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CHANGES IN MEAT COLOR FROM PIRENAICA CALVES DURING AIR EXPOSURE

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BACKGROUND

Pirenaica breed cattle are the most important source of beef meat from the West Spanish Pyrenees. Recently it has been included in a Quality Denomination: "*Ternera de Navarra*" following the EEC policy of promoting and guaranteeing the quality and authenticity of products due to some differential characteristics.

The color of fresh meat is one of the most important meat quality characteristics taken into account by consumers, (Clydesdale, 1991), and it is determined by concentration and chemical states of myoglobin, and by meat surface structure, directly related to pH (Renerre, 1988).

The consumers consider the bright red color of oximyoglobin in fresh meat desired, while the brown color of metmyoglobin is considered undesirable. Renerre and Mazuel (1985) set the limit for a meat to be rejected when the metmyoglobin accumulation at the surface reaches 20%.

Color is appreciated by consumer in terms of value (L*), Chrome (C*) and Hue (H*). In order to study meat color numerous researchers have used L*, a*, b* parameters defined by CIE-1976. Strange *et al* (1974); Renerre and Mazuel (1985) have found correlation between instrumental parameters and visual scores. Other ways of studying meat color is to know the relative concentration of myoglobin, oximyoglobin and metmyoglobin at the meat surface. Stewart *et al* (1965) and Krzywicki (1979) developed different spectrophotometric methods for determining them.

The purpose of this study was to investigate the changes in color parameters (L*, a*, b*, C*, H*) and in the relative concentration of metmyoglobin at the meat surface during seven days of air exposure, in order to know the color stability of meat from *Pirenaica* breed and correlation between color parameters and the concentration of metmyoglobin.

MATERIAL AND METHODS

Fourteen steers from *Pirenaica* breed were slaughtered with 13.2 ± 0.4 months old and 330.9 ± 7.36 Kg of average carcass weight. The animals were fed mother milk and concentrate until weaning and since then concentrated commercial fodder and barley straw "ad libitum" until they were slaughtered.

A steak (2.5 cm thick) was prepared from Longissimus dorsi muscle, removed from the left side of the carcass at 48 h postmortem. Beef steaks were placed individually in plastic foam packaging trays and overwrapped with oxygen-permeable film. The samples were placed in the dark in a cooler maintained at 2ºC. A spectrophotometer MINOLTA CM2002, (D65 type light source and a 10° position of the standard observer) was used. Measures were recorded in four different moments: immediately after the steaks were prepared (0 days), after 24h, the 5th day and the 7th day of air exposure. Each measure is the average of 5 different measures taken with different angles on the meat surface.

CIE L*, a*, b* parameters, Hue angle (H*) and Chrome or Intensity of the color (C*) were obtained. The relative concentration of metmyoglobin (MMb) was determined following the methods described by Stewart *et al* (1965) and Krzywicki (1979). Spectra were recorded from 400-700 nm. The reflectance at 730 nm was obtained by extrapolation.

RESULTS AND CONCLUSIONS

There are two of the 14 calves that present high postmortem pH (6.3 and 5.8 versus 5.46 ± 0.04 of the rest) and so, their meat present characteristics of dark cutting (Marsh, 1954). In the Fig.1 can be observed the different evolution that occurs in the pH normal meat and in the dark cutting meat. In this one, all the color parameters are increasing along the time of air exposure studied. L*, b* and H* show significant lower values than those of the normal meat but a* and C* from dark cutting meat reach the 5th day higher values than the normal meat.

The color parameters from the normal pH meat were submitted to an analysis of variance (table 1) that indicates a significant effect of time of air exposure ($p<0.001$) in all the parameters studied except for Luminosity that remains constant. Redness (a*) and Chrome (C*) values increase remarkably during the first 24h coinciding with myoglobin oxygenation and they decrease afterwards. Hernández (1994) describes a similar evolution but with higher values in crossbreed Freisian beef meat. b* and H* increase significantly during the first 24h.

