MINCED PORK LEAN MEAT: COLOUR PROPERTIES

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BACKGROUND

Of all the processes involved in elaborating meat products, especially sausages, the mincing step is particularly important since on this depends the homogeneity of the product and the tenderising of the initial material, the more finely cut the pieces, the easier they are to mix. The mincing step is one of the most delicate parts of the elaboration process since the final characteristics of many dry and semidry products are related with the size of the meat pieces (Rust, 1994). The degree of mincing (or particle size) differs substantially in the final product and frequently constitutes one of its principal characteristics. Some products (Spanish "chorizo", for example) contain coarsely chopped pieces of 10-30 mm, while others (salami, "salchichón") contain medium sized pieces of 5-10 mm. Although the colour of different meat products has been studied, particularly in the final product (Üren & Babayigit, 1997), these studies do not separate the influence of degree of mincing from other factors such as additives, spices, manufacturin process, etc.

OBJECTIVE

The principal aim of this study, then, was to analyse the effect of different degrees of mincing on the colour properties (CIELAB space) of pork lean meat.

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 diameter or 20 mm diameter holes, while the third size (fine) was obtained by using a cutter. Meat from the abattoir was used as control. For each size of mince studied (10 mm, 20 mm and fine) three lots of meat (1100 g each) were used. Each lot, after mincing, was divided into 9 cylindrical glass containers (120 g approximately) 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: Colour measurements were taken immediately after mincing the samples. The CIELAB colour space was studied following the suggestions of Cassens *et al.*, (1995). From CIELAB coordinates (D65, 10°), the chroma (C*) and hue (H*) parameters were calculated:. 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. The statistical data analysis was undertaken using the statistical package BMDP version 9.0.

RESULTS AND DISCUSSION

Lightness (L*): Significant differences ($P<0.01$) were found for this coordinate in the mincing factor. The Tukey test showed that the differences were significant between all the degrees of mincing (table 1). L* increased with the degree of mincing and being highest in the fine samples. Mincing has been seen to modify lightness values in other studies of lean meat. Palombo *et al.*, (1989) found that the increases in L* in meat batters were due to changes in the state of the myoglobin. However, the L* value of most dry-cured meat products (Pérez-Alvarez, 1996) was also found to be directly related with the lightness, pH and water holding capacity. A similar pattern for the effect of mincing has been described for different types of lean meat (chicken and beef) (Pérez-Alvarez *et al.*, 1998), although the same authors describe how in fatty meats (pork backfat, dewlap and bacon) and in viscera (heart and lung) L* behaves in the contrary way with mincing (L* decreasing). Perlo (1997), too, pointed out that mincing reduces the lightness in pork liver, while in fatty fishes the same process increases the value. However, Perlo (1997) suggested that over-mincing reduced the L* value in fine fish batters and pork liver, respectively. Lightness depends on various factors (among them pH and WHC). In our study mincing did not affect pH and so the changes observed in L* must have been due to other causes. Having seen the results obtained for WHC, it might be expected that fine mincing (which gives the highest WHC values) would lead to low L* values since an increase in WHC reduces L*. However, it was precisely this process which led to the highest L* values being obtained, suggesting that the modifications in the structure of the meat caused by mincing (which leads to a greater amount of water being available on the surface) 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 batter (Palombo *et al.*, 1989).

Redness (a*): The ANOVA identified significant differences ($P<0.01$) for the mincing factor in this coordinate. The Tukey test showed that there were only significant differences ($P<0.05$) between the control and the levels of mincing studied (10, 20 and fine) but not between the degrees of mincing themselves (table 1). When this coordinate was studied in the different minced meats it could be concluded taht mincing (regardless of the degree) reduced the a* values. It should be borne in mind that lean pork shoulder meat is made up of different muscles and that different a* values have been described for each (Iriarte et al., 1993). It has been suggested that the coordinate is related with the Mb content (Johansson *et al.*, 1991), and this was confirmed by Pérez-Alvarez *et al.* (1998) and by Fernández-López (1998) who also pointed out that a* values fall with increasing levels fo metmyoglobin (MMb). The fact that there were no significant differences between the three mincing processes for this factor suggest that the process itself acts as a homogeneizer of this process, the diminution in a* caused by mincing being due to the changes in the different states of Mb. The mincing process would favours the development of oxidative phenomena which would, in turn, be partly responsible for transforming Mb into MMb. The study by Fernández-López (1998) mentions how the incorporation of water in lean pork meat reduces the a* values since it has a "dilutant" effect. The mincing process provokes a breakdown (of varying degrees of intensity) of the muscle structure, favouring the liberation of liquids from the interior of the muscle cells. The presence of these liquids in minced pork meat could also be responsible for the decreased a* values observed in the study described here.

