PAPRIKA EFFECT ON COLOUR PARAMETERS AND REFLECTANCE VALUES IN SPANISH-TYPE SAUSAGES DURING RESTING STAGE

Fernández-López, J.[1]; Pérez-Alvarez, J. A.[1]; Sayas-Barberá, E.[1]; López-Santoveña, F.[2] and Rosmini, M.R.[3].
[1]Departamento de Tecnología Agroalimentaria, Escuela Politécnica Superior de Orihuela, Universidad Miguel Hernández, Ctra. Beniel Km 3,2.Orihuela 03312, Alicante, Spain. [2]Instituto de Agroquímica y Tecnología de Alimentos, CSIC, Burjasot, Valencia, Spain. [3]Departamento de Salud Pública. Facultad de Veterinaria. Universidad Nacional del Litoral, Esperanza, Santa Fe, Argentina

Background.

Colour is one of the most important characteristics that the consumers use when selecting and purchasing foods. Several methods are available for objectively measuring the colour of meat products and other food products (*Pérez-Alvarez, 1996*). The technological processes applied to the foodstuffs, in particular size reduction (comminution) (*Judge et al., 1989*) and mixing techniques, as well as adding additives and spices, affect colour properties (*Mabon, 1993; Giese, 1995*). In studies carried out upon colour changes during the dry-cured sausage making process, variations have been observed in the colour properties of the meat batter during that rest period, but the way in which those changes develop during that period has yet to be established (*Pérez-Álvarez, 1996*).

Objective.

The aim of this work was to evaluate the effect of different paprika concentrations (0%, 1,5% & 3%) on colour parameters (CIEL*a*b*) and reflectance values in Spanish dry-cured sausages model systems, during resting stage.

Methods.

Sample preparation: For the present study, pork lean shoulder meat cut into pieces of approximately 10 x 10 cm (the usual form of supplying meat for subsequent processing) and provided by a registered abattoir, were used. Three sizes of mince were studied, two obtained by using a screw mincer provided with plates with 10 mm or 20 mm diameter holes, while the third size (fine) was obtained by using a cutter. For each size of mince studied three lots of meat (1100 g each) were used. Two of these lots were mixing with paprika (1,5% & 3%, respectively) and the other one was not paprika added. Each lot, after mixing, was divided into 9 cylindrical glass containers (120 g) with a diameter of 6 cm and height of 3 cm so that the sample could be considered as an infinite solid for colour determinations.

Analytical methods: The CIELAB coordinates (D_{65}, 10°) was determined following the suggestions of *Cassens et al.*, (1995). The reflectance spectra, every 10 nm, between 400 and 700 nm were also obtained. Colour determinations were made by means of a Minolta CM-2002 spectrophotometer. American Meat Science Association Guidelines for colour measurements were followed (*Hunt et al., 1991*).

Statistical Analysis: Each parameter was tested in triplicate. Statistical analysis (ANOVA) and Tukey´s test were applied (*Affifi & Azen, 1979*). The statistical data analysis was undertaken using the statistical package BMDP ver. 9.0.

Results and Discussion.

Lightness (L):* ANOVA results showed differences ($P<0,01$) for mincing and paprika factors, but not for time factor. These results indicated that L* modifications due to paprika addition were made at the moment that this spice was added. L* increasing with the degree of mincing and being highest in the fine samples (table 1). Mincing has been seen to modify lightness values in other studies of lean meat. The results obtained in this study, suggesting that the modifications in the structure of the meat caused by mincing are responsible for this increase. This might also be responsible for the increased L* values obtained with higher degrees of mincing since the structural breakdown of the muscle is that much greater and so more water from the sarcoplasm is made available on the surface of the batter. The incorporation of air by the action of mincing should also be taken into account since this increases L*, a greater dispersion of light being caused by the air bubbles trapped in the paste (*Palombo et al., 1989*). L* values were highest in the samples without paprika, diminishing when paprika was added to the minced meat (table 1). Paprika, like other spices absorbs water. This absorption depends on the content of compounds with high molecular weight and on the size and number of particles.

