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We hereby declare that we have checked this thesis and in our opinion, this thesis is adequate in terms of scope and quality for the award of the degree of Master of Science.

____
(Supervisor's Signature)

Full Name : DR NASRATUN BINTI MASNGUT
Position : SENIOR LECTURER
Date : 28 OCTOBER 2021

____
(Co-supervisor's Signature)

Full Name : DR SHALYDA BINTI MD SHAARANI@MD NAWI
Position : SENIOR LECTURER
Date : 28 OCTOBER 2021

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I hereby declare that the work in this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Malaysia Pahang or any other institutions.

(Student's Signature)

Full Name : YASHINI A/P K.SELVANATHAN

ID Number : MKC19005

Date : 28 OCTOBER 2021

MICROBIAL ACID PRODUCTION BY INDIGENOUS MICROORGANISM FROM *Ananas comosus*

YASHINI A/P K.SELVANATHAN

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Yashini Selvanathan
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ABSTRAK

Akibat kekurangan sumber tenaga fosil, penghasilan asid mikrob daripada biojisim bagi menggantikan proses petrokimia semakin mendapat perhatian. Penggunaan sisa buangan dari industri buah, termasuklah industri nanas, boleh dilihat sebagai salah satu pendekatan yang boleh dilaksanakan. Kulit, isi, batang, dan daun dari tanaman nanas adalah biojisim bukan sumber makanan yang kompetitif, banyak dan murah yang boleh digunakan untuk penghasilan asid mikrob. Penghasilan asid mikrob pada masa kini menggunakan mikroorganisma tertentu, yang memerlukan keadaan spesifik untuk hidup. Kepelbagaian asid yang dihasilkan adalah terhad kepada metabolisma mikroorganisma tersebut. Sehingga kini, tidak ada kajian yang dilaporkan mengenai penggunaan mikroorganisma asli dari sisa nanas dan penggunaan sisa nanas tersebut sebagai sumber karbon untuk penghasilan asid mikrob. Kajian ini mengetengahkan pengoptimuman secara statistik untuk penghasilan asid mikrob dari mikroorganisma asli dalam kulit nanas. Ini turut merangkumi beberapa kajian mengenai fizikokimia, kualiti dan fungsi asid mikrob yang dihasilkan. Kajian ini melibatkan proses penyaringan faktor menggunakan reka bentuk faktorial (FFD) untuk menentukan faktor yang signifikan, diikuti dengan proses pengoptimuman statistik menggunakan reka bentuk komposit berpusat (CCD) daripada kaedah gerak balas permukaan (RSM). Prestasi proses penapaian dinilai berdasarkan keasidan (%). Keadaan optimum untuk fermentasi asid mikrob menggunakan mikroorganisma asli dicapai pada suhu 27 °C, dengan penambahan glukosa 7 % di dalam jus kulit nanas. Penapaian dilakukan selama lima hari secara aerobik tanpa menambahkan ragi. Keadaan fermentasi seperti penambahan glukosa dan mod penapaian sangat mempengaruhi pengeluaran asid yang mana ianya berkaitan dengan kesan *Crabtree*. Asid mikrob yang dihasilkan dicirikan berdasarkan fizikokimia, kualiti dan fungsi. Asid mikrob mengandungi 3.18 % gula pengurangan, 4.0 % sukrosa, 1.03 % etanol, dan 3.03 % asid, terutamanya asid asetik, malik dan sitrik dengan pH 3.16 dan 8.0 °Brix jumlah pepejal larut. Sementara itu, untuk kualiti dan kefungsian, asid mikrob yang dihasilkan mengandungi 1.43 mg equi. AA/100mL asid askorbik dan 82.06 % aktiviti radikal bebas antioksidan. Kesimpulannya, pengeluaran asid mikrob oleh mikroorganisma asli dari kulit nanas berjaya dioptimumkan menggunakan RSM. Walaupun dengan kandungan asid yang lebih rendah daripada asid mikrob komersial, kualitinya asid yang dihasilkan adalah setara.

ABSTRACT

Threatened with the gradual and inescapable exhaustion of the earth's fossil energy resources, fermentative acid production from renewable biomass to replace the conventional petrochemical process is receiving an increasing amount of attention. Microbial acids production from fruit waste to compensate for the wastage from fruit industries, including pineapple fruit, can be seen as one of the feasible approach. Peel, core, stem, and leaves from the pineapple plant are attractive, abundant, cheap, and non-food competitive biomass feedstock for microbial acid production. Current microbial acid production uses specific strains which require particular condition to grow. The diversity of the produced acid was limited to the strain metabolism. To date, there is no study reported on using indigenous microorganisms from the pineapple waste and using such waste as the carbon source for microbial acid fermentation. This study had work on a statistical optimisation for microbial acid production from indigenous microorganisms in the pineapple peel. The works involved were factors screening using Full Factorial Design (FFD) to determine the significant one, followed by a statistical optimisation process using Central Composite Design (CCD) of Response Surface Methodology (RSM). Study on the physicochemical, quality, and functionality of the produced microbial acid were also carried out. The performance of the fermentation process was evaluated based on the percentage of acidity (%). The optimised condition for the fermentation of pineapple peel using indigenous microorganisms was achieved at 27 °C, with 7 % glucose addition to the pineapple peel juice. The fermentation was carried out aerobically for five days without adding yeast. The condition of fermentation, such as sugar and mode of fermentation, was identified to affect the acid production in which showing the Crabtree effect. The produced microbial acid was characterised based on its physicochemical, quality, and functionality. The microbial acid contained 3.18 % reducing sugar, 4.0 % sucrose, 1.03 % ethanol, and 3.03 % acids, mainly acetic, malic, and citric acid with pH of 3.16 and 8.0 °Brix total soluble solid. Meanwhile, for the quality and functionality, the microbial acid produced contained 1.43 mg equi. AA/100mL ascorbic acid and 82.06 % free-radical scavenging activity of antioxidant. In conclusion, microbial acid production by indigenous microorganisms from pineapple peel was successfully optimised using RSM. Although with lower acid content than the commercial microbial acids, its quality was at par.

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