CURING AGENTS EFFECT ON COLOR PROPERTIES IN PORK LEAN MEAT DURING VACUUM DEHYDRATION PROCESS

Sayas-Barberá, E.[1]; Pérez-Alvarez, J.A.[1]; Fernández-López, J.[1]; López-Noguera, S.M.[1] and Perlo, F.[2]

[1]Departamento de Tecnología Agroalimentaria, Escuela Politécnica Superior de Orihuela, Universidad Miguel Hernández, Ctra. Beniel Km 3,2, Orihuela-03312, Alicante, Spain. [2] Facultad de Ciencias de la Alimentación, UNER, Universidad Nacional de Entre Ríos, Concordia, Argentina.

BACKGROUND

Color is one of the most important characteristics that the consumers use when selecting meat products (*McDougall, 1982*). Dry-cured products have a great importance in the Spanish meat industry. These type of products are being studied recently, the color (in objective way) is one of the properties that few research have been done. The interaction between curing agents, meat dehydration, myoglobin forms have not been well established in these type of products. *Fernández*-López (1998) has studied some of these interaction in dry-cured model systems. *Sayas (1997)* studied the evolution of meat structure and its influence in lightness in dry-cured ham process.

OBJECTIVE

The aim of this work was to evaluate color (CIELAB color space) and chemical parameters (pH, moisture and residual nitrite level) on pork lean meat using two different curing agents formulas during its vacuum dehydration.

METHODS

Sample preparation: For the present study, lean pork meat cut into pieces of approximately 10 x 5x 2 cm. The half of samples were cover with a dry salt mixture (90 g NaCl, 6 g $NaNO_2$ and 4 g $NaNO_3$) on 1,5% of meat weight (Formula 1) and the other half samples with a Formula 2 (95 g NaCl, 3 g $NaNO_2$ and 2 g $NaNO_3$) on 1,5% of weight. The samples were kept for 24 hours in cold storage (4°C). Finally, the samples were vacuum dehydrated at room temperature (18 ± 2°C) during 9 hours. Color coordinates [Lightness (L*), Redness (a*) and Yellowness (b*)] and chemical parameters [pH, moisture content and residual nitrite level] was determined, at 60 minutes intervals until all time was completed. This studies were performed with three replications.

Analytical methods: The *CIELAB coordinates* (D_{65} y 10°) was determined following the recommendations of *Cassens et al. (1995)*. Color determinations were made by means of a Minolta Reader CR-10 (Minolta Camera Co. Ltd. Osaka, Japan). American Meat Science Association Recommendation for color measurements were followed (*Hunt et al., 1991)*. The *moisture content* was determined according to *ISO method (1975a)*. Results were expressed as water (g)/100 g tissue. *Residual nitrite levels* were determined according to the *ISO method (1975b)* with results expressed as mg per Kg. The *pH* determinations were taken using a Crison GLP21 pHmeter and a Crison CAT n°52-32 electrode (Crison Instruments, S.A., Alella, Barcelona, Spain) in accordance with Spanish Ministry of Health regulations *(Ministerio de Sanidad y Consumo, 1985).*

Statistical Analysis. Results were statistically analyzed by ANOVA test. Orthogonal contrasts were assessed by Tukey`s test (*Affi & Azen, 1979*) using the Statistical Software Statgraphics Plus 2.0.

RESULTS AND DISCUSSIONS

ANOVA results for lightness (L*) indicated significant differences (P<0,05) for the time factor and no significant differences (P> 0.05) between formula 1 and 2 were found (table 1). The lightness is related to the thin aqueous layer on the meat's surface (*Hunt, 1980*), additives and species incorporated, muscle structure and the water movement (dehydration) (*Swatland, 1995; Sayas, 1997*). These results suggest that lightness depends on the water content and water movement towards the surface (*Pérez-Alvarez, et al., 1999*) and not depends on curing agents concentration. L* values diminishing during dehydration, this might be due to lost of moisture contents of samples during vacuum dehydration process. The decrease of the lightness values during dehydration stage has been reported by other authors in dry-cured sausages model system (*Pérez-Alvarez, 1996; Fernandez, 1998*).

For redness (a*), significant differences (P<0.05) between times and between formulas were found. a* values increased during the dehydration process, this could be due to the formation of nitrosomyoglobin, moisture loss and the increase of salt content. This coordinate is related with the myoglobin (Mb) content *(Johansson et al., 1991). Fernández-López (1998)* reported that the salt content was responsible for increases on this color co-ordinate in a dry-cured sausage model system. The formula 1 showed the highest redness (table 1), this could be attributed to the higher $NaNO_2$ concentration in this formula.

For yellowness (b*), significant differences (P<0.05) between times and between formulas were found. The formula 1 showed the highest values (table 1), this could be due to the lowest salt concentration in this formula. During the dehydration b* decreased, this behavior could be attributed to metamyoglobin formation due to the low oxygen concentration during vacuum dehydration process.

ANOVA results for pH showed no significant differences (P>0.05) between formula 1 and formula 2 (table 1) and significant differences (P<0.05) were found between times. The decreased in pH during dehydration may be due to incorporation of salt (*Arnau et al., 1995, Sayas, 1997*).

ANOVA results for moisture show that significant differences (P<0,05) existed between times, but not between (P>0,05) formulas (table 1). The curing agent concentration would not affect at dehydration process.

