Development and implementation of an innovative food freezing under microwave radiation process

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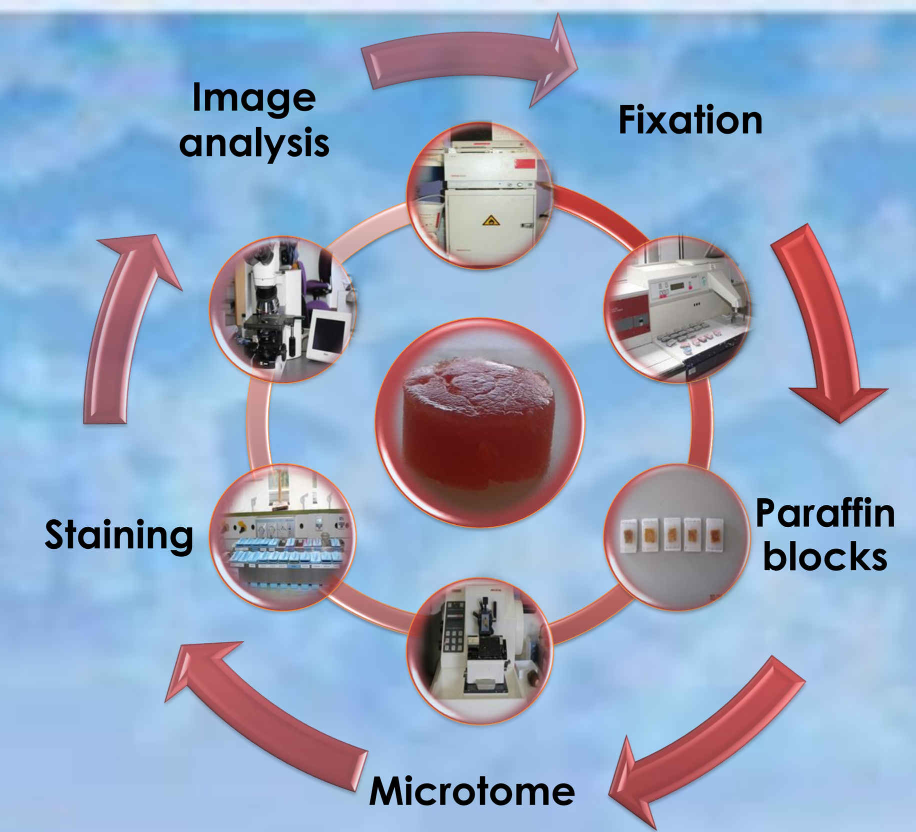
Introduction:

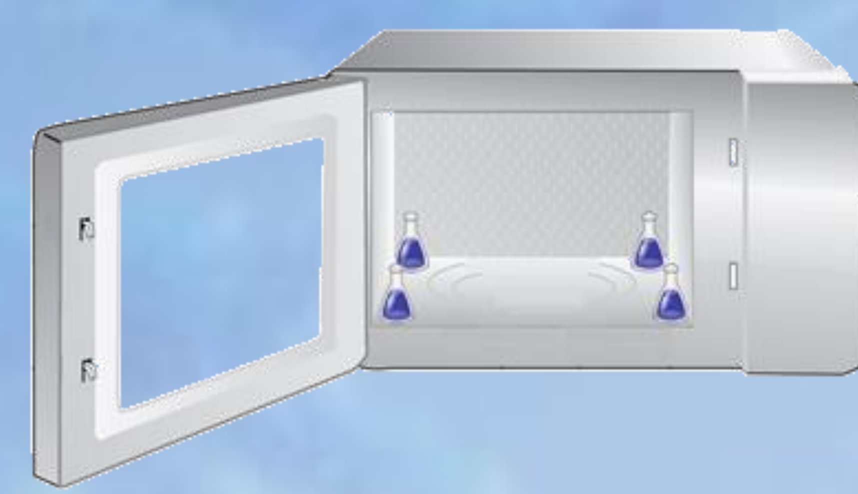
The freezing process of food matrices is affected by their dominant constituent which is water. The final quality of the frozen product depends on the phase transition or the crystallization process of changing water into ice (Xanthakis et al., 2013). The size of the ice crystals is critical for the final quality of the frozen food as it can cause irreversible damage to the cellular structure which in turn degrades the texture and colour of the product.

