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Effect of Frequency Intensity on the Ohmic Thawing Process in Frozen Gelatin Matrix

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Abstract

This study was designed to investigate effects of AC frequency on the thawing process, using laboratory scale ohmic thawing system. The ohmic thawing property of 30% gelatin matrix was examined by using low frequency alternating current (20 Hz-110 Hz, sine wave). When the voltage was fixed to 50V, thawing time was negligible influenced as the frequency decreased. Total thawing time of the gelatin matrix decreased sharply at the frequency of 50 Hz. The current flow was first observed during the thawing process in the temperature ranges of - 5 ℃~ - 3 ℃.

Introduction

Ohmic heating occurs when an electric current passes through food, resulting in a temperature rise in the product due to the conversion of the electric energy into heat(Joule effect). In comparison with microwave heating, ohmic heating is more efficient because all of the energy enters the food as heat and ohmic heating has no limitation of penetration depth. This method can also be used in thawing frozen foods by placing them between two electrodes and applying an alternating current. Using ohmic thawing method, frozen foodstuffs can be thawed rapidly in the temperature range 3 to 3 ℃(Ohtsuki, 1991,1993). Yun, Lee, and Park(1998) also used ohmic heating to thaw meat block. They showed that ohmic thawing using 60-120V at 60 Hz-60 kHz frequencies resulted in less drip loss and higher water binding capacity for meat blocks. It was found that frequency changes did not significantly affect thawing time. Recently, Kim, Park and Min(2004) presented the higher gelatin concentration, the faster increment of PTT(phase transition time, ice

to water) and high ohmic intensity causes short PTT. In this study, the 30% gelatin matrix was used to show the amount of current on frequency changes during ohmic thawing at 50V and also to show the trend of thawing time.

Materials and Methods

Sample preparation

Gelatin(Shinyo Pure Chemicals Co., LTD Osaka, Japan) was mixed with distilled water and heated at 80 ℃. The 30% gelatin solution was put in a rectangle unit and frozen at - 40℃. The 30% gelatin matrix was only used to ensure the proper low-frequency from 20 Hz to 110 Hz at constant voltage condition for the ohmic thawing process.

Experimental setup

The frozen gelatin matrix was powered by low-frequency(AC Power Korea Co., LTD Gyeonggi-Do, Korea) in a refrigerator. A rectangle ohmic thawing unit which was made of acrylic(120 x 56 x 60mm) has two cupper electrodes and three type K thermocouples.

Thawing curves and the current flow by ohmic thawing frequency

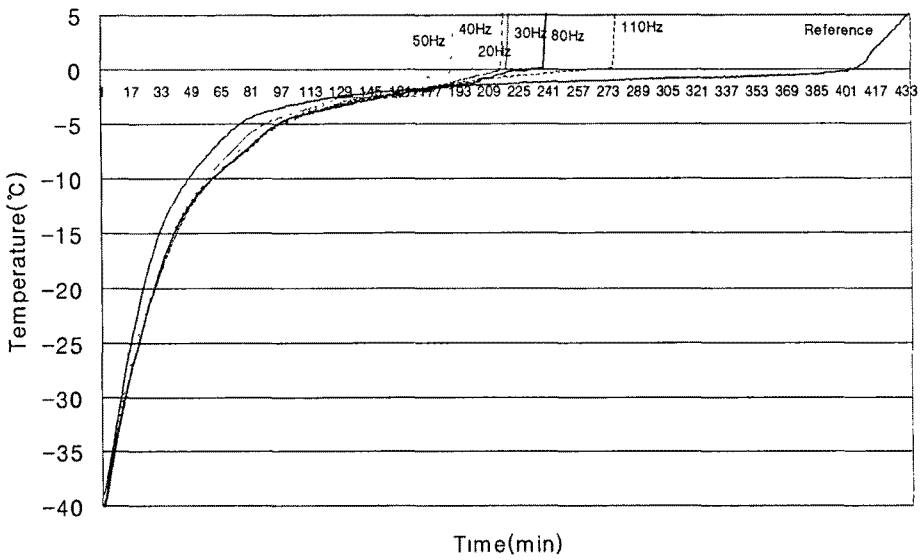

Fig. 1 : Thawing curves of gelatin matrix(30%) by ohmic thawing frequency at 50V.