ANOVA results for residual nitrite levels showed significant differences ((P<0.05) between times and formulas. The nitrite values decreased during the dehydration process. Other author has reported that the residual nitrite levels diminishes during the dry-cured process due to several mechanisms: transformation into other compounds (nitrates), reaction to other meat components (proteins, cytochromes, etc.) and the presence of ascorbate acid and its salts (*Pérez-Alvarez et al., 1999*).

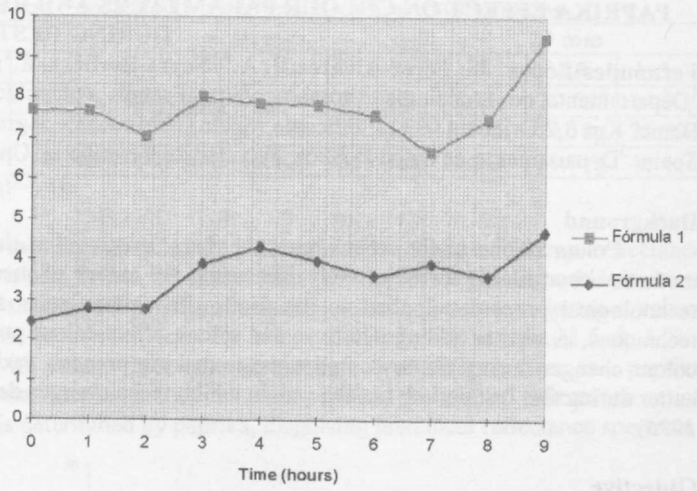

Figure 1.- Redness (a*) evolution during vacuum dehydration.

Table 1.- Average values of color coordinates chemical and parameters in lean pork meat with different curing agents formulas (formula 1 and formula 2).

FORMULA	L*	a*	b*	pH	MOISTURE	NITRITE
1	36,87 a	7,75 a	6,67 a	5,55 a	69,94 a	728,6 b
2	37,07 a	3,55 b	3,50 b	5,52 a	70,54 a	408,63 a

a-b Values with the same letter within the same row do not significantly differ (P> 0,05)

CONCLUSION

The curing agent concentration did not affect L* values, pH and moisture content. The coordinates a* and b* depended the curing agent concentration. During vacuum dehydration process the L* and b* values, moisture content and residual nitrite levels decreased and a* values increased.

REFERENCES

Affi, A & Azen S.P. (1979). Statistical analysis. A computer oriented approach. Academic Press Inc. Londres

Arnau, J.; Guerreo, L.; Casademont, G. & Gou, P. (1995). Physical and chemical changes in different zones of normal and Pse dry cured ham during processing. Food Chemistry, 52, 63-69.

Cassens, R.G.; Demeyer, D.; Eidelenboom, G.; Honikel, K.O.; Johansson, G.; Nielsen, T.; Renerre, M.; Richardson, Y. & Sakata, R. (1995). Recommendation of reference method for assessment of meat color. Proc. 41th Intern. Cong. Meat Sci. and Technol.. San Antonio (Texas), C86, p. 410-411.

Fernández-López, J. (1998) Estudio del color por métodos objetivos en sistemas modelo de pastas de embutidos. Ph.D. Thesis. Murcia University, Murcia, Spain.

Hunt, M.C.; Acton, J.C.; Benedict,R.C.; Calkins, C.R.; Cornforth, D.P.; Jeremiah L.E.; Olson, D.P.; Salm,C.P.; Savell, J.W. & Shivas, S.D. (1991) American Meat Science Association, Guidelines for meat color evaluation. Chicago.

ISO 1975a Meat and meat products Determination of Moisture content. R 1442 International Organization of Standardization. Geneva, Switzerland.

ISO 1975b Meat and meat products Determination of Nitrite content. R 2918 International Organization of Standardization. Geneva, Switzerland.

Johansson, G.; Tornberg, E. & Lundström, K. (1991) Meat colour in loin and ham muscles of normal meat quality from Hampshire, Swedish Landrace and Yorlshire pigs. Proc. 37th Intern. Congr. Meat Sci. and Technol. Kulmbach (Germany). p.394-397.

McDougall, D.B. (1982). Changes in the colour and opacity of meat. Food Chemistry, 9, 75-88.

Ministerio de Sanidad y Consumo (1985). Carnes y derivados. Colección: El Código Alimentario Español y su desarrollo normativo (Vol. II. Pp. 132-133). Madrid: Ministerio de Sanidad y Consumo.

Pérez-Alvarez, J.A. 1996. Aportaciones al estudio objetivo del color en embutidos crudo-curados. Ph. D. Thesis. UPV ,Valencia.

Pérez-Alvarez, J.A.; Sayas-Barberá, E.; Férnandez-López, J. &Aranda-Catalá, V. (1999). Physicochemical characteristics of Spanish-type dry –cured sausage. Food Research International 32, 599-607.

Sayas, E. (1997) Contribuciones al proceso tecnológico de elaboración del jamón curado: Aspectos físicos, físico químicos y ultraestructurales en los procesos de curado tradicional y rápido. Ph.D. Thesis. Universidad Politécnia de Valencia, Valencia, Spain.

Swatland, H.J. (1995) Optical properties of meat. In: On-line evaluation of meat. Technomic Publishing Co. Inc. Lancaster. USA, pp. 121-154.