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Produciton of Fermented Sausage through Addition of Isolated Soy Protein

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SUMMARY

The present study was intended to evaluate the utilities of ISP (Isolated Soy Protein) for fermented sausage production as well as to find a way to reduce the amount of salts added for production of fermented sausages through the substitution of ISP for salts. In the study, the physico-chemical and microbial properties of the products manufactured by commercial method were investigated under the addition of 0, 2, 3, 4 and 5% of ISP levels during production of European style fermented sausages and the panel test was conducted for the final products. With the increment of ISP level, there was no difference of growth in *Lactobacillus plantarum* and *Staphylococcus simulans* used by starter culture between control and treated groups, although an increase of pH ($P<0.05$) and a reduction of water activity ($P<0.05$) were observed. In Hunter Color Value, increment of ISP added level resulted in a decrease of a value (redness) in 3, 4 and 5% of ISP treatment but not in 2% compared with control one. There was also not any difference of color in 2% of ISP treatment compared with control in panel test. No difference of texture and taste was also shown in 2% of ISP added groups compared with control.

INTRODUCTION

Addition of salt to fermented dry sausage contributes greatly to the stability of microorganism through reducing water activity (Aw). Since perishable gram-negative bacteria which have weak tolerance of Aw are easy to grow in the early stage of ripening, the proper addition of salt inhibits their growth.

Food poisoning can be induced by the reduction of addition of salt because of the lack of inhibition against *Enterobacteriaceae* including *Salmonella*. Therefore, above level of 2.5% salt should be added for the prevention of growth of *Salmonalla* (SCHMIDT, 1983). However, the use of such high levels in addition of salt is unacceptable in countries which are traditionally unfamiliar to fermented meat products because of salty taste. The present study was performed to examine the substitutive effects of ISP which was permitted as an additive of meat products for salt through addition of ISP to raw meat as well as to investigate reductive effects of production cost through decrease of loss of weight using by low-cost ISP.

MATERIALS AND METHODS

Fermented dry sausage was produced by commercial method used in Europe. Raw pork meat was frozen at −20°C and maintained at −5°C for easy cutting prior to production. The mixing of raw meat, cut-fat and other additives were done by the table cutter (Seydelmann/ Germany). The mixture was consisted of pork 67%, pork speck 30%, salt 2.7%, GdL 0.7%, pepper 0.3%, ascorbic acid 0.1%, corriander 0.05%, KNO_3 (200 ppm) and $NaNO_2$ (150 ppm). ISP (Purina protein 500 E, U.S.A.) treated groups were divided into 0, 2, 3, 4 and 5%. Starter culture was prepared after inoculating the mixture of *Lactobacillus plantarum* L 74 (10^7 cells/g) and *Staphylococcus simulans* M II (10^6 cells/g) (Rudorfmüller co. Germany). Raw mixture was filled to securex-fibrous casing (ϕ5.5 cm Walsroder/Germany), ripened and dried. At 3 days after ripening, it was smoked for 3 hr at 20°C and ripened for 21 days.

Physico-chemical analysis were performed in ripening process and final products of fermented dry sausages. pH was measured 5 times per each sample. Aw was monitered 3 times per each sample using by Novasina-electronic hygrometer (EEJA-3/Switzland).

Color values determined by using Color and Color Difference Meter (Yasuda/Japan) Mean values of loss of weight gain were calculated from three samples in each group during the ripening periods.

All instrumental texture analyses of products were performed at room temperature using by Instron (model 1140). The results of panel test were scored 6-point scales (1 = prime to 6 = worst) for the color, taste and texture by 25 trained members according to score sheet.

Each of total bacteria, lactobacilli, staphylococci and streptococci were examined by selective agars such as SI (Merck), MRS (Difco), staphylococcus selective agar (Difco) and KF-strepto agar (Difco) after manufacturing as well as the during ripening periods.

RESULTS AND DISCUSSION

pH values in the each treatment group were decreasing significantly during the ripening periods (14 days) ($P<0.05$). The high values of pH in the final products were presented with the increase of ISP addition. Protein content of ISP used in this study was over 91% with no carbohydrate. The pH measured from the final products was similar to that of salami marketed commercially in Europe, of which mean pH was reported 4.92 by RÖDEL (1975) (Fig. 1). Since the change of pH values caused by the increase of ISP is narrow, the pH of fermented dry sausage with below 5% ISP may not influence to microbial stability.

