

Optimization of Radio Frequency Thawing Process Parameters in Frozen Bulk Chicken Thigh Meat

ALTIN O. (1), KONG F. (2), MARRA F. (3), DEMİROK SONCU E. (1), COSKUN E. (1), HUSEYNLI H. (1), ERDOGDU F. (1),
FARMANFARMAEE A. (2)

1 Ankara University, Ankara, Turkey
2 University of Georgia, Athens, United States
3 University of Salerno, Salerno, Italy

Recent studies demonstrated that radio frequency (RF) processing might be effectively used for thawing by decreasing process time, saving energy and minimizing the quality changes. In this study, experimental optimization of RF thawing of frozen chicken thighs, in retail package and commercial sizes, was carried out in industrial scale conditions.

Thawing experiments were carried out in a free oscillating pilot scale RF system (10 kW, 27.12 MHz), and frozen samples (retail package ~1 kg and commercial bulk size ~9 kg in a 60x40x10 cm box) was processed in five different electrode gaps (8, 10, 11.5, 12, 17.5 cm) and two power levels (2000 and 3500 V) to determine the optimum process condition. Time dependent temperature changes within the samples were measured with fiber optic sensors during the thawing process. The target temperature was average -1 °C along the cold region. Following the experiments, mathematical modeling studies were also carried out, using COMSOL Multiphysics v5.6 (Comsol AB, Stockholm, Sweden) using the enthalpy method to better predict the phase change. Experimental results were used for model validation, and the validated model was further applied for various industrial scale process cases to improve the process efficiency.

The experimental results indicated that the optimum condition was 8 cm electrode gap at 3500 V potential and 17.5 cm electrode gap at 2000 V for retail and commercial sizes, respectively. These setting were also confirmed with the developed model for temperature uniformity. Various geometrical orientations were also demonstrated for process efficiency where higher loads were thawed with the similar potential appliances.

In conclusion, RF processing was suggested as a promising technique for efficient thawing of frozen chicken thigh meat bulks with an improved temperature uniformity and efficiency as a sustainable process.

Acknowledgement

The authors acknowledge the support of TUBITAK (Project No: 120R075).