

ANALYSIS OF DISPERSED PHASE OF COCONUT MILK EMULSION

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ABSTRACT

Experiments were conducted to study the dispersed phase of coconut milk emulsion. They were optical microscopy analysis using a Nikon Microscope and particle size analysis using a Coulter Counter Multisizer.

Particle size analysis using a Coulter Counter Multisizer on both original coconut milk and homogenized coconut milk at $T = 19\text{ }^{\circ}\text{C}$ indicated that they had a wide range of particle size with average value of $5.988 \pm 1.0\text{ }\mu\text{m}$ and $6.696 \pm 1.1\text{ }\mu\text{m}$ in diameter respectively.

Optical microscopy analysis showed that homogenization of coconut milk after it was heated in a water bath at $T = 35\text{ }^{\circ}\text{C}$ for about 15 minutes resulted in changes of particle size, the particle size became smaller.

The result lead to a conclusion that the coconut milk emulsion may be considered as a polydisperse emulsion and it indicates that the system should not be sensitive to small variations in preparation or subsequent handling.

Key-words : dispersed phase, coconut milk emulsion, optical microscopy analysis, Particle size analysis, homogenized coconut milk, polydisperse emulsion.

ANALISIS FASA TERDISPERSI DARI EMUSLI SANTAN KELAPA

ABSTRAK

Telah dilakukan penelitian tentang fasa terdispersi dari emulsi santan kelapa. Penelitian dilakukan dengan menggunakan mikroskop optis merk Nikon dan Analisis ukuran partikel menggunakan Coulter Conter Multisizer.

Analisis ukuran partikel pada santan kelapa segar dan yang telah dihomogenisasi pada $T = 19^{\circ}\text{C}$ menunjukkan bahwa keduanya memiliki ukuran partikel yang sangat beragam dengan harga diameter rata-ratanya $5,98 \pm 1,0\text{ }\mu\text{m}$ dan $6,696 \pm 1,1\text{ }\mu\text{m}$. Analisis mikroskopi optis menunjukkan bahwa proses homogenisasi setelah santan dipanaskan dalam water bath, $T = 35^{\circ}\text{C}$, selama 15 menit menghasilkan perubahan ukuran partikel menjadi lebih kecil.

Dari hasil tersebut dapat disimpulkan bahwa emulsi santan kelapa dapat dipandang sebagai emulsi polidisperse dan sistem tersebut tidak terpengaruh oleh sedikit variasi dalam preparasi maupun penanganannya.

Kata kunci : Fasa terdispersi, emulsi santan kelapa, Analisis mikroskop optis, Analisis ukuran partikrl, santan kelapa terhomogenisasi, emulsi polidispersi

INTRODUCTION

The size and shape of colloidal particles are amongs their most important characteristics because they determine many

other features of the behaviour of colloidal suspensions. The rate of settling/creaming, the ease with which they can

be filtered, and their flow properties when poured or pumped through a pipe, all depend on particle size and shape.⁽¹⁾

Coconut milk is widely used in Indonesia. It is used as a cooking ingredient. Traditionally, It is used as raw material for producing coconut oil by evaporating the water content.

Coconut milk has an interesting behaviour. When it is allowed to stand for a short time, it will form two layers, cream (upper part, rich of oil) and skim (lower part, rich of water) but not oil and water layers. This apparent behaviour which occurred during standing was the subject which led the author to carry out this project. The objective of this project is to study the colloidal particles of the coconut milk emulsion. Hopefully, the result will bring the author to an understanding of the emulsion system in coconut milk.

EXPERIMENTS

Preparation of Coconut Milk

After removing the coconut pulp from its shell, the thin brown skin was peeled to get the white pulp. After that it was blended with water (1:1 w/v) using a blender for about 15 minutes, so that it became a white juicy mixture. Finally, the coconut milk was obtained by filtering this mixture through a muslin cloth. Unless stated otherwise, the coconut milk used for all these experiments were obtained by this procedure.