At the early ripening stage of sausage added with ISP, Aw was 0.964-0.967 but gradually reduced in the final products up to 0.887-0.893 (Fig. 2). As the amount of ISP addition increase, Aw was significantly reduced ($P<0.05$). LEISTNER et al. (1981) reported that 1% NaCl reduced 0.0062 of Aw but 1% ISP reduced 0.0013 of Aw in meat. 2% and 5% ISP are considered as substitutes for about 0.4% and 1% NaCl, respectively. Figure 2 shows that the loss of weight of production during the ripening periods was significantly decreased ($P<0.05$) 1.5, 3.7, 4.6 and 5.6%, respectively, compared with control with increasing the addition of ISP in final products. As shown above, although the loss of weight was decreased, the more ISP is, the lower Aw is in the final products.

Nitrite added to raw materials decreased gradually during the ripening periods, especially rapidly up to 5 days after the production. As addition of ISP was increased, degradation rate of nitrite was low. Control group was 5 ppm at the final products but 2, 3, 4 and 5% were 6, 8, 11 and 15 ppm, respectively.

On the other hand, the 200 ppm nitrate was decreased rapidly at the early stage of fermented dry sausages but increased slightly at the late stage of ripening. As ISP addition was increased, residues of nitrate were higher without statistical significance (Table 1).

Color values in the ripening process of fermented dry sausage were presented in Table 2. The a-value (redness) between control and 5% treatment groups showed much difference ($P<0.05$) but control 10.5 and 5% was 9.8 at the final products. The a-value was decreasing as ISP addition was increased ($P<0.05$) but no significance was between control and 2% treatment groups. The b-value (yellowness) was increased in all groups ($P<0.05$) but 5% showed the highest one. The results from color measurement by color difference meter was in accordance with them from panel test. There was no difference between control and 2% ISP group but differences were revealed, significantly in 3, 4 and 5% ISP groups compared with control ($P<0.05$).

The properties of texture in the ripening process of sausage were shown in Fig. 3. Hardness was increased in that process but the degree was decreased with increase of ISP. Springiness, cohesiveness and chewiness were decreased as ISP was increased with no significance between groups.

From the results of panel test in the final products, significance were approved about texture, taste and color between control and others (3, 4, 5% ISP groups ($P<0.05$) but not between control and 2% group (table 3). It was considered that texture, taste and color of the final products of sausage added with 2% of ISP was similar to those of control group.

In all treatments, 10^7 cells/g of total bacteria counts in the early ripening was rapidly increased up to 10^8 cells/g at 14th day and slightly decreased after 14th day. Each treatment showed no significance on the growth of the total bacteria. *Lactobacillus plantarum* inoculated with 10^7 cells/g was also increased in ripening without any significance between treatments.

The growth curve of total bacteria had similar trend to that of Lactobacilli as shown in table 4. Therefore, most of total bacteria is considered as Lactobacilli. Staphylococci with 10^6 cells/g inoculated as starter culture with Lactobacilli was gradually decreased in ripening with no significance between groups. TERRA et al. (1987) reported that the soy protein did not stimulate the growth of either coliform or *Staphylococcus aureus*.

In ripening, Streptococci slightly was grown up to 10^3 cells/g and was decreased below 10^2 cells/g in the end of ripening.

On the other hand, *Enterobacteriaceae* was $10^2 - 10^3$ cells/g in early ripening but were not detected from the 7th days of ripenin (<10^2 cells/g). It was considered that the growth of *Enterobacteriaceae* was inhibited by low pH and Aw.

CONCLUSIONS

From the results of this study presented above, it is possible to ISP added into the raw meat for production of sausages up to 2% withou any adverse influence on texture, color, taste and microbial growth. It may be suggested that the addition of 2% ISP can be substitute fo approximately 0.4% salt.

On the basis of results from this study, since the loss of weight in the final products was approximately 30%, the substitutive effect of 2% ISP for NaCl would be same as above 0.5% salt in products.

