SPANISH-TYPE DRY-CURED SAUSAGE: COLOUR PARAMETERS

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BACKGROUND: In Spain, dry-cured sausages can be divided into two types: "fermented sausages" and "non-fermented sausages", although, nowadays, all these sausages tend to be classified as fermented. At present, fermented sausages, even though they are made to different recipes and use different technologies, have the common properties of using differing proportions of lean meat and fat (which both relates them, but, at the same time, differentiates them) a high room temperature preservability and a high microbial content. The physical, chemical and biochemical changes that take place during processing have not been adequately studied and very few articles study colour evolution in this type of meat product. Several authors have reported that moisture loss during the elaboration of some meat products, could affect the colour properties (Sayas, 1997).

OBJECTIVES: The aim of this work was to study the evolution of the colour (CIELAB colour space) and chemical properties evolution of Spanish-type dry-cured sausage during processing and to compare these characteristics in different zones (centre and periphery) of the sausage.

METHODS:

Processing and Sampling: Three batches, each consisting of 50 sausages (500 g each), were processed according to commercial formula and practices in a pilot plant. Sausage processing lasted of 24 days, starting from when the sausage casing was filled..Three portions of each sausage were cut off along their cross-sectional diameter. Two areas were considered in each of them: the centre (10mm radius from the centre) and the periphery (from the central zone to the casing). Readings were carried out in triplicate on each zone of each portion.

Colour analysis: Colour measurements were taken immediately after cutting the samples, in accordance with the recommendations on colour determination and pH of the American Meat Science Association (Hunt *et al.*, 1991). The CIELAB colour space (D65; 10°) was determined. The colour parameters were determined using a Minolta CM300 colorimeter.

Statistical Analysis: Conventional statistical methods (ANOVA and Tukey´s test) were used. ANOVAs with two factors (time and zone) were applied for each parameter, one for the fermentation stage (time: 0, 12, 24, 36 and 48 h, and zone: centre and periphery) and the other for the ripening stage (time: 6, 12, 18 and 24 days, and zone: centre and periphery). The statistical data analysis was analized by the BMDP version 9.0.

RESULTS AND DISCUSSION

Lightness (L*): ANOVA results for lightness only pointed to that significant differences between time ($P<0.01$) in the fermentation stage, but during the ripening stage the differences were significant ($P<0.01$) between times and zones. The results of Tukey´s test are showed in table 1. The decrease in L* during the first 36 h could be attributed to moisture lost, such as occurs, in other dry-cured (Sayas,1997). The increase observed after 36 h and during the first 12 d of the ripening stage can be attributed to the changes in lactic acid and pH that cause exudation in the meat because the meat proteins have reached their isoelectric point. As regards the significant differences found between zones (lower values in the peripheral zone than in the centre), these may be attributable to the moisture gradient in the sausage and the differences in relative humidity between the drying-room atmosphere and the sausages (Rosmini, 1997).

Table 1.- Lightness values (center and periphery) during the spanish type dry-cured sausage elaboration process

Time (hour)	L*p	L*c	Time (days)	L*p	L*c
0	40,28Aa	41,29Aa	6	45,89Aa	48,39Ba
12	35,58Ab	40,29Aa	12	45,29Ab	53,17Bb
24	36,62Ab	39,56Aa	18	42,23Ac	49,67Bc
36	35,77Ab	38,41Aa	24	40,86Ad	47,80Bd
48	41,05Ac	43,15Ab			

Values in the same and different columns bearing similar superscripts are not different ($P>0.05$); L*c: ligthness in the center zone; L*p: lightness in the periphery zone

Redness (a*)

ANOVA results for redness showed that significant differences existed between times ($P<0.05$) in both the fermentation and ripening stage, but not between zones ($P>0.05$). The Tukey test applied to the time factor in both the fermentation and ripening stage showed significant differences ($P<0.05$) between each time. During the fermentation stage redness increased but diminished during the ripening stage (figure 1). The increase in redness during the fermentation stage can be attributed to the formation of nitrosomyoglobin which has been previously related with the characteristic red colour of this type of meat product. Fernández-López (1998) reported that the salt content is responsible for increases on this colour co-ordinate in a dry-cured sausage model system. The a* increase we observed during fermentation may also be due to moisture loss, which would increase the salt content (on a wet basis). The decrease in a* observed during the ripening stage can only be attributed to the effect of lactic acid effect on the different states of myoglobin (myoglobin, nitrosomyoglobin and oxymyoglobin). This acid might partially or totally denaturalize this haemo-compound. Fernández-López, (1998) reported that this acid decrease redness. As regards the effect of salt on this co-

ordinate, one might expect significant differences between zones because the periphery has a lower moisture and so higher salt content (on a wet basis) than the centre. This effect could promote higher redness in the periphery zone. However, it has been reported that in a dry-cured sausage model system, the lactic acid effect is stronger than the effect of salt in mixtures of these two additives (Fernández-López, 1998). This dominance of lactic acid could be responsible for the effect that significant differences between zones were not found for redness.