In the present study a novel experimental setup was designed and developed for the application of microwave radiation during freezing. The influence of microwave assisted freezing on a food system has been considered (Xanthakis et al., 2014).

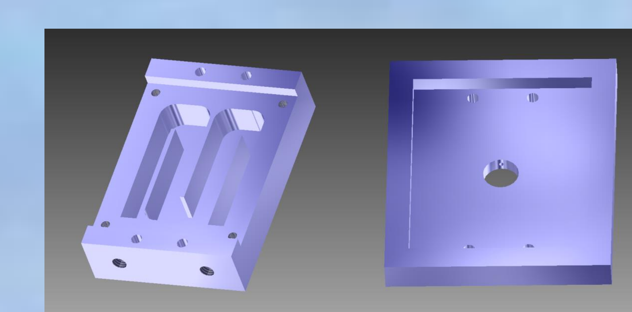
Materials & Methods :

Pork tenderloin was considered for microwave assisted freezing on microstructure (size of ice crystals) analysis.



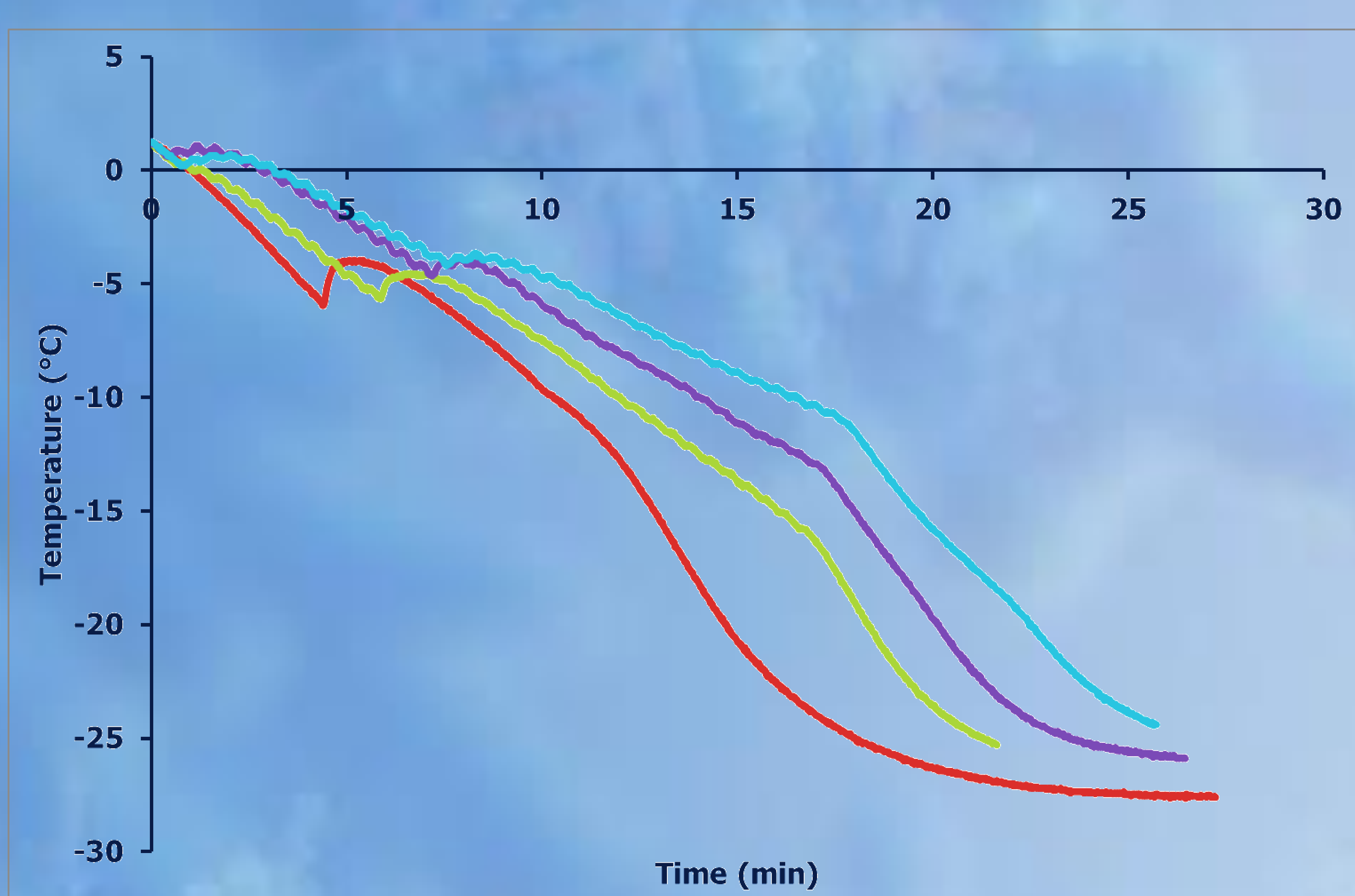


4 glass flasks filled with 250 mL distilled water each were placed at the four corners of the cavity of a domestic MW oven.

