

Evaluation of functional and textural properties of low-salt comminuted meats as affected by different hydrocolloids and transglutaminase

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Abstract

This study was performed to improve the functional and textural properties of reduced-salt meat products with different hydrocolloids with or without transglutaminase (TGase). The minced pork formulated with various salt levels (0.9~1.5%) and sodium tripolyphosphate (0.4%) were processed with two hydrocolloids (acorn vs. mung bean) and TGase. After cooking at 75°C for 30 min, the cooked meats with various salt and hydrocolloid combinations were measured pH, and physicochemical and textural properties. The increased salt level decreased pH and cooking loss ($P<0.05$), regardless of type of hydrocolloid and TGase. Especially, acorn powder affected the hunter color values, regardless of TGase, resulting in decreases in lightness (L) and yellowness (b) values ($P<0.05$), whereas the addition of mung bean powder did not affect hunter color values ($P>0.05$). The increased salt level increased springiness, and the addition of hydrocolloids into the pork meat batters tended to increase the gumminess, whereas the addition of TG improved the most textural properties even at reduced-salt meat batter, similar to those of the regular-salt control. Results of this study suggested that the addition of hydrocolloids in combined with TGase improved the textural characteristics at reduced-salt comminuted meat products.

Introduction

Recently, consumer's trend tended to select healthier meat product with low level of calories and salt content due to their well-being life style (Jimenez-Colmenero, 2001). The manufacture of these products focused on reducing ingredients that may cause to health problems, such as cardiovascular disease related to high-fat or salt diets. However, excessively reduced salt and fat in processed meats could make products defects associated with functional, textural and sensory properties of meat products. Therefore, novel combinations that may improve their product quality with reduced salt and fat are needed. Transglutaminase (TGase) has been used to improve the textural and functional properties in reduced-salt meat products (Kuraishi et al., 2001). In addition, the combination of TGase and other ingredients, such as dairy or soy proteins or hydrocolloids, has been reported to enhance product quality at reduced-sodium meat products (Muguruma et al., 2003). However, not many studies were performed the effect of TG and various hydrocolloids on the product quality. Thus, the objectives of our study were to develop novel formulation to manufacture low-fat, reduced-salt processed meat by combination of two hydrocolloids (acorn or mung bean) with or without TGase and to select the best combination of reduced-salt comminuted meat which had similar functional and textural properties to those of regular-salt control.

Materials and methods

Pork meat batters were manufactured with reduced-salt levels in combined with different hydrocolloids (acorn vs. mung bean) with or without TGase. The boston shoulder was homogenized with 0.4% sodium tripolyphosphate, 0.5% sodium caseinate, different salt levels (1.5~0.9%) and hydrated acorn or mung bean powder (0.3%) in combined with TGase (1%). And then, the homogenized meat batters stuffed into centrifuge tubes and cooked in a water bath until the internal temperature reached to 72°C (75°C for 30 min). The cooked comminuted meats were chilled in an ice water, and stored at refrigerator until analyzed. pH and proximate analyses were measured according to AOAC (1995). Hunter color values of comminuted meat products were measured by Minolta colorimeter expressing hunter L (lightness), a (redness) and b (yellowness). Cooking loss (CL, %) was measured by a weigh difference of cooking before and after. Textural profile analysis was measured by Instron Universal Testing Machine (Bourne, 1978). Statistical analyses were performed by two-way analysis of variance (ANOVA) using the SPSS 12.0 (2003) program. The significant differences among treatments were determined by Duncan's multiple range test ($P<0.05$).

Results and discussion

Since most parameters did not have interactions between salt level and hydrocolloids ($P>0.05$), data were pooled and compared the pooled mean among the various salt levels and treatments (Tables 1 and 2). pH values, moisture and fat contents of comminuted meats were 6.39-6.49, 77.0-79.5% and 2.34-2.70%,

respectively (Table 1). Salt level affected pH, cooking loss (Fig. 1) and textural springiness, whereas acorn affected hunter lightness (hunter L) and yellowness (hunter b), regardless of TGase. In addition, the addition of acorn into the comminuted meat products improved the textural gumminess (Table 2).