Yellowness (b*): The ANOVA showed significant differences ($P<0.05$) for the mincing factor in this coordinate. As in the case of a*, Tukey`s test showed significant differences between the control and the minced meats (table 1), the mincing process (regardless of degree) increasing the values of this coordinate. In a study of the colour parameters in different primary meat products, Pérez-Alvarez *et al.* (1998) reported that the concentration of Mb is not an influential factor for this coordinate. Johansson *et al.* (1991) reported that the yellowness coordinate in fresh meat is related with the oxymyoglobin content (OMb). Fernández-López (1998) reported that both oxidation and Mb oxygenation affect the b* values, by increasing them. The mincing process destroys muscle structure, liberating the sarcoplasmic proteins, among them Mb. The mincing process per se, would facilitate the incorporation of air and the consequent formation of OMb, which would contribute to the increase in b* values recorded in own study. As already mentioned for the a* coordinate, mincing would favors MMb formation and this would increase the b* values observed.

Chroma (C*): The ANOVA carried out found no significant differences ($P>0.05$) for the mincing factor in this parameter, meaning that mincing (at the levels studied) did not affect the saturation levels of the batters. Chroma depends directly on the concentration of Mb in the muscle or anatomical piece (Johansson *et al.*, 1991), although Pérez-Alvarez (1997) also mention that it might be related with the state of the Mb, and would diminish as the proportion of MMb increased.

Hue (H*): ANOVA showed significant differences ($P<0.01$) for the mincing factor. Tukey`s test showed that the differences were not significant ($P<0.05$) between the 10 and 20 mm minced meats, but were so between these two levels an the others, and between the finely minced meat and the control (table 1). The mean values obtained for the different degrees of mincing show that the mincing process itself increased the values of H*, which passed from orange-red (control) to a rage of colours between orange-yellow (10 and 20 mm minced meat) and orange-red (finely mincing meat) (Instituto Nacional de Racionalización, 1981). These hues depend on the concentration of Mb (Pérez-Alvarez, 1996) and on its state (Johansson *et al.*, 1991) so that, if the Mb concentration is considered as more or less constant, the resulting H* values after mincing would be more related with the state of the Mb rather than its concentration.

CONCLUSIONS

Mincing, regardless of the type used, increased the values of L*, b* and H* but decreased the values of a* and a*/b* ratio. The L* values increased with the degree of mincing. The H* values and a*/b* ratio differentiated the plate minced meats (10 and 20 mm) from that which had been finely minced. The mincing process used did not modify the saturation values of the batters. Only the fine mincing process modified (by increasing it) the water holding capacity of the batters.

PERTINENT LITERATURE

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Table 1.- Tukey`s test results for the colour coordinates: lightness (L*), redness (a*) and yellowness (b*), psycophysical magnitudes: hue (H*) and chroma (C*), in different minced lean pork meats.

minced meat	L*	a*	b*	C*	H*
control	40.56a	9.51a	10.54a	14.21a	48.03a
20 mm	40.98b	6.02b	14.68b	15.88a	67.52b
10 mm	41.20c	5.54b	14.66b	15.72a	69.71b
fine	44.48d	7.81b	13.04b	15.21a	58.97c

[a-d] For each variable, means within the same colum with different superscripts differ significantly)P<0.05)
L* (lightness); a* (redness): b* (yellowness); C* (chroma); H* (hue); WHC (water holding capacity).