Development of Non-dairy Whipping Cream using Palm Kernel, Palm Kernel Olein and Palm Stearin

Che Man YB, Shamsi, K, Yusoff, MSA and Jinap, S

Faculty of Food Science & Biotechnology
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Telephone Number of Corresponding Author: 03- 89468413
E-mail of Corresponding Author: yaakub@fsb.upm.edu.my

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Introduction

Dairy products and derivatives have found a wide range of consumption and a high demand in all countries due to their vast application in various products. In confectionery, bakery, pharmaceutical and some other non-dairy industries, there is an increasing demand for at least one of the milk components like caseinate, milk powder, etc. In developed countries the access to ruminants milk is much easier than developing countries. Furthermore, countries located in the tropical regions, due to the high ambient temperature have liminations in using milk products because of the sensitivity of milk to high temperature. For this reason, tropical countries prefer to use the substitutes and imitations for milk products.Non-dairy whipping cream has attracted the attention of many researchers either Malaysian or non-Malaysian and many studies have been undertaken to facilitate the application of a vegetable fat like palm oil or its fractions for the production of whipping cream. However, the studies undertaken so far on dairy or non-dairy whipping cream are mostly dealing with the effect of stabilisers and emulsifiers on the structure of cream, and very few studies have fundamentally focused on the effect of FAs on the physical characteristics of whipping cream either dairy or non-dairy. Furthermore, most researchers have focused on dairy creams since it is widely consumed in the developed countries. Nesaretnam *et al.* (1993) studied the application of hydrogenation of palm kernel oil (HPKO) and palm stearin (PS) in whipping cream. Accordingly, the addition of PS to HPKO in the ratio of PS:HPKO 34:66 was judged to be the most promosing blend in terms of its whipping performance and stability. The interesterification helped to eliminate increase in solid fat content at the highest temperatures. Liew (1999) carried out a study to develop a non-dairy whipping cream formula by using interesterified palm oil products. In his study, a formula was developed for non-dairy whipping cream by the application of different percentages of stabilisers and emulsifiers. The objective of this study was to develope new formulations to produce a substitute for a dairy whipping cream, which can be whipped easily and effectively .

Materials and Methods

*Materials.*Refined, bleached, and deodorized palm kernel oil (RBDPKO) and refined, bleached, and deodorized palm oil (RBDPO), sucrose, corn syrup solids, sodium caseinate, soybean lecithin, carboxymethyl cellulose (CMC), and MG were provided by the Malaysian Palm Oil Board (MPOB). Anchor Dairy Whipping Cream (according to the label, containing 36% fat, and 64% nonfat milk solids including emulsifiers 471 and 433 and stabilizers 412, 415, and 407) was purchased from a local shop.

Methods. The oils were kept overnight at 60°C. Then they were blended in different portions as shown in Table 1. No interesterification or hydrogenation was applied to the oils. The blended oils were combined with other ingredients according to the following formulation (ingredient, wt%): vegetable fat (blends of RBDPKO and RBDPO), 25.0; sodium caseinate, 1.0; sucrose, 10.0; corn syrup solids, 3.0; sodium CMC, 1.0; soybean lecithin, 0.3; MG, 0.05; water (distilled), 59.95.

Preparation of emulsions. Distilled water was heated to 80°C, and all dry ingredients were added to it and mixed for 1 min at low speed, then 2 min at high speed in a commercial blender (Model 32BL80; Waring Commercial Blender, New Hartford, CT) to prevent lump formation. Then the oil was added to the liquid phase and mixed for 3 min at high speed. The mixture was heated to 71°C in a water bath for 30 min and then homogenized in a Heavy Duty Laboratory Homogenizer (Model L4RT; Silverson Machines Ltd., Waterside, Chesham, Bucks, England) at 1,656 x g rpm for 2 min in order to disperse the oil molecules evenly in the emulsion and reduce the risk of serum separation. The homogenized cream was immediately cooled to 5°C and aged for 24 h in the refrigerator. The finished mixes usually require 18-24 h of tempering before satisfactory whipping performance can be expected (5).

Analyses: The following analyses were conducted – Fatty acid analysis by GC, determination of consistency, slip melting point (SMP), iodine value (Wijs method), whipping test, stability test of whipped and unwhipped cream, determination of solid fat content (SFC), thermal analysis of blended oils by DSC, viscosity and XRD.

Statistical analysis. Collected data were analyzed using Microsoft Excel 2000 software, which was used to establish equations of regression between the data. The accuracy was assessed based on the smallest standard error (SE) and the highest coefficient of determination (R2).

Results and Discussion

The experimental parts of this study comprised of 3 parts. In PART 1, it was shown that the increase in unsaturated fatty acids would produce foam with higher stability in palm oil-based whipping cream. It was also shown that rising of the IV has an increasing impact on the stability of foam in non-dairy whipping cream as well. This part has introduced the physical

advantages of a palm oil-based whipping cream over commercial DWC particularly when the stability of the foam is being considered and the product is supposed to be consumed in hot weather. It was also concluded that the percentage of fat in whipping cream, whether dairy or non-dairy, is not the only determining characteristic for producing a stable foam and the composition of the component fat must be taken into account as well. In PART II, it was concluded that the IV was highly correlated with overrun and SFC in a palm oil-based whipping cream and the increase in the degree of unsaturation can lead to the raising of overrun. However, there was no correlation between IV and viscosity because viscosity is mostly under the influence of stabilisers and emulsifiers rather than the degree of unsaturation in fatty acids, and it acts as an independent variable of SFC. In PART III, the creams and blends of RBDPO and RBDPKO were prepared in two stages and the crystal structure of DWC and palm oil-based whipping creams were analysed by the application of DSC and XRD. The results in the Stage I, showed that ail blends possessed a stable and shiny beta-prime polymorph at 25°C, which stands RBDPO and RBDPKO in an advantage for application in a non-dairy whipping cream. In Stage II, it was shown that addition of RBDPO and RBDPKO increased the stability of DWC, however, had no effect on overrun.
The new non-dairy whipping cream product must be filled hot and aged for at least 24 hours before consumption to show the most optimum result in whippability. The product can be also consumed in hot weather above 25°C with no separation of serum. However, it is advised to whip this product when taken immediately out of the refrigerator to achieve the most optimum result.

