OPTIMISING HEAT TREATMENT OF MEAT PRODUCTS USING LOW COOKING TEMPERATURES

L. Nersting[1*], M. D. Aaslyng[1)] and I. Simonsen[1]

[1]Department of Meat Technology, Danish Meat Research Institute, Taastrup, Denmark.

*Corresponding author email: lng@dti.dk

The aim was to investigate if heat treatment of cured smoked pork loins to a low core temperature could reduce cooking loss and process time and result in a better and more uniform quality. Core temperatures of 65°C/5 min and 70°C/30 sec were compared with 75°C/5 sec. Heat treatment to low core temperatures resulted in reduced process time and a significantly lower cooking loss: 5.4% at 65°C and 6.2% at 70°C, compared with 7.6% at 75°C. The standard deviation was decreased markedly, resulting in a more uniform quality. The products cooked at 65°C and 70°C were significantly juicier and less crumbly.

Key Words – Cured smoked pork loin, product quality, yield.

I. INTRODUCTION

Heat treatment of meat products is a challenge for the meat industry, and products are often overheated due to the increased focus on food safety. This often results in significant cooking losses with a large product-to-product variation. Therefore, there is a great potential in optimising the current heat treatment processes to avoid excessive heating. Danish legislation prescribes heat treatment to a core temperature of minimum 75°C in food products; otherwise, it must be demonstrated that another heat treatment is equivalent with respect to safety [1]. When using the D/z concept with a z-value of 5°C, a lower core temperature is acceptable if maintained for a longer time, at 65°C for 5 min or 70°C for 30 sec corresponding to the required 75°C for the reduction of *L. monocytogenes*. The application of sous vide cooking and cooking at low temperatures (<75°C) for prolonged times (>6 hours) has received considerable attention in recent years due to the increased juiciness and low cooking loss of the meat [2]. However, these methods have mainly been studied in connection with the cooking of whole muscles and not processed products, such as cured smoked pork loin, with shorter heating times.

The aim of this study was to determine whether heat treatment of cured smoked pork loin to core temperatures of 65°C/5 min and 70°C/30 sec compared with the traditional heat treatment of 75°C/5 sec can reduce the cooking loss and process time and improve the sensory quality without affecting the microbiological safety of the product.

II. MATERIALS AND METHODS

The tested temperature and holding times were 65°C/5 min and 70°C/30 sec, which correspond to 75°C/5 sec in terms of reducing *L. monocytogenes* using a z-value of 5°C [3]. Pork loins without bone (1660 according to ESS-FOOD standards [4]) was used. In each experiment, 12 loins were included per heat treatment, and the test was repeated three times for each temperature (108 loins in total). The loins were injected with brine to a 30% gain. Brine ingredient: water 80.28%, NaCl 5.63%, nitrite salt (0.6%) 3.9%, C346i phosphate 1.3%, dextrose 8.67% and ascorbate 0.22%. The loins were tumbled for 90 minutes at 4 RPM and with vacuum, drained until the following day and stuffed into 85 mm perforated casings. The loins were dried at 65°C/25 min, smoked at 65°C/RH45%/17 min and cooked to a core temperature of 65°C/5 min, 70°C/30 sec or 75°C/5 sec. The cooking cabinets were set at 80°C, and, when the core temperature of the products was ten degrees below the set temperature (65°C, 70°C or 75°C), the cooking temperature was reduced to 68°C, 73°C or 78°C. The core temperature was measured continuously in one loin per test. The study comprised three experiments. In experiments 1 and 2, the pork loins were tumbled at the same time and then grouped randomly for the selected heat treatments, resulting in a certain amount of waiting time for some loins prior to the heat treatment. In experiment 3, the loins were grouped according to heat treatments before the tumbling step to avoid this waiting time. The cooking loss was measured by weighing each loin before and after cooking and subsequent cooling to 2°C. An in-house accredited sensory panel evaluated the texture of the cured smoked pork loins cooked in experiment 3 with regard to the following attributes: cohesiveness, juiciness, springiness, tenderness, crumbliness and chewing time. All parameters were rated on a continuous unstructured scale from 1 to 15 ranging from low to high intensity.

III. RESULTS AND DISCUSSION

The average process time was reduced by 33 min at 65°C/5 min and 16 min at 70°C/30 sec compared with 75°C/5 sec. Additional reduction of the process time will be achieved during cooling. The total cooking and cooling loss is shown in Table 1. The average cooling loss was 2% in all experiments. The total loss was significantly reduced at both 65°C and 70°C ($p<0.001$ ANOVA analyses of variance). In average, the total loss was reduced with 28.9% at 65°C/5 min and 18.5% at 70°C/30 sec compared to 75°C/5 sec. The standard deviation (SD) decreases with decreasing temperatures, which resulted in a more uniform product quality. The decrease in the SD was consistent throughout all three experiments, indicating that the same trend can be seen even though the procedure used in experiments 1 and 2 is slightly different from that used in experiment 3.

Table 1. Total loss (cooking + cooling loss) with the standard deviation (SD) for three heat treatments (65°C, 70°C and 75°C) in the three experiments.

		65°C		**70°C**		**75°C**	
Experiment	n	Average (%)	SD	Average (%)	SD	Average (%)	SD
1	12	5.33	0.34	6.20	0.51	8.21	0.88
2	12	6.60	0.38	7.25	0.58	7.45	0.82
3	12	4.30	0.63	5.16	0.69	7.18	1.75
Total average		5.41		6.20		7.61	

Individual analysis of the sensory attributes showed that the loins that were heat-treated at 65°C were much more springy ($p<0.001$) than those heated at 70°C and 75°C. Furthermore, lower heat treatments at 65°C and 70°C resulted in juicier products ($p<0.01$). Products heat-treated at 75°C resulted in a more crumbly texture ($p<0.05$).

IV. CONCLUSION

Heat treatment of cured smoked pork loin to a core temperature at 65°C/5 min and 70°C/30 sec resulted in significantly lower cooking losses, shorter process time and more uniform product quality compared with 75°C/5 sec. Furthermore, the low temperature products were more springy and juicy and less crumbly. Decreasing the temperature from 75°C/5 sec. to 65°C/5 min or to 70°C/30 sec can be recommended both from a production perspective and a quality perspective.

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