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Tengkawang (Borneo Illipe) Butter Optimization Study as a Cost-Effective Substitution of Cocoa Butter in Body Lotion Formula

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Introduction:

The need for more sustainable and economical use of emollients in lotion formulas is increasing, so better alternatives are needed to meet these demands. Cocoa butter has a quite high cost, meanwhile, the tengkawang butter has a similar fatty acid composition to cocoa butter at a cheaper cost.

Tengkawang butter derived from the fruit of the *Shorea stenoptera* tree that spread in Southeast Asia (Indonesia, Malaysia, and the Philippines), have a composition of fatty acids like cocoa butter so it is often classified as Cocoa Butter Substitute (CBS)[3], [4]. The use of tengkawang butter in the field of cosmetics has been researched several times in products in the form of creams and lipsticks in terms of their stability and acceptability[4]– [6]. However, with its reputation as CBS, few studies are comparing tengkawang butter and cocoa butter in cosmetic preparations.

The study of properties related to the function of tengkawang butter as emollients is also hard to find. This research aims to find the optimal composition of Illipe butter to substitute cocoa butter in a body lotion formula.

Materials & Methods:

I. Lotion Preparation

Table 1. Formulation matrix

Material Name	Composition (%w/w)				
	CT1	CT2	CT3	CT4	CT5
Phase A (water)					
RO Water	85,07	85,07	85,07	85,07	85,07
EDTA	0,10	0,10	0,10	0,10	0,10
Glycerin	4,00	4,00	4,00	4,00	4,00
Carbomer	0,13	0,13	0,13	0,13	0,13
Phase B (Oil)					
Isopropyl myristate	1,00	1,00	1,00	1,00	1,00
Dimethicone	1,00	1,00	1,00	1,00	1,00
Cocoa butter	2,00	1,50	1,00	0,50	-
Tengkawang butter	-	0,50	1,00	1,50	2,00
Stearic acid	1,00	1,00	1,00	1,00	1,00
Palmitic acid	1,50	1,50	1,50	1,50	1,50
Glyceryl monostearate	3,00	3,00	3,00	3,00	3,00
BHT	0,20	0,20	0,20	0,20	0,20
Phase C					
Triethanolamine	0,70	0,70	0,70	0,70	0,70
Phenoxyethanol	0,72	0,72	0,72	0,72	0,72
Ethylhexylglycerin	0,08	0,08	0,08	0,08	0,08

II. Lotion Characterization

Table 2. List of evaluated parameter

Evaluation Method			
Viscosity Check (Brookfield)	pH Check (Metler Toledo)	Centrifugation Test	Accelerated Stability Test For 28 days (Room Temperature, Oven 45°C, Oven 50°C, Sunlight)
Microscopic Check (Keyence VHX-700)	Sensory Analysis	Occlusion Factor (In Vitro)	Statistical Analysis (ANOVA)

Figure 1. Coca-Tengkawang (CT) Lotion Appearance

On pH test showed that all of the formulas were in the range of 7.50 to 8.00. Although it is more alkaline, the pH of the preparation is still at an acceptable level because no symptoms of skin irritation are observed during application.

Based on the Friedman Test in the ranking test results for the sensory feel, it was found that there is no significant difference between the value of the number of rank sums ($P > 0.05$). Furthermore, the top 3 sensory liking, CT1, CT3, and CT4, showed good stability during globule evaluation and accelerated stability test for 28 days.

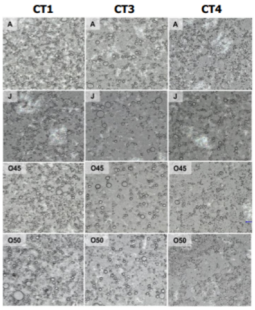

Figure 2. Coca-Tengkawang (CT) Lotion Globule

Based on the measurement of occlusive factors, it was found that there were differences in significance between variations in preparations in both 24-hour and 48-hour durations ($P < 0.05$). The low occlusive factor was experienced in the CT with only cocoa butter (CT1). It can also be seen that in the CT variation, the variation containing tengkawang butter produces an average occlusive factor, and the fraction of tengkawang butter has a positive correlation with the occlusive factor of lotion.

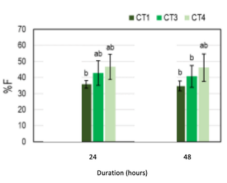

Figure 3. In Vitro Result of Occlusion Factor

Results & Discussion:

On organoleptic tests, a formula with a high fraction of cacao butter (50% and above) showed a vanilla white color, this can be caused by the basic color of the cocoa butter being yellow, like the typical colors of vegetable fats in general, as well as with tengkawang butter of paler color. Meanwhile, the higher cocoa butter fraction also increases the consistency of the lotion that can correspond to the solid fraction of emollients under space conditions.

