THE EFFECT OF DIFFERENT NACL LEVELS ON THE *IN VITRO* PROTEIN DIGESTIBILITY OF PORK GEL

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I. INTRODUCTION

Protein digestibility, which is one of the important parameters to evaluate the nutritional quality of dietary proteins, is influenced by functional qualities such as protein solubility and resulting gel-forming capacity [1]. Sodium chloride (NaCl) is ionized into cations and anions in solutions leading to a 'salt in' behavior and increasing the dissolution of salt-soluble myofibrillar proteins (MPs) [2]. The increase in the solubility of MPs enhances the protein gel-forming capacity and thereby, the textural properties. Therefore, the levels of NaCl in meat products can influence not only the sensorial and functional properties but also the nutritional qualities by changing the digestive accessibility of proteases into MPs that mainly participate in gelation. Therefore, this study aimed to investigate the effect of the different NaCl levels (1.0, 1.5, and 2.0%) in pork gel on the *in vitro* protein digestibility.

II. MATERIALS AND METHODS

Meat batter was manufactured with front leg meat (70%), back fat (20%), ice (10%), three levels of NaCl (1.0, 1.5, and 2.0%), sodium pyrophosphate (0.3%), sodium nitrite (0.01%), isolated soy protein powder (1%), and ascorbic acid (0.03%). In the meat batters, protein solubility and the content of actomyosin were monitored. The meat batters were stuffed in stainless cans (5 cm in diameter) and vacuum-packed to heat at 80°C to reach the core temperature of 75°C, followed by cooling at 25°C. The gels were ground after being subjected to *in vitro* digestion. *In vitro* digestion proceeded using the INFOGEST protocol [3] with two compartments of gastric and duodenal phases. Sodium dodecyl sulfate-polyacrylamide gel electrophoresis (SDS-PAGE) and the content of α-amino groups using O-phthaldialdehyde assay were monitored in the digest.

III. RESULTS AND DISCUSSION

Meat batter containing 1.5 and 2.0% NaCl had lower content of actomyosin and higher total protein solubility than the meat batter containing 1.0% NaCl ($P<0.05$, Table 1). Myosin, which is responsible for water binding and gelation, has limited solubility as it is organized in thick filaments. Once the NaCl is added, the Cl- ions bind to the filament to increase the repulsive forces between filaments. Then, the dissolution of thick filaments occurs at the ends of the A-band so that the actomyosin, which is a cross-bridge between myosin and actin, is dissociated by the synergic effects of phosphate and NaCl [2]. Therefore, the NaCl levels of 1.5 and 2.0% seem to increase the actomyosin dissociation so that the amount of myosin and actin participating in the water-binding increases.

There was no significant difference in the α-amino groups among treatments (Figure 1A, $P>0.05$). However, in the SDS-PAGE electrophoretogram (Figure 1B), the pork gel with 2.0% NaCl had a lower intensity of actin and myosin heavy chain bands in both gastric and duodenal digesta. These results indicate that although there is no difference in protein digestibility after duodenal digestion, the protein digestion rate can differ. This phenomenon may have been caused by the gel structure. It has been reported that low levels of salt form a finely-stranded gel with high rigidity while high levels of salt form coarsely aggregated elastic gels [4]. Therefore, a less rigid structure of 2.0% during digestion would have accelerated the dissociation of the gels upon the mechanical agitation during mixing, resulting in the highest pepsinolysis. However, these effects appear to be insignificant when trypsin and chymotrypsin, which extensively cleave proteins in the small intestine, are added.

Table 1. The actomyosin content (mg/g) and total protein solubility (mg/g) of the meat batter prepared with different levels (1.0, 1.5, and 2.0%, w/w) of sodium chloride

Treatment	Actomyosin content (mg/g)	Protein solubility (mg/g)
1.0%	65.48^{A}	103.31^{B}
1.5%	52.53^{B}	114.07^{A}
2.0%	49.52^{B}	115.61^{A}
SEM[1]	2.906	1.230
P-value	0.0084	0.0001

[1]Standard error of the least square mean; $^{A-B}$ Different upper case letters indicate significant differences between means (P<0.05)

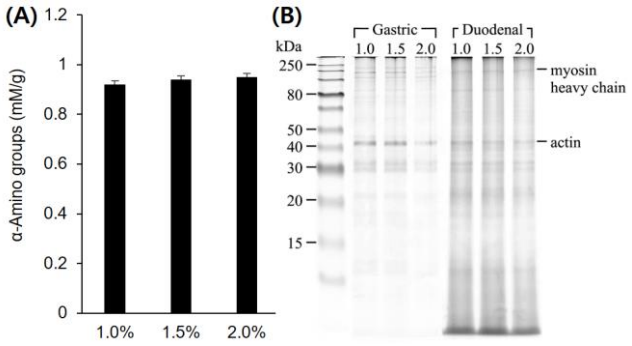

Figure 1. The content of α-amino groups (A, mM/g) and SDS-PAGE electrophoretogram (B) in the digesta of pork gels after *in vitro* gastrointestinal digestion

1.0, pork gel containing 1.0% NaCl; 1.5, pork gel containing 1.5% NaCl; 2.0, pork gel containing 2.0% NaCl.

IV. CONCLUSION

The meat batters prepared with 1.5 and 2.0% of NaCl had lower actomyosin content and higher protein solubility than that prepared with 1.0%. Although there was no significant difference in α-amino group content of the digesta among treatments, the SDS-PAGE electrophoretogram of the digesta showed fainter bands of myosin heavy chain and actin in pork gel containing 2.0% of NaCl than the other two. Therefore, according to the results of this study, NaCl levels in the pork gel can influence the protein solubility of MPs and the rate of protein digestion rather than the protein digestibility itself.

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