P-05-19

Effects of ascorbic acid and frozen storage condition on processing characteristics and oxidative stability of pre-rigor salted chicken breast (#450)

Jae Ho Ha, Dong Heon Song, Sin Woo Noh, Yu Ri Kim, Hyun Wook Kim

Gyeongnam national university of science and technology, Department of animal science & biotechnology, Jinju, South Korea

Introduction

Processing and economic advantages of pre-rigor muscle have been known well (Hamm, 1977). However, the practical use of pre-rigor muscle is mostly limited in the meat processing industry, in which there is no continues hot processing system (a series of slaughtering, deboning and manufacturing). In this regard, pre-rigor salting has been considered to preserve the processing benefits, thereby inhibiting postmortem anaerobic glycolysis (Bernthal et al., 1989). In fact, previous studies have indicated that the processing characteristics of pre-rigor salted meat could be maintained for 14 days at chilled storage condition or for 6 weeks at frozen storage (Abu-Bakar et al., 1989; Sadler and Swan, 1996). However, accelerated lipid oxidation in pre-rigor salted meat has been observed during further storage (Torres et al., 1988; Lee et al., 1997). In the way that freezing/thawing and frozen storage can accelerate lipid oxidation, oxidative quality changes in pre-rigor salted meat during frozen storage should be prevented for its practical use in the meat industry. Therefore, the aim of this study was to evaluate the effects of ascorbic acid (AA) and frozen storage condition on the processing characteristics and oxidative stability of pre-rigor salted chicken breasts.

Methods

A total of 60 broilers (Ross 308 broiler, 4 weeks of age) was slaughtered in a commercial slaughterhouse. Immediately after evisceration, chicken breast muscles from both left and right sides of each carcass were obtained within 15 min after slaughter. The left side of the chicken breast was ground using a meat grinder and separated into two portions for pre-rigor treatments. Each portion was mixed with 2% NaCl (w/w) or 2% NaCl (w/w) plus 500 ppm AA within 25 min after slaughter. The right side of chicken breast muscles was vacuum-packaged and stored at 2°C for 24 h (post-rigor treatment). The post-rigor muscles were salted as mentioned above. The pre- and post-rigor salted chicken breasts were vacuum-packaged and grouped into five storage conditions; unfrozen control (in a 2°C refrigerator for 24 h), frozen at either -20°C or -70°C for 6 weeks and 12 weeks. On the target storage days, frozen samples were thawed in a 2°C refrigerator for 24 h before analysis. The frozen/thawed samples were used to determine pH value, cooking loss, protein solubility (Warner, 1997), emulsion activity index (Chan et al., 2011), texture profile analysis (Bourne, 1978), 2-thiobarbituric acid reactive substances (TBARS) value (Buege and Aust, 1978) and protein carbonyls (Levine et al., 1990). An analysis of variance was performed on all the variables measured using the general linear model (GLM) procedure of the SPSS 18.0 program, in which two factors (4 treatments × 5 frozen storage conditions) and their interaction were considered as main effects. T-test and Duncan's multiple range test ($p<0.05$) were used to determine the differences among treatment means.

Results

Pre-rigor salted chicken breasts showed higher pH value, EAI, protein solubility and some textural parameters (e.g. cohesiveness, springiness and chewiness) than post-rigor salted chicken breasts ($p<0.05$). However, the addition of AA had no impacts on the processing characteristics ($p>0.05$). Frozen storage of salted chicken breasts modified the protein solubility and textural properties ($p<0.05$). In particular, frozen storage for 12 weeks significantly decreased the protein solubility and textural parameters, in which frozen storage at -70°C showed higher protein solubility, hardness, springiness and chewiness compared to frozen storage at -20°C. Pre-rigor salted chicken breasts had a lower cooking loss than post-rigor salted chicken breast (Figure 1(a), $p<0.05$), regardless of AA addition. All frozen/thawed chicken breasts showed a lower cooking loss than unfrozen control (Figure 1(b), $p<0.05$). The pre-rigor salted chicken breasts resulted in a lower TBARS value than post-rigor salted chicken breasts without AA ($p<0.05$). Frozen storage for 12 weeks increased TBARS value, however, there was no significant difference in TBARS value between unfrozen control and frozen storage at -70°C for 12 weeks. Similar carbonyls content was observed among treatments ($p>0.05$). In addition, frozen storage for 12 weeks also resulted in significant protein oxidation of salted chicken breasts. However, frozen storage at -70°C had no impact on the carbonyls content ($p>0.05$), unlike lipid oxidation.

