C89

COLOR PARAMETERS EVOLUTION DURING THE SALTING AND POSTSALTING STAGES OF DRY-CURED HAM

M.A. GAGO-GAGO, J.A. PEREZ-ALVAREZ, R. FORCEN, M.J. PAGAN-MORENO, F. PERLO, M.R. ROSMINI(*), M.L. IRIARTE-ITOIZ, F. LOPEZ-SANTOVEÑA(**), V. ARANDA-CATALA.
Departamento de Tecnología de Alimentos. Universidad Politécnica de Valencia. Camino de Vera 14. 46022 Valencia. SPAIN
*Departamento de Salud Pública, Facultad de Agronomía y Veterinaria. Universidad Nacional del Litoral. Esperanza. ARGENTINA.
**Instituto de Agroquímica y Tecnología de Alimentos. Valencia. SPAIN.

KEYWORDS: salting - postsalting - dry cured ham - CIEL*a*b* 1976 - reflectance ratios (R560/R500, R680/R580, R650/R570).

BRACKGROUND

The Spanish meat industry has traditionally made dry-cured products. From all of these, dry-cured ham is the most important of them. The study of color development is very important because in the mind of the average consumer about to purchase this type of product, color is synonymous with dry-cured ham quality. Little information on color is available for dry-cured ham.

OBJECTIVE

The aim of this work was to study the color parameter evolution (CIEL*a*b*, 1976 notations) and reflectance ratios (IN: R560/R500, ITP: R630/R580, ID: R650/R570) during salting and the postsalting stage of the dry-curing process.

EXPERIMENTAL METHODS

This study was carried out with 8 female raw hams with a pH of 5.6 (measured with a Crison 507 pHmeter and in accordance with the industrial practice). The hams were put in salt for 8 days (salting stage) and let to rest for 21 days (2 ± 1°C) (postsalting stage).

The area under study was limited to between the central part of the femur bone and the perpendicular area of that bone. Six slices from each ham, 2.5 cm thick, were obtained and, on each one of these, the following muscles were studied: Semimembranosus (SM), Semitendinosus (ST) and Biceps femoris (BF). The samples were taken at 0, 3, 4, 5, 6, 7, 8, 16, 24 and 30 days after the beginning of the process.

CIE L* a* b*, 1976 notations and reflectance ratios (R560/R500, R680/R580, R650/R570 were measured. For all color measurements a Minolta CM1000R spectrophotometer was used and the American Meat Science Association Guidelines for color measurements were followed. Statistical analysis (ANOVA) with a BMDP version 9 was undertaken.

TABLE 1: Means (x) and standard deviations (Sd) of reflectance ratios (IN; ID and ITP) during salting and postsalting stages.

		Biceps femoris			Semitendinosus			Semimembranosus		
t		IN	ID	ITP	IN	ID	ITP	IN	ID	ITP
3	x	1.48	1.24	1.15	1.63	1.05	1.04	1.72	1.06	1.04
	Sd	0.03	0.17	0.14	0.03	0.17	0.14	0.03	0.17	0.14
4	x	0.68	2.50	2.31	0.57	3.79	3.26	0.83	2.12	1.83
	Sd	0.03	0.17	0.14	0.03	0.17	0.14	0.03	0.17	0.14
5	x	0.63	2.82	2.55	0.67	3.07	2.69	0.78	2.31	2.07
	Sd	0.03	0.17	0.14	0.03	0.17	0.14	0.03	0.17	0.14
6	x	0.61	3.15	2.85	0.63	3.22	2.85	0.78	2.14	1.96
	Sd	0.03	0.17	0.14	0.03	0.17	0.14	0.03	0.17	0.14
7	x	0.69	3.18	2.94	0.65	4.02	3.65	0.79	2.21	2.02
	Sd	0.03	0.17	0.14	0.03	0.17	0.14	0.03	0.17	0.14
8	x	0.65	3.66	3.41	0.65	4.41	4.04	0.78	2.15	1.97
	Sd	0.03	0.17	0.14	0.03	0.17	0.14	0.03	0.17	0.14
16	x	0.62	2.79	2.61	0.64	3.46	3.11	0.86	2.16	1.90
	Sd	0.02	0.07	0.10	0.02	0.07	0.10	0.02	0.07	0.10
24	x	0.61	2.77	2.49	0.60	3.41	3.05	0.86	1.94	1.71
	Sd	0.02	0.07	0.10	0.02	0.07	0.10	0.02	0.07	0.10
30	x	0.60	2.78	2.50	0.82	2.07	1.87	0.86	1.78	1.58
	Sd	0.02	0.07	0.10	0.02	0.07	0.10	0.02	0.07	0.10

