CURING AGENTS EFFECTS ON LIGHTNESS IN A DRY-CURED SAUSAGE MODEL SYSTEM DURING THE MIXING-RESTING STAGE.

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KEYWORDS: Dry-cured sausages - mincing - salt - nitrite - ascorbate - water - lightness (CIELAB) - mixing-resting stage.

BACKGROUND

The technological processes applied to 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). The depth of light penetration and reflection are pH dependent. Thus, the low pH causes more light scattering and the high pH less (Kropf *et al.*, 1984). During the manufacture of Spanish dry-cured sausages, the raw materials are comminuted and then mixed with additives and spices to make up a filling, which is generally left to rest for 12 h, after which it is stuffed, fermented and matured. In studies carried out upon colour changes during the dry-cured sausage making process, variations have been observed in the lightness of the meat filling during that rest period, but the way in which those changes develop during that period has yet to be established (Pérez-Álvarez, 1996).

OBJECTIVES

The aim of this work was to study the evolution of lightness in the minced lean pork as a result of the effect of the mincing process and of the additives used in curing it during the rest period, prior to the sausage stuffing stage.

METHODS

A model system to a standard formula of Spanish dry-cured sausages was prepared with lean meat, with added curing agents (5 % water, 2.306 % NaCl, 0.010 % $NaNO_3$, 0.05 % Na-ascorbate). Lean meat from three de-boned pig shoulders was used. Each shoulder was processed separately, cut into cubes (approximately 10 x 10 cm) and then minced using a plate with a 20 mm hole. The minced meat obtained from each of the shoulders was divided into seven 400 g portions. One of the portions was used as a control (minced lean meat without additives) and the six remaining ones had water and the additives added to them. To add the additives of each treatment, they were first dissolved in 5% water and the filling was then mixed to ensure correct distribution. From each of the seven portions three replications were made. The determinations were made: before mincing (pre-treatment samples, time -1), immediately after mincing and adding the additives (time 0) and over 12 h at intervals of 1 h between each measurement. The time lapse between the lightness determinations on the whole lean meat (time -1) and those made on the minced meat, with or without additives (time 0) was minimal (approximately 5-6 min) and only that needed to carry out the mincing and mixing operations. Lightness determinations were made using CIELAB colour space (illuminant D65 and 10° observer). American Meat Science Association Guidelines for colour measurements were followed (Hunt *et al.*, 1991).

To analyse the effect of mincing on pH and lightness, a 2-way ANOVA with interaction was carried out, considering the shoulder factor and the treatment factors. To analyse the other treatments, a 3-way ANOVA with all interactions was undertaken, considering the shoulder, time and treatment factors. For both analyses the program 8V was used of the BMDP (version 9.0) statistical software. To discover where there were significant differences among the levels of the main factors or their interactions, contrasts between means were made (Gómez & Gómez, 1976).

RESULTS AND DISCUSSION

In the ANOVA of pH significant differences ($P < 0.01$) for the main shoulder factor were found, but these differences were not present for the mincing factor. This indicates that shoulder meat comminution does not affect the pH.

The mean whole lean meat L* was 37.975 (std = 2.146) and that of the minced lean meat was 40.612 (std = 2.299) (Fig. 1). The ANOVA showed significant differences ($P < 0.05$) for mincing. This observation seems to indicate that, independently of the pH possessed by the shoulders themselves, on carrying out the mincing operation, the lightness of the lean meat increases. ANOVA showed that the differences were significant ($P < 0.01$) when the shoulder factor was considered. This means that the shoulders were different in their lightness. It may also be seen that the L* did not present any significant differences ($P > 0.05$) for the main time factor. Regarding the main treatment factor (T), the ANOVA showed that there were significant differences ($P < 0.01$), which indicates that L* was modified by at least one of the treatments applied. When the contrasts were made (Tukey test), significant differences were found between the following treatments: water/salt+sodium nitrite and water/salt ($P < 0.05$).

