PE7.20 Meat quality of three types of Portuguese certified beef 222.00

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Abstract The aim of this trial was to study VTM-PGI veal, Mertolenga-PDO beef and Mertolenga-PDO veal meat quality. Muscle pH (pH3) and temperature (T3) measurements were made three hours post-mortem, whilst, final pH (pHf), colour and dry matter were measured six days post-mortem in longissimus lumborum samples. Chemical analyses were made in minced, frozen samples. Two steaks were taken for cooking losses and WBSF measurements and for sensory evaluation. T3 reflected the age and carcass weight differences between meat groups, with PDO beef presenting the highest values. PDO beef also presented the lowest value in L* and the highest values in a*, b* and chroma parameters of colour, and in pigment content. VTM veal showed the lowest value in a* and chroma parameters of colour, and in pigments content. Moreover, VTM veal presented the lowest collagen content and the highest collagen solubility, the latter not different from PDO beef. PDO beef showed the highest cooking losses and WBSF values. VTM and PDO veal were considered to be lighter and tender than PDO beef, which values of tenderness made this meat hard. The chemical and physical results did not reflect the sensory panel evaluation. The results of the Principal Component Analysis of meat quality characteristics showed that PDO-beef was clearly differentiated from the other types of beef.

Keywords: Beef, Colour, Meat Quality, Tenderness

1. INTRODUCTION

Consumers may be influenced by information about a product nutritional value, food safety issues and the image associated with the product but sensory properties such as appearance, texture, juiciness and flavour still remain the main purchasing criteria [1]. Certified meats are recognised by consumers as healthier, due to a more extensive production system. In addition, the impact of such production on the regional economy and biodiversity is of utmost importance since it contributes to farmers' income and to the sustainability of the environment (Council Regulation no. 2081/92 of 14/7, EEC). One such example is Mertolenga breed, which could be marketed purebred as beef and veal Mertolenga-PDO (Protected Designation of Origin) or crossbred, as Vitela Tradicional do Montado-PGI (Protected Geographic Indication). Mertolenga purebred and crossbred cattle are raised in a traditional semi-extensive production system in the Alentejo region of Portugal, characterized by natural pastures under holm and cork oak, referred to as "Montado". However, finishing cattle on pasture has been associated with toughening, decreased beef colour and flavour acceptability [2] and development of off-flavours post-mortem (pm). Predicting consumer acceptance of beef is of primary concern, but sensory evaluation, regardless it involves sensory panels or consumers, is time-consuming and expensive. So, it is important to know how effective objective measurements of beef tenderness, the most important beef palatability attribute for consumers, are as predictor of sensory characteristics. The aim of this work was to study the chemical, physical and sensorial characteristics of Portuguese Mertolenga-PDO beef and veal, and "Vitela Tradicional do Montado' PGI veal raised under the typical production systems. Moreover we intended to relate the objective measurements with the results of the sensory panel in order to determine if the formers can predict the latter.

2. MATERIALS AND METHODS

This study was performed on 23 crossbred veals 'Vitela Tradicional do Montado-PGI" (VTM, age<12 month), 22 purebred Mertolenga-PDO young bulls (PDO beef, age<30 month), and 23 purebred Mertolenga-PDO veal (PDO veal, age<15 months). All animals were raised under the PGI and the PDO specifications, respectively, in a semi-extensive grazing system. After slaughter carcasses were electrically stimulated, and three hours pm longissimus lumborum (LL) pH3 and T3 were measured. Carcasses were kept in the cooler for ageing during 3-5 days, when samples of LL muscle were removed. Six days after slaughter final pH (pHf), colour (Minolta CR 300) and dry matter (Smart System 5 Microwaves) were measured.

Samples were minced, vacuum packaged and frozen at -18 ºC. Total pigment (% DM) [3], intramuscular fat (IMF) (% DM) [4], collagen concentration (% DM) and solubility (% total collagen) [5] and Myofibrillar Fragmentation Index (MFI) [5] were determined. Steaks were weighted, grilled until it reached 70 ºC of internal temperature, and weighted again for cooking losses determination. Afterwards, a minimum of eight cores were removed parallel to the muscle fiber orientation, for Warner Bratzler Shear Force (WBSF) evaluation (TA-tx2i, Stable Micro Systems). Panellists assessed a profile composed by tenderness, juiciness, flavour and overall acceptability (OA). Statistical analysis was carried out using the GLM procedure of SAS by analysis of variance and principal component analysis.