t: time (days)

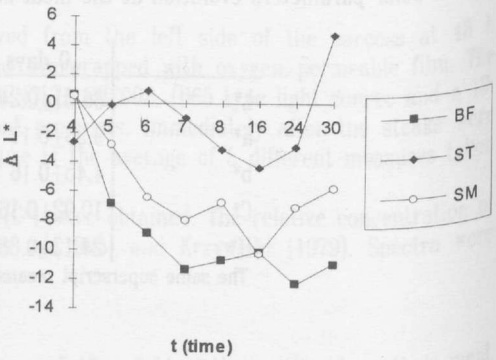

Figure 1: ΔL*/ time.

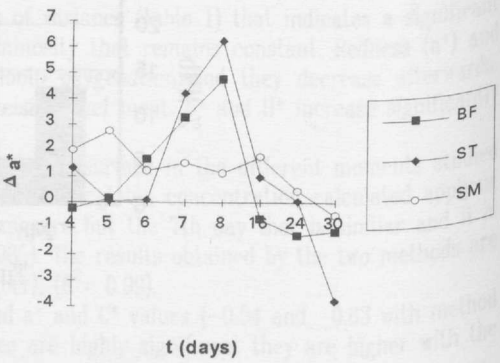

Figure 2: Δb*/ time.

TABLE 2: Means (x) and standard deviations (Sd) of color parameters (L*, a*, b*) during salting and postsalting stages.

t		Biceps femoris			Semitendinosus			Semimembranosus		
		L*	a*	b*	L*	a*	b*	L*	a*	b*
3	x	53.50	9.11	13.07	44.03	11.35	11.74	44.72	5.44	8.25
	Sd	2.78	3.02	0.72	2.78	3.02	0.72	2.78	3.02	0.72
4	x	54.1	8.87	13.72	41.39	12.67	11.77	45.24	7.47	11.14
	Sd	2.78	3.02	0.72	2.78	3.02	0.72	2.78	3.02	0.72
5	x	46.63	9.27	11.75	43.96	11.40	12.27	41.88	8.18	8.19
	Sd	2.78	3.02	0.72	2.78	3.02	0.72	2.78	3.02	0.72
6	x	44.62	10.79	12.11	44.93	11.46	12.71	38.29	6.67	6.06
	Sd	2.78	3.02	0.72	2.78	3.02	0.72	2.78	3.02	0.72
7	x	42.20	12.4	11.47	43.03	15.57	13.75	36.76	6.98	5.61
	Sd	2.78	3.02	0.72	2.78	3.02	0.72	2.78	3.02	0.72
8	x	42.8	13.87	13.02	40.87	17.57	14.13	37.94	6.59	5.89
	Sd	2.78	3.02	0.72	2.78	3.02	0.72	2.78	3.02	0.72
16	x	43.37	8.46	10.60	39.60	12.35	11.22	34.42	7.19	7.05
	Sd	0.80	0.58	0.38	0.80	0.58	0.38	0.80	0.58	0.38
24	x	41.18	7.82	8.85	41.00	11.41	10.86	37.60	5.89	7.10
	Sd	0.80	0.58	0.38	0.80	0.58	0.38	0.80	0.58	0.38
30	x	42.17	8.00	9.27	48.72	7.49	9.77	38.93	4.94	7.49
	Sd	0.80	0.58	0.38	0.80	0.58	0.38	0.80	0.58	0.38

t: time (days)

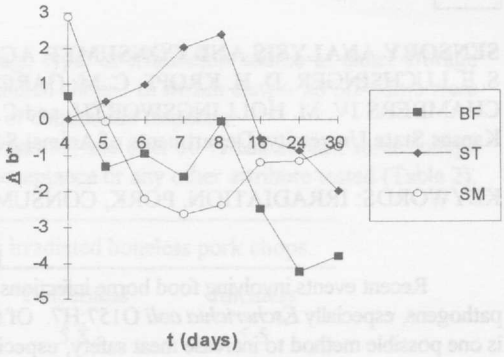

Figure 3: Δb*/ time.

