# Effect of raw meat L* -value, pH and marination on cooked meat quality of broiler thigh meat

E.S. Lee*[1], 2, S. Dadgar[1], C.J. Kim[2], and P.J. Shand[1]
[1]*Department of Food and Bioproduct Sciences, University of Saskatchewan, Saskatoon, SK, S7N 5A8, Canada*
[2]*Department of Food Science and Biotechnology of Animal Resources, Konkuk University, Seoul 143-701, South Korea*

## Introduction

L* value (lightness) and pH have been used as predictive tools for estimating meat quality. In general, measurement of L* value is easier and faster than pH. Woelfel et al. (2002) reported that L* value seems to be of more predictive value than pH. Broiler meat with low pH or high L* value has been associated with low water-holding capacity, which results in increased cooking loss and shear value. The relationship among breast meat L* value, pH and meat quality has been reported by several researchers (Allen et al., 1998; Qiao et al., 2002).

Marination can improve meat quality, product yield, and sensory properties of meat. The major methods of marination are still-marination, injection and tumbling. The still-marinating process requires more space and time than the tumbling and injection processes, but does not require major capital investment. In addition, an advantage of still-marination is that it protects the integrity of fragile products such as deboned thigh meat. A number of researchers have studied the effect of marination on breast fillets; however, no studies have been done to investigate the effect of marination on thigh meat. Thus, the objective of this study was to determine the effects of L* value, pH and still-marination on raw and cooked meat quality properties of broiler thigh meat.

## Materials and Methods

In three trials, a total of 216 broilers (34~39 days old) were slaughtered at a commercial poultry processing plant. After chilling, the carcasses were returned to the University meat laboratory and deboned at 6 hr postmortem. Deboned and skinless left and right thigh samples were stored at 4°C and CIE L*a*b* values were measured on the iliotibialis muscle using a Minolta chroma meter at 30 hr postmortem. Each sample was individually vacuum packed, and stored at -30°C until tested. Samples from the left side served as unmarinated controls, while those from the right side were selected for still-marination treatment.
Before use, frozen thigh samples were thawed for 24 hr in a 4°C cooler and pH was measured in 2 locations on the raw meat using a probe type pH meter. After removing external fat and excess pieces of flesh, the samples were weighed individually to establish green weight. The marinade (pH 7.4) was made by mixing 95% water, 3% NaCl, and 2% sodium tripolyphosphate (STPP). Each thigh sample was still-marinated with 200 % (solution weight:green weight) of the prechilled marinade solution and marination uptake was determined after marination for 24 hr at 4°C. The marinated samples were placed in polyethylene bags and after an additional 24 hr, marination retention was determined, and then marinated sample pH and color were remeasured. Each thigh meat sample was sealed in a vacuum bag and cooked in a 80°C steam-heated water bath to an internal temperature of 78°C. The cooking loss and product yield were calculated by weight before and after cooking or from green weight. A sample (3×4cm) was cut from each cooked thigh sample and the piece was sheared to measure Allo-Kramer (AK) shear value. Unmarinated samples were thawed, reweighed to determine thaw purge and then cooked and sheared according to the procedures described above.
Correlation coefficients among L-value, pH, marination uptake, retention, cooking loss, final product yield, and shear value were generated using the Pearson's correlation coefficient option of SAS program.

## Results and Discussion

Marinade uptake and retention: In this study, the average L* value of raw thigh meat was 50.67±3.35. After marinating, there was no significant difference between raw and marinated meat L* values; however, a* and b* values of marinated meat were significantly lower than

those of raw meat (data not shown). The average pH of raw and marinated meat were 6.37±0.23 and 6.43±0.12, respectively. The percentage of marinade absorbed by still-marination was about 22% and the marinated thighs retained approximately 18% marinade after 24 hr of holding. As expected, marinated thighs had lower cooking loss and AK shear value than those of unmarinated samples (Table 1).

The correlation coefficients between various parameters (marinade uptake and retention, cooking loss, final product yield, shear value) and raw meat L* values and pH are presented in Table 2. As expected, there were strong and negative correlations between raw meat L* value and pH (r= -0.825). In general, both factors had similar predictive ability of meat quality. The raw meat L* values were negatively correlated to marinade uptake and retention. On the other hand, the pH of raw meats was significantly and positively correlated with marinade uptake and retention. These results agree with the findings of Allen et al. (2002) and Qiao et al. (2002).

**Table 1.** Mean and SD of marinade uptake, marinade retention, cooking loss (CL), product yield (PY), and Allo-Kramer shear value (AK) of broiler thigh meat

| Measurement [1)] | Mean±SD |
|---|---|
| Uptake (%) | 21.99±2.05 |
| Retention (%) | 18.00±1.92 |
| U-CL (%) | 16.52±3.93 |
| M-CL (%) | 5.17±1.00 |
| M-PY (%) | 111.9±2.16 |
| U-AK (N/g) | 29.99±6.58 |
| M-AK (N/g) | 19.07±2.00 |

[1)] U: unmarinated, M: marinated.