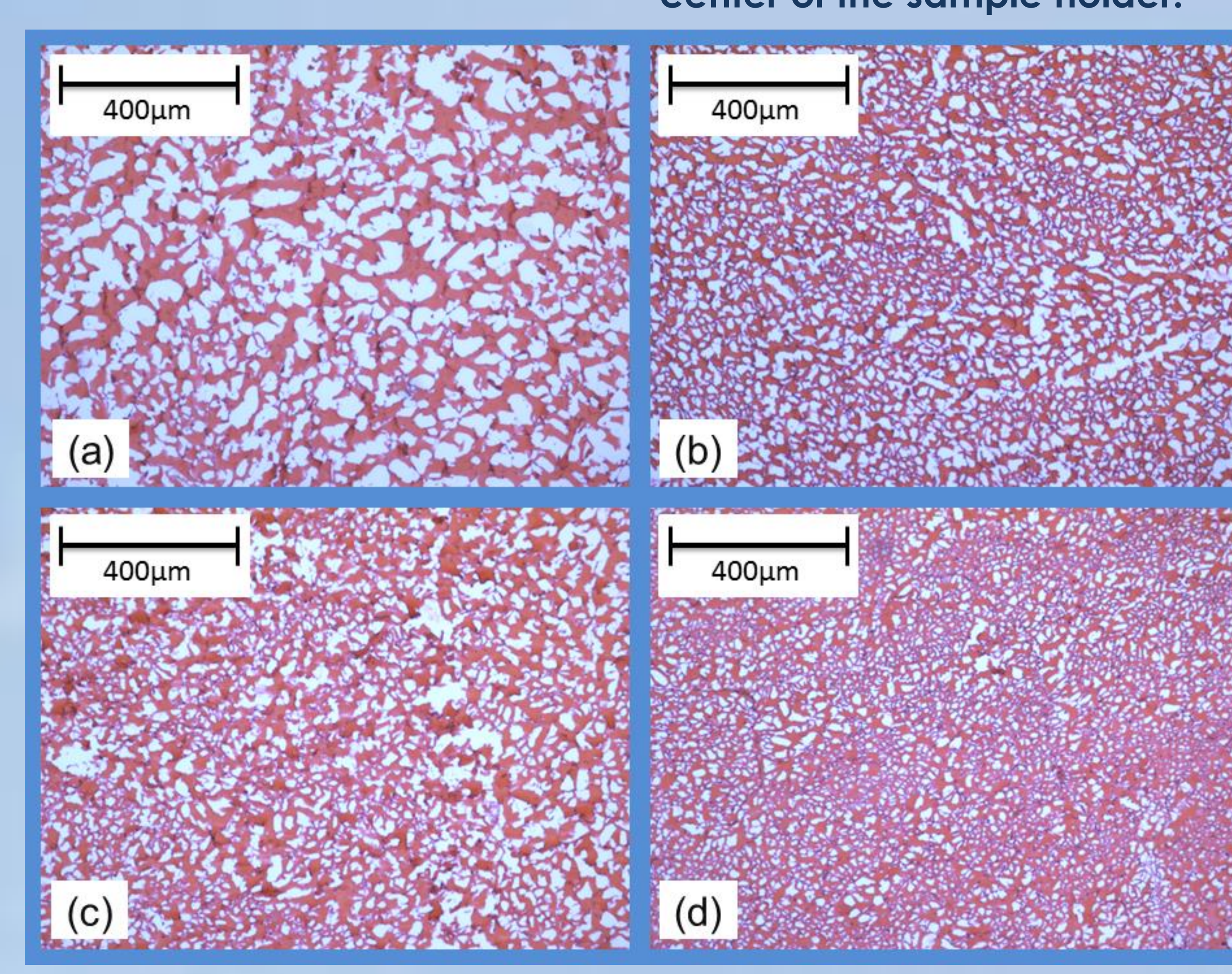


The heat exchanger and the sample holder where pork tenderloin was frozen were placed at the centre of