3. RESULTS AND DISCUSSION

Data are presented in Table 1. As expected PDO beef were the oldest and the heaviest animals at slaughter. Consequently, they had greater muscular mass, which lead to a slower temperature rate decline, and hence to a higher T3. Muscle pHf was significantly higher in PDO veal than in PDO beef. According to Monin [6], final pH decrease with increasing age, which partly explains ours results. VTM group, which had similar age than PDO veal, but similar pHf than PDO beef, was composed by crossbred females, which means that gender and/or breed might have some influence on the results. PDO beef showed the lowest L* value, and the highest a*, b* and chroma values. On contrary, VTM presented the lowest a* and chroma values. PDO beef also presented the highest pigment content and VTM the lowest one. These results suggest that PDO beef was darker and had a more saturated colour. According to our results some other authors stated that older animals had darker muscle colour [7]. Pigment content of muscle increases with age, especially up to 24 months, and then remains relatively stable [8]. This justifies the highest value of pigment content in PDO beef, since these animals were older at slaughter. However, VTM and PDO veal had similar age, but different pigment content. The higher pigment content of PDO veal could be due to its male status, since that at the same age males have higher pigment content than females [9], and/or to breed effect, since these animals were purebred and VTM were crossbred. Tenderness is the most important component of eating quality, and appears to be related to the rates of pm degradation of the myofibrillar network, linked to the biochemical proteolysis and the amount and nature of collagen present around and between the fibres [10]. Moreover, Savell and Cross [11] suggested that marbling also improves meat tenderness. All meat groups presented a similar and low IMF value (1.98-2.33 %), which is an advantage from the consumers' point of view. VTM group presented the lowest collagen content, and the highest collagen solubility, which was similar to PDO beef. PDO veal showed a particularly low collagen solubility value which wasn't expected. Dransfield et al. [12] justified some differences obtained in total collagen content with the fact that collagen determination is the least precise analysis. The highest collagen content value of PDO beef and veal comparing to VTM could be a sex effect, since some authors realized that males have greater collagen content than females [10]. On the other hand, it could be a breed effect, since PDO beef and veal were purebred animals, which have higher collagen content comparing with breeds or crosses with higher muscular development, like VTM. There were no differences between groups in MFI values. MFI indicates the amount of myofibrillar proteolysis that has occurred, and is often correlated with WBSF. PDO beef showed the highest value in WBSF. There were no differences between VTM and PDO veal. According to the results, we would expect PDO beef and veal to have higher WBSF, since they have higher collagen content and lower collagen solubility, and no differences in IMF content and in MFI. However this was only true for PDO beef. These results are in accordance with other authors who realised that collagen content is not related neither with WBSF nor with taste panel tenderness [13]. The values obtained in WBSF made VTM and PDO veal a medium tender meat, whilst PDO beef is considered a hard meat [14]. PDO beef showed the highest value of cooking losses (CL). CL are inversely correlated with meat pH and IMF content [11]. The lower pHf of PDO beef can explain the results obtained. Furthermore, CL are highly correlated with tenderness (data not shown), with higher CL corresponding to higher WBSF, which helps to explain the PDO beef results. Trained sensory panel didn't found differences between meat types in tenderness, juiciness, flavour and overall acceptability. This is not in accordance with the differences observed in the chemical and physical measurements, since PDO beef group showed a higher WBSF. The results of the principal component analysis are presented in Figure 1. Figure 1 (a) shows the projected data of the variables studied in the three meat types, whilst Figure 1 (b) shows the projected data of the meat group samples in the plane defined by the two principal component analysis. The PC1 explained 29.23 % of the total variation and was characterized by chroma, a*, carcass weight, age, T3, b* and total pigment content. The PC2 explained 15.99 % of the variation and was defined by tenderness, juiciness, overall acceptability and pigment content and in the opposite side by L* parameter. PDO beef was clearly distinguished lying on the right side of the plot.

4. CONCLUSION

PDO beef was darker and with a more intense colour. Moreover, this meat showed a higher value of WBSF than VTM and PDO veal. Considering this measurement PDO beef was classified as hard meat whilst VTM and PDO veal were medium tender. Instrumental measurement of meat tenderness didn't related with sensorial evaluation, since WBSF was higher for PDO beef group and sensory panel evaluated all meat types equally. PCA clearly distinguished PDO beef from VTM and PDO veal.

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Table 1
Data of age, carcass weight and chemical and physical characteristics of longissimus lomborum muscle of VTM, PDO beef and PDO veal

1)	***2) VTM***	***3) PDO beef***	PDO veal	SEM	P^{A}
Age (month)	10.09^{b}	18.05^{a}	11.09^{b}	0.516	***
CW (kg)	164.17^{b}	251.09^{a}	162.13^{b}	4.642	***
T_3 (ºC)	16.02^{b}	19.89^{a}	17.83^{b}	0.716	***
pH_3	6.08	6.06	6.21	0.539	NS
pH_f	5.46^{ab}	5.42^{b}	5.67^{a}	0.361	***
L*	35.73^{a}	31.52^{b}	34.87^{a}	0.500	***
a*	17.21^{c}	21.59^{a}	18.59^{b}	0.391	***
b*	2.88^{ab}	3.79^{a}	2.35^{b}	0.349	*
h*	9.19	9.74	6.92	0.994	NS
C*	17.51^{c}	21.95^{a}	18.81^{b}	0.416	***
TP (% DM)	1.05^{c}	1.78^{a}	1.26^{b}	0.071	***
IMF (% DM)	2.04	2.33	1.98	0.149	NS
TC (% DM)	2.22^{b}	2.82^{a}	3.00^{a}	0.092	***
CS (%)	19.51^{a}	17.08^{ab}	15.31^{b}	0.978	*
MFI	22.28	23.01	25.79	2.093	NS
CL (%)	22.51^{b}	25.25^{a}	22.34^{b}	0.751	*
WBSF (kg)	5.16^{b}	7.43^{a}	5.56^{b}	0.462	***

[A] Statistical probability of treatment: ns, P>0.05; *, P<0.05; **,P<0.01; ***, P<0.001; means in the same row with different subscripts are significantly different (P<0.05); SEM= standard error of the mean
CW=carcass weight; TP=total pigments; IMF=intramuscular fat; TC=Total collagen; CS=collagen solubility; MFI=myofibrillar fragmentation index; CL=cooking losses

Figure 1 (a) – Projection of the variables of meat quality studied in the plane defined by the two principal components; (b) – Projection of the samples of VTM, PDO beef and PDO veal in the plane defined by the two principal components