EFFECTS OF SALT AND PHOSPHATE TYPES ON THE DEVELOPMENT OF A NATURAL PINK COLOR IN COOKED GROUND CHICKEN BREAST

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I. INTRODUCTION

Salts and phosphates have been widely used in meat products as important food ingredients. These ingredients can affect the color and pigment characteristics of cooked products [1, 2]. Sodium chloride increases the stability of hemoglobin and myoglobin, most likely due to the presence of chloride ions. The addition of sodium tripolyphosphate results in increased heat stability of myoglobin contributed by pH changes. On the other hand, the heat stability of cytochrome c has been found to increase in the presence of salt, but is decreased by the addition of phosphate [3]. Recent studies have attempted to investigate the effects of various processing conditions of poultry breast meat, such as timing of salt addition, NaCl levels, storage period, and final cooking temperature. Results indicated that the natural pink color of cooked poultry meat can be reproduced without any of pink-generating ligands [1, 2]. Solar and bamboo salt has certain trace minerals and elements rather than refined salt. Especially, they are known to have stronger alkalinity (higher pH) than common refined salts. In addition, solar salt used in natural meat products contains small amount of nitrate and nitrite. Therefore, the objective of this study was to investigate the effects of various salts and phosphates on the development of the natural pink color, and to identify pigment properties in cooked ground chicken breasts.

II. MATERIALS AND METHODS

Fresh chicken breasts (1 day postmortem) were obtained from a local processor and were ground with a 0.3-cm plate using a chopper. The ground chicken trimmings were assigned as a 3 × 4 factorial, which was dependent on salt (refined, solar, bamboo) and phosphate types (Control; no phosphate, SAPP; sodium acid pyrophosphate, SHMP; sodium hexametaphosphate, STPP; sodium tripolyphosphate). In each treatment, salt (1.5%) and phosphate (0.5%) was incorporated into the ground meat, and then mixed for 5 min. All mixed meat was vacuum-packaged and stored (2-3°C) for 7 days. Following the storage, the pre-salted meat was stuffed into centrifuge tubes (50 g each). The tubes were centrifuged at 2000 × *g* for 10 min to remove air pockets. All samples were stored overnight at 2-3°C and were cooked to an internal temperature of 75°C by loading the tubes into a 50°C water bath and then immediately setting the water bath to 90°C. The samples were cooled on ice and were stored (2-3°C) in the dark until further analysis. The experimental design was a 3 × 4 factorial with three types of salts and four types of phosphates. The main effects for salts and phosphate types and their interactions were analyzed using the PROC MIXED Model of SAS program. Means of dependent variable were separated ($p < 0.05$) by pairwise comparisons using the pdiff option.

III. RESULTS AND DISCUSSION

Two-way interactions (salts × phosphates) were not observed for any of the dependent variables. Therefore, discussion will focus on the main effects in cooked chicken breast.

Effects of salts types

Salt types did not result in significant differences in cooking yield and pH values. CIE a* values and nitrosyl hemochrome contents were in the order of solar > refined > bamboo treatments. It seems likely that the formation of nitrosyl hemochrome from trace nitrate or nitrite in solar salt is at least responsible for the more red of cooked products. Cooked chicken products with solar salt had higher ($p < 0.05$) CIE a* values compared with those with bamboo salt (Table 1). Although the addition of solar salt to chicken breast increased redness, the CIE a* values (a* 3.6) were lower compared with results (more than a* 3.8), corresponded to the pink color reported by Holownia et al. [4]. In addition, myoglobin contents were higher (*p*

< 0.05) in samples with bamboo salt compared to those containing refined or solar salt. However, no significant differences ($p > 0.05$) in total pigments, ORP, and PMD were detected between products with different types of salts.

Effects of phosphates types

There were no differences ($p > 0.05$) in cooking yield for cooked ground chicken breast with different type of phosphate. However, pH values were highest ($p < 0.05$) in STPP treatments (pH 6.4) and lowest ($p < 0.05$) in SAPP samples (pH 6.1). Control and SHMP treatments exhibited higher ($p < 0.05$) CIE a* values than SAPP treatments, while STPP treatments were in between (Table 1). The reduced redness in SAPP treatments may be due to lower pH [7]. However, nitrosyl hemochrome and total pigments were similar ($p > 0.05$) across the phosphate treatments. In addition, SAPP treatments had less ($p < 0.05$) negative ORP and PMD compared with those of other treatments (Control, SHMP, and STPP), which were most likely affected by the lower pH [5, 6].

Table 1. Effect of salt and phosphate types on colour and pigment properties in cooked ground chicken breasts

Main effects	Dependent variables					
	CIE a*	Nitrosyl hemochrome (ppm)	Total pigment (ppm)	ORP (mV)	Myoglobin (mg/g)	PMD (%)
Salts						
Refined	3.4^{ab}	2.5^{ab}	13.9	-100.9	0.20^{b}	85.9
Solar	3.6^{a}	2.8^{a}	13.8	-97.4	0.20^{b}	86.5
Bamboo	3.3^{b}	2.2^{b}	13.8	-101.6	0.24^{a}	84.8
(S.E)	(0.18)	(0.28)	(0.52)	(3.02)	(0.01)	(1.31)
Phosphates						
Control	3.6^{a}	2.5	13.8	-107.9^{c}	0.18^{c}	89.1^{a}
SAPP	3.3^{b}	2.6	13.9	-84.9^{a}	0.20^{b}	82.8^{c}
SHMP	3.5^{a}	2.4	13.7	-108.9^{c}	0.25^{a}	85.4^{b}
STPP	3.4^{ab}	2.6	13.9	-98.3^{b}	0.21^{b}	85.7^{b}
(S.E)	(0.18)	(0.28)	(0.53)	(3.16)	(0.01)	(1.38)

$^{a-c}$ Means within a column with different superscript letters are different ($p < 0.05$).

IV. CONCLUSION

The addition of solar salt to ground chicken followed by 7 days of storage can increase the pinkness of meat upon cooking. The use of SAPP may reduce redness and PMD in cooked chicken breasts via reduction of pH.

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