

## RELATIONSHIP BETWEEN CONSUMER SCORES AND OXIDATIVE STATUS OF BEEF

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**Keywords:** beef, tenderisation, muscular hypertrophy, oxidative damage, sensory quality

### Introduction

The most important quality traits required by consumers in beef are tenderness, juiciness and flavour. Those parameters are affected not only by pre-slaughtering management but also by processes of proteolysis and lipid oxidation occurring during meat *post-mortem* storage. Lipid oxidation produces a deterioration of the sensory quality of beef due to the development of undesirable flavour and odour notes. In muscle, lipid oxidation initiates at the membrane level in the phospholipid fractions as a free-radical autocatalytic chain mechanism. However, there is a group of enzymes that can act as antioxidants absorbing energy from reactive species of oxygen. The main groups are Superoxide Dismutase (SOD), Catalase (CAT) and Glutathione Reductase (GR). The aim of this work was to study the relationship between consumer perception of flavour and acceptability of beef after long *post-mortem* storage (3 to 21 days), the oxidative status of meat evaluated by the amount of malonaldehyde (TBARS) and the antioxidant activity of enzymes SOD, CAT and GR.

### Materials and Methods

Twenty yearling bulls of two local breeds from northern Spain, Asturiana de los Valles (AV) and Asturiana de la Montaña (AM) were studied. Animals of the AV breed were homozygous (*mh/mh*), heterozygous (*mh/+*) or normal (*+/+*) for muscular hypertrophy gene. Bulls were fattened by feeding concentrate meal and barley straw *ad libitum* and were slaughtered at a live weight of  $512.4 \pm 37.2$  kg. At 24 h *post-mortem* the *Longissimus dorsi* muscle was sliced, aged at 4°C and stored at -20°C for further analysis. Samples for TBARS and sensory analysis were aged under vacuum conditions, while samples for antioxidant enzymes analysis were kept in bags permeable to O<sub>2</sub>. All meat samples were aged 7, 14 and 21 days (except animals of double-muscled AV bulls which were aged 3, 7 and 14 days, as faster maturation was supposed). Thiobarbituric acid reactive substances (TBARS) were analyzed by the method of Botsoglou *et al.* (1994) and expressed as mg of malonaldehyde per kg of lean muscle. The activity of antioxidant enzymes SOD, CAT and GR were analysed as described by Caballero *et al.*, (2006). Sensory analysis was conducted using 120 consumers. Consumers evaluated flavour quality and overall acceptability of meat using a nine point hedonic scale (1= very low, 9= very high). Linear regressions were assessed between the sensory traits and the chemical variables (SPSS 11.5, 2002).

### Results and Discussion

There was a significant correlation ( $p < 0.001$ ) between consumer scores for flavour and acceptability and TBARS values (Figure 1), indicating a clear inverse relationship between the consumer perception of meat quality and the increase in lipid oxidation. This agrees with findings of Campo *et al.*, (2006) who described that oxidation produces a deterioration of beef flavour that can be detected by TBARS measurements. When looking to the evolution of TBARS values along meat aged separately by genetic groups (Figure 2), meat of AV bulls homozygous (*mh/mh*) for muscular hypertrophy showed higher values of TBARS in the early *post-mortem* period (3 to 14 days). The rest of genotypes showed an increase of TBARS that is, of lipid oxidation at later ageing times (14 to 21 days). This could be due to the different fat quantities and composition in the loin of these genotypes (Aldai *et al.*, 2006), with lower fat content but higher PUFA proportion in the intramuscular fat of double-muscled (*mh/mh*) AV animals with respect to the others. This could make them more sensitive to early oxidation. From these data it appears there are parallels between the evolution of lipid oxidation and the evolution of meat tenderization in meat of the different genotypes. Oliván *et al.*, (2004) described that meat of AV bulls homozygous (*mh/mh*) for muscular hypertrophy showed higher cathepsin activities at early ageing periods. Also a higher tenderization rate than normal AV or AM bulls for which the end of the tenderisation process should be expected at longer ageing times than the figures detailed in this study (21 days). Another parallel was observed between antioxidant enzymes and the cathepsins. It was found that, under refrigerated conditions (4°C), antioxidant enzymes increased earlier for AV (*mh/mh*) than for other genotypes. The period of ageing studied was too short for showing high antioxidant activity in meat of AM (*+/+*) (Caballero *et al.*, 2006), that is, the genotype with slower tenderisation.

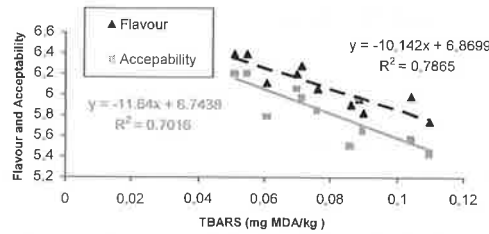


Figure 1: Linear regressions between TBARS values and sensory attributes flavour and acceptability.

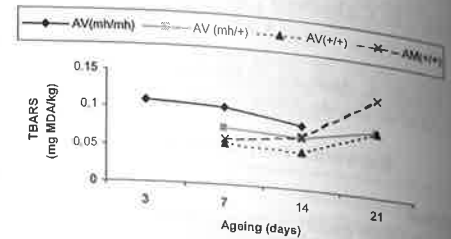


Figure 2: TBARS evolution along ageing for the four genotypes.

It is known that the activity of antioxidant enzymes decreases free radical damage by converting free radicals or derivatives that would affect negatively proteins, lipids and other components of meat into harmless products for tissues. This data supports the hypothesis that antioxidant enzymes have a synergic action with proteolytic enzymes applied in the process of meat tenderization by avoiding free radical inactivation of proteolytic enzymes, since both enzymatic groups showed similar evolution along the maturation in all studied genotypes. On basis of exposure (detailed above), a certain role in the tenderisation pathway can be hypothesised to be antioxidant enzymes. From the different antioxidant enzymes studied, GR showed stronger relationship with sensory quality of meat detected by consumers, especially with global meat acceptability ( $R^2=0.82$ ). This correlation data showed a relationship between sensory quality and oxidative processes along with meat ageing. However, this implication requires further study.

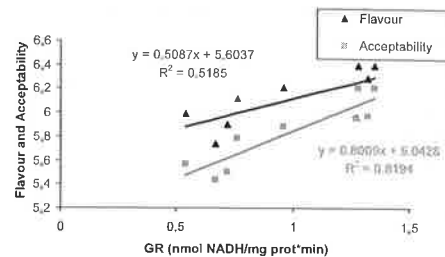


Figure 3: Linear regressions between the activity of GR and sensory attributes flavour and acceptability.

### Conclusions

Consumer scores for acceptability and flavour quality were highly correlated with the oxidative status of meat measured as TBARS and the activity of some antioxidant enzymes (mainly GR). TBARS follow the same pattern along ageing than proteolytic enzymes, which are related to the different tenderization pattern of studied genotypes along maturation.

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