UNIVERSITI TEKNOLOGI MARA

OPTIMISATION OF PROCESSING METHODS FOR ROASTING COFFEE BEANS AND CLASSIFICATION OF ROASTED COFFEE BEANS USING MULTIVARIATE ANALYSIS

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of the requirements for the degree of
Doctor of Philosophy

Faculty of Applied Science

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AUTHOR'S DECLARATION

I hereby declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and my own work except for quotations and summaries which have been duly acknowledged. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

I, hereby, acknowledged that I have been supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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ABSTRACT

The aroma and flavour of coffee are developed in the roasting process. Major volatile flavour compounds identified in roasted coffee beans are pyrazines. Since the roasting process significantly affects these volatile compounds, the roasting conditions need to be optimised in ensuring the quality of roasted coffee beans. In this study, the roasting temperature and roasting time for Indonesian Arabica and Robusta coffee beans were optimised based on the concentration of selected pyrazines (2-methylpyrazine, 2,3-dimethylpyrazine, 2,5-dimethylpyrazine, 2,3,5-trimethylpyrazine and 2,3,5,6-tetramethylpyrazine) using response surface methodology (RSM), supported by overall sensory evaluation by an expert panelist and trained panelists. Since undesirable acrylamide is known to be produced during roasting process, minimising the amount of acrylamide was also considered in the optimisation of roasting process. Pyrazines were extracted using solid phase microextraction (SPME) and gas chromatgraphy with flame ionisation detector (GC-FID) while acrylamide was analysed using solid-phase extraction (SPE) and GC-FID. Optimised conditions for roasting coffee beans were obtained at roasting temperature of 167°C for 22 minutes for Arabica coffee beans and roasting temperature of 167°C for 27 minutes for Robusta coffee beans. The optimised conditions were applied in roasting coffee beans samples from different varieties (Arabica and Robusta) and origins (Asia, Africa and America) and the dataset on the amount of pyrazines was subjected to multivariate analysis. Principal component analysis (PCA) was able to discriminate between Arabica and Robusta coffee beans with total variance of 91.94%, supported by hierarchical cluster analysis (HCA) showing two distinct clusters and discriminant analysis (DA) with 100% correct classification. PCA revealed two groups whereby coffee beans from Asia were distinctly separated from those of America and Africa with total variance of 92.74%. In accordance, HCA showed 2 clusters, cluster 1 for Asia and cluster 2 for America and Africa. The analysis of pyrazines was applied to commercial coffee samples. Application of PCA and HCA resulted in 5 groups; 2 groups consisting of pure coffee samples and three groups of instant coffee samples. A method to reduce the amount of acrylamide produced during roasting without affecting the amount of pyrazines was studied by the addition of asparaginase. Reduction of acrylamide up to 96.53% was obtained by soaking the coffee beans with 3000U/g of prior incubating at 50°C for 30 min. This study highlighted the significant contribution of pyrazines in the production of quality coffee beans and can be a promising parameter in classifying the types and origins of coffee beans.

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