Machine Learning Model for Quality Parameters Prediction and Control System Design in the Kecombrang Flower (*Etlingera elatior*) Extraction Process

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Abstract	Kecombrang flowers have bioactive components that can be used as food additives. The development of the kecombrang functional food industry for the production of food additives requires information on production parameters. The extraction process for kecombrang to obtain bioactive components, especially phenols and flavonoids, requires maximum temperature treatment and extraction time. This study aims to determine the standard for the kecombrang flower extraction process, create a machine learning model to estimate the quality parameters of the extraction results (phenol, flavonoid, pH, color, and viscosity), and design a strategy for controlling the extraction machine work to maintain the quality of the extraction, especially of phenols and flavonoids. This research was conducted at extraction temperatures of 60 degrees C, 65 degrees C, 70 degrees C, and 75 degrees C. During the extraction process, the quality of the material was checked by measuring phenol and flavonoid contents, as well as color, pH, and viscosity. Sampling was carried out at 5 min intervals. The data on the quality parameters during the extraction process were analyzed for trends. A machine learning model, which is an artificial neural network, was developed using a 2-6-1 architecture for each quality parameter. The two inputs of ANN were temperature of extraction and extraction time (duration). The output was the quality parameters of the products (phenols, flavonoids, pH, viscosity, and color), which were evaluated separately. The results show a good correlation between the model and the experimental data, with both the training dataset and the testing dataset. These results were then used to formulate a strategy for controlling the extraction process. A neuro-control system was used as a strategy. This control system was adaptive to changes that occurred during the extraction process so that phenols and flavonoids could be maintained.
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