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Effects of calcium salts on meat color of frankfurt sausage (#353)

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Introduction

Under the condition of co-extrusion technology, adding calcium salt in the ingredients often results in a grayish brown color in the center of the sausage. However, the effect of calcium salt on meat color was controversial in previous research. This objective was to study effects of application of different kinds of calcium salts on cut color of frankfurt sausage.

Methods

According to the production technology of frankfurt sausage, the 0 %, 0.2 %, 0.4 % and 0.7 % CaCl_2 and CaLac to the total weight of the ingredients were added into the cured solution respectively. The sausage was made according to the frankfurt sausage processing and was then packed in vacuum and stored at 0 ~ 4 °C for 7 days. The meat color, pH, texture, water holding capability and lipid oxidation index were measured during processing and storage periods. The data was analyzed using SPSS 18.0. Significant difference was considered at $P < 0.05$.

Results

As shown in Table 1 and Fig.1, the application of 0.4 % CaCl_2 significantly reduced the a^* values during processing and storage ($P < 0.05$), and the a^* value decreased significantly with the increasing of CaCl_2 ($P < 0.05$) application. The pH values were also greatly decreased with CaCl_2 application ($P < 0.05$, Table 1). In addition, adding CaCl_2 also significantly accelerated lipid oxidation. The degree of lipid oxidation in 0.7 % CaCl_2 treatment was significantly higher ($P < 0.05$).

For CaLac treatments, adding CaLac had no significant effect on a^* value of sausage, which was showed in Fig.1 and Table 2. However, pH value was also decreased ($P < 0.05$) which were similar to those in CaCl_2 treatments. Adding CaLac also significantly accelerated lipid oxidation ($P < 0.05$), and the degree of lipid oxidation in 0.4% CaLac treatment was significantly high-

er than those in other treatments ($P < 0.05$). The application of CaLac also decreased the water holding capability and texture.

Conclusion

The application of CaCl_2 had significant effect on the a^* value of sausage. Adding above 0.4 % CaCl_2 could significantly decrease the a^* value and pH value during processing and in final products. The application of CaLac had no significant effect on the a^* value of sausage, however, it decreased the texture and water holding capability when the addition was above 0.4 %. The CaLac also significantly decreased the pH value ($P < 0.05$). So, the application of CaCl_2 would have more negative effect on the meat color of sausage compared to CaLac. While CaLac would have more negative effect on texture and water holding capability.

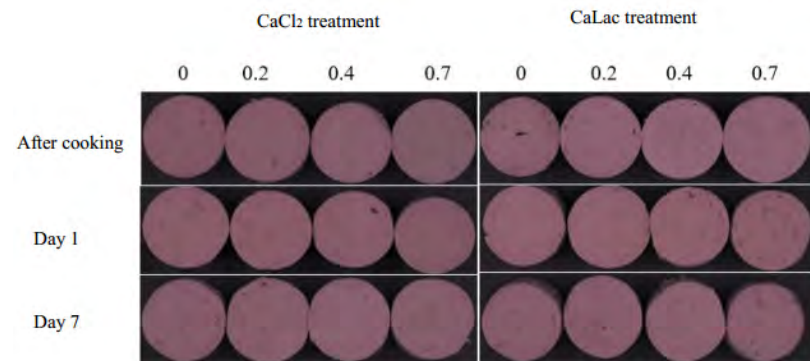


Fig. 1
Effects of CaCl_2 and CaLac addition on sausage cut color

Notes

Table 2 Effects of CaLac addition on the meat color and pH value of frankfurt sausage during processing and storage

