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# Study of the PSE Expression in the Pectoralis Major Muscle of Three Genetic Lines of Turkeys

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**Abstract:** The objectives of this study were to characterize the sensory and the technological quality of meat of three genetic lines of turkey (Hybride, Nicholas and BUT9). The muscle pH was measured at 15 mn after slaughter (pH1) and 5 h post-mortem (pH 5). The was measured on the pectoralis major muscle at the time of deboning. The pH results showed that the mean of pH1 was significantly higher for two groups of Nicholas and BUT9. For the pH 5 h post mortem, the differences were significant between three groups; the mean of pH of Hybride group was always highest. The colour observed had a significant difference between Nicolas and two others groups (Hybride and BUT9); however there was not significantly different between Hybride and BUT9. Consider the PSE problem in turkeys is similar to the pork, the fall of pH post-mortem and the meat colour can help us to conclude that the quality of the meat of Turkeys of the Nicholas group is better than the Hybrid and BUT9 groups.

**Key words:** PSE, pH, colour, Turkey, meat quality, pectoralis major muscle, post-mortem

## INTRODUCTION

Pale Soft Exudative (PSE) syndrome is always an important problem to meat quality which leads to a paler colour of meat, higher toughness and lower water holding capacity. In pork, PSE syndrome is a major industrial preoccupation because the cooked hams industries in France are supplied with at least 15-20% of PSE meat. Additionally, it is now well established that cooked hams manufactured from severe PSE meat may reached a 50% of financial losses (O'Neill *et al*., 2003).

In Turkey, some studies recently have found the PSE syndrome which were similar to these observed in pork (Penny, 1969; Warris and Brown, 1987). The PSE Turkey meat is pale in colur has lower water-holding capacity and forms softer gels (Barbut, 1993, 1997; McKee and Sams, 1997; McKee *et al*., 1998).

The demands of Turkey now-a-days were more and higher especially for the industry of processed cooked products. So the PSE Turkey meat problem was more important for the meat quality and it could be bad influenced during processing. Therefore, the objective of this study was to evaluate the quality of meat of three lines Turkey difference (Hybride, Nicholas and BUT9) with these parameters: the rate of pH fall post-mortem and the colour in Turkey breast meat.

## MATERIALS AND METHODS

**Animals:** Three groups of Turkey (Hybride, Nicholas and BUT9) from 240-260 for each group were used in this study. All of birds were housed in three building of the same farmer in the region of Rhône (France) and slaughtered at 12 weeks old in the Corico slaughter (Monsols, France). The conditions of housing such as sanitary condition, environment, nutrition and water were similar for three groups.

All of birds were carried to the slaughter house on the same day after a night collection; about 10 Turkeys were packaged in one box and transported by car where the transport time from the farmer to the slaughter house would not be >2 h. At the slaughter house, the birds were allowed to rest for 1 h before being slaughtered. Then they were hung on shackles line and electrically stunned by placing their heads in a charged water bath. Immediately after stunning, birds were killed by bleeding through a unilateral neck cut.

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**Measurements**

**pH:** The muscle pH was measured at 15 mn after slaughter (pH1) and 5 h post-mortem (pH5). On the other hand, the mean of rate of pH fall per hour for three groups of Turkey were calculated. The pHs were measured with a portable pH meter equipped with a xerolyte electrode (pH plus, Sydel).

**Colour:** The colour of meat was measured on the pectoralis major muscle at the time of deboning (5 h post-mortem) by using a Minolta colourimeter CR 300 (Indice D 65). The colour was determined by using the CIELAB colour values for L*, redness (a*) and yellowness (b*).

**Statistical analysis:** The experiment have 3 groups of Turkey; the main effects of pH and colour were analyzed by using the Analysis of Variance (ANOVA). Difference was considered significant if $p<0.05$.

## RESULTS

**pH:** The mean of pH1 for Hybride was 6.34 (SD 0.24); Nicholas = 6.26 (SD 0.23) and BUT9 = 6.23 (SD 0.24). These values were significantly different between the Hybride group and two other groups (Nicholas and BUT 9) but no significant difference were found between two groups Nicholas and BUT9 ($p>0.05$).

The significant differences were observed among 3 groups for the mean of pH 5; Hybride = 6.08 (SD 0.19); Nicholas = 6.04 (SD 0.21) and BUT9 = 5.98 (SD 0.22).