Fig. 2 represents the evolution of the metmyoglobin concentration found at the meat surface in the different moments studied using the methods described by Krzywicki (1979) (1) and Stewart *et al* (1965) (2). The metmyoglobin concentration calculated applying the method 1 is higher than that obtained by method 2 during all the time of air exposure but the 7th day that is similar and it is about 23%, so one of every two consumers will reject this meat (Renerre and Mazuel, 1985). The results obtained by the two methods are highly correlated ($r=0.97$), and the regression equation is $MMb(2) = -24.97 + 2.07\ MMb(1)$, ($R^2= 0.99$).

An inverse correlation was found ($p<0.001$) between metmyoglobin percentage and a* and C* values (-0.54 and -0.63 with method 1 and -0.67 and -0.75 with method 2, respectively) and though the correlation indexes are highly significant they are higher with the one obtained by the method described by Stewart *et al* 1995 (2).

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Fig.1 Tridimentional representation of the evolution of color parameters (L*, a*, b*) during the time of air exposure in the normal meat (normal) and in the dark cutting meat

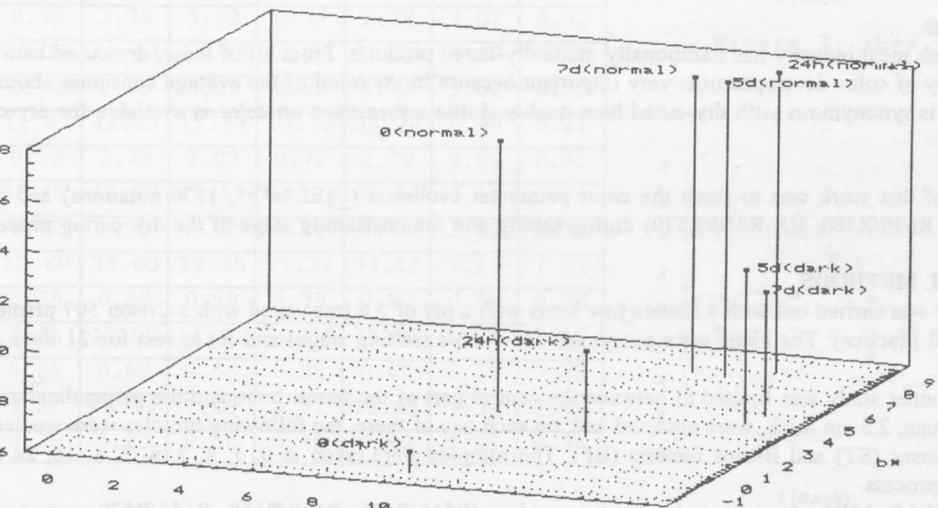

Table 1. Color parameters evolution at the meat surface from *Pirenaica* veal breed during 7 days of air exposure

	0 days	24 hours	5 days	7 days	signification
L*	36.81±0.24	38.00±0.27	37.83±0.35	37.82±0.41	ns
a*	9.96±0.17 [a]	15.53±0.20 [b]	14.39±0.23 [c]	13.29±0.23 [d]	***
b*	4.45±0.16 [a]	9.10±0.25 [b]	8.40±0.23 [b]	8.59±0.24 [b]	***
C*	10.92±0.16 [a]	18.10±0.22 [b]	16.77±0.21 [c]	15.90±0.25 [d]	***
H*	24.12±0.88 [a]	30.21±0.74 [b]	30.37±0.88 [b]	32.82±0.79 [b]	***

The same superscript means no sifnificant differences ($p>0.05$), ns=no significant differences, *** $p<0.001$

Fig. 2 Evolution of metmyoglobin concentration, calculated by the method 1, decribed by Krzywicki (1979), and 2, decribed by Stewart et al, (1965) during the time of air exposure studied at the meat surface of *Pirenaica* beef breed