EFFECTS OF TURKEY AGE AND CONDITIONING ON MEAT PH, COLOR AND SARCOMERE LENGTH

Julie K. Northcutt[a], and Louis L. Young[b], R. Jeff Buhr[b]

Department of Poultry Science, The University of Georgia[a] and Richard B. Russell Agricultural Research Center, ARS, USDA[b], Athens, Georgia 30613-5677, USA.

Key words: turkey meat, pH, color, sarcomere length, meat quality

Background

Color and texture are of paramount importance in poultry marketing. Because consumers have no way to evaluate texture prior to purchase, initial purchasing decisions are made primarily on the basis of color, whereas product satisfaction, which affects repeat purchasing decisions, is primarily determined by texture when the product is consumed. Successful marketing requires control of both these quality attributes. In order to ensure that control, additional information on biological and processing factors which affect color and texture is needed. Results of this study will help provide that information.

Objective

The objective of this study was to evaluate effects of bird age at slaughter and time postmortem on turkey breast and thigh meat pH, sarcomere lengths and C.I.E. (1978) color values.

Methods

Commercially reared turkey toms were procured at 9, 13 and 17 weeks of age. At each age, three birds were electrically stunned and then slaughtered without scalding, defeathering or eviscerating. Immediately following a 90 s exsanguination, the breast meat (*M. Pectoralis*) and thigh meat (*M. iliofibularis* and *M. iliotibialis*) from the left side were excised (in-rigor meat). The remaining portion of each carcass was placed in a plastic bag and stored for 24 h at 4° at which time the right muscles were excised (post-rigor meat). The pH values were evaluated on the in-rigor and post-rigor meat (initial pH and final pH, respectively) using the method of Jeacock (1977) as a measure of the progress of rigor mortis, a determinant of both meat color and texture (Lyon *et al.*, 1985; Young *et al.*, 1996). Sarcomere length of the same muscles was evaluated according to the method of Cross *et al.* (1980) (initial and final sarcomere length, respectively) as a measure of fiber length, a determinant of ultimate meat texture (Lyon and Lyon, 1994). Surface C.I.E. (1978) L*, a* and b* color values were measured on all in-rigor and post-rigor muscles (initial and final L*, a*, and b*, respectively) using a Minolta®. CR 2000 color meter. The experiment was replicated a total of two times. Data were analyzed by ANOVA using SAS GLM Procedure with the LSMeans/pdiff option (SAS® Institute, 1994). Dependent variables were initial and final pH, sarcomere lengths and color values. Replicates, birds ages and meat type were used as main effects. Interactions among main effects were tested using the error MS. In cases of non-significant interactions, data were pooled over the main effects. Differences were considered statistically significant at the 0.05 level of probability. Because significant interactions were detected in the first analysis, initial and final a* and b* values were analyzes as a paired t-test to determine whether or not surface color changes during the conditioning period were affected by the birds' ages.

Results and Discussion

Effects of birds' age on pH and sarcomere lengths are shown in Table 1. Breast and thigh meat were affected by age similarly. Initial pH was unaffected by age, exhibiting an overall mean of 6.44 ± 0.008, but the final muscle pH of the 17 week old birds was significantly lower than those of younger birds. Sarcomere lengths followed a somewhat different trend. Initial sarcomere lengths shortened as the turkeys became older, but there were no differences in final sarcomere lengths. These data suggest that muscles from older turkeys become more highly contracted than do those of younger turkeys, but that rigor is resolved more quickly in muscles of older turkeys than of younger ones. The implication is that it might be beneficial to consider birds' ages in setting postmortem conditioning periods.

Although pH and sarcomere length of both meat types responded to the birds' ages similarly, there were significant differences in these measures between the meat types. Table 2 shows mean initial and final pH and sarcomere lengths of the breast and thigh meat. Initial pH of the breast meat was significantly lower than that of thigh meat. Even though the difference was reduced for the final pH, breast pH remained significantly lower that thigh pH. Similarly, initial mean sarcomere lengths of breast meat were significantly smaller than those of thigh meat, and, although the difference was reduced in the final sarcomere lengths, they remained significant. In chickens, the rigor process is much more rapid in thigh muscle than in breast muscle. These data indicate that the rigor process in turkey thigh muscle may be more prolonged than in chicken thigh muscle.

