

# EFFECT OF INCLUSION DUROC BREED IN MATERNAL LINE ON THE QUALITY OF PORK PACKAGED IN MODIFIED ATMOSPHERE

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**Abstract** – The main objective of this study was to assess the inclusion of Duroc breed in maternal line on the colour and oxidative stability of meat throughout 14 days of storage at 4±1 °C under modified atmosphere. The experiment was conducted with 19 female pigs from two different crossbreeding schemes: Pietrain (P) × (Landrace (LR) × Large White (LW)) and P × (LR × Duroc (D)). The inclusion of Duroc breed in maternal line ( $P>0.05$ ) and display period ( $P>0.05$ ) did not influence pH values. Pork from P×(LR×D) had the lowest lightness ( $L^*$ ) values and exudative loss and the highest redness and yellowness values. Furthermore, pork from P×(LR×D) had the greatest TBARS values from the 10<sup>th</sup> day of storage. Lipid oxidation increased with the length of the display in modified atmosphere conditions chops, but it had a moderate drop in the 14<sup>th</sup> day of storage. In conclusion, the inclusion of Duroc breed in maternal line could improve the colour and exudative loss but with a slight increase of lipid oxidation during 14 days of storage under modified atmosphere packaging.

**Key Words** – Colour, Crossbreeding, Lipid oxidation

## • INTRODUCTION

There is a great need for research on new genetic lines that can be found in the market, since crossbreeding can be used to improve lean growth without decreasing pork eating quality [1]. Traditionally, pig production in Spain has been based on crossing Landrace × Large White dams with lean sire lines, such as Pietrain [2]. However, crossbreeding with Duroc as a sire line could be adequate either for fresh meat or for improving dry meat products quality probably due to the resulting increased intramuscular fat [3]. Therefore, the introduction of Duroc in maternal line in pig breeding programmes may help to improve the eating quality of pork without any loss lean growth.

Modified atmosphere packaging (MAP) is a common means of retail sale display in supermarkets [4], and is used to maximise meat shelf-life and maintain an attractive fresh appearance [5]. High O<sub>2</sub>/low CO<sub>2</sub> is a common mix used in today's case-ready products [6]. However, high O<sub>2</sub> MAP also promotes lipid oxidation [7]. Therefore, the main objective of this study was to assess the inclusion of Duroc breed in maternal line on the colour and oxidative stability of meat during MAP storage.

## • MATERIALS AND METHODS

### *Animals and sampling*

The experiment was conducted with 19 female pigs from two different crossbreeding schemes: Pietrain (P) × (Landrace (LR) × Large White (LW)) and P × (LR × Duroc (D)). During the experiment all pigs were subjected to the same feeding and management. The pigs were stunned using carbon dioxide and slaughtered at an abattoir at approximately 91.0 ± 4.9 kg carcass weight.

The *M. Longissimus thoracis et lumborum* (LTL) were refrigerated at 4°C for 12 hours, after it was sliced into 2 cm thick steaks and packaged in polystyrene tray sealed with a polyethylene and polyamide laminate film, using a packaging machine. The modified atmosphere used was 70% O<sub>2</sub> and 30% CO<sub>2</sub>. All the packs were kept at 4°C±1°C and standard supermarket lighting conditions (14 h at day) during 14 days of storage time. Physical and chemical analyses were performed on day 0, 4, 7, 10, 12 and 14.

#### *pH measurement*

Ultimate (24 h postmortem) pH of the LTL, as well as pork chops stored in MAP (on days 4, 7, 10, 12 and 14 of storage), was measured using a pH meter equipped with a glass electrode. Each value was the mean of four measurements that were carried out on each sample.

#### *Instrumental measurement of colour*

A Minolta CM-2002 (Osaka, Japan) spectrophotometer was used to measure colour at the

surface of a 2-cm-thick LTL chop after opening the trays and exposing them to air for 2 h. The parameters registered were *L\** (lightness), *a\** (redness) and *b\** (yellowness). Each value was the mean of ten observations on the same chop.

#### *Exudative loss*

After the appropriate MAP storage duration, LTL chops were removed from trays and excess moisture removed before being weighed. Exudative loss was expressed as a percentage of the initial chop weight (24 h postmortem).

#### *Lipid oxidation*

Lipid oxidation was measured by the 2-thiobarbituric acid (TBA) method [8]. TBA-reactive substances (TBARS) values were calculated from a standard curve of malondialdehyde and expressed as mg malondialdehyde per kg sample.

#### *Statistical analysis*

All data were statistically analysed by the general linear model (GLM) procedure of IBM SPSS version 19 (IBM SPSS, 2010). The model included crossbreeding and display period as main effects and also their interaction. Duncan's post hoc test was used to assess differences between mean values when  $P \leq 0.05$ .

## • RESULTS AND DISCUSSION

The inclusion of Duroc breed in maternal line ( $P > 0.05$ ) and display period ( $P > 0.05$ ) did not influence pH values and no interaction occurred (data did not show). The pH values in both crossbreeding were normally by swine ( $5.61 \pm 0.12$ ).

Crossbreeding ( $P \leq 0.001$ ) and display period ( $P \leq 0.001$ ) influenced lightness (Fig. 1a), redness (Fig. 1b) and yellowness (data did not show), but no interaction occurred. Chops from  $P \times (LR \times LW)$  had *L\** values greater ( $P \leq 0.05$ ) than  $P \times (LR \times D)$  from 12 to 14 days of storage. The lightness of pork increased throughout display for both crossbreeding, which agrees with

Alonso *et al.* [9].

