UNIVERSITI PUTRA MALAYSIA

USE OF BACTERIAL CELLULOSE PRODUCED BY *Acetobacter xylinum* AS BINDING AGENT IN FACIAL SCRUB FORMULATION

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By

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Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Master of Science

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Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Master of Science

USE OF BACTERIAL CELLULOSE PRODUCED BY *Acetobacter xylinum* AS BINDING AGENT IN FACIAL SCRUB FORMULATION

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July 2013

Chair: Dayang Radiah Binti Awang Biak, PhD

Faculty: Engineering

This study focuses on the production of bacterial cellulose (BC) and methylcellulose (MC) from *Acetobacter xylinum* and their applications as binding agent in facial scrubs formulation. The BC was prepared from the fermentation process using *A. xylinum*. MC was produced by chemically modified the BC. The facial scrubs formulation is consisted of BC or MC powder, glutinous rice powder, Aloe vera extract, ascorbic acid powder, olive oil, potato starch powder and deionized water. The characteristics of the binding agent, the rheology, shelf life and spreadability of the formulation were analysed. The BC powder has higher crystallinity index, larger pore size and smaller fibril size compared to MC powder. Meanwhile, MC powder has higher opacity value, but more brittle compared to BC powder. For this research, there were two types of formulated facial scrub prepared, namely water-based and oil-based facial scrub.
From the rheological characteristic, BC oil-based facial scrub was indicated to have less viscosity (18.54 Pa.s) at lower shear rate than BC water-based facial scrub (300.4 Pa.s) and MC oil-based facial scrub (38.84 Pa.s). All formulated and commercial facial scrubs shows flow behaviour index, $n < 1$, this means that the products exhibit shear thinning fluid as analysed using the Power law model. Furthermore, BC oil-based facial scrub gave higher value for work of shear (2.23 mJ), firmness (9448.7 g) and stickiness (-766.9 g), indicating that BC oil-based facial scrub is less spreadable than others but is more adhesive sample (2.30 mJ).

As a comparison with the commercial product, BC water-based facial scrub act as more spreadable product with Simple scrub, compared to BC oil-based that act as more adhesive product. MC oil-based facial scrub also showed the characteristic of adhesiveness but not as high as BC oil-based facial scrub. Eventhough BC water-based facial scrub showed very spreadable characteristic than others, it still has shorter shelf life and thus susceptible to microorganisms growth. Meanwhile, BC oil-based facial scrub has longer shelf life and is more adhesive indicating BC as a good potential for binding agent.

In conclusion, this study focused on facial scrub formulation using bacterial cellulose as binding agent. Comparison between BC and MC resulted in BC oil-based facial scrub formulation showed as a better binding agent due to the higher adhesiveness effect.
Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia Sebagai memenuhi keperluan untuk Ijazah Master Sains

PENGUNGAAN SELULOSA BAKTERIA YANG DIHASILKAN OLEH Acetobacter xylinum SEBAGAI EJEN PENGIKAT DALAM FORMULASI SKRUB MUKA

Oleh

NORHASLIZA BINTI HASAN

Julai 2013

Pengerusi: Dayang Radiah Binti Awang Biak, PhD

Fakulti: Kejuruteraan

Kajian ini memberikan tumpuan kepada pengeluaran selulosa bakteria (BC) dan metilselulosa (MC) daripada Acetobacter xylinum dan aplikasinya sebagai ejen pengikat di dalam formulasi skrub muka. BC telah disediakan daripada proses penapaian menggunakan A. xylinum. MC telah dihasilkan daripada BC secara ubahsuai kimia. Formulasi skrub muka ini terdiri daripada serbuk BC dan MC, tepung beras pulut, ekstrak Aloe vera, serbuk asid askorbik, minyak zaitun, tepung kanji ubi kentang dan air ternyahkan. Ciri-ciri ejen pengikat, reologi, jangka hayat dan kebolehsapuan telah dianalisis. Serbuk BC mempunyai indeks penghabluran yang lebih tinggi, saiz liang yang lebih besar dan saiz fibril yang lebih kecil berbanding serbuk MC. Sementara itu, serbuk MC mempunyai kelegapan yang tinggi, tetapi lebih rapuh berbanding serbuk BC. Bagi penyelidikan ini, terdapat dua
jenis skrub muka yang diformulasikan telah disediakan, iaitu skrub muka berasaskan air dan berasaskan minyak.

Dari ciri reologi, skrub muka BC berasaskan minyak telah menunjukkan untuk mempunyai kelikatan yang kurang (18.54 Pa.s) pada kadar ricih yang rendah daripada skrub muka BC berasaskan air (300.4 Pa.s) dan skrub muka MC berasaskan minyak (38.84 Pa.s). Kesemua skrub muka yang diformulasi dan yang dikomersilkan menunjukkan indeks tingkah laku aliran, \( n < 1 \), ini bermaksud produk-produk tersebut mempamerkan ceccair penipisan ricih seperti yang dianalisis menggunakan model undang-undang kuasa. Tambah pula, skrub muka BC memberikan nilai yang lebih tinggi untuk kerja-kerja ricih \( (2.23 \text{ mJ}) \), ketegasan \( (9448.7 \text{ g}) \) dan kelekitan \( (-766.9 \text{ g}) \), menunjukkan bahawa skrub muka BC berasaskan minyak adalah kurang merebak daripada yang lain tetapi adalah sampel yang lebih melekat \( (2.30 \text{ mJ}) \).

Sebagai perbandingan dengan produk komersil, skrub muka BC berasaskan air bertindak sebagai produk yang lebih merebak dengan skrub *Simple*, berbanding dengan BC berasaskan minyak yang lebih bertindak sebagai produk yang lebih melekat. Skrub muka MC berasaskan minyak juga menunjukkan ciri-ciri perlekatan tetapi tidak setinggi skrub muka BC berasaskan minyak. Walaupun skrub muka BC berasaskan air menunjukkan ciri-ciri yang sangat merebak daripada yang lain, ia masih mempunyai jangka hayat yang lebih pendek dan oleh itu mudah terdedah kepada pertumbuhan mikroorganisma. Sementara itu, skrub muka BC berasaskan
minyak mempunyai jangka hayat yang lebih panjang dan lebih melekat menunjukkan BC mempunyai potensi sebagai ejen pengikatan yang lebih baik.

Kesimpulannya, kajian ini memberikan tumpuan kepada formulasi skrub muka menggunakan selulosa bakteria sebagai ejen pengikat. Perbandingan di antara BC dan MC memberikan keputusan bahawa formulasi BC berasaskan minyak menunjukkan ejen pengikat yang lebih baik disebabkan oleh kesan perlekat yang lebih tinggi.
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I certify that a Thesis Examination Committee has met on July 2013 to conduct the final examination of Norhasliza Binti Hasan on her thesis entitled "Use of Bacterial Cellulose Produced by Acetobacter xylinum as Binding Agent in Facial Scrub Formulation" in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the Master of Science.

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This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Master of Science. The members of the Supervisory Committee were as follows:

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DECLARATION

I hereby conform that:

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Signature: _______________________ Signature: _______________________
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