Table 1. pH and proximate composition, hunter color values of pork meat batter with reduced-salt levels and two hydrocolloids with or without TGase

	No TGase						TGase					
	Salt level			Treatment			Salt level			Treatment		
	0.9	1.2	1.5	CTL ¹	T1 ²	T2 ³	0.9	1.2	1.5	CTL	T1	T2
pH	6.43 ^{a4}	6.40 ^{ab}	6.39 ^b	6.41	6.40	6.41	6.49 ^a	6.47 ^{ab}	6.46 ^b	6.48	6.47	6.47
Moisture	79.5	79.4	79.1	79.4	79.2	79.2	77.6	78.0	77.0	77.8	77.4	77.4
Fat	2.49	2.37	2.34	2.39	2.39	2.40	2.63	2.70	2.61	2.67	2.67	2.61
Hunter L	72.6	72.5	72.4	73.3 ^a	70.9 ^b	73.3 ^a	72.0	72.3	71.9	72.9 ^a	70.8 ^b	72.5 ^a
Hunter a	7.11	7.09	7.30	7.09	6.94	7.47	7.52	7.38	7.45	7.14	7.00	8.20
Hunter b	9.32	9.22	9.36	9.56 ^a	8.61 ^b	9.73 ^a	9.15	9.62	9.32	9.77 ^a	8.68 ^b	9.65 ^a

¹CTL = pork meat batter with transglutaminase or without; ²T1 = acorn powder; ³T2 = mung bean powder; ⁴All values are the pooled mean; ^{a-b}Means having same superscript within same row (salt level or treatment) are not different ($P>0.05$).

In the presence of TGase, cooking loss of comminuted meat tended to increase (Fig. 1) and the textural characteristics improved significantly as compared to those without TGase (Table 2). These results indicated that the cross linking of protein molecules were produced with the addition of TGase and confirmed by Kuraishi et al. (2001) who reported strong protein network of cross linking between glutamine and lysine residues formed by TGase. Therefore, the addition of hydrocolloids may prevent the moisture loss from the comminuted meat products during cooking and the enhanced textural characteristics were achieved by the addition of TGase. Results of this study suggested that the addition of hydrocolloid in combined with TGase improved both cooking loss and textural characteristics at reduced-salt comminuted meat products and better product attributes, while combination effect of non-meat protein and microbial TGase on the functional and

