

## THE EFFECT OF DIFFERENT MARINADE FORMULATIONS ON QUALITY OF CATTLE MEAT

Alper ÖNENÇ<sup>1</sup> Meltem SERDAROĞLU<sup>2</sup> Kıyalbek ABDRAIMOV<sup>2</sup>

<sup>1</sup>University of Ege, Faculty of Engineering, Department of Food Engineering

<sup>2</sup>Faculty of Agriculture, Department of Animal Science, 35100, Bornova-Izmir -TURKEY.

### ABSTRACT

The effects of marination in solutions containing NaCl, sodium tripolyphosphate (STP), citric acid (CA) and dicalciumhydrogen phosphate (CHP) on chemical composition, pH, color, textural properties (hardness, fracturability, cohesiveness, springiness, chewiness, gumminess, resilience, compressibility), cooking loss, WHC, marinade uptake and slice square gain at 0, 24<sup>th</sup> h and 3<sup>rd</sup>, 5<sup>th</sup> and 7<sup>th</sup> days of ageing were studied. Marinade treatment and ageing period had significant effect on marinade pH, muscle pH, colorimetric color parameters, protein content and marinade uptake ( $P<0.05$ ). Also, resilience, compressibility, fat content and cooking loss were affected by ageing ( $P<0.05$ ). Neither marinade treatment nor ageing period have not shown any significant differences on hardness, fracturability, cohesiveness, springiness, chewiness and gumminess. As a result of the study, sodium triphosphate have altered chemical status, textural properties and meat quality traits compared with the other marinade ingredients.

**Key words:** marination, phosphates, meat quality, texture, citric acid

### Introduction

Many consumers rate tenderness as the most important factor determining the quality of meat (Chrystall, 1994). Although, meat tenderness depends on preslaughter conditions, it can be improved by various methods after slaughter. Marination is more preferable into these methods. Marination process has many positive effects on palatability and shelf life of meat (Cannon *et al.*, 1993) and marination is a method of reducing ageing time required for meat tenderization (Goodwin and Maness, 1984). Various functions of marinade ingredients such as salt, phosphates, weak acids, tenderizers, sugar, seasonings and flavoring have been reported (Hashim, *et al.*, 1999; Detienne and Wicker, 1999; Lois *et al.*, 1992; Howat *et al.*, 1983; Oreskovich *et al.*, 1992). It has been determined that marinades act by altering the ultimate muscle pH which in turn, alters the physical and/or chemical properties (Oreskovich *et al.*, 1992). These include WHC, moisture retention and tenderness and cooking loss (Landes, 1972, Shults and Wierbicki, 1973, Chen, 1982, Young *et al.*, 1992). Also, Rongrong *et al.*, (2000) reported that salt and phosphates in marinades enhance WHC, overall moisture, juiciness and yield while limiting cooking and purge loss. Besides, different chemical forms of phosphates do not necessarily produce identical effects in the product and processors may use various forms or combinations of phosphates in the marinades (Rongrong *et al.*, 2000). Polyphosphates have been used in meat and poultry products for many years to improve yields, texture and moisture retention (Louis *et al.*, 1992). The aim of the present study was to examine the effect of different marinade formulations on some quality parameters of beef *Longissimus dorsi thoracis* during aging period.

### Materials and Methods

Carcasses of four Holstein Friesian young bulls that were raised in the same environment conditions were used in the research. After carcasses were chilled at +4°C for 24 hour at commercial abattoir, *M. longissimus thoracis* were sliced into 1.5 mm thickness and distributed to marinade treatments randomly. Marinade formulations were (w/v) 2% NaCl (CON), 2% NaCl+ 0.05% (STP), 2% NaCl+ 0.05% (CA) and 2% NaCl + 0.05% (CHP). Meat slices were then dipped in marinade solutions. On 0 and 24<sup>th</sup> h and 3<sup>rd</sup>, 5<sup>th</sup>, 7<sup>th</sup> days of ageing, muscle pH (Landvogt, 1991), WHC (Wierbicki and Deatherage 1958), marinade uptake, color CIE, (1976), cooking loss (Campo, 2000), textural properties and chemical analyses (Moisture, AOAC,1990; protein, Anon,1979; fat, Flynn and Bramblett, 1975) were evaluated. Data were analyzed by MANOVA using general linear model (GLM) procedure of SPSS V.8 (1997) with a significance level of  $p=0.05$ .