Figure n° 1 shows at time -1 the mean L* for the whole lean meat and at time 0 the mean L* for the same lean meat after mincing (representation of value -1 is only graphic). Taking the L* value at time -1 into account, it can be seen how lightness increases on mincing the lean meat. Moreover, that increase was greater when the lean meat was minced and 5% water was added. On the contrary, when the lean meat was minced and salt was added in addition to the 5% water, no increase in the lightness was observed. Considering that the mincing took place under atmospheric pressure conditions and involves a process that destroys the tissue structure and incorporates air into the filling (Girard *et al.*, 1991), it can be assumed, and be consistent with Palombo & Wijngaards (1989), that the air included is one of the factors responsible for the increase in lightness. However, it must not be overlooked that mincing leads to the partial liberation of the tissue liquids through the destruction of the structure itself. Those liquids will be found on the surface of the meat adding to the effect of the incorporated air. Taking into consideration that the lean meat used in the experiment probably did not present its maximum water holding capacity (WHC) owing to the pH (mean for three shoulders = 6.37), it seems logical to think that for this reason the 5% of water added to the mince could not be retained and formed a surface layer, so raising the lightness value. Considering that the contrast between the water and salt treatments indicated that the L* differences between both were significant ($P < 0.05$) and that then there was no evolution in time, this shows that the effect of the salt on L* (Fig. 1), occurred at the moment of its being added.

Salt alters the osmotic balance of the tissue changes the electrostatic charges of the myofilaments and affects the isoelectric point of the proteins, increasing its WHC (Girard, 1991; Wismer-Pedersen, 1994). The quantity of salt added during the experiment seems to have been sufficient to allow the 5% of water added to be retained by the meat's structure. This could explain how the salt compensated for the effect of the water and that of mincing on lightness. Figure n° 2 shows the evolution of lightness differences (ΔL) over time for following treatments: water in regard to the minced lean meat (control), salt in regard to water. In this figure it can be seen how adding water makes the minced meat lighter ($\Delta L+$), while adding salt darkens it ($\Delta L-$).

In the contrasts (Tukey test) it was observed, that both the ascorbate and the nitrite did not present significant differences ($P > 0.05$) with water and minced meat. This would indicate that both the ascorbate and the nitrite do not affect the lightness of minced meat. In Fig. 2 it can be seen how water treatment lightens the meat, whilst the others darken it. The combined treatment with salt+sodium nitrite in contrast to the water treatment showed significant differences ($P < 0.05$), which are a result of the individual effects of the salt and water.

CONCLUSIONS

Mincing produces an increase in the lean meat's lightness at the moment of carrying out the treatment, which does not evolve for the following 12 h. Adding 5% water to the minced meat does not result in any significant changes to its lightness, but increases lightness in relation to whole lean meat. The salt treatment compensates for the effect that the mincing and adding of water has on the meat's lightness. The treatments using sodium nitrite (0.01 %) and sodium ascorbate (0.05%) do not change the lightness.

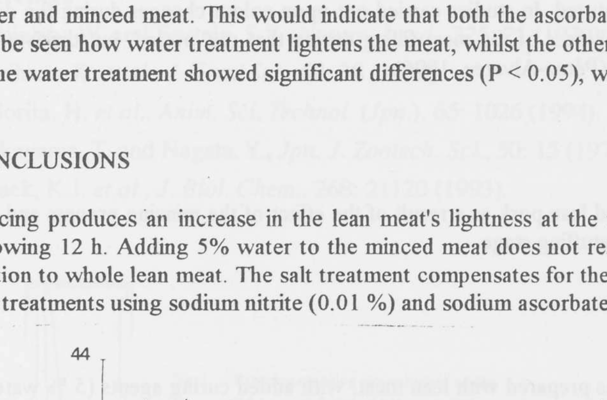

Fig. 1: Lightness (L*) evolution for minced lean meat (control and water) and salt treatments.

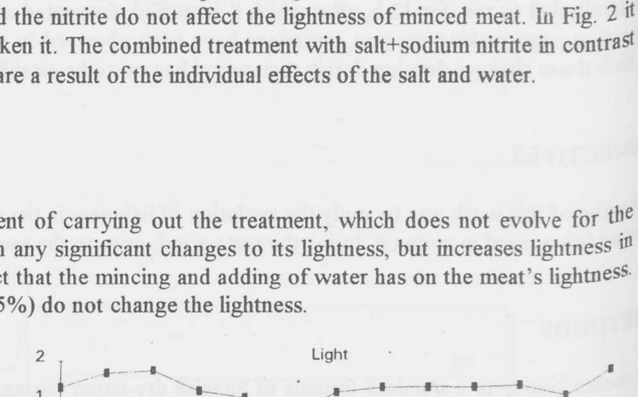

Fig. 2: Lightness diferences (ΔL^*) for water treatment using minced lean meat (W-C) as reference and salt treatment using water (S-W) as reference.

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