PE7.42 Effect of Low Temperature-Long Time (LTLT) Thermal Treatments on Tenderness, Cooking Loss and Color of Porcine *M. longissimus dorsi* 392.00

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Long term thermal treatment at low temperature (LTLT) of meat is known to increase tenderness of meat. The low temperature was expected to reduce cooking loss, and thereby possibly increase tenderness and juiciness. The aim of the present study was to investigate the effect of LTLT treatments on tenderness, cooking loss and color of porcine *longissimus dorsi* muscle. Vacuum packed muscle samples were heat treated at 48°C, 53°C, 58°C and 63°C in water bath for 3, 8 and 20 hours. Cooking loss, color (L*, a* and b*-values) and tenderness (Warner-Bratzler Shear Force) was measured on the heat treated samples. Results showed that cooking loss increased at temperatures above 53°C and with increasing heating time. L*-values increased with increasing heating time and temperature, while a*-values decreased similarly. Warner-Bratzler peak force (WBPF) of samples heated at 48°C and 53°C for 3 and 8 hours was significantly higher than samples heated at 58°C and 63°C. No change in WBPF was observed between 3 and 8 hours, whereas from 8 to 20 hours a significant decrease in WBPF was observed at 53°C, 58°C and 63°C. In conclusion, increasing temperatures to 58°C revealed significantly increased tenderness, decreased redness and increased lightness and cooking losses. Increasing heating time above 8 hours significantly increased tenderness and lightness.

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***Index Terms*— color, cooking loss, low temperature long time, pork, tenderness**

1 INTRODUCTION

Long term thermal treatments at low temperature (LTLT) has been known for several years to increase the tenderness of meat [1-6]. However, previous research has solely focused on LTLT treatments of beef muscles, and knowledge about how pork quality characteristics are affected by the LTLT treatment is lacking. As meat is usually cooked before consumption it is important to understand the heat-induced physical changes of the meat structure, as these processes affect e.g. meat tenderness, color and cooking loss. The low temperature treatments may reduce the cooking loss, and thereby possibly increase the eating quality of the meat i.e. tenderness and juiciness.

The aim of this study was to investigate the effect of LTLT treatments on tenderness, color and cooking loss of porcine *longissimus dorsi* muscle.

2 MATERIALS AND METHODS

2.1 Raw material

M. longissimus dorsi were excised 24 hours *postmortem* from 12 commercially available slaughterpigs. pH was measured and used as a selection criteria for the muscles (acceptable range pH 5.5-5.8). The muscles were vacuum packed, stored 4 days at 5°C, and were then cut into samples of app. 4x12x10 cm, vacuum packed and frozen at -20°C.

2.2 Thermal treatments

Muscle samples were thawed overnight at 4°C and the thermal treatments were carried out in water baths (ICC "Roner", Frinox Aps, Hillerød, Denmark) set at 48°C, 53°C, 58°C and 63°C. Each water bath contained 3 samples at the same time and heat treatments were performed for 3 h, 8 h and 20 h each. Heat treatments were arrested by keeping the samples on ice for 10 min and then stored overnight at 4°C.

2.3 Cooking loss

Cooking loss (CL) was measured by weighing the samples before and after heat treatments using the relationship CL = 100(mb-ma)/ma, where mb is the weight of the sample before the thermal treatment and ma is the weight of the sample after the thermal treatment. Mean values from six repetitions of each thermal treatment were obtained.

2.4 Color measurements

Instrumental color was measured on samples stored overnight at 4°C. A slice of app. 2-3 cm was cut from the hip end of the sample and the color (L*, a* and b* values) of the meat was measured four times on the fresh cut surface of the large part of the sample with a Minolta CR-300 Chroma meter (Minolta Camera Co., Osaka, Japan). Mean values from six repetitions on each thermal

treatment were obtained.

2.5 Warner-Bratzler Shear Force

Six blocks of 1x1x6 cm were cut from the meat stored overnight at 4°C and the shear force was measured 3 times on each block by TA-HDi Texture Analyzer (Stable Micro Systems, UK) equipped with a Warner-Bratzler test cell. The mean maximum force required to shear through the sample (Warner-Bratzler peak force, WBPF) from six repetitions of each thermal treatment was determined.

2.5 Statistical analysis

Analysis of variance was performed. The model included temperature and time as fixed effects, while animal and samples location were included as random effects. The model used was y = μ + temp + time + temp*time + ANIMAL + LOCATION.