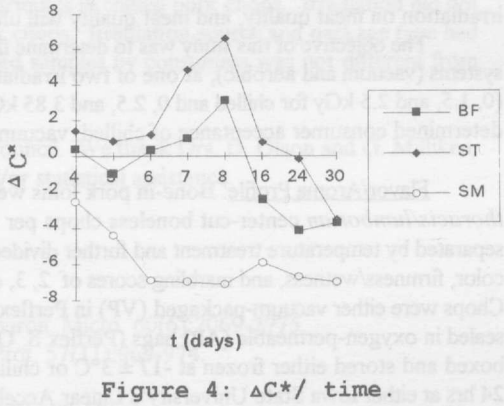

Figure 4: ΔC*/ time.

RESULTS

Tables 1 and 2 show the means and standard deviations of CIE L*a*b* parameters and the reflectance ratios respectively from each muscle during salting and postsalting stages. The lightness values for each raw muscle under study were similar to that obtained by Kauffman et al. (1991). Significant differences between fresh and salted muscles, during salting stage, were not found. Table 3 shows ΔE* for each muscle and sampling time. According to Prändl et al. interpretation (1994) on ΔE* values, it can be observed that the differences between the three muscles are big in general terms. The ΔE* increase on the BF muscle during salting stage was evident, but the increase was only irregularly maintained during postsalting. On the ST muscle ΔE* behavior shows an irregular evolution, with a noticiable increase at the end of the salting and postsalting stages. On the SM muscle, color differences are very evident at the beginning of salting, becoming big during the rest of the stage and also in the postsalting stage.

Significant differences between muscles were found for all color parameters. These differences on the color parameters evolution can also be observed in figures 1 to 4. Figure 1 shows the ΔL* evolution. In this figure it can be observed that the darkest muscle during the process evolution was the BF muscle, having a lower loss of L* on the ST muscle and the SM and BF muscles were the ones that became darker. The development of Δa* can be observed on figure 2. This figure reflects that, during salting, all the muscles become more reddish. However, during postsalting, this parameter decreases in all the muscles. Figure 3 shows the Δb* evolution. It can be observed that while the Δb* decreases on SM and BF during the whole studied process, on ST the values increase (it becomes yellowish) during salting and decrease during postsalting. Figure 4 shows the ΔC* evolution. During salting it can be seen that the SM muscle turns grayish and that BF and ST get more saturated; but during postsalting all the colors became grayer.

The evolution of reflectance ratios shows that IN decreased during salting stage, but ID and ITP increased during this stage. Significant differences for all reflectance ratios, during postsalting stage, were not found.

CONCLUSIONS

Big differences on color between the muscles can be observed during salting and postsalting. SM, BF and ST were more reddish during salting, losing the components of a* during postsalting. SM and BF lose the components of b* during the whole process, while, in ST, the values of the yellow component increase during salting and afterwards decrease during postsalting. The evolution of the ΔC* on SM during the whole process tend towards less satured colors. During salting C* of BF and ST leads to more satured colors, whereas on postsalting they tended towards gray. The excelent cured color was obtained at the end of the salting stage.

REFERENCES

Kauffman, R.G.; Warner, R.D. & Russell, R.L. (1991) Variations in lightness and exudation among ten porcine muscles. Proc. of 37th ICoMST, Kulmbach. Vol. 1, 135 - 138.

Prändl, O.; Fischer, A.; Schmidhofer, T. y Sinell, H.J. (1994) Tecnología e higiene de la carne. Zaragoza, Acribia.