P-03-06

Impact of KCl on processing characteristics of ground chicken breast as affected by postmortem salting time (#59)

Dong Heon Song[1], Youn Kyong Ham[2], Jae Ho Ha[1], Sin Woo Noh[1], Yu Ri Kim[1], Koo Bok Chin[3], Hyun Wook Kim[1]

[1] Gyeongnam National University of Science and Technology, Department of Animal Science & Biotechnology, Jinju, South Korea; [2] Gyeongnam National University of Science and Technology, Department of Animal Resources Technology, Jinju, South Korea; [3] Chonnam National University, Department of Animal Science and Functional Food Research Center, Gwangju, South Korea

Notes

Introduction

Potassium chloride (KCl) is one of chloride salts commonly used as a salt replacer in low-sodium meat products. In general, it has been reported that KCl can replace up to 50% of NaCl based on 2.0% of total salt concentration, without adverse impacts on quality and sensory attributes (Horita et al., 2011; Inguglia et al., 2017). However, some previous studies have indicated that KCl was less effective in forming desirable processing characteristics (e.g. protein solubility and water-holding capacity) and textural properties compared to NaCl at an equal salt concentration (Inguglia et al., 2017; Whiting and Jenkins, 1981). In addition, a recent study noted that the partial (50%) or complete replacement of NaCl with KCl could cause negative impacts on processing characteristics of pre-rigor salted chicken breasts (Song et al., 2018). Thus, it could be supposed that postmortem salting time is one of processing factors causing the difference in salting effect between NaCl and KCl. Therefore, the purpose of this study was to determine the impacts of salt type (NaCl vs KCl) and postmortem salting time (pre-rigor vs post-rigor) on processing characteristics of ground chicken breast at various ionic strength.

Methods

A total of sixty broilers (Ross 308 genotype, 32 days-old) was conventionally slaughtered at a commercial abattoir. Chicken breast muscles (*M. pectoralis major* and *minor*) were manually deboned within 10 min after slaughter. Left and right sides of chicken breast muscles were assigned into pre-rigor and post-rigor salting treatments, respectively. The left side muscles were immediately ground using a meat grinder and divided into eight portions. Each portion was individually mixed with 0.50, 1.00, 1.50 and 2.00% NaCl or 0.64%, 1.28%, 1.91% and 2.55% KCl, which corresponded to ionic strength of 0.86, 0.171, 0.257 and 0.342, respectively. At 24 h postmortem, the right side muscles stored in vacuum-refrigerated condition were ground and salted as mentioned above. The pH, protein solubility (Warner, 1997), cooking loss and texture profile analysis (Bourne, 1978) of salted chicken breasts were determined. The experimental design of this study was a completely randomized block design with three independent batches. An analysis of variance was performed on all the variables measured using the general linear model (GLM) procedure of the SPSS 18.0 program (SPSS Inc., Chicago, IL), in which salt type, postmortem salting time and ionic strength effects and their interactions were fixed as main effects. T-test and Tukey's method ($p<0.05$) were used to determine the significance of differences between treatment means.

Results

No significant interactions among three main effects, as well as, between salt type and ionic strength on all measured variables were found (Table 1, 2). The chicken breasts salted with KCl (5.93) had a significantly higher pH value than those salted with NaCl (5.84), regardless of postmortem salting time and ionic strength. The solubility of total and myofibrillar proteins was affected by three main effects ($p<0.05$). In addition, significant interactions between salt type and postmortem salting time effects were found on the protein solubility. The sarcoplasmic protein solubility was unaffected by the salt type and its interactions ($p>0.05$). Although the salt type had no impacts on the solubility of total and myofibrillar proteins in pre-rigor salted chicken breasts ($p>0.05$), post-rigor chicken breasts salted with KCl showed lower total and myofibrillar protein solubilities than those salted with NaCl ($p<0.05$). However, the salt type and its interaction effects had no impact on cooking loss of salted chicken breasts ($p>0.05$). In addition, the texture properties of salted chicken breasts were unaffected by salt type ($p>0.05$). Only interactions between salt type and postmortem salting time effects were found on cohesiveness ($p=0.021$) and chewiness ($p=0.036$), in which pre-rigor chicken breasts salted with KCl showed numerically lower cohesiveness and chewiness than those salted with NaCl ($p>0.05$).

