensive white film (scores 3 to 5)

From surfaces of hams (all six combinations of storing temperature and white film intensity) 2-mm thick slices were taken and analyzed for tyrosine content with following procedure (Pearson, 1968):

Slices were ground before analysis. Two g of sample was homogenized in an Ultra turrax T25 mixer with 40 ml of 5% threeclor acid for 2 min and then filtered through Schleicher & Schuell 583[3] filter paper. 10 ml of 0,5M NaOH and 3 ml of Folin & Ciocalteu reagent were added to 5 ml of filtrate and well shaken. After 5 minutes the absorbance at 660 nm was measured in Pye UNICAP SP 500 spectrophotometer. Tyrosine content in µmol of dry matter of dry-cured ham was calculate by formula:

$$c = \frac{\left(0{,}06363 \cdot A_{660} - 3{,}7924 \cdot 10^{-4}\right) \cdot R \cdot 40 \cdot 1000}{\left(100 - \%H_2O \cdot \frac{m}{100}\right) \cdot M_{tyr}}$$

Legend:

A_{660}-absorbance of sample at λ=660 nm, m-sample's mass (g), M_{ty}-mol mass of tyrosine, $\%H_2O$-percent of water in sample

RESULTS AND DISCUSSION

The results have shown that at higher storing temperatures (14°C and more) the frequency of white film and white film intensity are at low, which discovered Arnau et al. (1994), as well. But high temperatures (around 20°C) are not suitable for storing, because of improper sensory properties and possible microbiological spoilage of dry-cured hams.

Table 2 Comparison of average values (analysis of variance, Duncan's test) of frequency of white film, white crystals intensity and tyrosine content in thin slices of dry-cured hams with various white film intensity (of various weight, packaging methods and storing temperatures)

weight	light hams											
packaging	vacuum											
storing temperature (°C)	8-10				14-16				20-22			
white film intensity	no w.f.	moder.	inten.	F	no w.f.	moder.	inten.	F	no w.f.	moder.	inten.	F
white film frequency	1	6	0		0	7	0	-	0	7	0	-
white crystals (1-5 points)	1,1	1,2	-	0,2	-	1,1	-	-	-	1,3	-	-
tyrosine a.s. (μmol/g d.m.)	24,19	30,84	-	1,4	-	31,33	-	-	-	31,73	-	-
packaging	nitrogen atmosphere											
white film frequency	5	2	0		1	6	0		1	6	0	
white crystals (1-5 points)	1,4	1	-	8,5**	1	1,1	-	1,5	1	1,1	-	0,5
tyrosine a.s. (μmol/g d.m.)	28,97	41,27	-	20,6***	25,01	32,53	-	2,1	25,96	29,25	-	0,2
weight	heavy hams											
packaging	vacuum											
white film frequency	1	6	0		0	7	0	-	1	6	0	
white crystals (1-5 points)	1,5	1,1	-	18,6***	-	1,2	-	-	1	1,2	-	2,7
tyrosine a.s. (μmol/g d.m.)	25,87	29,83	-	2,7	-	30,68	-	-	26,56	32,49	-	5,4*
packaging	nitrogen atmosphere											
white film frequency	0	7	0	0	2	5	0		1	6	0	
white crystals (1-5 points)	-	1,5	-	-	1	1,2	-	6,1*	1	1,2	-	0,9
tyrosine a.s. (μmol/g d.m.)	-	30,87	-	-	29,29	31,38	-	1,9	28,34	32,21	-	1,9

Legend: a.s. = after storing; d.m. = dry matter; no w.f. = without white film (score 1); moder. = moderate white film (scores 1,5 to 2,5); inten. = intensive white film (scores 3 to 5)

Storing temperature has strong influence on formation of white crystals on dry-cured hams. Those are opposite to white film more present at higher storing temperatures.

Statistical analysis has shown that thick slices of dry-cured hams are more frequently defected by white film as thin one as discovered by Arnau et al. (1987) ant that white film is more intensive on thick slices.

The important discovery is that the weight of hams has important influence on white film. Drying of heavy hams is slower and at the end of drying process they contain more water, which is relevant for not only tyrosine solubility as main component of white film, but for other amino acids that are present in dry-cured hams, as well.

Compared to vacuum packaging, the packaging in nitrogen atmosphere does not reduce white film development.

Hams with more intensive white film on the surface contain more tyrosine than hams without one, which is a proof more that the white film development is related to tyrosine content in hams. The same was discovered by other authors, too (Butz et al., 1974; Arnau et al., 1987; Arnau et al., 1996). Statistical analysis has shown that the white crystals occur more often on thick than on thin slices and at higher temperatures (14-16°C and 20-22°C).

PERTINENT LITERATURE

Arnau, J. / Guerrero, L. / Hortós, M. / García-Regueiro, J. A. The composition of white film and white crystals found in dry-cured hams. Journal of the science of food and agriculture, 70(1996), 449-452.

Arnau, J. / Gou, P. / Guerrero, L. The effects of freezing, meat pH and storage temperature on the formation of white film and tyrosine crystals in dry-cured hams. Journal of the science of food and agriculture, 66(1994), p. 297-282.

Arnau, J. / Maneja, E. / Guerrero, L. L. / Monfort, J. M. Influence of freezing on tyrosine precipitate in Spanish raw cured ham. In: 35th international congress of meat science and technology. August 20-25, 1989. Copenhagen, Denmark. Proceedings, Vol. 3. Denmark, p. 716-718.

Arnau, J. / Hugas, M. / García-Regueiro, J. A. / Monfort, J. M. Tyrosine precipitate on the cut surfaces of dry-cured ham. Revista de agroquimica y tecnologia de alimentos, 27(1987a)3, p. 398-404.

Butz, R. G. / Blumer, T. N. / Christian, J. A. / Swaisgood, H. E. / Lucas, H. L. Factors responsible for white film formation on cut surfaces of dry-cured hams. Journal of food science, 39(1974), p. 516-519.

Pearson, D. Application of chemical methods for the assessment of beef quality-II. Methods related to protein breakdowm. Journal of the science of food and agriculture, 19(1968), p. 367-369.

Toldrá, F. / Flores, J. / Voyle, C. A. Study of the white film developed on the cut surface of vacuum-packed dry-cured ham slices. Journal of food science, 55(1990)4, p. 1189-1191.

Toldrá, F. / Flores, M. / Sanz, Y. Dry-cured ham flavour: enzymatic generation and process influence. Food chemistry, 59(1997)4, s. 523-530.

Vuk, K./ Žlender, B./Gašperlin, L. Amino acid composition and white film intensity of vacuum packed carso dry-cured hams stored at different temperatures. Proc. 44th ICOMST. 30. 8 - 4. 9 1998. Barcelona, Spain. Proceedings, C 85, p. 994-995.