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Table 1. Nitrite and Nitrate reduction in fermented dry sausage during ripening

	Sausage group	Ripening Day 0	2	4	7	14	21
Nitrite	Control	150	40	20	12	7	5
	2%	150	41	21	13	8	6
	3%	150	57	20	13	10	8
	4%	150	50	33	15	11	11
	5%	150	62	34	21	17	15
Nitrate	Control	200	118	115	101	80	75
	2%	200	120	113	104	79	80
	3%	200	120	117	110	83	72
	4%	200	125	120	110	87	74
	5%	200	130	115	111	85	84

Table 2. Hunter color value in fermented dry sausage during ripening

Color Value	Sausage group	Ripening Days 7 day	14 day	21 day
Hunter L (whiteness)	Control	49.30	48.34	44.59[a]
	2%	49.40	48.15	45.10[ab]
	3%	49.20	47.97	45.40[ab]
	4%	50.00	48.15	45.80[ab]
	5%	49.80	48.48	46.20[b]
Hunter a (redness)	Control	9.20	10.10	10.50[a]
	2%	9.00	10.10	10.30[ab]
	3%	8.90	9.80	10.10[ab]
	4%	9.00	9.50	9.90[ab]
	5%	9.10	9.40	9.80[b]
Hunter b (yellowness)	Control	8.65	8.96	9.13[a]
	2%	8.90	9.33	9.65[b]
	3%	9.05	10.10	10.23[c]
	4%	9.30	10.20	10.37[d]
	5%	9.70	10.46	10.65[e]

abcde Means in the same column bearing the superscripts are not significantly different (P<0.05).

Table 3. Sensory panel score of fermented sausage final products

	Treatment Control	2% ISP	3% ISP	4% ISP	5% ISP
Color Score	1.60[a]	1.66[a]	3.00[ab]	3.66[b]	4.06[c]
Taste Score	1.40[a]	1.66[a]	2.73[ab]	3.73[b]	4.20[c]
Texture Score	1.66[a]	1.60[a]	2.93[ab]	3.60[b]	4.20[c]

Mean score based on an 6-point scale (1=prime, 6=workst)

abc Means in the same column bearing the same superscripts are not significantly different (P<0.05).

Table 4. Changes of the growth of microorganism in fermented dry sausage during ripening.

Species	Day	Ripening Days 0	1	2	4	7	14	21
Total bacteria	Control	1.0 x 10^7	1.7 x 10^7	1.7 x 10^7	6.0 x 10^7	1.0 x 10^8	6.2 x 10^8	4.2 x 10^8
	2%	1.2 x 10^7	1.4 x 10^7	2.6 x 10^7	1.0 x 10^8	2.0 x 10^8	4.8 x 10^8	4.1 x 10^8
	3%	2.1 x 10^7	2.2 x 10^7	2.4 x 10^7	1.3 x 10^8	2.0 x 10^8	5.0 x 10^8	5.6 x 10^8
	4%	2.5 x 10^7	2.7 x 10^7	3.2 x 10^7	1.0 x 10^8	2.3 x 10^8	6.6 x 10^8	5.0 x 10^8
	5%	2.7 x 10^7	3.5 x 10^7	3.3 x 10^7	9.1 x 10^7	2.0 x 10^8	6.7 x 10^8	5.7 x 10^8
Lactobacilli	Control	1.0 x 10^7	1.0 x 10^7	2.0 x 10^7	3.0 x 10^7	7.0 x 10^7	5.1 x 10^8	4.5 x 10^8
	2%	1.0 x 10^7	1.2 x 10^7	5.0 x 10^7	1.0 x 10^8	1.2 x 10^8	4.5 x 10^8	4.2 x 10^8
	3%	1.2 x 10^7	1.4 x 10^7	4.5 x 10^7	9.0 x 10^7	1.0 x 10^8	4.5 x 10^8	4.4 x 10^8
	4%	1.6 x 10^7	2.0 x 10^7	5.0 x 10^7	8.0 x 10^7	1.3 x 10^8	5.3 x 10^8	5.3 x 10^8
	5%	2.0 x 10^7	3.5 x 10^7	5.5 x 10^7	9.0 x 10^7	1.3 x 10^8	5.5 x 10^8	5.4 x 10^8
Staphylococci	Control	3.0 x 10^6	3.1 x 10^6	3.0 x 10^6	2.7 x 10^6	2.2 x 10^6	4.0 x 10^6	3.0 x 10^6
	2%	4.0 x 10^6	5.0 x 10^6	4.7 x 10^6	4.1 x 10^6	3.0 x 10^6	3.1 x 10^6	2.2 x 10^6
	3%	4.0 x 10^6	4.8 x 10^6	4.9 x 10^6	4.5 x 10^6	4.0 x 10^6	3.5 x 10^6	3.2 x 10^6
	4%	1.0 x 10^7	1.1 x 10^7	8.0 x 10^6	5.4 x 10^6	5.0 x 10^6	3.6 x 10^6	3.4 x 10^6
	5%	9.0 x 10^6	1.3 x 10^7	8.4 x 10^6	5.4 x 10^6	5.1 x 10^6	4.1 x 10^6	4.0 x 10^6

