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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 costumer 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).

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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 were compared through an independent 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[1]

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

a,b - means in rows with differing letters are significantly different (P<0.05).
[1] Groups selected based on subjective color evaluation.

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

	Normal	Pale
Protein, %	27.59±0.115a	26.42±0.162b
Ash, %	1.24±0.035	1.21±0.006
Dry matter, %	28.05±0.160	28.11±0.188
Total lipid, %	0.42±0.022	0.46±0.015

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)

	Normal	Pale
D1, %	1.05±0.051b	1.94±0.183a
D2, %	1.68±0.073b	3.04±0.285a
D3, %	2.38±0.084b	3.86±0.271a
D4, %	3.44±0.165b	5.15±0.323a

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

Discussion

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.

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References

Allen, C. D.; Fletcher, D. L.; Northcutt, J. K. and Russel, S. M. 1998. The relationship of broiler breast color to meat quality and shelf-life. Poultry Science 77:361-366.

AOAC - Association of Official Analytical Chemists. 1990. Official methods of analysis. 15th ed. AOAC, Washington, DC, USA.

Barbut, S. 1993. Colour measurements for evaluating the pale soft exudative (PSE) occurrence in turkey meat. Food Research International 26:39-43.

Barbut, S. 1998. Estimating the magnitude of the PSE problem in poultry. Journal of Muscle Foods 9:35-49.

Boulianne, M. and King, A. J. 1995. Biochemical and color characteristic of skinless, boneless pale chicken breast. Poultry Science 74:1693-1698.

CIE - International Commission on Illumination. 1978. Recommendation on uniform color spaces, color difference equations, psychometric color terms. Supplement No.2 to CIE Publication No.15 (E-1.3.1) 1971/(TC-1.3). Bureau Central de la CIE, Paris, France.

Droval, A. A.: Benassi, V. T.; Rossa, A.; Prudencio, S. H.; Paiao, F. G. and Shimokomaki, A. 2012. Consumer attitudes and preferences regarding pale, soft, and exudative broiler breast meat. The Journal of Applied Poultry Research 21:502-507.

Fletcher, D. L. 1999. Broiler breast meat color variation, pH, and texture. Poultry Science 78:1323-1329.

Fletcher, D. L. 1989. Factors influencing pigmentation in poultry. CRC Critical Reviews in Poultry Biology 2:149-170.

Fletcher, D. L. 2002. Poultry meat quality. World's Poultry Science Journal 58:131-145.

Fletcher, D. L. 1995. Relationship of breast meat color variation to muscle pH and texture. Poultry Science 74(Suppl 1):120.

Froning, G. W. 1995. Color of poultry meat. Poultry and Avian Biology Review 6:83-93.

Garcia, R. G.; de Freitas, L. W.; Schwingel, A. W.; Farias, R. M.; Caldara, F. R.; Gabriel, A. M. A.; Graciano, J. D.; Komiyama, C. M. and Almeida Paz, I. C. L. 2010. Incidence and physical properties of pse chicken meat in a commercial processing plant. Brazilian Journal of Poultry Science 12:233-237.

Gokalp, H. Y.; Kaya, M.; Tulek, Y. and Zorba, O. 1999. Practical laboratory guide and quality control in meat and meat products. Atatürk University, Publication No: 786, Faculty of Agriculture, No: 69, Erzurum, Turkey.

Guidi, A.; Castigliego, L.; Benini, O; Armani, A.; Iannone, G. and Gianfaldoni, D. 2006. Biochemical survey on episodic localized darkening in turkey deboned thigh meat packaged in modified atmosphere. Poultry Science 85:787-793.

Honikel, K. O. 1998. Reference methods for the assessment of physical characteristics of meat. Meat Science 49:447-457.

Le Bihan-Duval, E.; Debut, M.; Berri, C.; Sellier, N.; Santé-Lhoutellier, V. and Jégo, Y. 2008. Beaumont C. Chicken meat quality: genetic variability and relationship with growth and muscle characteristics. BMC Genetics 9:53.

Li, K.; Chen, L.; Zhao, Y. Y.; Li, Y. P.; Wu, N.; Sun, H.; Xu, X. L. and Zhou, G. H. 2014. A comparative study of chemical composition, color, and thermal gelling properties of normal and PSE-like chicken breast meat. CyTA - Journal of Food 13:213-219. doi: 10.1080/19476337.2014.941411.

McKee, S. R.; Hargis, B. M. and Sams, A. R. 1998. Pale, soft, and exudative meat in Turkeys treated with succinylcholine. Poultry Science 77:356-360.

Owens, C. M.; Hirschler, E. M.; McKee, S. R.; Martinez-Dawson, R. and Sams, A. R. 2000. The characterization and incidence of pale, soft, exudative turkey meat in a commercial plant. Poultry Science 79:553-558.

Qiao, M.; Fletcher, D. L.; Northcutt, J. K. and Smith, D. P. 2002. The relationship between raw broiler breast meat color and composition. Poultry Science 81:422-427.

Rathgeber, B. M.; Boles, J. A. and Shand, P. J. 1999. Rapid postmortem ph decline and delayed chilling reduce quality of turkey breast meat. Poultry Science 78:477-484.

Sosnicki, A. A. and Wilson, B. W. 1991. Pathology of turkey skeletal muscle: implications for the poultry industry. Food Structure 10:317-326.

Wilson, B. W. 1990. Developmental and maturational aspects of inherited avian myopathies. Proceedings of Society for Experimental Biology and Medicine 194:87-96.