**Colour:** The values of lightness L* for Hybride groups was 45.8 (SD 3.1); Nicholas = 44.1 (SD 2.4) and BUT9 = 45.7 (SD 3.1). Significant differences were observed between Nicolas and two others groups (Hybride and BUT9) but there was not significantly different between Hybride and BUT9.

For the Hybride groups, the value of redness (a*) was 4.2 (SD 0.9) and there were significantly differences between this group and Nicholas (4.5; SD 0.8) and BUT9 (4.4; SD 0.9). No significant difference between Nicholas and BUT9 groups were detected.

## DISCUSSION

**pH:** The Pale Soft Exudative (PSE) syndrome was characterised by a paler colour, a lower water-holding capacity and an excessive hardness after cooking (Monin *et al*., 1999). Warris and Brown (1987) have reported that the early post-mortem pH decline from 30 $min^{-1}$ h was the most important factor which determined the degree of exudation in pork meat. So the rate of pH fall seemed to be the major factor which determined the severity of PSE meat. The relation between temperature and pH in the development of PSE characteristics was also important and well-established, the couples low pH-high temperature of carcass during the development of the rigor mortis involves the protein denaturation (Bendall and Wismer-Pedersen, 1962; Fernandez *et al*., 1994; Turkey: McKee *et al*., 1998; Molette *et al*., 2003; Alvarado and Sams, 2004).

In fact, Lawrie (1998) has showed that when the muscle was put simultaneously to a pH <6 and a temperature >35°C, the denaturation of proteins would be maximum.

The pH results showed that the mean of pH1 was higher for two groups of Nicholas and BUT9. There was significantly different ($p<0.05$) between these two groups and the group of Hybride but no significant difference between Nicholas and BUT9 groups.

For the pH 5 h post-mortem, the difference were significant between three groups; the mean of pH of Hybride group was always highest: 6.08 (SD 0.19), meanwhile, the mean of pH of BUT9 group was lowest: 5.98 (SD 0.22).

In addition, the mean of rate of pH fall per hour for Hybride and BUT9 were 0.05 (SD 0.04); however for Nicholas was 0.04 (SD 0.04). No significant differences were detected among three groups (Table 1).

For the pH fall, the mean value in the Hybride was higher than two other groups. After 5 h, this value was always highest in three groups but the noticed decrease of pH1-pH5 was 0.26 meanwhile 0.22 and 0.25 for Nicholas and BUT9 groups, respectively.

**Couleur:** The indicator role of colour in PSE poultry meat has been reported in a lot of previous study (Barbut, 1993, 1996, 1998; Woelfel *et al*., 2002). Indeed, a higher of L* value (lighter meat) was presented.

Moreover, Barbut (1993, 1996, 1998) supposed to sort the pectoralis major muscle according to their L*value with a limiting threshold of L*>53. Beyond this value, the meat will be considered PSE. However, Northcutt (1994)

Table 1: The values of pH 1; pH 5 h and the rate of pH fall of three groups of Turkey: Hybride, Nicholas and BUT9 (Mean±SD)

| Dindes | n | pH 1 | pH 5 h | Rate of pH fall/h (unit of pH) |
|---|---|---|---|---|
| Hybride | 248 | $6.34\pm0.24^{a}$ | $6.08\pm0.19^{c}$ | $0.05\pm0.04^{f}$ |
| Nicholas | 242 | $6.26\pm0.23^{b}$ | $6.04\pm0.21^{d}$ | $0.04\pm0.04^{f}$ |
| BUT9 | 256 | $6.23\pm0.24^{b}$ | $5.98\pm0.22^{e}$ | $0.05\pm0.04^{f}$ |

$^{a-f}$:Means within a column with no common superscript differ significantly ($p<0.05$)

Table 2: The values of the colour of three groups of Turkey: Hybride, Nicholas and BUT9 (Mean±SD)

| Dindes | n | L* | a* | b* |
|---|---|---|---|---|
| Hybride | 333 | 45.8±3.1[a] | 4.2±0.9[c] | 0.0±0.80[e] |
| Nicholas | 327 | 44.1±2.4[b] | 4.5±0.8[d] | -0.1±0.6[e] |
| BUT9 | 365 | 45.7±3.1[a] | 4.4±0.9[d] | 0.5±1.00[f] |

[a-f]: Means within a column with no common superscript differ significantly ($p<0.05$)

sorted the pectoralis major muscle of Turkey according to L* value at 24 h post-mortem but they can not reach to highlight in the modification of meat quality.