### Results and Discussion

Both marinade treatment and ageing period had significant effect on marinade pH, L\* and a\* values, protein content and marinade uptake of slices ( $P<0.05$ ). Muscle pH, b\* value, gumminess were affected by marinade treatment, resilience, compressibility, fat content and cooking loss were affected by ageing period ( $P<0.05$ ). Neither marinade treatment nor ageing period had not shown any significant difference on hardness, fracturability, cohesiveness, chewiness. Marinade pH decreased during the ageing period for all treatments except CA. On 7<sup>th</sup> day, the highest marinade pH was recorded for CHP (6.36), the lowest marinade pH was recorded for CA (5.19). CON and STP had 5.79 and 6.02 marinade pH, respectively at the same period. However, muscle pH showed a tendency to increase until 5<sup>th</sup> day of ageing then it decreased. Likewise, Cannon *et al.*, (1993) found that STP treatment increased muscle pH while CA resulted decrease on muscle pH. Detienne and Wicker, (1999) and Zheng *et al.*, (1989) reported that muscle pH increased in STP treatment significantly. Muscle pH was 5.43, 5.75, 4.16 and 5.89 at 7<sup>th</sup> day for CON, STP, CA, CHP respectively. For all marinade treatments, brightness increased until the third day of ageing, while red color coordinate decreased and yellow color coordinate increased. The results showed that CA converted meat color from red to brown. The color of meat slices in STP was not dark as the meat slices in CON and CHP treatments. Likewise, Qiaso *et al.*, (2002) showed that absolute color values changed with marination. Our study showed that color parameters increased during the ageing period. Although, there were no significant differences among marinade treatments and ageing period for hardness, fracturability, cohesiveness, chewiness, compressibility, these values were lower in slices treated with STP compared with the other treatments. Cannon *et al.*, (1993) found that storage time did not have significant effect on WB. In our study, tenderness was higher for STP compared with CON. Likewise, Cannon *et al.*, (1993) found that STP treatment had higher tenderness score than CON treatment at all storage periods. But these results were not consistent with results of Weakly *et al.*, (1986) who reported a reduction in WB of fresh pork as storage time increased. However, Sheard *et al.*, (1999) confirmed our results. Moisture was higher in CA (75.48%) until 24 hour of ageing but on 7<sup>th</sup> day of ageing STP showed the higher moisture contents (82.31%) while CA showed the lower moisture (74.96%) compared with the other treatments. On the 7<sup>th</sup> day of ageing, meat slices in STP had lower protein (13.18%) and high fat content (3.01%), CA had the highest protein content (21.45%) but CHP had the lowest fat content (1.95%) among the marinades treatments (3.01%). WHC showed increment during the ageing. At the final of the treatment, CHP produced the highest WHC (55.49%) compared to control (40.58%), STP (53.89%), CA (52.25). These results confirmed previous research (Oreskovich *et al.*, 1992; Cannon *et al.*, 1993). We found that cooking loss showed increasing as storage time increased, pH reduced. These results confirmed those reported by Bouton *et al.*, (1973), Harrell *et al.*, (1978) and Oreskovich *et al.*, (1992). Minimum cooking loss was observed at STP. Detienne and Wicker, (1999) confirmed our results. High marinade uptake was observed in STP treatments during ageing period compared with the other treatments. Marinade uptake was higher for STP and CHP (30.28% and 30.80%) when compared with CON and CA (20.02% and 8.61%) on the 7<sup>th</sup> day of ageing. Rongrong *et al.*, (2000) reported that weight gain was

18.97% and 17.52 STP and salt. Detienne and Wicker, (1999) observed that STP (%0.15) and salt (%0.5) marinades had 12.7% weight gain. Only STP (%0.15) had 11.4% weight gain, only salt marinade (%1) had 14.3% weight gain.

### Conclusions

As a result marinade treatments improved quality of meat as marinade act by altering the ultimate pH. This study suggest that marination with STP can be successfully used to enhance tenderness. Marination with weak acids caused to color problems. After cooking, we observed pink defect in CON, CHP treatments. Slight pink defect was observed in STP treatment.

