UNIVERSITI PUTRA MALAYSIA

ASSOCIATION BEHAVIOUR AND RHEOLOGY OF PALM BASED EMULSION USING MIXED SUGAR BASED EMULSIFIERS

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By

ZAHARIAH ISMAIL

Thesis Submitted in Fulfilment of the Requirement for the Degree of Doctor of Philosophy in the Faculty of Science and Environmental Studies
Universiti Putra Malaysia

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Dedicated to my loving husband; Zulkifli bin Jaafar

Thank you for your encouragement and persuasion to me to explore the ability to pursue for knowledge beyond the ambit of my mental horizon in Nov,1998. Without with I wouldn't have the confidence to embark in this research

I pray to Allah Almighty that HE would brighten your path in achieving your "academic dream" - Doctorate of Business Administration by Oct, 2002. InshaAllah!

Abstract of the thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Doctor of Philosophy

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Chairman: **Associate Professor Dr. Anuar Kassim**

Faculty : **Science Environmental Studies**

Methyl glucose based emulsifiers such as Glucamate SSE-20 (PEG-20 methyl glucose sesquistearate) and Glucate SS (methyl glucose sesquistearate) are widely used in the application of cosmetic products. The methyl glucoside products have excellent safety, mildness and effectiveness. Although these methyl glucosides are widely used as emulsifiers, little is known about their phase behaviour in binary and ternary systems. The phase behaviours in binary and ternary system have been studied at 80^{o}C under visual observation by polarizing light and they were confirmed by polarization microscope.

In the binary system, lamellar phases (Lα) were observed at the combination of 60/40, 70/30 and 80/20 of glucamate SSE-20 and glucate SS. It was identified as maltese crosses and oily streaks. When heated at 80°C, the oily streaks pattern of 70/30 took a longer time to change to isotropic phases if compared to the other ratios. This observation correlated well with yield value, viscosity, and thixotropy in the following order 70/30> 60/40>80/20.

In the ternary system (mixed sugar based emulsifiers/water/medium chain triglycerides), the optical pattern indicated a combination of maltese crosses + oily streaks, maltese crosses and oily streaks texture alone. This system exhibited viscoelastic properties

Equal ratio of medium chain triglycerides and water (1/1) were emulsified with 5% w/w of mixed nonionic sugar-based surfactants with various hydrophilic-lipophilic balance values (HLBs). The HLB numbers ranged from 6.6 to 15.0. The effect of HLB and with and without hydrocolloids on stability, particle size droplet and rheological properties of the resulting emulsions were studied. The presence of hydrocolloids in the emulsion system dramatically lowers the interfacial tension and thus increased interparticle attraction, weak van der Waals and increased steric repulsion to stabilize the system. The systems show increasing viscosity, yield value, critical stress and exhibit viscoelastic properties.

The ratio of bound water and bulk water in emulsion system is determined by thermogravimetry. Shifting the ratio of bound water and bulk water may result in regulated release of water, a principle that can be used to produce cream or lotion with controlled release of moisture.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia bagi memenuhi keperluan ijazah Doktor Falsafah

KELAKUAN PENYEKUTUAN DAN REOLOGI TERHADAP EMULSI BERASASKAN MINYAK SAWIT DENGAN MENGGUNAKAN PENGEMULSI CAMPURAN BERASAS GLUKOS

Oleh

ZAHARIAH ISMAIL

December 2001

Pengerusi: Profesor Madya Dr. Anuar Kassim

Fakulti: Sains dan Pengajian Alam Sekitar

Pengemulsi berasaskan glukos seperti glukamat SSE-20 (PEG-20 metil glukos sesquistearat) dan glukat SS (metil glukos sesquistearat) telah digunakan didalam barangan kosmetik. Ianya dikenali kerana tidak toksid, selamat di gunakan dan berkesan. Walaupun penggunaan bahan mentah ini terkenal, pengetahuan tentang perubahan dua fasa dan tiga fasa agak berkurangan. Dengan itu kajian dua dan tiga fasa di lakukan pada suhu 80^{o}C dengan menggunakan cahaya berpengutub dan mikroskop berpengetup.

Sistem dua fasa, didapati hablur cecair pada nisbah 60/40, 70/30 dan 80/20 (nisbah glukamat SSE-20/ glukat SS). Jenis tekstur hablur cecair ialah palang Maltese dan carikan berminyak. Apabila di panaskan pada suhu 80°C tekstur carikan berminyak pada nisbah 70/30 menggambil masa yang lama untuk lebur jika di bandingkan dengan nisbah yang lain. Pemerhatian tersebut menunjukkan korelasi yang baik terhadap viskositi dan tixotropi seperti berikut 70/30>60/40>80/20.

Sistem tiga fasa (campuran pengemulsi/air/MCT) telah menunjukkan jenis tekstur hablur cecair iaitu campuran palang Maltese dengan carikan berminyak, palang Maltese dan carikan berminyak. Sistem ini menunjukkan jalinan hablur cecair yang bersifat viskoelastik.

MCT dan air (1/1) telah diemulsikan dengan 5 % w/w campuran surfaktan tak ionik berasaskan gula dengan pelbagai nilai imbangan hidrofilik-lipofilik (HLB). Nilai HLB bemula dari 6.6 sehingga 15.0. Keberkesanan HLB dengan penggunaan hidrokoloid dan tanpa hidrokoloid terhadap kestabilan, saiz titisan dan sifat reologi dikaji. Kehadiran hidrokoloid di dalam sistem, dapat merendahkan ketegangan di antara dua permukaan, meningkatkan tarikan saling bertindak di antara titisan, melemahkan daya Van der Waals dan meningkat penolakan sterik untuk menstabilkan sistem ini. Sistem ini juga meningkatkan kepekatan, nilai kandungan, nilai kritikal dan sifat viskoelastik.

Nisbah air terkekang melalui perantaraan jalinan hablur cecair dan kandungan air pukal dalam sistem emulsi dilakukan dengan menggunakan alat termogravimetri. Peranjakan nilai nisbah tersebut berkemungkinan sifat yang diperlukan sebagai perlepasan air secara berperingkat dan konsep ini boleh di gunakan untuk menghasilkan krim atau losyen dengan pengawalan pelepasan kandungan air secara berperingkat.

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