Comparison of normal and PSE turkey breast meat for chemical composition, pH, color, myoglobin, and drip loss

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ABSTRACT - The objective of this investigation was to determine the differences between normal and PSE (pale, soft, exudative) turkey breast meat in terms of chemical composition, pH, color, myoglobin, and drip loss. Pale and normal skinless, boneless turkey breast fillets were taken from a poultry slaughterhouse in Van/Turkey at about 2-3 h postmortem. Spectrocolorimetry (CIE L*a*b*), pH, protein, ash, dry matter, lipid, myoglobin, and drip loss were measured in normal and pale color turkey breast muscle. The normal breast meat had significantly lower L*, a*, and b* values in comparison with the pale breast meat. Myoglobin concentration and pH were significantly higher in the normal breast meat compared with that of the pale breast meat. Protein content was found to be significantly lower for the pale group compared with the normal group. No significant difference was found in ash, dry matter, and total lipid content between normal and pale breast meat. Drip loss was significantly affected by breast meat color groups at days 1, 2, 3, and 4 postmortem. Pale, soft, exudative turkey breast meat can lead to differences in the chemical composition and shelf life of the product.

Key Words: breast meat, characteristic, quality

Introduction

Consumers would rather buy fresh boneless and skinless breast meat than other processed turkey meat. Turkey meat is generally demanded as fresh; therefore, it is necessary to extend shelf life as long as possible. Processed turkey meat has quality problems associated with the color, water holding capacity, cohesiveness, and texture characteristics (Sosnicki and Wilson, 1991; Guidi et al., 2006).

The color of raw poultry meat is an important sensory characteristic by which consumers initially select and evaluate the quality. Both the costume after buying the meat products and the producer, who produces value-added meat products, consider pH, drip loss, cook loss, juiciness, tenderness, and shelf life (Allen et al., 1998). Turkey and broiler meat colors affected by production and slaughter factors are well documented (Fletcher, 1989; Froning, 1995; Fletcher, 1999).

Selection for rapid growth in turkeys has led to muscle fiber defects and high plasma creatine kinase concentrations in meat (Wilson, 1990). Because a longer period is needed for decreasing the internal muscle temperature of the bigger carcasses in systems working on the basis of immersion chilling, higher temperatures are needed during the postmortem period (Rathgeber et al., 1999). Turkeys may be sensitive to ante mortem and postmortem stress factors that can result in accelerated rigor mortis formation (Owens et al., 2000). There is a close association between meat quality and decrease in muscle pH during the postmortem period, which results from accelerated postmortem glycolysis (Le Bihan-Duval et al., 2008). Rapid postmortem pH value decline while carcass temperatures are still high and an increase in lactic acid results in PSE (pale, soft, exudative) meat (McKee et al., 1998). The PSE characteristic is known as a meat defect. It is generally explained as a major defect that leads to poor texture, pale color, and poor water holding capacity of the meat (Fletcher, 1995), which was observed to have a different flavor by the consumer (Droval et al., 2012). Poultry meat consists of heme pigments such as myoglobin, hemoglobin, and cytochrome c. The main factor determining the poultry meat color is myoglobin content. The main factors determining myoglobin content were found to be species, muscle, and age of the animal (Froning, 1995; Fletcher, 2002). Drip loss is another determiner of water holding capacity and significantly affects L* value at 1.5 and 24 h postmortem (Owens et al., 2000).
The current study aimed to compare chemical composition, pH, color, myoglobin, and drip loss of normal and PSE turkey breast meat.

Material and Methods

Approximately 20 pale and normal skinless, boneless breast fillets from aged tom turkeys (Hybrid Converter-125 days), weighing 15.5-17 kg, were obtained from the Van-Et commercial turkey processing plant at about 2-3 h postmortem. They were then put into one of two subjective color categories: paler than normal color (n = 20) or normal color (n = 20). On the basis of color group, the samples were then put into bags (pale and normal), packed with ice, and transported to the laboratory.