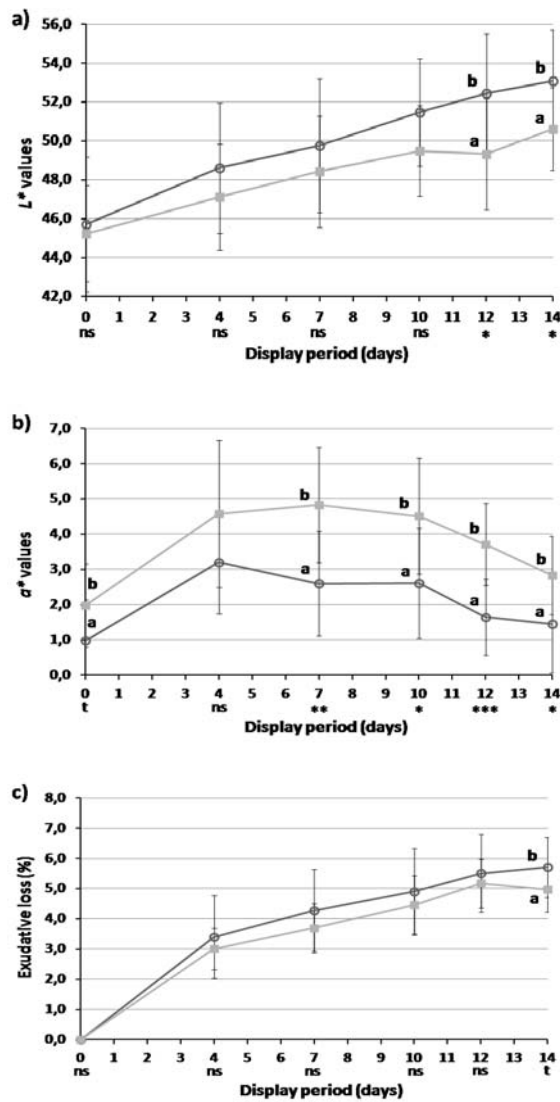


Figure 1. Evolution of a)  $L^*$  values, b)  $a^*$  values and c) exudative loss of chops from P×(LR×D) (○) and P×(LR×LW) (◐) throughout MAP display period. Different letters at the same day of storage indicate significant differences among mean values; ns= $p>0.1$ ; t= $p\leq 0.1$ ; \*= $p\leq 0.05$ ; \*\*= $p\leq 0.01$ ; \*\*\*= $p\leq 0.001$ .

Meanwhile, the inclusion of Duroc in maternal line produced greater  $a^*$  and  $b^*$  values than P×(LR×LW). Those results agreed with Blanchard *et al.* [10], who found that Japanese colour scores and EEL reflectance indicated that the *Longissimus* muscle was darker for the 0.25 and 0.50 Duroc genotypes. This phenomenon has been related to an increased muscle haem (red pigment) concentration for the Duroc suggesting more red oxidative fibres [11]. Redness and yellowness increased between day 0 and day 1 of display, and  $a^*$  values decreased from day 10, while  $b^*$  values remained stable during all days of storage.

Crossbreeding ( $P\leq 0.05$ ) and display period ( $P\leq 0.001$ ) both had significant effects on exudative loss (Fig. 1c), but no interaction occurred. Exudative loss increased throughout MAP storage, which agrees with Alonso *et al.* [9], and chops from P×(LR×D) had lower exudative loss percentages than chops from P×(LR×LW) on day 14 of storage.

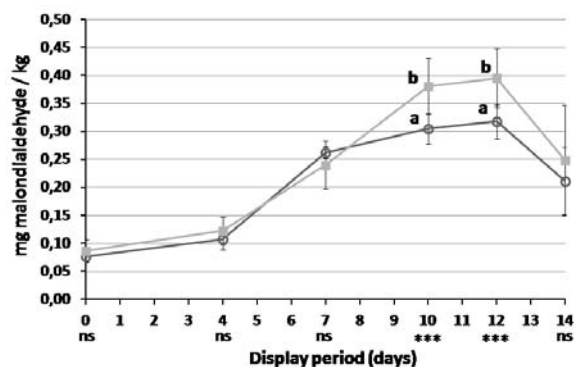


Figure 2. Evolution of TBARS values of chops from P×(LR×D) (○) and P×(LR×LW) (□) throughout MAP display period. Different letters at the same day of storage indicate significant differences among mean values; ns= $p>0.1$ ; \*\*\*= $p\leq0.001$ .

In general, lipid oxidation, as indicated by TBARS values, increased with the length of the display time in MAP chops (Fig. 2). Martínez *et al.* [12] concluded that increasing O<sub>2</sub> concentrations in packaging atmospheres caused a corresponding enhancement of oxidation and, therefore, a decrease of shelf-life due to discoloration development. The inclusion of Duroc breed in maternal line ( $P\leq0.001$ ) and display period ( $P\leq0.001$ ) both had significant effects on TBARS values, and also a significant interaction ( $P\leq0.01$ ) occurred. Both crossbreeding started with very low values of about 0.08 mg malonaldehyde/kg sample, without differences between them until the 10<sup>th</sup> day of storage. The chops from P×(LR×D) had greater ( $P\leq0.001$ ) TBARS values than chops from P×(LR×LW) from 10 to 12 days of storage. There were no differences in TBARS values between crossbreeding in the last day of storage. Also, the lipid oxidation had a moderate drop in the 14<sup>th</sup> day of storage. It could be due to malonaldehyde and other short chain carbon products of lipid oxidation are not stable for a long period of time [13].

## • CONCLUSION

The inclusion of Duroc breed in maternal line could improve the colour (greater  $a^*$  values and lower  $L^*$  values) and reduce the exudative loss in chops packaged in modified atmosphere during 14 days. However, a slight increase of lipid oxidation in this crossbreeding could be a problem from the 10<sup>th</sup> day of storage.

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