



UNIVERSITI PUTRA MALAYSIA

**FORMULATION OF COSMETIC CREAMS CONTAINING CENTELLA
ASIATICA L. AND ALOE VERA (L.) BURM. F. HERBAL EXTRACTS IN
NANOEMULSION SYSTEM**

ZITI AKHTAR BINTI SHAFII

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MASTER OF SCIENCE

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NANOEMULSION SYSTEM**



By

ZITI AKHTAR BINTI SHAFII

**Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia,
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FORMULATION OF COSMETIC CREAMS CONTAINING CENTELLA ASIATICA L. AND ALOE VERA (L.) BURM. F. HERBAL EXTRACTS IN NANOEMULSION SYSTEM

By

ZITI AKHTAR BINTI SHAFII

April 2011

Chairman : Professor Dzulkefly Kuang Abdullah, PhD

Faculty : Science

Nanoemulsions have attracted great attention recently because of their high stability due to their small particle size. In this study, nanoemulsion cosmetic creams containing *Centella asiatica* (pegaga) and *Aloe vera* (lidah buaya) extracts were formulated at 20% and 40% (w/w) oil-in-water (o/w) nanoemulsion systems using various concentrations (5.2%, 7.2% and 9.2% w/w) of mixed nonionic surfactant (Span 80/Tween 80 at 20:80 w/w ratio). The nanoemulsions were prepared using a spontaneous emulsification method. The physicochemical properties of the cosmetic creams were characterized by particle size analyzer, surface charge measurement (zeta potential) and thermodynamic stability tests. The antioxidant activity of the nanoemulsions was determined by a diphenylpicryl hydrazyl (DPPH) scavenging method. Meanwhile, the moisturizing

effects of 20% and 40% nanoemulsion cosmetic creams with and without herbal extracts on human skin were characterized using a Cutometer and Tewameter to determine the water content and percentage of water loss in the stratum corneum respectively. The rheological properties of the creams in the presence of xanthan gum as a thickening agent were characterized. The morphological properties of the cosmetic creams products were investigated by Transmission Electron Microscopy. Results showed that, the particle sizes of fresh and stored samples were constant within the nanosize range which was less than 200 nm measured for up to 4 months after preparation. They were significantly stable nanoemulsions. However, the formulation containing 40% oil-in-water using 5.2% (w/w) of surfactant gave a slightly bigger droplet size, ranging from 490 nm to 510 nm. The surface charge measurements or zeta potential of the 20% oil-in-water nanoemulsions varied from -26 mV to -37 mV indicated formation of very stable nanoemulsions creams. The presence of excess oil (40% oil-in-water) significantly influenced the surface charge values where the zeta potential shifted to very low values between -38 mV to -48 mV and the creams became more stable. All of the nanoemulsion cosmetic creams showed a good thermodynamic stability (measured by observing the physical appearance) at 5°C, 25°C and 45°C. The nanoemulsion creams produced did not interfere the antioxidant activity of *C. asiatica*. Thus, the nanoemulsion systems which are used as an antioxidant carrier in this study have no effect on the antioxidant activity of the cosmetic creams. A combination of *C. asiatica* and *Aloe vera* extracts has potential to be used as moisturizing agent and as a barrier on the skin to prevent water loss into the air. The presence of xanthan gum significantly influenced the viscosity and stability of the nanoemulsion creams. The nanoemulsion creams showed a

non-Newtonian or shear thinning fluid behaviour where the viscosity decreased with increasing shear rate. Morphological behaviour of the nanoemulsions as evaluated by a Transmission Electron Microscope showed that the oil droplets appeared dark against a bright background and the particle size (100 to 500 nm) was within the range determined by the Nanophox particle analyzer. As a conclusion, crude herbal extracts can be added into nanoemulsion cosmetic creams without interfering the creams stability and at the same time maintaining their functional properties.



Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia bagi memenuhi syarat bagi mendapatkan ijazah Master Sains

**FORMULASI KRIM KOSMETIK YANG MENGANDUNGI CENTELLA
ASIATICA L. AND ALOE VERA (L.) BURM. F. EKSTRAK HERBA DALAM
SISTEM NANOEMULSI**