To select the samples properly, a portable pH meter was used to calculate pH for the individual samples at 24 h postmortem (Beckman Coulter, Inc., Fullerton, CA 92834-3100) and this was done through the insertion of the pH probe into places similar to the ones in which color measurements were performed.

The normal and pale turkey breasts were selected according to three instrumental color measurements which were taken on the medial surface of each fillet. To take the measurements at approximately 1.5 h postmortem, a chrome meter was used (Lovibond RT-300 Potable Spectrophotometer, The Tintometer Limited) and this chrome meter was calibrated using a standard Lovibond calibration plate (D65/100; L* 94.54, a* −0.96, b* 0.11) according to CIE (1978). For the observations and color readings, meat samples were obtained from the skin side surface located in an area devoid of certain color defects (over scalding, bruises, and blood accumulation). In the determination of myoglobin contents, the procedure defined by Gokalp et al. (1999) was employed.

For the measurement of total protein, the Kjedahl method was utilized. Protein was converted using a factor of 6.25. The oven method at 105±2 °C was used to determine the moisture content of samples. The ash content was determined by oven-drying at 550 °C (AOAC, 1990). Total lipid was determined automatically using an ANKOMXT15 Lipid Extractor (ANKOM Technology, Macedon, NY).

Drip loss was evaluated on slices harvested at D1 (day 1 postmortem). Samples were individually packed and stored at 4 °C for 4 d. They were weighed at D2, D3, and D4 (days 2, 3, and 4 postmortem). Drip loss is expressed as a percentage of the weight at D1 (Honikel, 1998).

SPSS 16 program package was used for the descriptive analysis of the data; the differences between PSE and normal samples t-test. Differences between the means were considered significant at P<0.05.

Results

Pale breast meat had significantly higher L*, a, and b values when compared with the normal breast meat (Table 1). Myoglobin concentration and pH were significantly lower in the pale breast meat as compared with the normal breast meat.

There were significant differences in protein (%) content between the normal and pale groups (Table 2). The protein content was significantly higher in normal than pale group. There were no significant differences between normal and pale groups for ash, dry matter, and total lipid content.

Higher drip loss values were determined in the pale breasts in all evaluated periods (Table 3).

Table 1 - Physicochemical postmortem characteristics (mean ± standard error) of normal and pale turkey breast fillets

<table>
<thead>
<tr>
<th></th>
<th>Normal</th>
<th>Pale</th>
</tr>
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<tbody>
<tr>
<td>L*</td>
<td>48.49±0.254b</td>
<td>56.67±0.389a</td>
</tr>
<tr>
<td>a*</td>
<td>2.06±0.081b</td>
<td>2.70±0.095a</td>
</tr>
<tr>
<td>b*</td>
<td>1.41±0.034b</td>
<td>2.66±0.097a</td>
</tr>
<tr>
<td>pH</td>
<td>6.20±0.019a</td>
<td>6.04±0.017b</td>
</tr>
<tr>
<td>Myoglobin, mg/g</td>
<td>8.79±0.119a</td>
<td>7.56±0.141b</td>
</tr>
</tbody>
</table>

a,b - means in rows with differing letters are significantly different (P<0.05).

Table 2 - Chemical postmortem characteristics (mean ± standard error) of normal and pale turkey breast fillets

<table>
<thead>
<tr>
<th></th>
<th>Normal</th>
<th>Pale</th>
</tr>
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<tbody>
<tr>
<td>Protein, %</td>
<td>27.59±0.115a</td>
<td>26.42±0.162b</td>
</tr>
<tr>
<td>Ash, %</td>
<td>1.24±0.035</td>
<td>1.21±0.006</td>
</tr>
<tr>
<td>Dry matter, %</td>
<td>28.05±0.160</td>
<td>28.11±0.188</td>
</tr>
<tr>
<td>Total lipid, %</td>
<td>0.42±0.022</td>
<td>0.46±0.015</td>
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a,b - means in rows with differing letters are significantly different (P<0.05).

