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MATHEMATICAL MODELLING AND SIMULATION OF THE TEMPERATURE OF SESAME OIL EXTRACTED IN SEKKU - A TRADITIONAL OIL EXTRACTION TECHNOLOGY

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In sekku technology, 15 to 20 kg batch of sesame seeds are crushed to extract oil in the scooped circular pit of the stationary wooden mortar using a wooden pestle, which is revolved on its own axis while rotated about the vertical axis of the wooden mortar at 1 to 4 revolutions per min (rpm) by a complex mechanism powered by animal or hand tractors. Extracted sesame oil is subjected to gravity settling to separate the clear golden coloured sesame oil from the sediments. Sesame oil produced using sekku technology therefore has the potential to qualify as a candidate for attaining the cold-pressed or virgin-oil status. To attain cold-pressed oil standards, oil should be extracted at temperatures below 50oC. Field measurements showed that sekku extracted sesame oils reached temperatures well above 50oC. In this study, we mathematically model the temperature profile of sesame oil extracted in a sekku with the objective of understanding the governing mechanisms and thereby to explore viable means to control the temperature. Frictional heat generated at the sliding contact between the mortar and the pestle and viscous heat generated by the swirling flow of sesame slurry were found to be dominant energy input mechanisms in sekku, and were modeled using fundamental equations and property models. During processing, sesame seed gradually turns to a slurry of oil and cake, and the material properties of this paste are not known for certain. The said uncertainty was dealt with Monte Carlo simulation methodology. Simulation of the said model with data obtained from a real-life sekku resulted in an oil temperature band of 52-65oC. The said model could be used for optimizing system parameters to gain desired oil temperature and hence to improve or control the oil quality towards cold-pressed oil status.

Keywords: *Modelling, Sekku, Sesame oil, Monte Carlo Simulation, Temperature*