EVALUATION OF OLEORESIN PAPRIKA SOLUTION ON PRODUCT QUALITY OF EMULSIFIED-SAUSAGES DURING REFRIGERATED STORAGE

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I. INTRODUCTION

Sodium nitrite ($NaNO_2$) is a very important ingredient of cured meat products, because it inhibited the growth of microorganisms and developed color of meat products [1]. But, it can react with second amines to produce N-nitrosamine which was related to the cause of cancers. Oleoresin paprika (OP) has been extensively used in the food industry as coloring agent for various foods [2]. OP is a lipophilic matrix obtained by processing paprika (*Capsicum annuum var. angulosum*) fruits and is mainly composed of glycerides, liposoluble polyphenolic antioxidants and carotenoid pigments. It contains a high amount of carotenoids, which represent the pigment of paprika [3]. Thus, the objective of this study was to evaluate the quality characteristics, especially such as color, of emulsified-sausage (ES) containing OP to replace partially with $NaNO_2$.

II. MATERIALS AND METHODS

The pork hams and backfat were purchased from local meat market. They were stored at 4°C before manufacturing ES. Trimmed meat was mixed with additives by hood mixer. And then, meat batter cooked at 75°C in a water bath after stuffing on the conical tube. Cooked samples were stored at 4°C after rapidly chilling in an ice. emulsified-sausages were prepared with different combinations of $NaNO_2$ and OP solution (5% OP+95% sunflower seed oil). And, then the sausages were prepared with 4 treatments (REF-150 ppm $NaNO_2$; TRT1-0.1 % OP solution + No $NaNO_2$; TRT2-0.1 % OP solution+37.5 ppm $NaNO_2$; 0.1% OP solution+ TRT3-75 ppm $NaNO_2$). Color values (CIE, L*, a*, b*), pH, expressible moisture (EM, %), Thiobarbituric acid reactive substances (TBARS, lipid oxidation determination), residual nitrite and microbiological counts (TPC, VRB) were measured to evaluate ES during the storage at refrigerator (10°C$\pm$2°C) for 35 days. The whole experiment replicated two times and two-way ANOVA was performed using SPSS 21.0 software as a factor of treatment and storage time.

III. RESULTS AND DISCUSSION

Table 1 shows the pH, CIE L*, a*, b*, EM and microbiological counts of ES with OP solution. Although TRT2 and TRT3 had lower concentration of $NaNO_2$ than REF, redness(a*) and yellowness (b*) values of those were higher than REF (p<0.05). Although TRT1 had higher EM values than others (p<0.05), those of TRT2 and TRT3 were lower than REF (p<0.05). No differences among REF, TRT2 and TRT3 in microbiological analysis were observed (p>0.05), even though *Enterobacteriaceae* counts (CFU/g) of TRT1 were higher than those of other treatments during storage (p<0.05).

Table 1 pH, CIE values, expressible moisture and microbiological counts of pork emulsified-sausage with oleoresin paprika solution

	Parameters						
Treatments	pH	CIE L*	CIE a*	CIE b*	EM[1)]	TPC[2)]	VRB[3)]
REF	6.09±0.07^{a}	73.1±0.36^{b}	11.0±0.35^{c}	6.24±0.89^{d}	18.8±0.77^{b}	2.01±2.12^{b}	<2^{b}
TRT1	6.08±0.09^{a}	74.3±0.98^{a}	6.42±0.38^{d}	9.81±0.55^{a}	19.0±1.13^{a}	2.54±2.31^{a}	2.04±2.15^{a}
TRT2	6.12±0.07^{a}	73.0±0.27^{bc}	12.2±0.21^{b}	7.59±0.23^{c}	18.5±0.96^{c}	2.28±2.11^{ab}	<2^{b}
TRT2	6.12±0.07^{a}	72.7±0.36^{c}	12.7±0.26 ^{a}	7.97±0.31^{b}	18.5±0.88^{c}	2.21±2.07^{ab}	<2^{b}

