EVALUATION OF PHYSICO-CHEMICAL AND TEXTURAL PROPERTIES, AND SENSORY EVALUATION OF LOW-FAT/SALT RESTRUCTURED HAMS MANUFACTURED WITH MILK PROTEINS

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Key Words: sensory evaluation, low-fat/salt restructured hams, milk proteins

Introduction

Salt functions as improving water holding capacity, fat binding, attributing the desirable texture and sensory properties and increasing cooking yield. The combination of salt and phosphate decreased cooking loss of meats and meat products, and similar firmness were observed with lower sodium content when phosphate was used (Ruusunen et al., 2005). However, excessive sodium intake may be potential possibility to induce hypertension (Cortlandt, 2004). Thus, reducing sodium content in diet is highly recommended. But, salt reduction in the manufacture of meat products may have problems related to flavor, texture and sensory characteristics. Instead of completely removing the salt content, minimum level of salt may be required to produce meat products to keep cooking loss (Shults and Wierbicki, 1973) and protein solubility (Gordon and Barbut, 1992). Microbial transglutaminase (MTGase) has been successfully used to manufacture of low-fat, low-salt functional meat products for the improvement of textural characteristics and binding capacity (Chin and Chung, 2003). Improved enzymatic activities of MTGase were observed when the sodium chloride was added to the water. Replacing the salt with MTGase and other functional ingredients might be alternatives to reduce the salt or phosphate level in meat products (Muguruma et al., 2003; Serrano et al., 2004). However, no information is available how many level of salt could be reduced with the combination of MTGase and various milk proteins in the manufacture of restructured ham without quality defects.

Objectives

To complement the quality defects of restructured hams(Rh) due to salt reduction, the combination of 0.3% microbial transglutaminase (MTGase, Ajinomoto Activa-TG B) and 1% milk proteins (Sodium Caseinate and Whey protein concentrate) with reduced salt levels from 1.5 to 0.5% were added to the manufacture of Rhs. Thus, the objectives of this study were to compare the low-fat/salt restructured hams with MTGase and milk proteins with the control with 1.5% salt and finally, select the most similar characteristics to those with control.

Methodology

The low-salt/fat restructured hams, which contained MTGase and milk proteins (sodium caseinate and whey protein conncentrate), were manufactured followed by Lee and Chin (2004). Proximate analyses were measured the contents of moisture, fat and protein according to AOAC (1995) procedure. Color measurements were performed using a color meter and expressed by L, a and b values. Water holding capacity (WHC, %) and cookin loss (CL, %) were measured to detemine the functional proeprties. WHC was measured according to the modified method of Jauregui et al (1981) and CL was evaluated by a weigh difference of cooking before and after. Texture analyses were measrued by Instron Universal Testing Machine and expressed by hardness, springiness, gumminess, chewiness and cohesiveness (Bourne, 1978). Warner-Bratzler shear values were also measured. Sensory evaluation was performed by 7 sensory panels and evaluated the color, taste, texture and overall acceptability rating as #1 being a most like, and # 8 least like with 8-points hedonic scale. Statistical analyses were performed by one-way analysis of variance (ANOVA) using the SPSS 12.0 (2003) program with three replicates, and then the significant differences among tratments were evaluated by Student-Newman-Keuls multiple range test ($p<0.05$).

Results & Discussion

pH and proximate composition of the low-salt/fat restructured hams(Rhs) manufactured with MTGase and milk proteins are shown in Table 1. pH values, moisture, fat and protein contents of Rhs were 6.07-6.22, 68-72%, 2-5%, 18-22%, respectively. Addition of MTGase and milk proteins with various salt levels did not affect ($p>0.05$) pH values and proximate composition (Table 1). Hunter L, a, b values of Rhs were not affected by addition of MTGase and milk proteins ($p>0.05$) either. Among treatments tested, expressible moisture (EM, %) were not different from each other ($p>0.05$), whereas cooking loss (CL, %) were significantly affected ($P<0.05$) by salt level and milk proteins ($p<0.05$). As salt level increased, CL decreased and Rhs containing sodium caeinate (SC) had lower CL than those with whey protein concentrate(WPC) due to higher protein contents of SC rather than WPC (Table 2, $p<0.05$). These results are confirmed with the previous report by Marsh (1983) who reported that myofibrillar proteins extracted by salt lead to enhance the protein solubility and water holding capacity. Especially, Rhs containing 1.0% WPC and 0.5% or 1% SC with either 0.5 and 1% salt had lower CL, whereas Rhs containing 1.0% salt and 1.0% SC were not different from control in CL. These results indicated that the addition of 0.3% MTGase with 1% SC had similar functionality to those with control (Table 2, $p>0.05$). In texture profile analysis, no differences in hardness were observed among treatments ($p>0.05$), whereas Rhs with 0.3% MTGase and milk proteins had significantly higher than the control in other textural characteristics ($p<0.05$, Table 3). These results showed that addition of 0.3% MTGase and 1% milk proteins may contribute to enhance the binding capacity (Motoki, 1998). On the other hand, no differences in shear values were observed among treatments including the control ($p>0.05$, Table 3). In sensory evaluation, Rhs containing 1.0% salt with 0.3% MTGase and milk proteins (SC, WPC) were similar to the control. Furthermore, Rhs containing 1% salt with 0.3% MTGase and 1.0% SC were similar to

those containing 1.5% salt with TGase and 1% SC(T3), and more acceptable than control(1.5% salt alone). Even, Rhs containing 0.5% salt in combined with 0.3% MTGase and 1% SC had similar sensory palatability to the control.