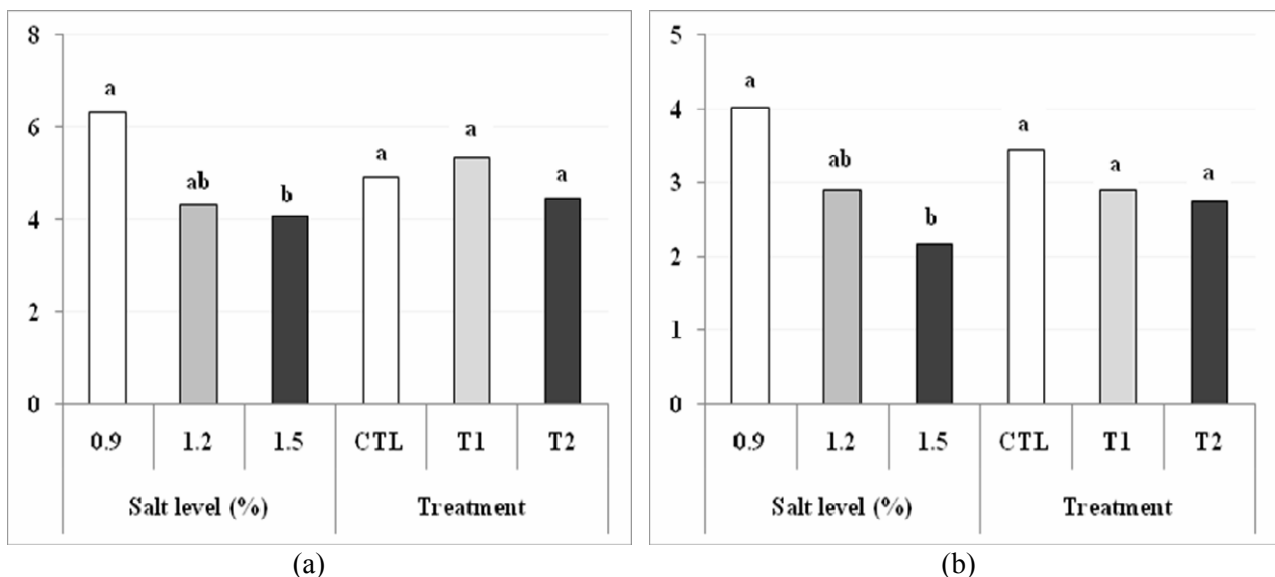


Figure 1. Cooking loss of pork meat batter with reduced-salt levels and different hydrocolloids with (a) or without (b) TGase.

a-b: same letters have no significant differences ($P>0.05$) in the same section (salt level or treatment)

Textural characteristics decreased sometimes due to the physical entrapment in comminuted meat systems (Pietrasik and Jarmoluk, 2003). Therefore, best combination with ideal meat protein and hydrocolloid interaction could be selected based on the functional and textural characteristics and the formulation ratio of each component would be an important factor affecting the product quality.

Table 2. Texture characteristics of pork meat batter with reduced-salt levels and different hydrocolloids with or without TGase

	No TGase						TGase					
	Salt level			Treatment			Salt level			Treatment		
	0.9	1.2	1.5	CTL ¹	T1 ²	T2 ³	0.9	1.2	1.5	CTL	T1	T2
Hardness (gf)	2442 ⁴	2240	2881	2222	3045	2295	5682	4606	6274	4234	6071	6256
Springiness (cm)	0.15 ^b	0.25 ^a	0.22 ^a	0.21	0.23	0.19	0.48	0.34	0.49	0.36	0.51	0.44
Gumminess	25.5	20.7	28.0	20.4 ^b	30.7 ^a	23.2 ^{ab}	53.1	46.5	60.5	41.6	59.1	59.4
Chewiness	4.10	5.20	6.09	4.22	6.71	4.45	25.1	18.3	30.2	15.6	30.5	27.5
Cohesiveness	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01

¹CTL = pork meat batter with TGase or without; ²T1 = acorn powder; ³T2 = mung bean powder; ⁴All values are the pooled mean; ^{a-b}Means having same superscript within same row (salt level or treatment) are not different (P>0.05).

Conclusions

Comminuted meat products containing reduced-salt (0.9%) had problems related to the cooking loss and textural characteristics. However, the addition of hydrocolloids improved the textural gumminess. In addition, the combination of TGase and hydrocolloids improved the textural characteristics at even reduced-salt products, similar to those of regular-salt control (1.5% salt). Thus, the addition of both TGase and hydrocolloids might have synergistic effect, and thus significantly contributed to the textural characteristics at reduced-salt comminuted products. These results indicated that the combination of TGase and hydrocolloids might be applicable to the comminuted meat products to have better functional and textural characteristics.

References

1. AOAC. (1995). *Official Methods of Analysis* (15th ed). Washington, DC.
2. Bourne, M. C. (1978). Texture profile analysis. *Food Technology*, 32, 62-66, 72.
3. Jimenez-Colmenero, F., Carballo, J., and Cofrades, S. (2001). Healthier meat and meat products: their role as functional foods. *Meat Science*, 59, 5-13.
4. Kuraishi, C., Yamazaki, K., and Susa, Y. (2001). Transglutaminase: its utilization in the food industry. *Food Reviews International*, 17, 221-246.
5. Muguruma, M., Tsuruoka, K., Katayama, K., Erwanto, Y., Kawahara, S., Yamauchi, K., Sathe, S. K., Kawahara, S. (2003). Soybean and milk proteins modified by transglutaminase improves chicken sausage texture even at reduced levels of phosphate. *Meat Science*, 63, 191-197.
6. Pietrasik, Z. and Jamolouk, A. (2003). Effect of sodium caseinate and k-carrageenan on binding and textural properties of pork muscle gels enhanced by microbial transglutaminase addition.
7. SPSS. (2003). SPSS 12.0 for windows. SPSS Inc., USA.