Yellowness (b*): ANOVA results for yellowness showed that significant differences between times existed for the fermentation ($P<0.01$) and ripening stages ($P<0.05$), but not between zones ($P>0.05$). The Tukey test applied to the time factor during the fermentation stage showed significant differences ($P<0.05$) between all the times. Of note is the clear decrease that takes place during the fermentation stage (figure 1). The observed changes in b* during fermentation are probably due to the fact that, during their exponential growth phase, microorganisms consume the oxygen present in the mixture and thus contribute to the decrease in oxymyoglobin, given that this state of the myoglobin greatly contributes, to the value of this colour co-ordinate (Johansson *et al.*, 1991). Fernández-López (1998) reported that the salt content lowers the value of b* (due to the effect of salt on oxygen solubility in the meat batter), while the lactic acid concentration increases this colour co-ordinate in a dry-cured sausage model system. In accordance with these combined effect of these two additives, the decrease in yellowness observed during the fermentation stage could be due to the salt which dominates the effect of lactic acid, the concentration of which is low in this stage. The Tukey test applied to the time factor in the ripening stage showed no significant differences between 12, 18 and 24 d although the differencesbetween these times and 6 d were significant. In this stage the changes in this co-ordinate were less than in the fermentation stage (figure 4). In both stages the nitrite could be reacting with the myoglobin forming nitrosomyoglobin, and so the myoglobin and/or oxymyoglobin present might decrease and, with it, the b* value. This behaviour has also been observed in other dry-cured meat products (Pérez-Alvarez *et al.*, 1997). In the ripening stage the high lactic acid concentration reached might have been expected to increase this co-ordinate, although in fact a slight decrease was observed. This behaviour could indicate that the salt effect predominates upon lactic acid.

CONCLUSIONS: Lightness (L*) was the only colour parameter whose evolution (during the ripening stage) was dependent on the zone studied, in this case becoming lighter in the center zone. Redness (a*) increased during the fermentation stage and decreased during ripening, while the yellowness (b*) decreased throughout the process.

PERTINENT LITERATURE

Fernández-López, J. (1998). Estudio del color por métodos objetivos en sistemas modelo de pastas de embutidos crudo-curados. Ph.D. Thesis. Universidad de Murcia. 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 colour evaluation. National Livestock and Meat Board, 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. of 37th Int. Congr. Meat Sci. Technol. pp. 394-397. Kulmbach, Germany.

Pérez-Alvarez, J.A., Sánchez-Rodríguez, M.E., Fernández-López, J., Gago-Gago, M.A., Ruíz-Peluffo, M.C., Rosmini, M.R., Pagán-Moreno, M.J., López-Santoveña, F. & Aranda-Catalá, V. (1997). Chemical and colour characteristics of lomo embuchado during salting seasoning. *J. Muscle Food.* **8** (4), 395-411.

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

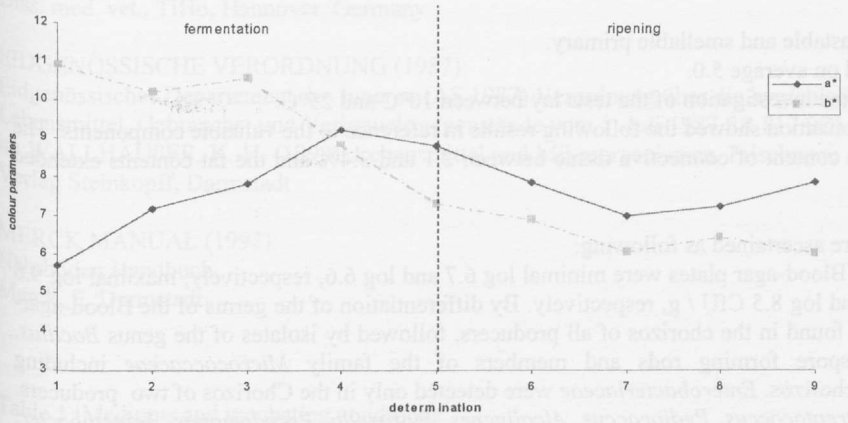

FIGURE 1.- Redness (a*) and yellowness (b*) during the fermentation and ripening stage in a Spanish-type dry-cured sausage.