Conclusion

In this current study, the processing benefits of pre-rigor salted chicken breasts on water-holding capacity, protein solubility and textural properties were confirmed. However, frozen storage for 12 weeks resulted in the oxidation of lipids and proteins, as well as, it diminished the protein solubility and textural properties. While the addition of AA had little impacts on the changes in processing benefits during frozen storage, frozen storage at -70°C could prevent the extent of lipid oxidation. Thus, this study suggests that the frozen storage at -70°C may be effective in preventing oxidative quality changes of pre-rigor salted chicken breasts, including lipid oxidation.

Notes

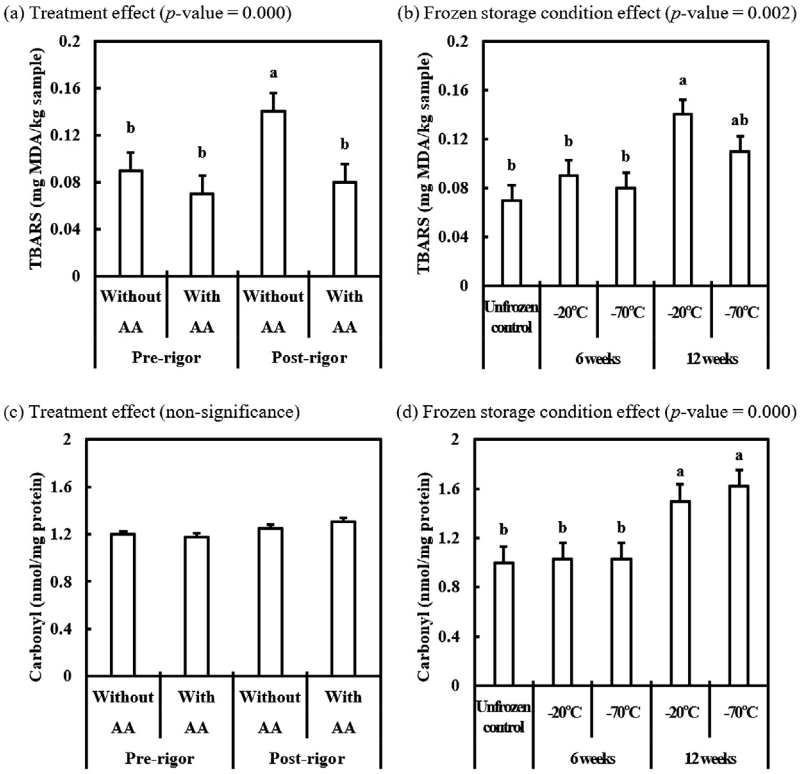

Figure 2. Oxidative stability of pre- and post-rigor salted chicken breast with ascorbic acid (AA).
[a,b]Means in the samples with different letters are significantly different ($p<0.05$).