### References

- AOAC, **1990**. *Official methods of analysis of the association of analytical chemist*. Edit, W. Horwitz. 15<sup>th</sup> Ed. Washington D. C., USA.
- Anonymous, **1979**. *Tekator manual kjeltec system 1002*, Sweeden.
- Bouton, P. E., Carrol, F. D., Fisher, A. L., Harris, P. V. and Shorthose, W. R., **1973**. *J. Food Sci.* 39:532.
- Campo, M. M. **1999**. *Influencia de la raza sobre la textura y las características sensoriales de la carne bovina a lo largo de la maduración*. 255 paginas. Tesis Doctoral. Universidad de Zaragoza Facultad de Veterinaria. España.
- Cannon, J.E., McKeith, F. K., Martin, S. E., Novakofski, J. And Carr, T. R., **1993**. *J. Food Sci.*58: 1249-1253.
- Chen, T. C., **1982**. *J. Food Sci.* 47: 1016-1019.
- Chrystall, B., **1994**. *Meat texture measurement Chapter:12, page 34-78, Quality attributes and their measurement in meat, poultry and fish products. Advances in meat research series. Volume 9. edited by A. M. Pearson and T. R. Dutson.*Blackie A.& P. UK. 505p.
- CIE, **1986**. *Colorimetry. 2<sup>nd</sup> ed. CIE Publication No. 15.2. Commission Internationale de l'Eclairage. Vienna.*
- Detienne, N. A: and Wicker, L. **1999**. *J. Food Sci.* 64:1042-1047.
- Flynn, A. W. And Bramblett, V. D., **1975**. *J. Food Sci.*40:631-633.
- Goodwin, T. L. And Maness, J. B., **1984**. *Poultry Sci.* 63:1925-1929.
- Harrel, R. A., Bidner, T. D. and Icaza, E. A., **1978**. *J. Anim. Sci.* 46:1592.
- Hashim, I. B., McWatters, K. H. and Hung, Y. C., **1999**. *J. Food Sci.* 64:163-166.
- Howat, P. M., Sievert, L. M., Myers, P. J., Koonce, K. L. and Bidner, T. D., **1983**. *J. Food Sci.* 48: 662-663.
- Landes, D. R., **1972**. *Poult. Sci.* 69:1420-1427. McNeal, J. E., **1990**. *Meat and meat products. Official methods of analysis. Edited by Kenneth Helrich, 5<sup>th</sup> edition. Association of Official Analytical Chemist Inc. USA.*
- Landvogt, A., **1991**. *Errors in pH measurement of meat and meat products by dilution effects . 37<sup>th</sup> International Congress of Meat Science and Technology, 8(10):1159-1162.*
- Louis, L. Y., Papa, C. M., Lyon, C. E. and Wilson, R. L., **1992**. *J. Food Sci.* 57:6:1291-1293.
- Oreskovich, D. C., Bechtel, P. J., McKeith, F. K., Novakofski, J., and Basgall, E. J., **1992**. *J. Food Sci.* 57:305.
- Qiaso, M., Fletcher, D. L., Smith, d. P., Nothcutt, J. K., **2002**. *Poultry Sci.* 81(2):276-280.
- Rongrong, LI, Kerr, W. L., Toledo, R. T. and Carpenter, J. A., **2000**. *J. Food Sci.* 65:575-580.
- Sheard, P. R. Nute, g. R.; Richardson, R. I., Perry, A. and Taylor, A. A., **1999**. *Meat Sci.* 51:371-376.
- Shults, G. W. and Wierbicki, E., **1973**. *J. Food Sci.* 38:991-994.
- Weakley, d. F., McKeith, f. K., Bechtel, P. J., Martin, S. E. and Thomas, D. L., **1986**. *J. Food Sci.* 51:281.
- Weirbicki, E. and Deatherage, F. E., **1958**. *Determination of water-holding capacity of fresh meats. J. Agr. Food Chem.* 6:387.
- Young, L., L., Papa, C. M., Lyon, C. E. and Wilson, R. L., **1992**. *J. Food Sci.* 57:1291-1293.
- Zheng, M., Toledo, R. and Wicker, L., **1999**. *J. Food Quality.* 22:553-564.