Particle Size Analysis

The coconut milk emulsion was stored in a Tumbler apparatus at 24°C to prevent it

from creaming. Meanwhile, from time to time its particle size was analysed using a Coulter Multisizer apparatus. The analysis was carried out by dispersing 1 to 2 drops of coconut milk in 15 mL Isoton II diluent and then analysing the particle size. An orifice diameter of 50 µm was used. The full range menu of 128 channel was applied. The coincidence correction was made below 105 to ensure its precision and accuracy. About 40,000 particles were measured to ensure that there were a large number of particles for statistical analysis. The procedure above was repeated for a homogenised coconut milk. It was obtained by homogenisation of coconut milk using a Silverson Emulsifier at room temperature.

Optical Microscopy Analysis

Dispersions of coconut milk and homogenised coconut milk in water were made. They were prepared by adding one or two droplets of them to 100 mL water. The homogenised coconut milk was prepared by increasing the coconut cream temperature to 35°C in a water bath for about 15 minutes and homogenising it using Silverson Emulsifier at :

$(1.5 \pm 15\%) \times 10^3$ cpm for about 5 minutes. The samples above were analysed using a Nikon Optical Microscope.

RESULT AND DISCUSSION

The results from the particle size analysis for both original coconut milk and homogenised coconut milk at $T = 19^\circ\text{C}$ indicated that they had a wide range of particle size with the average value of 5.988

$\pm 1.0 \mu\text{m}$ and $6.696 \pm 1.1 \mu\text{m}$ in diameter respectively.

In analysing the diameter as a function of time, it appeared that the particles in the sample were growing bigger as the time changed figure 1.

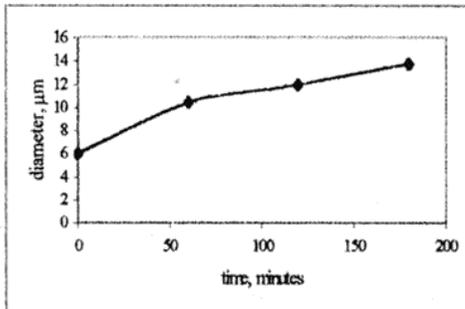


Figure 1. Particle diameter as a function of time

This result showed that eventhough the coconut milk was put in a Tumbler to prevent it from creaming, the preliminary process of breaking was still occurred either in the form of coalescence or flocculation. But this process happened very slow.

The results of optical microscopy indicated that homogenisation of coconut cream after it was put in a water bath at $T = 35^\circ\text{C}$ for about 15 minutes resulted in changes of particle size, the particle size became smaller.

The experiments show that the particle diameter do not change significantly before and after homogenisation at temperature below the coconut oil melting point range ($T = 20\text{-}26^\circ\text{C}$)⁽²⁾. But when the homogenisation was applied to coconut cream has been heated to $T = 35^\circ\text{C}$ for about 15 minutes, the particle size was

altered to smaller size. There are several possible explanations for these results. First of all, it is possibly because at temperature below the coconut oil melting point the oil is in its solid phase and the particle become hard and rigid so homogenisation at a short time does not affect its particle size. But when heat is introduced to the sample, it changes the state of particles from solid to liquid droplets so the homogenisation can break them down and produce smaller droplets. Secondly, smaller droplets increase the surface area to be covered by the emulsifier present in the dispersion so it may not be sufficient to cover all the smaller droplets surface resulted from homogenisation. The newly formed droplets do not have a full coverage of emulsifier, and so collisions between them during and after homogenisation leads to the formation of bridging flocculation⁽³⁾ between the droplets by macromolecules present in the system, such as: proteins or polysaccharides⁽⁴⁾.

Figure 2. Formation of Bridging flocculation



As a result, the average droplet size dont alter significantly before and after homogenisation, i.e. the droplet size is only a function of macromolecules (stabiliser) content and not of the preparation condition. But when the homogenisation is applied to a heated coconut cream, the heat affects the structure of stabiliser to be able to build bridges between the newly

formed smaller droplets, e.g. reduction of molecular weight. Hence the average droplet size become smaller after homogenisation.

CONCLUSION

The results obtained in the present work provide evidence that the coconut milk emulsion may be considered as a poly-disperse system with average value of $5.988 \pm 1.0 \mu\text{m}$ in diameter at temperature below the oil's melting point and homogenisation at temperature above the oil's melting point will lead to the formation of bridging flocculation between the

newly formed smaller droplets by macromolecules present in the system.

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