the MW cavity. The sample was located at the empty cavity at the center of the sample holder.

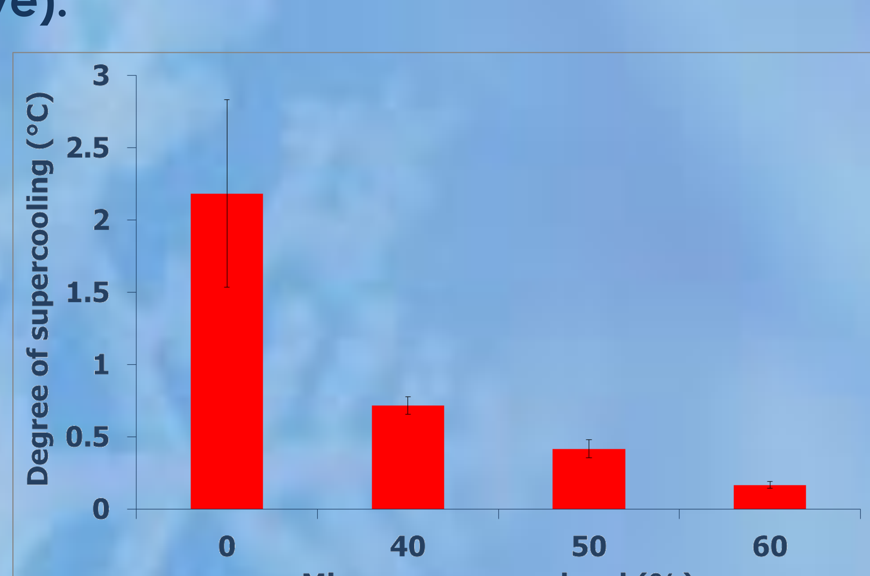
Results:



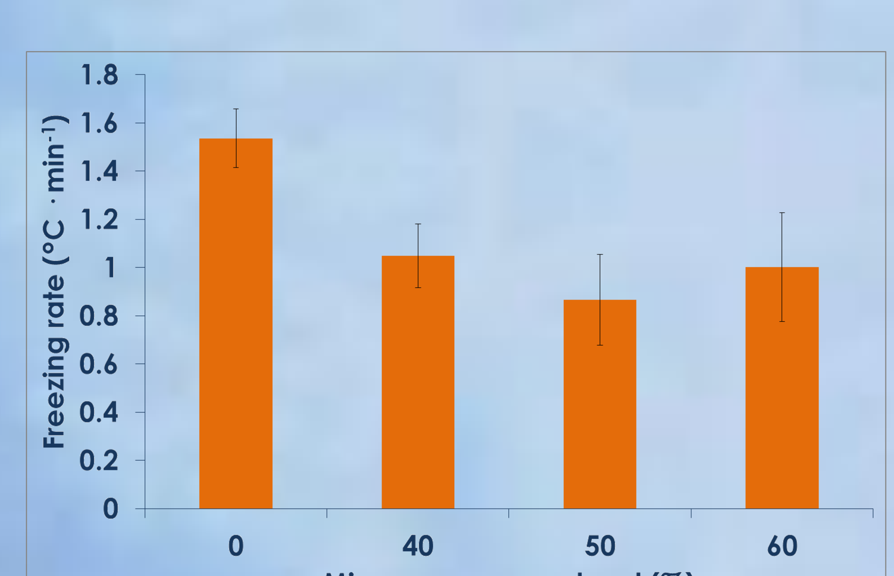
Real time – temperature plots obtained during conventional freezing (red curve) and under different power levels of microwave radiation of pork tenderloin samples (40% - green curve, 50% - purple curve, 60% - blue curve).



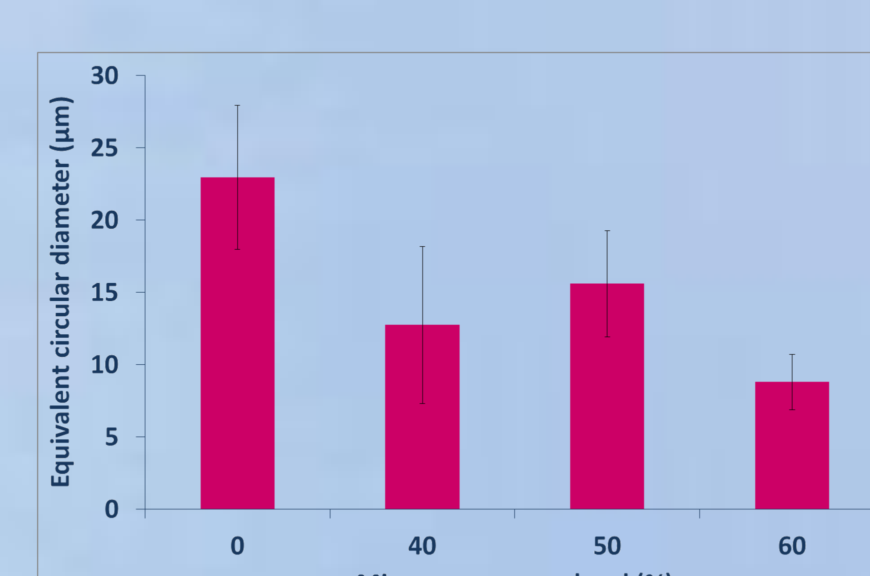
Micrograph images of frozen pork tenderloin transversal cuts under different levels of microwave power radiation. (a) 0 % (conventional freezing), (b) 40%, (c) 50% and (d) 60%.



Average values of the degrees of supercooling with their corresponding standard deviations of pork tenderloin samples during freezing.



Average values of the freezing rates with their corresponding standard deviations of pork tenderloin samples during freezing (at the temperature range from -5° C to -10 °C).



Averages of equivalent circular diameter (EqD) and their corresponding standard deviations of ice crystal voids.

Conclusions:

The application of microwaves during cooling the samples caused:

- ✓ oscillated decrease of temperature
- ✓ had a significant impact on the crystallization process as the degree of supercooling was decreased circa 92%.
- ✓ 62% decrease in the average ice crystal size when samples were frozen under a microwave field as compared to the conventional freezing process.

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References:

Xanthakis, E., Havet, M., Chevallier, S., Abadie, J. & Le-Bail, A., (2013). Effect of static electric field on ice crystal size reduction during freezing of pork meat. *Innovative Food Science & Emerging Technologies* 20: 115–120.

Xanthakis, E., Le-Bail, A., & Ramaswamy, H. (2014). Development of an innovative microwave assisted food freezing process. *Innovative Food Science & Emerging Technologies*.