Conclusion

The results of this current study show that the KCl salting to chicken breasts resulted in a higher pH value compared to NaCl salting, regardless of postmortem salting time. Despite the high pH value, some negative impacts of KCl salting were found on total and myofibrillar protein solubilities of post-rigor chicken breasts and on textural properties of pre-rigor chicken breasts. However, the salt type and its interactions had little to no impacts on cooking loss of salted chicken breasts. Thus, it could be suggested that KCl salting may result in the differences in protein solubility and texture, depending on postmortem salting time, when compared to NaCl salting at the same ionic strength. For a better understanding, further studies determining the effects of KCl salting on interrelations between pH and protein solubility would be warranted.

References

[1] Horita, C. N., Morgano, M. A., Celeghini, R. M. S., and Pollonio, M. A. R.

(2011) Physico-chemical and sensory properties of reduced-fat mortadella prepared with blends of calcium, magnesium and potassium chloride as partial substitutes for sodium chloride. Meat Sci. 89, 426-433.
[2] Inguglia, E. S., Z. Zhang, B. K. Tiwari, J. P. Kerry, and C. M. Burgess. (2017). Salt reduction strategies in processed meat products-a review. Trends Food Sci. Technol, 59, 70-78.
[3] Whiting, R. C. and Jenkins, R. K. (1981). Partial substitution of sodium chloride by potassium chloride in frankfurter formulations. J. Food Quali. 4, 259-269.
[4] Song, D. H., Ha, J. H., Choi, Y. S., Chin, K. B., and Kim, H. W. (2018). Replacing effect of NaCl with KCl on processing characteristics of pre-rigor ground chicken breast. 50 th KoSFA symposium. JeJu. Korea.
[5] Warner, R. D., Kauffman, R. G., and Greaser, M. L. (1997). Muscle protein changes post mortem in relation to pork quality traits. Meat sci., 45, 339-352.
[6] Bourne, M. C. (1978). Texture profile analysis. Food Technol. 32, 62-66.

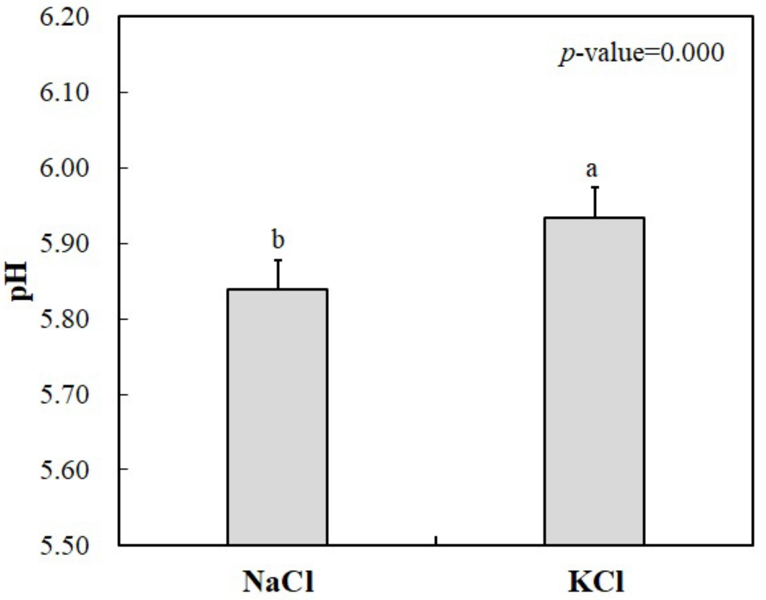

Fig. 1. pH of chicken breasts salted with NaCl or KCl.
a,b Means sharing the same letters are not significantly different (p<0.05).