Item	Time	CaLac addition (%)				SE	P value		
		0	0.2	0.4	0.7		Time	addition	Time × addition
L*	Raw meat	51.24 ^{Da}	51.24 ^{Ea}	51.24 ^{Da}	51.24 ^{Da}				
	After cured	56.48 ^{Cab}	57.03 ^{Da}	55.06 ^{Cc}	55.79 ^{Cb}				
	After cooking	63.04 ^{Bb}	62.86 ^{Bb}	64.04 ^{Aa}	62.53 ^{Bb}	0.25	0.044	0.000	0.000
	Day 1	62.33 ^{Bab}	61.83 ^{Cb}	62.81 ^{Ba}	62.21 ^{Bab}				
	Day 7	64.05 ^{Ab}	63.79 ^{Ab}	64.63 ^{Aa}	63.78 ^{Ab}				
a*	Raw meat	24.43 ^{Aa}	24.43 ^{Aa}	24.43 ^{Aa}	24.43 ^{Aa}				
	After cured	9.07 ^{Da}	8.85 ^{Da}	7.97 ^{Db}	7.66 ^{Db}				
	After cooking	14.00 ^{Ba}	14.25 ^{Ba}	14.12 ^{Ba}	14.11 ^{Ba}	0.14	0.000	0.000	0.000
	Day 1	13.55 ^{Ca}	13.65 ^{Ca}	13.41 ^{Ca}	13.40 ^{Ca}				
	Day 7	13.76 ^{Ba}	13.92 ^{Ba}	13.66 ^{Ca}	13.87 ^{Ba}				
b*	Raw meat	24.98 ^{Aa}	24.98 ^{Aa}	24.98 ^{Aa}	24.98 ^{Aa}				
	After cured	20.21 ^{Ba}	20.11 ^{Ba}	18.85 ^{Bb}	18.61 ^{Bb}				
	After cooking	13.14 ^{Ca}	13.07 ^{Ca}	13.36 ^{Ca}	13.42 ^{Ca}	0.21	0.000	0.082	0.000
	Day 1	12.40 ^{Da}	12.53 ^{Ca}	12.48 ^{Da}	12.32 ^{Da}				
	Day 7	12.62 ^{CDa}	12.77 ^{Ca}	12.79 ^{CDa}	12.68 ^{Da}				
pH value	After cured	5.63 ^{Da}	5.63 ^{Da}	5.63 ^{Ca}	5.63 ^{Ba}				
	After cooking	5.55 ^{Ea}	5.52 ^{Eab}	5.51 ^{Db}	5.50 ^{Db}				
	Day 1	5.78 ^{Ca}	5.77 ^{Ca}	5.48 ^{Eb}	5.38 ^{Ec}	0.01	0.000	0.000	0.000
	Day 7	5.83 ^{Ba}	5.83 ^{Ba}	5.69 ^{Bb}	5.54 ^{Cc}				
	After cured	5.96 ^{Aa}	6.00 ^{Ab}	5.87 ^{Ac}	5.73 ^{Ad}				

^{a-d} Values within a with different lowercase letters differ significantly at $P < 0.05$

^{A-E} Values within a column row with different uppercase letters differ significantly at $P < 0.05$

Table 2

Table 1 Effects of CaCl₂ addition on the meat color and pH value of frankfurt sausage during processing and storage

Item	Time	CaCl ₂ addition (%)				SE	Mean ± SE	P value		
		0	0.2	0.4	0.7			Time	Addition	Time × Addition
L*	Raw meat	52.00 ^{Ea}	52.00 ^{Ca}	52.00 ^{Da}	52.00 ^{Da}					
	After cured	56.48 ^{Da}	56.04 ^{Ba}	56.04 ^{Ca}	56.08 ^{Ca}					
	After cooking	63.04 ^{Bb}	64.00 ^{Aa}	63.26 ^{Bb}	61.69 ^{Bc}	0.34		0.000	0.005	0.041
	Day 1	62.33 ^{Cbc}	63.30 ^{Aa}	62.92 ^{Bab}	61.95 ^{Bc}					
	Day 7	64.05 ^{Aa}	64.20 ^{Aa}	64.65 ^{Aa}	64.11 ^{Aa}					
a*	Raw meat	24.43 ^{Aa}	24.43 ^{Aa}	24.43 ^{Aa}	24.43 ^{Aa}					
	After cured	9.07 ^{Da}	8.34 ^{Cc}	8.42 ^{Dbc}	8.77 ^{Eab}					
	After cooking	14.00 ^{Ba}	13.53 ^{Ba}	11.89 ^{Cb}	10.33 ^{Dc}	0.15		0.000	0.000	0.000
	Day 1	13.55 ^{Ca}	13.40 ^{Ba}	12.43 ^{Cb}	11.21 ^{Cc}					
	Day 7	13.76 ^{Ba}	13.63 ^{Ba}	13.11 ^{Bb}	12.33 ^{Bc}					
b*	Raw meat	24.98	24.98	24.98	24.98		24.98 ± 0.09 ^A			
	After cured	20.21	19.75	19.96	19.75		19.92 ± 0.09 ^B			
	After cooking	13.14	13.08	13.58	13.74	0.18	13.39 ± 0.09 ^C	0.000	0.727	0.235
	Day 1	12.40 ²	12.447	12.349	12.366		12.39 ± 0.09 ^D			
	Day 7	12.621	12.493	12.413	12.259		12.45 ± 0.09 ^D			
	Mean ± SE	16.67 ^a	16.55 ^a	16.66 ^a	16.62 ^a	0.08				
pH	Raw meat	5.63 ^{Da}	5.63 ^{Ba}	5.63 ^{Aa}	5.63 ^{Aa}					
	After cured	5.55 ^{Ea}	5.50 ^{Db}	5.49 ^{Bb}	5.43 ^{Cc}					
	After cooking	5.78 ^{Ca}	5.45 ^{Eb}	5.37 ^{Cc}	5.07 ^{Ed}	0.01		0.000	0.000	0.000
	Day 1	5.83 ^{Ba}	5.56 ^{Cb}	5.46 ^{Bc}	5.32 ^{Dd}					
	Day 7	5.96 ^{Aa}	5.76 ^{Ab}	5.66 ^{Ac}	5.53 ^{Bd}					

^{a-d} Values within a row with different lowercase letters differ significantly at $P < 0.05$

^{A-E} Values within a column with different uppercase letters differ significantly at $P < 0.05$

Table 1

Notes