**Table 2.** Correlation coefficients between marinade uptake, marinade retention, cooking loss (CL), product yield (PY), and Allo-Kramer shear value (AK) and L* value and pH of broiler thigh meat

| Measurement [1)] | L* value | pH |
|---|---|---|
| Uptake | -0.209* | 0.192* |
| Retention | -0.352*** | 0.336*** |
| U-CL | 0.731*** | -0.787*** |
| M-CL | 0.501*** | -0.456*** |
| M-PY | -0.573*** | 0.535*** |
| U-AK | 0.522*** | -0.602*** |
| M-AK | 0.044 | -0.250** |

[1)] See Table 1. *$P$<0.01, **$P$<0.001, ***$P$<0.0001.

*Cooking loss and shear value*: As expected, still-marination with STPP and NaCl had a significant effect on thigh cooking loss and shear values. Thigh meat with higher L* value showed higher cooking loss and the relationship was linear. Although marinated thigh meat absorbed and retained some marinade, these samples exhibited lower percentages of cooking loss than unmarinated meat (Fig. 1). There was an interaction for cooking loss between marination and L* or pH, with those samples that were lighter or of lower pH exhibiting greater decreases in cook loss when marinated. These results show that marination can effectively improve cooking properties for lighter meat such as PSE meat and decrease variability among samples.

For AK shear, as L* value increased, shear values of unmarinated meat also increased; however, after marination, there were no significant correlations between L* value and shear value (Table 1) as the thigh samples were now more tender with less variation among samples (Fig. 1). Unexpectedly, marinade uptake and retention were not significantly correlated to cooking loss, product yield, or AK-shear value (data not shown). These results agree with that from Qiao et al. (2002), who reported that there was no correlation between marination pickup and cooked yield or shear value of breast meat. On the other hand, Allen et al. (1998)

found that there was a significant correlation between marinade uptake and cooked breast meat yield.

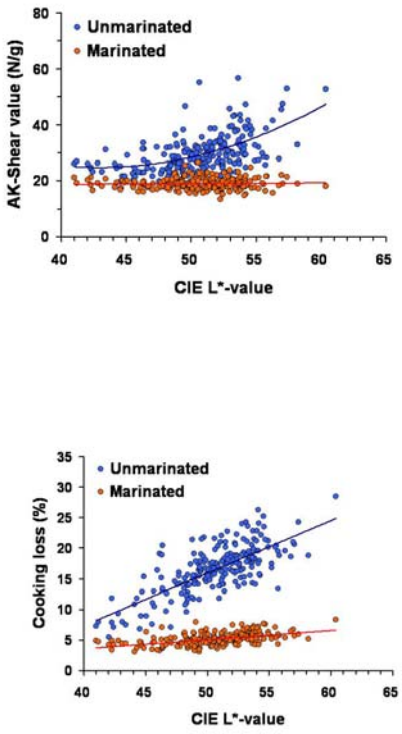


**Figure 1.** The relationship between cooking loss, AK-Shear value and CIE L*value of raw broiler thigh meat.

In conclusion, these results indicate that variations in meat color or pH of broiler thigh meat can be related to differences in meat quality properties. Still-marination can effectively reduce differences in cooked meat quality of broiler thigh meat.

**References**

1. Allen, C.D., Fletcher, D.L., Northcutt, J.K., and Russell, S.M. (1998). The relationship of broiler breast color to meat quality and shelf-life. *Poultry Science*, 77, 361-366.
2. Qiao, M., Fletcher, D.L., Smith, D.P., and Northcutt, J.K. (2002). Effects of raw broiler breast meat color variation on marination and cooked meat quality. *Poultry Science*, 81, 276-280.
3. Woelfel, R.L., Owens, C.M., Hirschler, E.M., Martinez-Dawson, R., and Sams, A.R. (2002). The characterization and incidence of pale, soft, and exudative broiler meat in a commercial processing plant. *Poultry Science*, 81, 579-584.

**Acknowledgements**

This work was partly supported by a Korea Research Foundation Grant and funding to the Poultry Transport Team at the University of Saskatchewan (NSERC/AAFC Partnership program, Alberta Chicken Producers, Alberta Farm Animal Care, Chicken Farmers of Saskatchewan, Poultry Industry Council and the Saskatchewan Chicken Industry Development Fund). The authors wish to thank the Poultry Transportation and Welfare Team for technical assistance and Lilydale Inc. for providing the chicken samples. Modified from a paper presented at the 53rd International Congress of Meat Science and Technology, August 5-10, Beijing, China.