Redness (a)*: ANOVA results showed differences ($P<0,01$) for all factors studied. a* values diminishing during resting stage (figure 1). Has been reported that during paprika oxidation the a* values decreased (*Grau, 1996*), therefore the decrease in a* values during the resting stage, observed in this study, could be indicated a incipient paprika oxidation. a* diminishing with the degree of mincing and being smallest in the fine samples (table 1). It has been suggested that this coordinate is related with the myoglobin (Mb) content (*Johansson et al., 1991*), and this was confirmed by *Fernández-López* (1998) who also pointed out that a* values fall with increasing levels of metmyoglobin. The diminution in a* caused by mincing degree being due to the changes in the different states of Mb. a* values increased when the paprika was incorporated to the sample. Paprika has a lot of red components (capsanten & capsorruben) (*Biacs et al., 1989; Levy et al., 1995*) which have a great contribution to redness and could be the responsibles to a* increase in the meat batter added with this spice. a* values obtained for paprika (25.33±1.85) were similar to a* values obtained for samples with 3% of paprika in the two levels of plate mincing (table 1), therefore, at these paprika concentration, a* values depend on paprika, disguising lean effect. These effect was not been observed at the fine mincing.

Yellowness (b):* ANOVA results showed significant differences for each factor and their interactions ($P<0,01$), but no for time factor ($P>0,05$). b* values were highest in 20 mm mincing, diminishing when the mincing were more intense (table 1). b* values were smallest for samples without paprika and increasing when these spice was added. Paprika has a lot of yellow components (criptoxantene & zeoxantene) (*Farrel, 1990; Navarro & Costa, 1993*) which would be the responsible for b* increase in samples added with paprika. b* values obtained for samples added with 3% of paprika were higher that obtains for paprika (table 1), so the value of this coordinate depends both the paprika as the yellow components of lean meat. These contribution is different depending on mincing level, being highest when the structural breakdown of the muscle is smaller.

Table 1.- Average values for colour coordinates of three meat mincing level added with different paprika concentrations

MINCING LEVEL	FINE			10 mm			20 mm		
PAPRIKA CONCENTRATION (%)	0	1.5	3	0	1.5	3	0	1.5	3
Lightness (L*)	48.99a	47.89a	41.17b	38.10c	37.50c	24.02d	42.96e	30.05f	24.92g
Redness (a*)	6.89a	16.44b	18.85c	8.08d	15.67b	25.33e	9.99f	24.18g	26.29e
Yellowness (b*)	16.31a	22.37b	24.58b	14.39c	18.32d	35.63e	10.04f	39.71g	41.45h

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

Reflectance Spectra: Paprika effect on reflectance spectrum of the three mincing levels was similar. Figure 2 shows reflectance spectra of 20 mm mincing added of different paprika concentrations. It can be observed as the typical form of pork lean meat reflectance spectrum disappears, and turn up paprika reflectance spectrum. Paprika reflectance spectrum has low reflectance values between 400 and 520 nm wavelength (orange and red zones). Reflectance spectra for samples added with paprika (1,5 & 3,0%) showed not differences at these wavelength, but is beginning with these values when is possible to difference these two paprika concentrations. Beginning with these results, it could be note that in samples added with paprika, the use of reflectance ratios (Gorospe et al., 1989) is wrong because the reflectance spectrum is determined by paprika, disguising lean meat reflectance spectrum.