Oleh

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Sejak kebelakangan ini, perhatian tertumpu kepada penghasilan nanoemulsi yang mempunyai ciri-ciri kestabilan yang tinggi berikutan saiznya yang kecil. Penyelidikan ini bertujuan menghasilkan krim kosmetik nanoemulsi yang mengandungi ekstrak pegaga dan gel daripada pokok lidah buaya yang diformulasi pada 20% dan 40% kandungan fasa minyak. Formulasi tersebut menggunakan bahan aktif yang bertujuan menstabilkannya pada kepekatan 5.2%, 7.2% dan 9.2%. Bahan aktif tersebut dipanggil Span80 dan Tween80 yang telah dicampur mengikut nisbah 20:80. Nanoemulsi krim tersebut dihasilkan menerusi kaedah pengemulsian spontan. Ciri-ciri fizikal dan kimia krim kosmetik tersebut telah dikaji menggunakan penganalisis saiz zarah, kiraan cas permukaan (keupayaan zeta) dan ujian kestabilan termodinamik. Krim kosmetik itu juga

diuji aktiviti antioksidan melalui kaedah pemerangkapan DPPH. Manakala, ciri-ciri fizikal krim kosmetik nanoemulsi yang mengandungi ekstrak dan tidak mengandungi ekstrak diuji untuk mengetahui tindakannya mengawal kelembapan kulit menggunakan alat Cutometer and Tewameter. Ujian ini bertujuan menentukan kandungan air dan peratus kehilangan air daripada stratum corneum kulit. Ciri-ciri reologi krim dengan kehadiran gam xantan sebagai pemekat juga dikaji. Gambaran struktur di dalam formulasi juga dikaji dengan menggunakan elektron mikroskop transmisi. Keputusan menunjukkan, saiz zarah formulasi yang di nilai serta merta dan selepas disimpan selama 4 bulan menunjukkan sifat yang konsisten iaitu kurang daripada 200nm. Saiz tersebut masih di dalam lingkungan nano dan menunjukkan bahawa formulasi tersebut adalah stabil. Walau bagaimanapun, formulasi yang mengandungi 40% kandungan fasa minyak yang mengandungi 5.2% bahan aktif memberikan saiz titisan yang agak besar dalam lingkungan di antara 490nm - 510 nm. Selain itu, nilai cas pada permukaan memberikan nilai dalam lingkungan -26 mV to -37 mV yang menyokong bahawa formulasi tersebut dikategorikan sebagai formulasi yang stabil. Kehadiran lebih fasa minyak mengubah nilai cas pada permukaan titisan tersebut kepada nilai yang lebih rendah iaitu dalam lingkungan -38 mV to -48 mV. Ia menunjukkan kestabilan yang lebih tinggi. Semua krim kosmetik nanoemulsi yang dihasilkan menunjukkan kestabilan termodinamik pada suhu 5°C, 25°C and 45°C yang di nilai melalui pemerhatian pada keadaan fizikal formulasi tersebut. Sifat antioksidan yang ada dalam ekstrak pegaga adalah kekal walaupun telah diformulasi dalam bentuk nanoemulsi. Oleh itu, sistem nanoemulsi boleh digunakan sebagai pembawa sifat antioksidan kerana dalam kajian ini membuktikan ia tidak mengganggu aktiviti antioksidan krim kosmetik tersebut. Oleh yang demikian,

kombinasi ekstrak pegaga dan gel daripada pokok lidah buaya berpotensi di gunakan sebagai agen pelembab dan sebagai penghalang kehilangan air daripada kulit ke persekitaran. Kehadiran gum xantan mempengaruhi secara signifikan kelikatan dan kestabilan nanoemulsi tersebut. Nanoemulsi menunjukkan ciri-ciri bendalir non-Newtonian dan kelikatannya adalah berkurangan dengan peningkatan kadar ricih sistem tersebut. Gambaran nanoemulsi yang dinilai melalui electron mikroskop transmisi menunjukkan titisan kecil berwarna gelap dan saiznya dalam lingkungan 100 to 500 nm menyamai saiz yang diukur menggunakan penganalisis zarah Nanophox. Sebagai kesimpulan, ekstrak daripada tumbuhan boleh dimasukkan ke dalam penghasilan krim kosmetik nanoemulsi tanpa mempengaruhi kestabilannya dan pada masa yang sama mengekalkan ciri-ciri kefungsiannya.



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I certify that an Examination Committee has met on date of viva voce to conduct the final examination of Ziti Akhtar Binti Shafii on her Master of Science thesis entitle “Formulation of cosmetic creams containing Centella Asiatica L. and Aoe Vera (L.) Burm F. Herbal Extracts in nanoemulsion system” in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Peertanian Malaysia (Higher Degree) Regulation 1981. The Committee recommends that the student be awarded the relevant degree.

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DECLARATION

I declare that the thesis is my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously, and is not concurrently, submitted for any other degree at Universiti Putra Malaysia or at any other institution.



ZITI AKHTAR BINTI SHAFII

Date: 15 April 2011



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