Table 3 - Drip loss of slices of normal and pale turkey breast fillets during a four-day storage period at 4 °C (mean ± standard error)

<table>
<thead>
<tr>
<th></th>
<th>Normal</th>
<th>Pale</th>
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<tbody>
<tr>
<td>D1, %</td>
<td>1.05±0.051b</td>
<td>1.94±0.183a</td>
</tr>
<tr>
<td>D2, %</td>
<td>1.68±0.073b</td>
<td>3.04±0.285a</td>
</tr>
<tr>
<td>D3, %</td>
<td>2.38±0.084b</td>
<td>3.86±0.271a</td>
</tr>
<tr>
<td>D4, %</td>
<td>3.44±0.165b</td>
<td>5.15±0.323a</td>
</tr>
</tbody>
</table>

a,b - means in rows with differing letters are significantly different (P<0.05).

D - day postmortem.
The detection of PSE meat color is an important indicator in terms of showing the quality of meat (Barbut, 1993). The average L*, a*, and b* values in the normal breast meat (48.49, 2.06, and 1.41, respectively) were lower than in the pale group (Table 1). This result concurs with the finding of Owens et al. (2000). Barbut (1993; 1998) suggested using a high L* value (>51-53) to determine PSE meats described by paler color and changed texture and water holding capacity in turkey. Garcia et al. (2010) showed that pale and normal chicken fillets presented significantly different L* and a* values. The pH values of the normal and pale groups were 6.20 and 6.04, respectively, and were significantly different from each other (Table 1). Fletcher (2002) reported that the lower pH meat is often characterized as being pale, soft, and exudative (PSE). Owens et al. (2000) reported significant differences of pH (1.5 h) between pale and normal turkey breast meat (5.72 vs. 6.09). They also observed that pH value was lower to a great extent in the pale fillets in comparison with normal fillet color. In this study, the myoglobin content of normal breast meat was 8.79 mg/g and was significantly greater than that of the pale group (7.56 mg/g). Similar to the present study, Boulianne and King (1995) found significantly lower amounts of the total pigment, myoglobin, and iron concentrations in pale breast meat than those of normal breast meat in chickens.

Protein content was significantly lower for the pale group, 26.42%, than in the normal group, 27.59% (Table 2). These results are similar to the findings reported by Qiao et al. (2002) and Li et al. (2014), who reported PSE broiler breast meat containing less protein content than normal colored meat. Qiao et al. (2002) reported significant differences in protein content between normal and pale broiler breast meat (22.96% vs. 22.58%). No differences were observed between normal and pale groups in ash (%), dry mater (%), and total lipid contents in this study (Table 2). The closest values to these results were reported by Qiao et al. (2002) and Li et al. (2014).

Drip loss is another indicator of water holding capacity. The most serious defect of PSE meat is drip loss. Water is not closely bound to proteins, and cell membranes are very permeable in pale meats (Garcia et al., 2010). Data illustrate that drip losses are higher for pale fillets than for normal fillets (Table 3). Drip loss at D1 was 1.05% for the normal groups and 1.94% for the pale groups, which were found to be quite different from each other. Drip loss was also significantly affected by breast meat color groups at D2, D3, and D4 postmortem. Pale turkey meat has a lower holding water capacity and produces softer gels structure (Sosnicki and Wilson, 1991; Barbut, 1993; Garcia et al., 2010).

**Conclusions**

Color is an important food quality property in poultry meat. Pale, soft, exudative turkey breast meat can be identified by color, pH, myoglobin content, and drip loss. There are relationships between muscle pH, myoglobin content, drip loss and meat color. Turkey breast meat color variations affect myoglobin content, pH, and drip loss. These color variations are associated with differences in the shelf life of the product.

**Acknowledgments**

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**References**