Conclusions

The minimum level of salt to manufacture of low-fat/salt Rhs was at least 1.0%. Rhs containing 1% salt with the combination of 0.3% MTGase and 1% SC had similar CL (%) to the control. The addition of 0.3% MTGase and 1% milk proteins increased most texture profile analysis values except hardness, resulting in improved textural characteristics as compared to the control. Sensory evaluation data showed that the combinations of 0.5% or 1% salt with 0.3% MTGase and 1% SC or 1% WPC were similar sensory characteristics to the control. In conclusion, the combination of 0.3% MTGase and 1% milk proteins compensated for the defects of Rhs with reducing salt levels, and SC was more efficient for the substrate of MTGase than WPC.

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Tables and Figures

Table 1. pH and proximate composition of restructured meat products as affected by the addition of TGase and milk proteins

Treatments* (Trt)	pH	Moist	Fat	Protein
		----------(%)----------		
Control	6.10±0.06	71.3±1.89	3.11±1.34	18.3±2.44
Trt 1	6.07±0.05	69.7±2.87	4.39±2.69	21.3±2.73
Trt 2	6.11±0.12	70.3±0.29	3.56±0.28	19.6±3.36
Trt 3	6.22±0.14	71.0±0.82	2.96±0.88	19.2±2.27
Trt 4	6.13±0.05	68.0±1.95	4.60±1.52	21.0±0.47
Trt 5	6.14±0.04	69.9±1.36	3.10±1.10	18.9±1.81

* Treatments (Trt): Control, Salt 1.5%; Treatment (Trt) 1, Salt 0.5%, Sodium Caseinate (SC) 1.0% + Transglutaminase (TGase) 0.3%; Trt 2, Salt 1.0%, SC 1.0% + TGase 0.3%; Trt 3, Salt 1.5%, SC 1.0% + TGase 0.3%; Trt 4, Salt 0.5%, Whey Protein Concentrate (WPC) 1.0% + TGase 0.3%; Trt 5, Salt 1.0%, WPC 1.0% + TGase 0.3%

Table 2. Hunter color and functional properties of restructured meat products as affected by the addition of TGase and milk proteins

Treatments*	Hunter Color Values			Functional Properties	
(Trt)	L	a	b	EM	CL
Control	66.6±1.40	13.2±1.31	4.19±0.25	22.8±2.03	7.82±1.06^{d}
Trt 1	65.8±1.15	14.4±0.63	5.35±1.11	20.4±4.54	14.1±2.88^{b}*
Trt 2	66.8±0.85	12.8±0.46	4.36±0.18	22.9±4.97	10.7±1.55^{c}
Trt 3	63.2±2.17	13.8±0.55	4.37±0.71	20.7±3.09	7.21±0.82^{d}
Trt 4	66.2±1.40	13.8±0.30	5.12±0.07	21.3±1.56	19.2±1.04^{a}*
Trt 5	65.5±3.79	13.0±0.85	4.54±0.08	19.4±3.60	14.2±1.10^{b}*

EM= expressible moisture (%); CL=cooking loss (%), * Treatments (Trts): See in Table 1

$^{a-d}$ Means having same superscript within same column are not different (P<0.05)

*: Significant (P<0.05) are expressed by the asterisk (Dunnett's T-test)

Table 4. Textural properties of restructured meat products as affected by the addition of TGase and milk proteins

Treatments* (Trt)	Hardness (g)	Springiness (cm)	Cohesiveness	Gumminess	Chewiness	Shear value
Control	5377±212	0.28±0.02^{b}	0.24±0.02^{b}	1251±75^{b}	340±49^{b}	4.28±1.65
Trt 1	7367±1161	0.30±0.01^{b}	0.28±0.01^{a}	2057±262^{a}	594±56^{a}	2.38±0.54
Trt 2	7104±1066	0.35±0.03^{ab}	0.28±0.01^{a}	2000±278^{a}	694±47^{a}	2.94±0.57
Trt 3	7150±2193	0.37±0.05^{a}	0.28±0.03^{a}	1913±395^{a}	691±62^{a}	3.41±0.87
Trt 4	6715±1291	0.28±0.01^{b}	0.28±0.01^{a}	1905±351^{a}	538±118^{a}	3.87±1.49
Trt 5	6515±342	0.31±0.04^{ab}	0.28±0.01^{a}	1808±78^{a}	539±58^{a}	4.01±1.71

Treatments(Trts): See in Table 1, $^{a-b}$: See in Table 2