AMINO ACID COMPOSITION AND WHITE FILM INTENSITY OF VACUUM PACKED CARSO DRY-CURED HAMS STORED AT DIFFERENT TEMPERATURES

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INTRODUCTION

White film on surface of vacuum packed, dry-cured hams is phenomena that is very seldom in that type of product, but is often rejected by consumers. The composition of white film is controversial, but it is generally excepted that the main component of white film is tyrosine (Toldra et al., 1990). The origin of white film is controversial, as well. It is known that white film is formed due to low tyrosine solubility (and also low water content in dried hams), which is together with other free amino acids result of ham ageing and endogenous protease activity (Arnau, 1994; Buschailhon et al. 1994; Arnau, 1989). Some authors find the cause of white film formation in tyrosine synthesis due to yeast, which can be found on ham surfaces (Comi et al. 1981).

The aim of our work was to investigate an existence of correlation between ham weight (ripeness), free amino acid content (not only tyrosine) and white film formation in Carso dry-cured hams.

MATERIAL AND METHODS

Fourteen Carso dry-cured hams were selected after they were aged for one year: seven light (average weight=4.73kg, a_w=0.856, %H_2O=48.63) and seven heavy (average weight=7.10kg, a_w=0.914, %H_2O=54.57) ones. Three 2-cm thick slices, which consisted of three muscles (*Biceps femoris, Semimembranosus and Semitendinosus*), were cut perpendicular to the femur from each ham and vacuum packed. Each of three slices from the same ham was then stored at different temperature: 8-10°C, 14-16°C and 20-22°C for 29 days. After storing slices were sensory evaluated for white film intensity (four-member sensory panel) and scored by scale from 1 to 5; where score 1 means absence of white film and score 5 means heavy white film.

According to sensory evaluation three hams from both light and heavy groups were selected: one with heavy white film (scores 3.5-5), one with moderate one (scores 1.5-3) and one with absence of white film (score 1). From surfaces of hams (all six combinations of storing temperature and white film intensity) 2-mm thick slices were taken and analysed for amino acids content.

Slices were ground before analysis.. As an internal standard 200 µl of L-norleucine solution (10 mg/ml 0.2 N Na-citrate) was then added to samples before homogenisation (modified method by Córdoba et al. 1994). One g of sample was homogenised in an Ultra turrax T25 mixer with 20 ml of 5% sulfosalicylic acid for 2 min. The homogenates were cooled at 2°C for 17 h and then centrifuged at 15300 x g for 10 min and filtered through Whatman No.541 filter paper. Filtrates were then extracted with diethyl ether in order to remove fat and neutralised with 4N NaOH. Amino acid analysis was done with Applied Biosystems 421 Amino Acid Analyzer. For amino acid identification solution (0.5 µmol/ml 0.2N Na-citrate) of standard amino acids (Pierce Chemical Co., Rockford, IL., USA) were used.

RESULTS AND DISCUSSION

Amino acid analysis has showed significantly different (P<0.001) Met, Ile, Leu, Phe, Pro and Tyr content in lighter (riper) hams with different white film intensity regardless to storing temperature (Table 1, Figure 1). Hams with heavy white film had the highest content of these amino acids (P<0.001). Samples without white film had the lowest content of previous mentioned amino acids (P<0.01). These results support the theory by Toldrá et al. (1990) that Pro, Met, Ile, Leu, Phe and Tyr are amino acids present in white film. But results also showed the significantly highest (P<0.001) Asp, Glu, Ser Gly and Ala and Val content in hams with heavy white film and the lowest in samples without it. That suggest that these amino acids may also be present in white film as discovered Butz et al. (1974).

Table 1 Amino acid content (µmol / g of ham dry matter) in light hams with various white film intensity stored at different temperatures.

