UNIVERSITI TEKNOLOGI MARA

TECHNICAL REPORT

HEAT TRANSFER BETWEEN HEATING MEDIUM AND FOOD PACKAGING USING NEWTON'S LAW OF COOLING

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ABSTRACT

In food processing, thermal processes exist where it is a process of reducing or destroying microbial activity. During thermal process, food is heated until it reaches a specific temperature for predetermined time and then cooled (Augusto & Cristianini, 2011). From the process, safety and stable food products will be obtained. In food processing operations such as food packaging, thermal processing is the safest method as there is no contact between the processed food and its surroundings. Newton's Law of Cooling is one of the model used in food processing. Newton's Law of Cooling states that the rate of cooled object is proportional to the difference in temperature between the object and its surroundings. In food processing, Newton's Law of Cooling is used to determine the convection of heat transfer between heating medium and package surface.

In this study, we are going to compare the quantity of heat flow in convective heat transfer between heating medium and package surface, and to determine the difference between the rate of temperature over time and the Laplacian of temperature. From the results we obtained for Phase 1, we observe that the quantity of heat transfer from heating medium to package surface is determined by the difference between temperature of heating medium and package surface. Huge difference in both temperatures will increase the heat flow quantity from heating medium to package surface. For Phase 2, we also observe that the Laplacian of the temperature through the package decrease as the longer the time taken for the heat to transfer through the package. In this process also, we manage to prove that this study indicates indirect system methods of thermal processing as the value of heating rate resulted between 0.01 to $10Ks^{-1}$ (de Jong, 2008).

Thermal processing has been one of the safest method used for food production. Since thermal processing involve a low intensity heat treatment of milk (Pratap-Singh & Mandal, 2019), thermal processing can be resulted to unintended consequences such as nutritional losses, the formation of toxic and hazardous substances (acrylamide, furan or acrolein) or having detrimental effects impacts on flavor perception, texture or color (van Boekel et al., 2010). Different types of packaging and liquid will be resulting different quantity of heat flow and Laplacian of temperature. Therefore, extreme care during the process is needed to ensure that none of the unintended consequences happen.