From the thawing curves of 30% gelatin matrix, the shortest thawing time was obtained at 50 Hz AC current(Fig. 1). Thawing curves in the temperature ranges of - 40℃~ - 3℃ were almost all the same thawing curves at any frequency. Fig. 2 shows that the initial point of current flow is the time when frozen gelatin matrix starts to thaw. It was observed that throwing current between two electrodes might be able to go through the frozen gelatin matrix when the ice changes to the water in the gelatin matrix. Current flow is not affected by low frequency alternating current. Experiments showed that both 80 Hz and 110 Hz required longer total thawing time due to lower current flow.

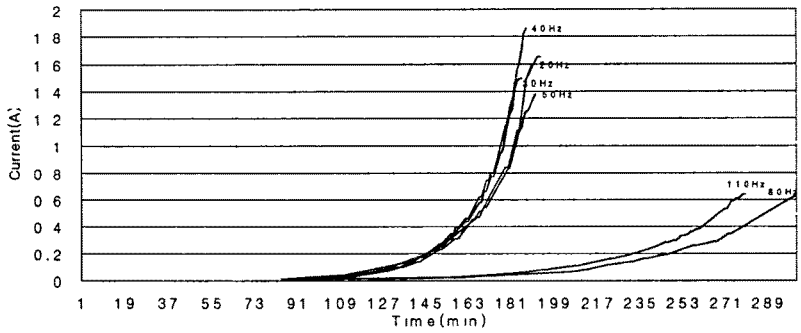

Fig. 2 : The initial point of current flow with different frequency.

Total thawing time with different frequency

Fig. 3 shows that frequency changes gave no significant effect on thawing time. Thawing of 30% gelatin matrix, which has relatively ordered network structure, was not influenced much with the changing frequency. Generally speaking, thawing at constant voltage condition is closely related to the structure of frozen samples(Sung-Jin Choi et al.,1997). Therefore, studies on fundamental data influencing ohmic thawing process and its optimization frequency is important to each frozen samples. Further work is in progress.

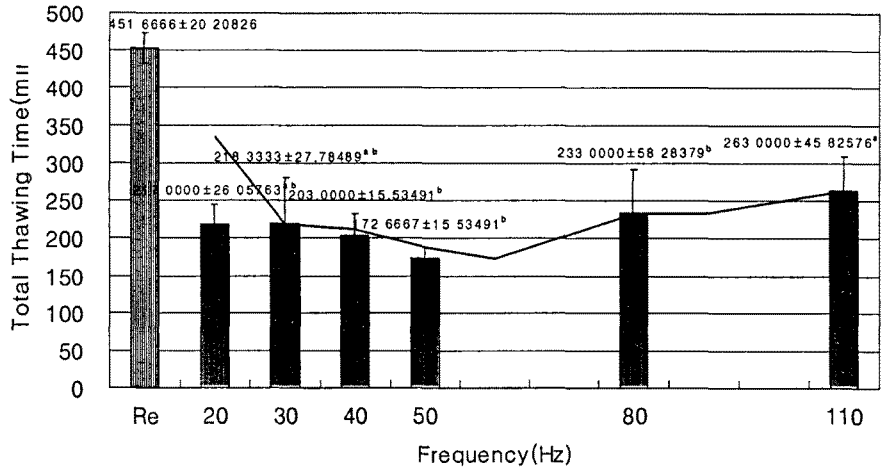

Fig. 3 : Changes in ohmic thawing time with different frequency at 50V. (RE = reference in air blast thawing at 5 ℃).

References

Choi, S. J., Yoon, S. W., Lee, C. H. (1997) Ohmic heating characteristics of foods having different chemical composition and microstructure. *Food Engineering Process* Vol. 1, No 1, pp 5-10.

Kim, J. Y., Park, S. H., Min, S. G., (2004) A numerical modeling for the prediction of phase transition time(ice-water) in frozen gelatin matrix by ohmic thawing process. *34th International Symposium of Korean Society for Food Science of Animal Sources*, 407-411.

Ohtsuki, T. (1991) Process for thawing foodstuffs. US Patent 5,034, 236.

Ohtsuku, T. (1993) Process for thawing foodstuffs. European Patent 0409430.

Yun, C. G.., Lee, D. H., & Park, J. Y. (1998) Ohmic thawing of a frozen meat chunk. *Journal of Food Science and Technology(Korean)*, 30(4), 842-847.