

Comparison Study between FEM Simulation and Experimental of Heat and Mass Transfer in Kek Lapis Sarawak Baking

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Abstract: Kek Lapis Sarawak is specialty dish from Sarawak. Kek Lapis Sarawak industry contributes a lot to the state's economy. In cake industry, the use of oven in the baking process contributes to high energy consumption. Nowadays, energy has become an operational issue and there is a need to minimize energy consumption to reduce production cost. This research aims to optimize the baking process for an efficient energy consumption. Therefore, it is important to investigate the relationship between baking temperature, time and cake quality. Accurate temperature and time will define an efficient baking process. Kek Lapis Sarawak baking process has been modelled and simulated using finite element method (FEM). Results from the model was validated with an experiment. There is specific oven temperature needed to enable perfect gelatinization and coagulation to happen which is 190 °C. While baking time are varied by layers. The baking time is reducing as more layers added. The finding shows interdependent relationship between porosity, thermal conductivity and moisture content where higher porosity can lead to poor thermal conductivity.

Keywords: Kek Lapis Sarawak, FEM simulation, baking process, thermal conductivity.

1. Introduction

Kek Lapis Sarawak is a special cake from Sarawak with unique texture and flavor that capture the tourists' attention [1]. Conventional process of making Kek Lapis Sarawak is very tedious and repetitive. Basically, the process consists of five main sequential methods namely depositing, baking, cooling and pressing [1-2]. Fig. 1 shows process flow of making Kek Lapis Sarawak. Most of the conventional baking process used liquified petroleum gas (LPG) oven. As the industry started to move towards automation there is a need to replace the conventional oven with electrical oven for more accurate control of the process.

Energy cost is quite substantial and there is a demand to minimize energy consumption. In the cake industry, the use of oven for baking process contributes to the biggest energy consumption. The effectiveness of oven operation relies on oven design and the baking process itself [3]. Optimization of the oven operating condition enable significant reduction in energy consumption that consequently reduce the production cost.

Hamsawi et al. (2017) summarized number of related patents for the baking process. Convection oven and bi-directional heating cooker are potentially able to improve the baking process due to controllable heat transfer [4-9]. On