Day							
0	6.08±0.08^{a}	73.8±1.04^{a}	10.5±2.18^{a}	7.74±1.56^{a}	17.7±0.18^{f}	<2^{d}	<2^{d}
3	6.11±0.09^{a}	73.9±1.36^{a}	10.2±2.42^{a}	7.80±1.48^{a}	18.0±0.39^{e}	<2^{d}	<2^{d}
7	6.10±0.08^{a}	73.9±1.36^{a}	10.3±2.57^{a}	7.79±1.55^{a}	18.0±0.33^{e}	<2^{d}	<2^{d}
14	6.05±0.12^{a}	74.1±1.06^{a}	10.4±2.39^{a}	7.87±1.40^{a}	18.5±0.37^{d}	2.30±1.40^{c}	<2^{d}
21	6.03±0.06^{a}	73.8±1.28^{a}	10.3±2.34^{a}	7.72±1.25^{a}	19.2±0.42^{c}	3.90±0.24^{b}	3.31±0.32^{c}
28	6.06±0.06^{a}	73.9±1.12^{a}	10.3±2.32^{a}	7.95±1.10^{a}	15.5±0.38^{b}	4.31±0.27^{ab}	3.78±0.37^{b}
35	6.05±0.06^{a}	74.1±1.41^{a}	10.3±2.44^{a}	7.69±1.21^{a}	20.1±0.39^{a}	4.61±0.32^{a}	4.17±0.48^{a}

1) Expressible moisture
2) Total plate counts
3) *Enterobacteriaceae* counts
^{a,b,c,d} Means with different superscript in the same row significantly differ with $p<0.05$

TBARS values of REF, TRT2 and TRT3 were not different until the 14 days of storage ($p>0.05$), however, those of REF were lower than those of TRT2 and TRT3 ($p<0.05$). TRT1 was the highest TBARS values among the treatments over the refrigerated storage ($p<0.05$)

Table 2 The TBARS (mg MDA/kg) of pork emulsified-sausage with oleoresin paprika solution

	Storage time (days)						
Treatments	0	3	7	14	21	28	35
REF	0.09±0.00^{Ca}	0.18±0.07 ^{Ba}	0.20±0.05^{Ba}	0.24±0.01^{Ba}	0.26±0.01^{Ca}	0.29±0.00^{Da}	0.28±0.00^{Ca}
TRT1	0.18±0.00^{Ac}	0.43±0.02 ^{Ab}	0.59±0.23^{Ab}	0.78±0.06^{Aab}	0.83±0.02^{Aa}	0.85±0.00^{Aa}	0.85±0.00^{Aa}
TRT2	0.11±0.00^{Bc}	0.22±0.10^{ABbc}	0.24±0.11^{ABabc}	0.22±0.01^{Bab}	0.36±0.03^{Bab}	0.38±0.00^{Ba}	0.37±0.00^{Ba}
TRT2	0.09±0.01^{Cc}	0.15±0.07^{Bbc}	0.20±0.02^{Babc}	0.24±0.03^{Bab}	0.31±0.06^{BCab}	0.36±0.00^{Ca}	0.37±0.00^{Ba}

^{A,B,C,D} Means with different superscript uppercase letters in the same column significantly differ with $p<0.05$
^{a,b,c,d} Means with different superscript lowercase letter in the same row significantly differ with p<0.05

Residual nitrite levels were in the decreasing order of REF, TRT3, TRT2 and TRT1 ($p<0.05$), which were proportional to the amount of added level of nitrite.

Table 3 Residual nitrite (ppm) of pork emulsified-sausage with oleoresin paprika solution

	Storage time (days)						
Treatments	0	3	7	14	21	28	35
REF	20.8±0.99^{Aa}	17.7±0.00^{Ab}	15.0±0.35^{Ac}	9.54±0.15^{Ad}	8.66±0.08^{Ad}	6.80±0.09^{Ae}	4.87±0.12^{Af}
TRT1	0.00 ±0.00^{Da}	0.00±0.00^{Da}	0.00±0.00^{Da}	0.00±0.00^{Da}	0.00±0.00^{Da}	0.00±0.00^{Da}	0.00±0.00^{Da}
TRT2	6.83±0.28^{Ca}	5.38±1.77^{Cab}	3.98±0.21^{Cbc}	2.95±0.91^{Ccd}	1.57±0.37^{Cde}	0.76±0.25^{Ce}	0.57±0.01^{Ce}
TRT2	9.41±0.11^{Ba}	8.92±0.00^{Ba}	7.19±0.09^{Bb}	4.81±0.08^{Bc}	4.18±0.19^{Bc}	2.84±0.40^{Bd}	1.98±0.12^{Be}

^{A,B,C,D} Means with different superscript uppercase letters in the same column significantly differ with $p<0.05$
^{a,b,c,d} Means with different superscript lowercase letter in the same row significantly differ with p<0.05

IV. CONCLUSION

In conclusion, 0.1 % OP solution in combined with 37.5 ppm $NaNO_2$ would be similar quality characteristics to those of REF(150 ppm), and therefore, approximately 3/4 of initial nitrite level could be replaced with 0.1% OP solution. These results could be applicable for the meat industry to reduce the nitrite.

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