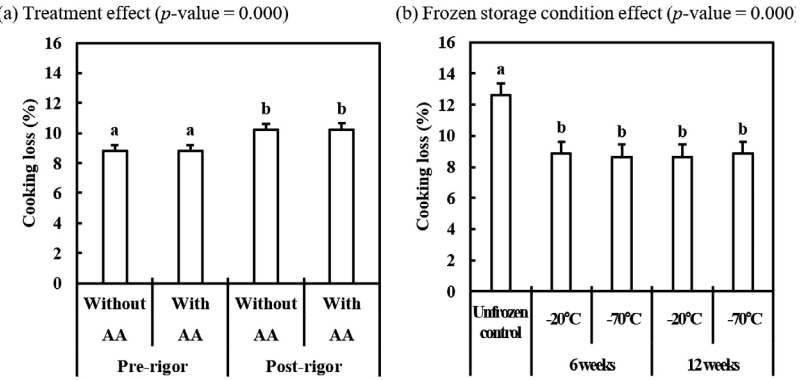

Figure 1. Cooking loss of pre- and post-rigor salted chicken breast with ascorbic acid (AA).
[a,b]Means in the samples with different letters are significantly different ($p<0.05$).

Effects	pH	Protein functionality		Texture profile analysis (TPA)				
		EAI	Protein solubility (mg/mL)	Hardness (kg)	Cohesiveness	Springiness	Gumminess (kg)	Chewiness (kg)
Treatment effect								
Pre-rigor salted	5.94±0.26[a]	0.95±0.12[a]	146.46±13.96[a]	30.60±4.27	0.25±0.02[a]	0.67±0.04[a]	7.70±1.30[a]	5.10±0.81[a]
Pre-rigor salted with AA[1)]	5.99±0.04[a]	0.96±0.08[a]	144.27±12.34[ab]	29.63±3.63	0.25±0.02[a]	0.68±0.04[a]	7.38±1.17[ab]	4.99±0.83[a]
Post-rigor salted	5.83±0.02[b]	0.84±0.12[b]	135.11±12.00[bc]	29.96±3.41	0.22±0.02[b]	0.59±0.05[b]	6.70±0.99[b]	3.75±0.86[b]
Post-rigor salted with AA	5.80±0.04[b]	0.84±0.07[b]	132.84±12.63[c]	31.53±3.75	0.23±0.01[b]	0.59±0.07[b]	7.07±0.89[ab]	4.04±0.61[b]
Frozen storage condition effect								
Unfrozen control	5.92±0.12	0.97±0.17	143.18±6.32[b]	32.02±3.75[a]	0.25±0.03[a]	0.61±0.06[b]	8.11±1.47[a]	4.65±1.55[ab]
6 weeks at -20°C	5.93±0.09	0.85±0.13	151.70±7.65[a]	31.80±3.59[a]	0.23±0.02[b]	0.59±0.06[b]	7.16±0.74[b]	4.15±0.36[bc]
6 weeks at -70°C	5.89±0.10	0.90±0.08	151.49±7.89[a]	33.27±2.77[a]	0.24±0.01[ab]	0.66±0.04[a]	7.90±0.58[a]	5.17±0.44[a]
12 weeks at -20°C	5.84±0.27	0.87±0.07	122.39±7.52[d]	26.36±1.52[b]	0.24±0.02[ab]	0.61±0.07[b]	6.23±0.52[c]	3.78±0.66[c]
12 weeks at -70°C	5.87±0.09	0.91±0.06	129.58±5.80[c]	28.69±1.91[b]	0.23±0.02[b]	0.69±0.04[a]	6.67±0.90[bc]	4.61±0.77[ab]
Significance of p-value								
Treatment	0.001	0.002	0.000	NS	0.000	0.000	0.009	0.000
Frozen storage condition	NS[2)]	NS	0.000	0.000	0.000	0.000	0.000	0.000
Interaction	NS	NS	NS	NS	0.002	0.003	NS	0.007

Table 1. Processing characteristics of pre- and post-rigor salted chicken breast with ascorbic acid.
All values are mean±standard deviation. [a-d]Means within each column with different letters are significantly different ($p<0.05$).
[1)]AA: ascorbic acid. [2)]NS: non-significance ($p>0.05$).

Notes