MODELLING SOME QUALITY PARAMETERS BY USING RSM OF BEEF GELS WITH DIFFERENT HIGH PRESSURE PROCESSING CONDITIONS AND SALT ADDITIONS

Gamze Okur[1*] Satomi Tsutsuura[1] and Tadayuki Nishiumi[1]

[1]Graduate School of Science and Technology, Niigata University, Japan

*Corresponding author email: gmzeokr@gmail.com

I. INTRODUCTION

Meat is one of the most demanded foods at global scale that considered an important source of high-quality proteins which coupled with its flavour, aroma, and texture profile [1]. High pressure processing in the meat industry is mainly used to increase the shelf-life and to improve the food safety of ready-to-eat meat products as a novel post-packaging non-thermal decontamination technology [2]. Also, the application of high pressure treatment to reduce to salt or phosphate have been studied and reported that improved properties of different kind of meats offers some opportunities in the processing of gel-type meat products [3-6]. Optimising refers to improving the performance of a system, a process or a product in order to obtain the maximum benefit from it [7]. Identifying and fitting from experimental data an appropriate response surface model requires some use of statistical experimental design fundamentals, regression modelling techniques, and optimisation methods. All three of these topics are usually combined into response surface methodology (RSM) [8]. Box and Behnken design, one of the RSM's design, suggested how to select points from the three-level factorial arrangement. This allows the efficient estimation of the first- and second-order coefficients of the mathematical model so mainly for a large number of variables, these designs are more efficient and economical then their corresponding 3^k designs (full three-level factorial designs, k represents factor number) [9]. Considering all these, the objective of this study is investigating simultaneously the effect of the addition different concentration of NaCl and sodium pyrophosphate (SPP), pressure level and temperature on some quality parameters of beef gels using Response Surface Methodology.

II. MATERIALS AND METHODS

In this study, 4 different conditions experimented; high pressure treatment at 100-300 MPa, temperature at 4-36°C, concentration of 0-2% NaCl and 0-0.5% SPP and RSM 4-factor, 3-level, Box-Behnken design with 3 replicates at the centre point used as an experimental design. Minced beef used as sample in this study. Different concentrations of salts were added to the minced beef and then treated with high pressure according to the RSM design plan. After preparing the samples cooking loss, texture profile analyses, protein solubility and SDS-PAGE analyses were performed. The results from these analyses were processed by using RSM design programme and obtained the 3D graphs.

III. RESULTS AND DISCUSSION

NaCl and SPP had a negative linear effect on cooking loss (Figure 1). NaCl and high pressure also, had significant quadratic effect on cooking loss. Temperature had no significant effect on cooking loss and besides, there was no significant interaction between factors. For the hardness, high pressure had a significant effect and caused a maximum point around 200 MPa moreover SPP had a significant positive linear effect (Figure 1). High pressure and NaCl had significant interaction on hardness also, temperature and high pressure had significant quadratic effect. Temperature and high pressure had a significant negative linear effect on elasticity while high pressure, NaCl and SPP had significant quadratic effect. In addition, there was no significant interaction between factors for elasticity results. Only temperature had a significant positive linear effect and quadratic effect on cohesiveness although there was no significant interaction between factors. All of the factors had a significant effect on protein solubility and there was a maximum point around 20°C, 200 MPa (Figure 1). NaCl and SPP had a negative linear effect on protein solubility whereas high pressure had a significant quadratic effect. There was no significant interaction between factors for protein solubility. SDS-PAGE results were corresponded with protein solubility results. Band density of actin was darker around 200 MPa and 20°C. Band density of most proteins increased with both salt addition.

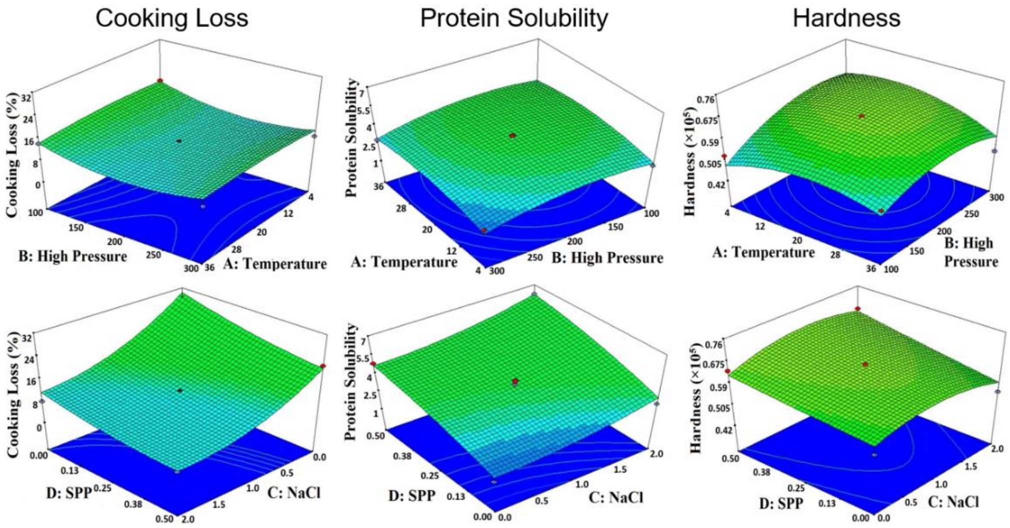

Figure 1. Response surface of cooking loss, protein solubility and hardness results.

IV. CONCLUSION

Summarising the above results, it is recommended that 150-200 MPa, 1-1.5% NaCl, 0.25-0.5% SPP, 20-28°C are the optimum conditions for the beef gels with different high pressure processing conditions and salt additions. However, it is important to compare these results with analyses such as sensory analysis, for more reliable evaluation.

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