In the study, the mean of L* value was 45.54 (SD 4.24) for Hybride and 45.72 (SD 3.07) for BUT9 which were higher than Nicholas group: 44.09 (SD 2.37) (Table 2).

The mean value of Nicholas group was 1-2 points lower than two other groups with a significant difference between Nicholas and two other groups ($p<0.05$) but no significant difference for the L* value between Hybride and BUT9 groups.

In pork, two categories of meats with a less quality related to the acceleration rate of pH fall post mortem have been presented by many researchs (Van Laack *et al.*, 1994; Warner *et al.*, 1997; Cheah *et al.*, 1998; Joo *et al.*, 1999; Moya *et al.*, 2001).

In Turkey, the results was inverse (Froning *et al.*, 1978; Northcutt, 1994; Pietrzak *et al.*, 1997; McKee and Sams, 1997; Rathgeber *et al.*, 1999; Fernandez *et al.*, 2001; Hahn *et al.*, 2002; Soares *et al.*, 2003; Alvarado and Sams, 2004). Indeed, when Turkeys were placed in the conditions of acute thermal stress just before slaughter, the L* values of meat were not different (Turkey: Northcutt, 1994; Owens *et al.*, 2000) or higher (Turkey: Froning *et al.*, 1978); or lower (chicken: Soares *et al.*, 2003) in the stressed animals to compare with the unstressed animals. When Turkeys were selected according to the early pH value (15-20 min post-mortem), Pietrzak *et al.* (1997) and Fernandez *et al.* (2001) highlighted a higher values of L* for the meat of the GR to compare to the GN Turkeys.

The increase in the values of L* observed in the PSE meats was generally related with a post-mortem glycolysis accelerated (McKee and Sams, 1997; Pietrzak *et al.*, 1997) which could be explained the differences in rate of pH fall.

In the research, if only L* value is considered the for the PSE meats judgment such as done in the pork, the Nicholas group presents a clearly superior to compare with two other groups. According to Bendall and Wismer-Pedersen (1962), the differences in L* value related to the proteins denaturation and more specifically for the sarcoplasmic proteins because this protein led to a more important reflection of the light (light scattering).

For a* value, the results of bibliography were rather variable. In the study of Pietrzak *et al.* (1997), the values of a* were not different between GR and GN. However, Froning *et al.* (1978) have proven that the value of a* were higher for the stressed animals by the heat just before slaughter.

Moreover, Rathgeber *et al.* (1999), Fernandez *et al.* (2002), Hahn *et al.* (2002) in Turkey and Joo *et al.* (1999), in pork reported that a* values were higher for PSE meats than the normal one. For that, an increasing on the a* value can be assigned and were done by an concentration of this pigment in the muscle following the leak of aqueous diluents.

In the study, the red index (a*) was significantly higher for the Nicholas than two groups of Hybride and BUT9 ($p<0.05$). But there was not significantly difference between Hybride and BUT9 groups. That means the meats of Nicholas groups were redder than two other groups.

The yellow index (b*), the 3rd component of the Lab system was generally not exploited for the characterization of PSE meat like in the pork or in the poultry because of the low variability of its value but Franck *et al.* (1999, 2000) showed the interest of the b* value which varies in the same direction with L*. In the meat generally, the value of b* strongly increases between the slaughter day and the 3rd day conservation of the meat (Sante, 1993).

We found that the yellow index (b*) was significantly higher in the BUT9 groups to compare with the two other groups ($p<0.05$). But there was not significant difference between Hybride and Nicholas groups.

The previous study in the pork showed that the pH excepting the pH 1 was not the prediction value; if we continue this way, The L* value in Turkey give the best results and Nicholas group have a highest quality of meat.

## CONCLUSION

The objectives of this study were to characterize the sensory and the technological quality of meat of three genetic lines of Turkey thanks to the values of pH at the time of slaughter, pH 5 h post-mortem and the colour of pectoralis major muscle.

During this study, The fall speed of pH 5 h post-mortem of Nicholas Turkeys group were less important to compare to the Hybrid or BUT9 group. Moreover, the pale colour of meat was mainly used to describe the PSE meats. In the study, the colours values of three groups of Turkeys has evalualedand the results showed that the meat colour of Nicholas group were less pale than the Hybride and BUT9 groups.

If the PSE problem in Turkeys is similar to the pork, the fall of pH post-mortem and the meat colour can help us to conclude that the quality of the meat of Turkeys of the Nicholas group is better than the Hybrid and BUT9 groups.

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