A NEW APPROACH TO MAINTAIN THE MANUFACTURING PROPERTIES OF FROZEN PORK MEAT

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Introduction

Frozen storage is an economically favorable way of meat storage. However, it can affect meat quality attributes such as thawing loss, colour and tenderness (Farouk and Swan 1998; Honikel et al. 1986; Farouk et al. 2003). Coating the foods with edible materials has also been researched as a means to improve the freezing procedure (Matuska et al. 2006). Coating fish, Shrimp, Scallop with sodium alginate showed that coating with sodium alginate can prolong shelf life of them, reducing thawing loss, cooking loss and weight loss during frozen storage (wang et al. 1994; Zeng and Xu 1997).However, whether it can improve the quality of frozen pork cuts is unknown. The main objective of this study was to explore an edible coating with sodium alginate to improve frozen meat quality. The difference impact of sodium alginate concentration (SAC), calcium chloride concentration ($CaCl_2$) and the time of sodium alginate solution reacts with $CaCl_2$ solution on the meat surface (Time) were examined. For the optimal coating conditions of pork meat, frozen storage was performed to investigate whether coating pork meat with sodium alginate could increase its quality during frozen storage.

Materials and methods

Six pork M. Longissimus dorsi muscles from six pigs were obtained from carcasses that had been stored for 24 h at 4□ after slaughter. Each muscle was divided into 10 equal portions (100±5g) and assigned to a control and 9 treatments using an orthogonal experimental design (Table 1). When the optimal coating conditions were found, frozen storage experiment was done. The material meat (six pork M. Longissimus dorsi muscles) were also obtained through the same process. From each muscle two cuts (100±5g) were obtained and assigned to a control and a treatment using the optimal coating condition.

Table 1 $L_9(3^4)$ orthogonal experimental design and its factors and levels

Experimental number	1(SAC)	2($CaCl_2$)	3(Time)	4(Vacant)
1	1(1%)	1(3%)	1(3 min)	1
2	1(1%)	2(5%)	2(5 min)	2
3	1(1%)	3(7%)	3(7 min)	3
4	2(2%)	1(3%)	2(5 min)	3
5	2(2%)	2(5%)	3(7 min)	1
6	2(2%)	3(7%)	1(3 min)	2
7	3(3%)	1(3%)	3(7 min)	2
8	3(3%)	2(5%)	1(3 min)	3
9	3(3%)	3(7%)	2(5 min)	1

Note: a In our orthogonal experimental design, three factors, i.e., sodium alginate concentration (SAC), calcium chloride concentration ($CaCl_2$) and the time of sodium alginate solution reacts with $CaCl_2$ solution on the meat surface (Time), were considered, and each factor with three levels; b n(x%): n represent the level in original orthogonal experimental table, x% represent the level of the factor considered, w/w concentration.

Thawing loss, cooking loss and water holding capacity under pressure were measured according to Farouk (2003). Lipid oxidation was measured only after 7 months frozen storage according to Cilla, et al. (2006). All of the statistical procedures were carried out using the SPSS13.0 software.

Results and discussion

Thawing loss，cooking loss and water holding capacity. The effects of different factors and levels on thawing loss，cooking loss and water holding capacity were shown in table 2. It showed that SAC, $CaCl_2$ and Time all had a significant influence on thawing loss, both SAC and $CaCl_2$ had significant influences on water holding capacity($p<0.05$),$CaCl_2$ had a significant influence on cooking loss ($p<0.05$), the effects of other factors considered on cooking loss were not significant($p>0.05$), and there were no interaction between SAC, $CaCl_2$ and Time. The results of correlation analysis of thawing loss, cooking loss and water holding capacity

showed that the Pearson Correlation between cooking loss and water holding capacity is -0.557 ($p<0.01$), cooking loss and thawing loss is -0.319 ($p<0.05$) and water holding capacity and thawing loss is 0.640 ($p<0.01$). These indicate that the more the thawing loss is, the less the cooking loss is, and the larger the water holding capacity is, and disclose that the reason of coating with sodium alginate can reducing the thawing loss is the exudates are partly hold by coatings. Both EA and SH value are larger in the treatment of 3% SAC comparing with other treatments (data not shown). This supposed that the substance hold by coating is very useful to the functional properties of frozen pork.

Table 2. Effects of different factors and levels on thawing loss, cooking loss and water holding capacity

factors and levels		1(SAC)	2($CaCl_2$)	3(Time)	4(Vacant)
Thawing loss	1	2.79^b	0.65^a	0.79^a	1.08
	2	0.31^a	2.09^b	1.87^b	0.85
	3	0.09^a	0.44^a	0.53^a	1.25
	Range	2.70	1.65	1.34	0.40
cooking loss	1	28.47	30.37^b	28.04	28.52
	2	28.57	28.52^a	29.40	29.78
	3	29.37	27.52^a	28.97	28.11
	Range	0.90	2.84	1.36	1.67
water holding capacity	1	79.62^c	74.86^a	76.58	74.83
	2	75.42^b	76.37^b	76.71	76.41
	3	73.73^a	77.54^b	75.48	77.53
	Range	5.89	2.69	1.23	2.70

Note: Levels with different letters differed at the significance level of 0.05

Frozen storage After 7 months frozen storage there were significant ($p<0.05$) difference of thawing loss, and TBARS between the treatment and the control (Table 3). It showed that coating pork meat with sodium alginate can decrease thawing loss and TBARS, and can maintain the quality of frozen pork meat during frozen storage.

Table 3 Indexes after 7 months frozen storage

Index	treatment（Mean±Sd）	control（Mean±Sd）
Cooking loss (%)	28.09±2.66	29.62±1.39
Thawing loss (%)	$1.57±0.57^a$	$4.10±1.25^b$
WHC (%)	64.53±2.89	65.31±1.78
TBARS (mg/kg meat)	$0.07±0.04^a$	$0.10±0.04^b$

Note: Numbers with different letters in the same row differed at the significance level of 0.05.

Conclusions

The optimal coating conditions in the experiments are sodium alginate concentration: 3%, concentration of $CaCl_2$:7%, and the time of sodium alginate solution on the meat surface reacts with $CaCl_2$ solution: 5~7 minutes. Coating with sodium alginate could decrease thawing loss and might be very useful to maintain functional properties during freezing processing and frozen storage of meat.

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