Conclusions

Producing a palm oil-based counterpart for a DWC with superior physical characteristics was the main goal in this study. However, it was also tried to develop a practical formula for the fat phase of a palm oil-based whipping cream emulsion in order to produce a more stable froth in cream after whipping. Determination of composition of the fatty acids in a palm oil-based whipping cream, and its impact on some physical characteristics of the non-dairy whipping cream namely stability, viscosity, overrun, etc. and also increase the stability of the foam in DWC by addition of RBDPO and RBDKO to DWC were the objectives of the study. To attain the goals, RBDPKO, RBDPO, sucrose, corn syrup solids, sodium caseinate, soybean lecithin, CMC, MAG and distilled water were blended and made into emulsion. The creams and blended oils were measured in terms of FA, consistency, SMP, IV, whipping test, stability, overrun, viscosity and SFC. DSC and XRD were used to study the crystal structure of palm oil-based whipping cream. This study showed the advantages of a palm oil-based whipping cream over commercial dairy whipping cream (DWC) particularly when the stability of the foam is being considered and the product is destined to be consumed in hot weather.

Benefits from the study

The change in trend of consumers' awareness towards their diets from the animal-based products and foodstuffs to vegetable-based ones creates a great opportunity for the development of non-dairy based products e.g. palm oil-based whipping cream. Therefore, further studies can be carried out in order to obtain a better understanding of this product. Since Malaysia is the largest producer and exporter of palm oil and its products in the world, any research in this area can promote Malaysian palm oil application in a wide range of products. Hence, this study aims at the developing an non-dairy whipping cream by the application of RBDPO and RBDPKO, which can be widely and commercally used in tropical areas.

Patent(s), if applicable:

Nil

Stage of Commercialization, if applicable:

In order to commercialise this product, some further steps are to be taken. This study was carried out without applying interesterification (IE) to the blends of RBDPO and RBDPKO. In fact, the experiments were designed to make clear the physical characteristics of palm oil-based whipping cream produced from non-interesterified blended oils. Lack of IE has shown some eutectic effects in blended RBDPO and RBDPKO. The experiments can be also done after applying IE to blends to observe the advantages or even probable liminations produced by IE. In this way, it will be possible to make a comparison between the interesterified and the non-interesterified palm oil-based whipping cream. A sensory evaluation seems also to be necessary for this product although it cannot be consumed by itself. To commercialise this product, it had to be treated with artificial or natural flavours like cream, chocolate or strawberry. The effect of the flavour on the structure of the whipping cream should be also taken into account. Furthermore, the effect of homogenisation and pasteurisation can also be studied since it assumed that these two processes can have a detrimental effect of the whippability of the cream. It might be possible to use a kind of mixer, which has also a partial homogenising effect on the cream. Usually, the high-speed blenders of over 1500 rpm with sharp blades have homogenising effect as well.

Project Publications in Refereed Journals

1. Shamsi, K, Che Man, YB, Yusoff MSA and Jinap, S. 2002. Comparative Studies between Dairy Whipping Cream and Palm Oil-based Non-dairy Whipping Cream in terms of Fatty Acid composition and stability of Foam. Journal American Oil Chemists Society 79(6)583-588

2. Che Man, YB, Shamsi, K, Yusoff MSA and Jinap, S. 2003. A Study on Crystals of Palm Oil-based Whipping Cream. Journal American Oil Chemists Society. 80(5)409-415

3. Che Man, YB, Shamsi, K, Yusoff MSA and Jinap, S. 2003. A Study on the Physical and Chemical Characteristics of Palm Oil-based whipping Cream. Journal of the Science of Food and Agriculture. JSFA 36/2003 (In Press)

Project Publications in Conference Proceedings

1. Che Man, YB, Shamsi, K, Yusoff MSA and Jinap, S. 2001. The Impact of Fatty Acids on the Foam Stability in Palm Oil-based Whipping Cream. In: Proceedings Malaysian Science and Technology Congress, September 24-26, 2001.

2. Che Man, YB, Shamsi, K, Yusoff MSA and Jinap, S. 2001. The Impact of Unsaturated Fatty Acids on the Foam Stability in Palm Oil-based Whipping Cream. R& D Exhibition at Universiti Putra Malaysia, October 2-4, 2001.

3. Che Man, YB, Shamsi, K, Yusoff MSA and Jinap, S. 2002. A Comparative Study on the Impact of Fatty Acids on Physical Characteristics of Palm Oil-based Whipping Cream and Dairy Whipping Cream. 4th Asian Scientific Technology Congress, April 25 –27, 2002.

Graduate Research

Name of Graduate	Research Topic	Field of Expertise	Degree Awarded *(e.g. M.SC/Ph.D.)*	Graduation Year *(or expected)*
Kambiz Shamsi	Application of Palm Oil and Palm Kernel Oil in Producing Non-dairy Whipping Cream	Food Technology	M.Sc.	2003

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