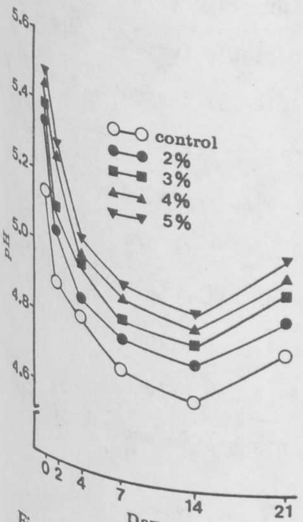

Fig. 1 Changes of pH in fermented dry sausage in ripening.

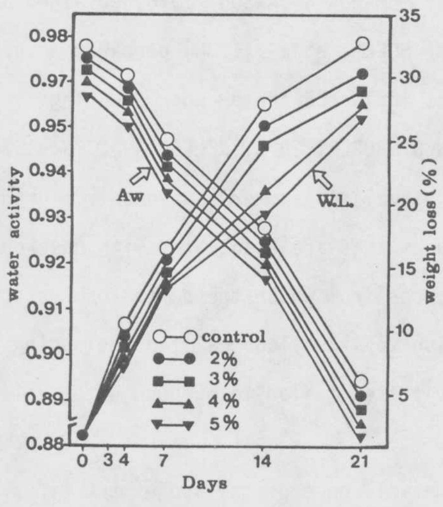

Fig. 2 Changes of Aw and weight loss in fermented dry sausage in ripening.

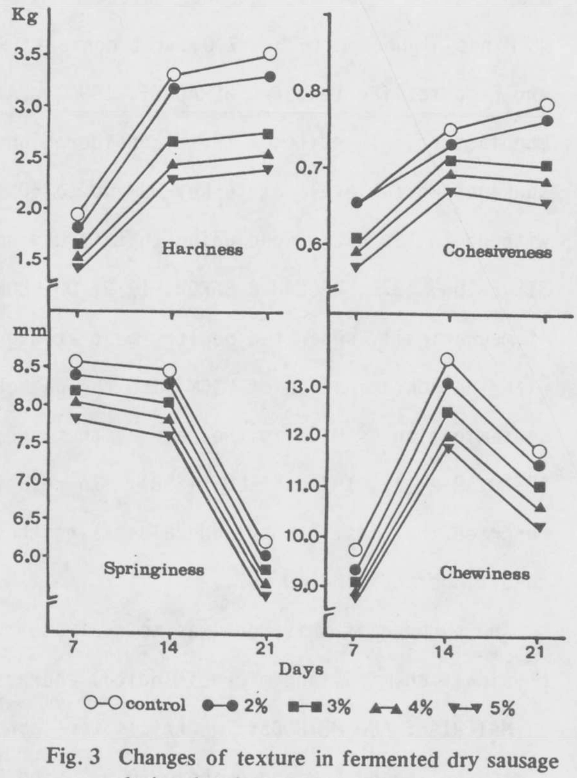

Fig. 3 Changes of texture in fermented dry sausage during ripening.