The age by meat type interaction for color values was significant in some cases, so the values for each meat type were compared at each age. Results are presented in Figure 1. Initially, L* (lightness) values were similar for both breast and thigh; however, age affected the muscles in different ways. Breast L* values remained essentially constant through 13 wk, but by 17 wk increased significantly. L* values of thigh meat decreased significantly between the 9th and 13th wk and remained constant thereafter. Apparently, breast meat of older birds is lighter than that of younger birds, but that of thigh meat grows darker in older birds.

Color difference between breast and thigh which is apparent to even casual observers was apparent in the a* (redness)values. Mean initial a* for breast and thigh were 2.91 and 11.46, respectively and mean final a* values were 4.93 and 10.17, respectively. Both breast and thigh became less red as the birds became older; however a significant interaction was detected. During

conditioning, breast meat became redder exhibiting mean a* changes of +3.14, +2.02 and +1.12 at 9, 13 and 17 wk, respectively, whereas thigh meat became less red exhibiting changes of -2.60, -0.68 and-0.58, respectively at similar ages. Initial b* (yellowness) values were significantly lower on thigh meat from 17 wk old turkeys than that from younger ones, but age had no effect on initial b* values of breast meat. Final b* values of both meat types significantly declined as the birds grew older.

Product appearance is clearly affected by both biological and processing variables. Fletcher (1999) conducted a sensory surveyed of 997 commercially packaged chicken breast fillet 4-packs and reported that 7.1 % of the packages exhibited noticeable muscle-to-muscle surface color variation. Undoubtedly the sources of this variation are numerous, but the data in this report clearly show that for turkeys, age of birds and postmortem conditioning are contributing factors.

Conclusions

Both biological and processing factors affect turkey color and texture, quality characteristics which consumers use in making purchasing decisions. Controlling variation in these characteristics will require control of those factors.

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Table 1. Effect of age on initial and final pH and sarcomere lengths of turkey pooled over meat types

Age (wk)	pH		Sarcomere Length (μm)	
	Initial	Final	Initial	Final
9	6.48	6.01[a]	2.33[a]	2.01
13	6.43	6.07[a]	2.19[b]	2.10
17	6.41	5.86[b]	2.03[c]	2.15
SEM	0.008	0.008	0.011	0.008

[a, b, c] Means in the same column bearing no common superscripts

Table 2. Effect of meat type on initial and final pH and sarcomere lengths of turkey pooled over age

Meat Type	pH		Sarcomere Length (μm)	
	Initial	Final	Initial	Final
Breast	6.28[b]	5.88[b]	2.01[b]	1.97[b]
Thigh	6.60[a]	6.07[a]	2.36[a]	2.21[a]
SEM	0.008	0.008	0.011	0.008

[a, b] Means in the same column with no common superscripts differ significantly ($P < 0.05$).

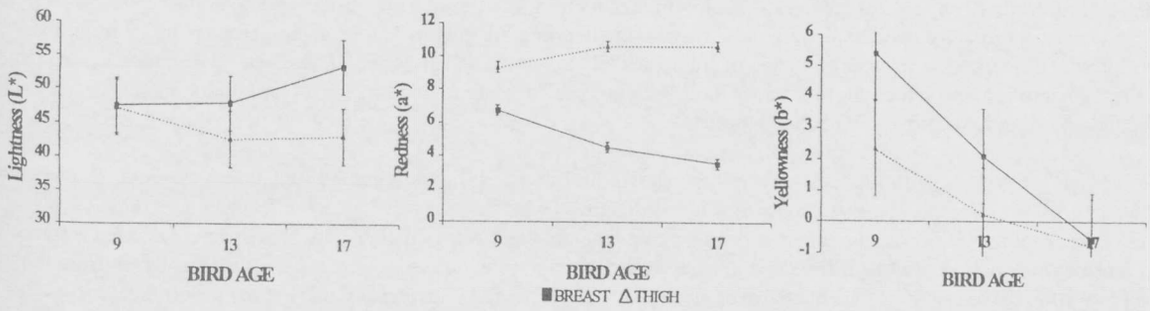

Figure 1. Effect of age and meat type on initial and final C.I.E. (1978) color values of turkey meat.