3 RESULTS AND DISCUSSION

WBPF of pork LD was affected by both time ($P < 0.05$) and temperature ($P < 0.05$). Figure 1 shows that WBPF did not change with increasing heating time at 48°C and 63°C. At 53°C and 58°C a significant decrease in WBPF from 8 h to 20 h was observed, while no change appeared between 3 h and 8 h. WBPF was lower ($P > 0.05$) when samples were heat treated at 58°C for 20 h compared to 48°C and 53°C for 20 h. Similarly, in a study of LTLT treated beef *Semitendinosus*[6] the authors found decreasing Warner-Bratzler shear force values when increasing the temperature from 50°C to 60°C, however, the effect of treatment time was not apparent.

WBPF of samples heat treated at 48°C and 53°C for 3 h and 8 h was significantly higher than samples heat treated at 58°C and 63°C. No change in WBPF was observed between 3 and 8 hours for any of the heating temperatures, whereas from 8 to 20 hours a significant decrease in WBPF was observed at all temperatures except at 48°C.

A significant effect of time on L*, a* and b* values was observed (data not shown). Increasing heating time resulted in increased L*- and b*-values, while a*-values decreased. In addition, increasing temperature significantly increased L*-values and decreased a*-values. In accordance to [6], the samples heat treated to around 50°C presented a bright red color, while the samples heat treated at around 60-65°C had a pink interior color.

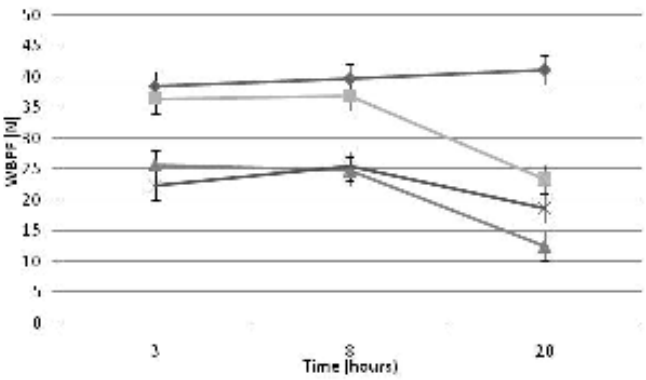

Figure 1. Effect of time and temperature on Warner-Bratzler peak force (N) of porcine *Longissimus dorsi*. ♦: 48°C; ■: 53°C; ▲: 58°C; ×: 63°C. Bars represent standard errors.

The effect of temperature and time on cooking losses is shown in Figure 2. As expected, increasing temperature from 53°C significantly increased the cooking losses, however heating to 48°C and 53°C did not result in different cooking losses. Increasing heating time also significantly increased the cooking loss.

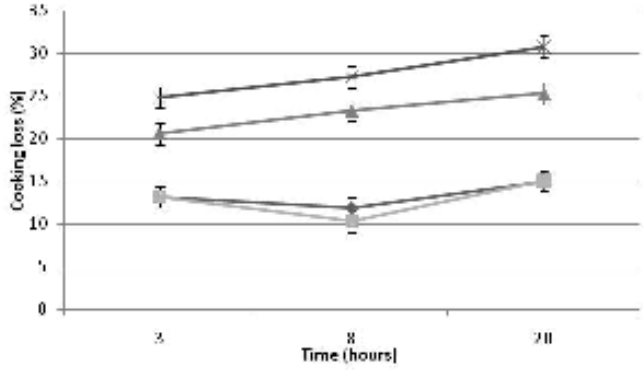

Figure 2. Effect of time and temperature on cooking loss (%) of porcine *Longissimus dorsi*. ♦: 48°C; ■: 53°C; ▲: 58°C; ×: 63°C. Bars represent standard errors.

Future studies will be carried out in order to explain the changes observed in the present study. The texture changes occurring during LTLT treatment may be explained by solubilisation of collagen or by proteolytic degradation of structural proteins, as well as the changes in color might be caused by denaturation of myoglobin.

4 CONCLUSION

LTLT treatment of porcine *M. longissimus dorsi* affected tenderness, color and cooking loss. Increasing temperatures to 58°C revealed significantly increased tenderness, decreased redness and increased lightness and cooking losses.

Increasing treatment time above 8 hours significantly increased tenderness and lightness, while tenderness was the only parameter significantly affected by the different treatments applied. Future work will focus on investigations of the structural changes occurring during LTLT treatment of porcine LD.

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