Notes

Effects	Hardness (kg)	Springiness	Cohesiveness	Gumminess (kg)	Chewiness (kg)
Postmortem salting time effect					
Pre-rigor	20.30[a]	0.68	0.28[a]	5.67[a]	3.87[a]
Post-rigor	17.39[b]	0.68	0.27[b]	4.61[b]	3.13[b]
SEM[1)]	0.710	0.007	0.003	0.257	0.187
Ionic strength effect					
0.087	17.24[b]	0.62[c]	0.26[b]	4.55[b]	2.80[c]
0.171	17.69[b]	0.66[b]	0.27[b]	4.67[b]	3.03[c]
0.257	19.43[ab]	0.71[a]	0.27[ab]	5.31[ab]	3.74[b]
0.342	21.02[a]	0.73[a]	0.29[a]	6.04[a]	4.44[a]
SEM	0.520	0.015	0.003	0.199	0.204
Salt type × postmortem salting time effects					
Pre-rigor salted with NaCl	20.73	0.69	0.29[A]	5.92	4.08[A]
Pre-rigor salted with KCl	19.86	0.67	0.27[AB]	5.42	3.66[AB]
Post-rigor salted with NaCl	17.19	0.68	0.26[B]	4.56	3.10[B]
Post-rigor salted with KCl	17.59	0.68	0.26[B]	4.66	3.17[B]
SEM	0.542	0.005	0.003	0.194	0.139
Significance of *p*-value					
Salt type effect (S)	NS[2)]	NS	NS	NS	NS
Postmortem salting time effect (P)	0.000	NS	0.000	0.000	0.000
Ionic strength effect (I)	0.000	0.000	0.000	0.000	0.000
Interactions					
S × P	NS	NS	0.021	NS	0.036
S × I	NS	NS	NS	NS	NS
P × I	NS	NS	0.032	NS	0.005
S × P × I	NS	NS	NS	NS	NS

Table 2. Textural properties of chicken breasts salted with NaCl or KCl

[a,b]Means sharing the same letters in each column are not significantly different among each treatments in main effect (p<0.05).
[A,B]Means sharing the same letters in each column are not significantly different among each treatments in interaction effects (p<0.05).
[1)]SEM: standard errors of the mean.
[2)]NS: non-significance (p>0.05).

Notes

Effects	Protein solubility (%)			Cooking loss (%)
	Total	Sarcoplasmic	Myofibrillar	
Salt type effect				
NaCl	84.84[a]	39.16	45.80[a]	13.16
KCl	82.29[b]	39.35	42.94[b]	13.42
SEM[1)]	0.817	0.312	0.800	0.297
Postmortem salting time effect				
Pre-rigor	93.53[a]	40.81[a]	52.72[a]	12.90[b]
Post-rigor	73.60[b]	37.70[b]	36.02[b]	13.68[a]
SEM	4.485	0.772	3.796	0.314
Ionic strength effect				
0.087	79.48[b]	39.72	39.98[b]	18.70[a]
0.171	82.07[b]	39.10	42.97[b]	13.64[b]
0.257	85.83[a]	39.34	46.51[a]	11.06[b]
0.342	86.88[a]	38.87	48.03[a]	9.76[b]
SEM	0.984	0.238	1.036	1.037
Salt type × postmortem salting time effects				
Pre-rigor salted with NaCl	93.54[A]	40.50	53.04[A]	12.84
Pre-rigor salted with KCl	93.52[A]	41.12	52.40[A]	12.96
Post-rigor salted with NaCl	76.14[B]	37.82	38.57[B]	13.48
Post-rigor salted with KCl	71.06[C]	37.59	33.47[C]	13.89
SEM	3.100	0.537	2.641	0.258
Significance of *p*-value				
Salt type effect (S)	0.003	NS[2)]	0.003	NS
Postmortem salting time effect (P)	0.000	0.000	0.000	0.015
Ionic strength effect (I)	0.000	NS	0.000	0.000
Interactions				
S × P	0.006	NS	0.027	NS
S × I	NS	NS	NS	NS
P × I	NS	0.013	NS	0.017
S × P × I	NS	NS	NS	NS

Table 1. Protein solubility and cooking loss of chicken breasts salted with NaCl or KCl [a,b]Means sharing the same letters in each column are not significantly different among each treatments in main effect (p<0.05). [A-C]Means sharing the same letters in each column are not significantly different among each treatments in interaction effects (p<0.05). [1)]SEM: standard errors of the mean. [2)]NS: non-significance (p>0.05).

Notes