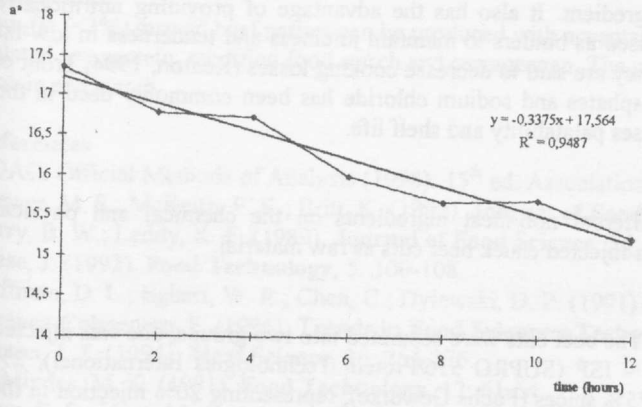

Figure 1.- Redness (a*) evolution during resting stage in minced meat added with paprika

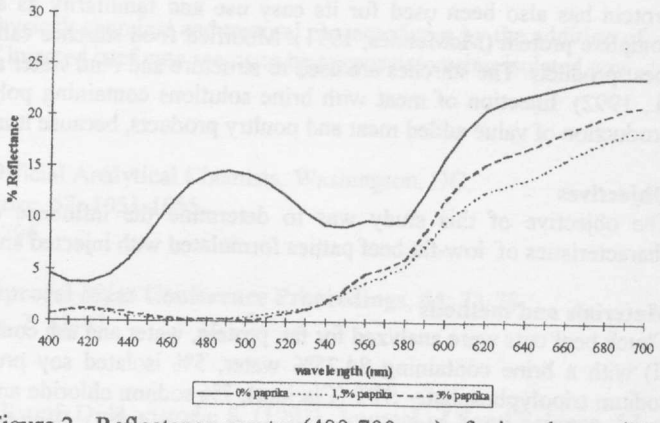

Figure 2.- Reflectance spectra (400-700 nm) of minced meat (20 mm) added with different paprika concentrations (0, 1,5 & 3%)

Conclusions.

Lightness increased with the degree of mincing and decreased when paprika was added. Redness was the only colour parameter that showed evolution during resting time. The use of reflectance ratios is not suitable in meat products which include paprika in its composition.

Pertinent literature.

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

Biacs, P.A.; Daood, H.G.; Padisa, A. Y Hadju, F. (1989) Studies on the carotenoid pigments of paprika (*Capsicum annuum* L. var. Sz-20). *J. Food Chem.*, 37, 350-353.

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.

Farrel, K.T. (1990) Spices, condiments and seasonings. 2e. New York, Avi book by Nostrand Reinhold.

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

Giese, J. (1995) Measuring physical properties of food. *Food Technol.*, 49, 54-63.

Gorospe, O.; Astiasaran, Y.; Sánchez-Monge, J.M. & Bello, J. (1989) Estudio del desarrollo del color en derivados cárnicos crudos, valorado por medidas químicas y físicas. *Alimentaria*, 37, 37-41.

Grau, R. (1996) Estandarización de un método objetivo para determinar la estabilidad del color en el pimentón (*Capsicum annum L.*). Proyecto Fin de Carrera. Valencia, E.U.I.T.A. Universidad Politécnica de Valencia

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.

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.

Judge, M.; Aberle, E.; Forrest, J. Hedrich, H. & Merkel, R. (1989) Principles of meat science. Dubuque, Kendall/Hunt Publishing Co.

Levy, A.; Harel, S.; Palevitch, D.; Akiri, B.; Menagem, E. & Kanner, J. (1995) Carotenoid pigments and β-carotene in paprika fruits (Capsicum, spp) with differents genotypes. *J. Agric. Food Chem.*, 43, 362-366.

Mabon, J.T. (1993) Color measurements of food. *Cereal Foods World*, 38, 21-25.

Navarro, F. & Costa, J. (1993) La oleorresina del pimentón. Murcia, Universidad de Murcia.

Palombo, R.; Van Roon, P.S.; Wijngaards, G. & Prins, A. (1989) Kinetic analysis of changes in lightness attribute of color during the processing of comminuted meat product. Proc. 35th Intern. Cong. Meat Sci. and Technol.. Copenhage, p. 624-631.

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