weight	light group											
temperatu	8-10°C				14-16°C				20-22°C			
white film	h	m^{i}	a^{ii}	F value	h	m	a	F value	h	m	a	F value
ASP	$7.15^{a,m}$	5.01	4.42	11.54^{**}	$9.92^{a,m}$	4.99^{h}	3.36	55.28^{***}	$11.55^{a,m}$	6.02	6.37	579.5^{***}
GLU	$24.12^{a,m}$	22.16^{a}	19.49	17.22^{**}	$27.21^{a,m}$	21.6^{h}	17.21	28.50^{***}	$28.61^{a,m}$	21.62	21.45	19.69^{**}
SER	$9.98^{a,m}$	8.44	7.56	17.08^{**}	$11.62^{a,m}$	8.21	7.05	33.99^{***}	$12.09^{a,m}$	8.48	8.79	28.91^{***}
GLY	$13.84^{a,m}$	11.16	9.41	8.54^{*}	$18.01^{a,m}$	10.82	8.74	29.46^{***}	$16.82^{a,m}$	10.91	10.71	44.89^{***}
HIS	3.9	2.69	3.31	1.24	4.65	2.99	2.8	3.06	$4.86^{a,m}$	2.97	3.32	6.04^{*}
ARG	8.46	7.61	7.35	1.18	$13.27^{a,m}$	7.38	6.55	10.51^{*}	10.11	8.26	8.95	0.87
THR	9.86	7.39	9.16	2.17	$9.67^{a,m}$	7.75	7.97	5.18^{*}	$11.7^{a,m}$	9.17	9.06	13.56^{**}
ALA	23.97^{a}	22.24^{a}	17.89	21.69^{**}	$25.34^{a,m}$	21.54^{a}	16.36	19.22^{**}	$25.78^{a,m}$	22.57	19.83	7.87^{*}
PRO	$9.27^{a,m}$	7.92	7.25	16.30^{**}	$9.94^{a,m}$	7.98^{a}	6.4	30.16^{***}	$11.22^{a,m}$	8.29	8.34	21.83^{**}
TYR	$9^{a,m}$	4.67^{a}	3.72	517.6^{***}	$9.56^{a,m}$	4.58^{a}	2.8	590.4^{***}	$9.88^{a,m}$	4.37^{a}	3.5	7695^{***}
VAL	$11.6^{a,m}$	9.88^{a}	8.55	41.05^{***}	$12.13^{a,m}$	9.98^{2}	7.86	33.41^{***}	$13.75^{a,m}$	10.55	9.81	32.44^{***}
MET	$3.8^{a,m}$	2.49	2.59	14.61^{**}	2.94	3.17	2.26^{3}	4.90^{*}	$4.43^{a,m}$	2.83	2.81	8.87^{*}
CYS	0.18	0.11	0.12	0.23	0.08	0.14	0.2^{1}	5.14^{*}	0.3	0.13	0.18	0.95
ILE	$8.75^{a,m}$	6.22^{a}	5.8	341.3^{***}	$9.41^{a,m}$	6.49^{a}	5.24	62.30^{***}	$10.08^{a,m}$	6.6	6.35	135.3^{***}
LEU	$14.69^{a,m}$	10.76	9.73^{2}	96.59^{***}	$15.66^{a,m}$	11.29^{a}	8.58	53.32^{***}	$17.03^{a,m}$	11.48	10.88	52.63^{***}
PHE	7.38	5.13^{a}	4.72	961.2^{***}	$7.6^{a,m}$	5.46	4.16	18.06^{**}	$8.06^{a,m}$	5.31	4.99	315.9^{***}
LYS	15.62	13.79	13.2	8.22^{*}	$16.92^{a,m}$	14.23	11.97	11.33^{**}	$18.83^{a,m}$	14.08	14.19	35.40^{***}

h-heavy white film m-moderate white film a-absence of white film
* P<0.05 ** P<0.01 ***P<0.001

Results in heavy (less ripe) hams (Table 2, Figure 2) showed only significantly different (P<0.01) Tyr content (the highest in hams with heavy white film) regardless to temperature, which proofs again that tyrosine is the main component of white film (Arnau et al. 1996).

But it can also be assumed that the difference in amino acid content between heavy and light hams is due to difference between ripeness of both ham groups (Table 1, Table 2).

Tyr content in hams with heavy white film is significantly higher in light group then in heavy one (regardless to temperature), but both groups have almost the same Tyr content in hams with moderate white film or without it, regardless to temperature (Fig. 1 and Fig. 2).

Table 2 Amino acid content (μmol / g of ham dry matter) in heavy hams with various white film intensity stored at different temperatures.

weight	heavy group											
temperat.	8-10°C				14-16°C				20-22°C			
white film	h	m	a	F value	h	m	a	F value	h	m	a	F value
ASP	4.21	4.57	6.93^{h,m}	32.60***	4.98	5.76	7.51^{h,m}	9.31*	6.33	6.34	9.28^{h,m}	19.58**
GLU	18.64	16.24	17.26	1.51	19.61	17.87	18.96	0.46	18.04	18.87	21.07	2.18
SER	8.44	7.43	7.03	1.74	8.72	7.84	7.64	1.09	7.15^{a,m}	4.8	4	20.41**
GLY	11.12	9.55	12.01	0.53	11.9	10.52	14.14	0.66	10.96	11.36	14.56	0.79
HIS	3.19	3.44	1.97	3.41	3.31	3.06	2.5	0.50	3.35	3.3	2.57	1.53
ARG	8.7	7.83	6.49	1.56	9.09	7.46	6.52	1.48	3.39	3.88	2.05	1.67
THR	7.85	7.41	5.79	4.29	7.42	7.02	6.13	3.46	7.42^{A}	6.83	5.82	6.56*
ALA	19.6^{a}	15.78	14.53	5.45*	20.83	16.59	15.43	4.71	17.32	18.06	17.51	0.14
PRO	7.23	6.42	6.2	2.62	7.87	6.8	6.96	1.45	7.26	7.37	8.16	1.55
TYR	5.63^{a,m}	4.1	2.76	37.53***	5.89^{a,m}	3.4	2.89	48.77***	6^{a,m}	3.3	3.02	30.99***
VAL	8.56	7.52^{a}	7.18	1.92	9.35	8.31	7.58	2.32	9.07	8.89	8.17	0.48
MET	2.16^{a,m}	1.62	1.47	8.48*	2.27^{a}	2.05^{a}	1.41	6.31*	2.59	2.58	1.66	4.25
CYS	0.23	0.15	0.12	4.88	0.18	0.12	0.11	1.14	0.19	0.31	0.12	2.40
ILE	6.04	5.04	4.67	4.96	6.42	5.47	4.9	4.49	6.29	5.97	5.44	1.38
LEU	10.24	8.68	7.96	4.78	11.01	9.44	8.43	4.04	10.6	10.19	9.6	0.80
PHE	5.15^{a}	4.31	3.47	9.48*	5.13^{a}	4.29	3.54	5.74*	4.95	4.48	3.97	2.18
LYS	13.4^{a}	11.27	10.02	6.11*	13.71	11.96	10.19	3.61	12.9	12.69	12.12	0.19

h-heavy white film m-moderate white film a-absence of white film

* P<0.05 ** P<0.01 ***P<0.001

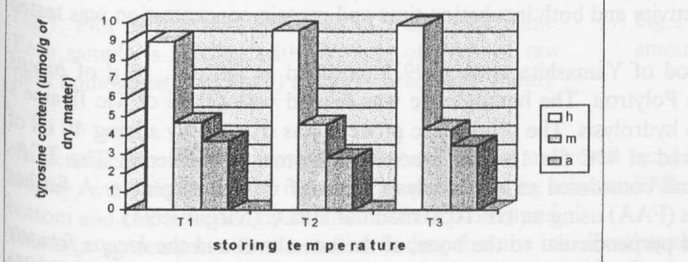

Figure 1 Tyr content in light hams with various white film intensity stored at different temperatures.

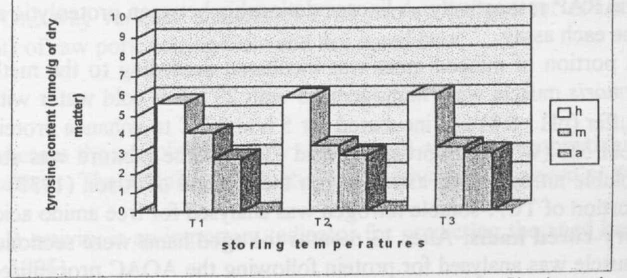

Figure 2 Tyr content in light hams with various white film intensity stored at different temperatures.

REFERENCES

Arnau, J.; Guerrero, L.; Hortós, Regueiro, J. A. G. The Composition of White Film and White Crystals Found in Dry-Cured Hams. J. Sci. Food Agric. 1996, 70, 449-452.

Arnau, J.; Guerrero, L.; Gou, P.; The Effect of freezing , Meat pH and storage temperature on the formation of white film and tyrosine crystals in dry-cured hams. J. Sci. Food Agric. 1994, 66, 279-282.

Arnau, J.; Maneja, E.; Guerrero, L. L.; Monfort, J. Influence of Freezing on Tyrosine Precipitate in Spanish Raw Cured Ham. In: 35th International Congress of Meat Science and Technology, Aug. 20-25, 1989. Copenhagen, Denmark. Roskilde, Denmark. Vol. 3, 716-718.

Buschailhon, S.; Monin, G. Time-related Changes in Nitroge Fractions and Free Amino Acids of Lean Tissue of French Dry-cured Ham. Meat Science 1994, 37, 449-546.

Butz, R. G.; Blumer, T. N.; Christian, J. A.; Swaisgood, H. E. Factors Responsible For Wite Film Formation on Cut Surfaces of Dry-cured Hams. 1974, 39, 516-519.

Comi, G.; Cantoni, C.; Saronni, G.; Denozza, D. Ipotesi sulla formazione di cristalli di tirosina nei prosciutti crudi da parte dei lieviti. Industrie alimentari 1981, 20, 879-884.

Córdoba, J. J.; Rojas, T. A.; González, C. G.; Barroso, J. V.; Bote, C. L.; Asensio, M. A. Evolution of Free Amino Acids and Amines during Ripening of Iberian Cured Ham. J. Agric. Food Chem. 1994, 42, 2296-2301.

Kemp, J. D.; Langlois, B. E.; Akers, K.; Means, W. J; Aaron, D. K. Effect of Storage Temperature and Time on the Quality of Vacuum Packaged Dry-Cured Ham Slices. J Food Sci. 1988, 53, 402-406.

Toldrá, F.; Flores, J.; Voyle, C. A. Study of the White Film Developed on the Cut Surface of Vacuum-packed Dry-cured Ham Slices. J. Food Sci. 1990, 55, 1189-1191.