Conclusions:

- The tengkawang butter substitution resulted in a minor change in pH, viscosity, rheology, and degree of liking of all sensory attributes except for aroma
- The tengkawang butter also tends to increase the occlusive properties of a lotion.
- The optimal composition of tengkawang butter that can be used as cocoa butter substitution comfortably up to 50% and 75%, respectively.

References:

[1] A. Sethi, T. Kaur, S. K. Malhotra, and M. L. Gambhir, "Moisturizers: The Slippery Road," *Indian J Dermatol*, vol. 61, no. 3, pp. 279–287, 2016, doi: 10.4103/0019-5154.182427.
[2] R. Miyahara, "Chapter 18 - Emollients," in *Cosmetic Science and Technology*, K. Sakamoto, R. Y. Lochhead, H. I. Maibach, and Y. Yamashita, Eds. Amsterdam: Elsevier, 2017, pp. 245–253. doi: https://doi.org/10.1016/B978-0-12-802005-0.00016-1.
[3] M. Lipp and E. Anklam, "Review of cocoa butter and alternative fats for use in chocolate—Part A. Compositional data," *Food Chemistry*, vol. 62, no. 1, pp. 73–97, 1998, doi: https://doi.org/10.1016/S0308-8146(97)00160-X.
[4] H. Warnida, D. Wahyuni, and Y. Sukawaty, "FORMULASI DAN EVALUASI VANISHING CREAM BERBASIS LEMAK TENGKAWANG," 2019.
[5] H. Warnida, N. Trisuci, and Y. Sukawaty, "Stabilitas Lemak Tengkawang (Shorae mecistopteryx) Dalam Krim Pelembab Dengan Emulgator Tween 80 Dan Span 80," 2019.
[6] R. E. P. Gusti and T. K. Waluyo, "Formulasi Lemak Tengkawang Sebagai Bahan Dasar Lipstik," *Jurnal Penelitian Hasil Hutan*, vol. 34, no. 4, pp. 297–307, 2016, doi: 10.20886/jphh.2016.34.4.297-307.
[7] N. Raval, R. Maheshwari, D. Kalyane, S. R. Youngren-Ortiz, M. B. Chougule, and R. K. Tekade, "Chapter 10 - Importance of Physicochemical Characterization of Nanoparticles in Pharmaceutical Product Development," in *Basic Fundamentals of Drug Delivery*, R. K. Tekade, Ed. Academic Press, 2019, pp. 369–400. doi: https://doi.org/10.1016/B978-0-12-817909-3.00010-8.
[8] P. K. Farris, *Cosmeceuticals and Cosmetic Practice*. 2013. doi: 10.1002/9781118384824.
[9] M. Yao and J. Patel, "Rheological Characterization of Body Lotions," *Applied Rheology*, vol. 11, pp. 83–88, Apr. 2001, doi: 10.1515/arh-2001-0005.
[10] E. Parente, A. Mbaro, and G. Solana, "Study of sensory properties of emollients used in cosmetics and their correlation with physicochemical properties," *International Journal of Cosmetic Science*, vol. 27, p. 354, Nov. 2005, doi: 10.1111/j.1467-2494.2005.00289_3.x.
[11] L. Schramm, *Emulsions, Foams, Suspensions, and Aerosols: Microscience and Applications, 2nd Edition*. 2014. doi: 10.1002/9783527679478.
[12] D. Granato, M. Masson, and J. Ribeiro, "Sensory acceptability and physical stability evaluation of a prebiotic soy-based dessert developed with passion fruit juice," *Food Science and Technology (Campinas)*, vol. 32, pp. 119–126, Mar. 2012, doi: 10.1590/S0101-20612012005000004.
[13] ANVISA, *Cosmetic Product Stability Guide*, 1st ed. Brasília: National Health Surveillance Agency Press, 2005.
[14] L. Montenegro and L. Santagati, "Use of Vegetable Oils to Improve the Sun Protection Factor of Sunscreen Formulations," *Cosmetics*, vol. 6, p. 25, Apr. 2019, doi: 10.3390/cosmetics6020025.
[15] E. Fetil, S. Akarsu, T. Ilknur, E. Kuşku, and A. Güneş, "Effects of some emollients on the transmission of ultraviolet [J]," *Photodermatol Photoimmunol Photomed*, vol. 22, pp. 137–140, Jul. 2006, doi: 10.1111/j.1600-0781.2006.00221.x.
[16] M. L. Asztalos, M. M. Heller, E. S. Lee, and J. Koo, "The impact of emollients on phototherapy: A review," *J Am Acad Dermatol*, vol. 68, no. 5, pp. 817–824, 2013, doi: https://doi.org/10.1016/j.jaad.2012.05.034.
[17] Lubrizol, "Polymer Handling and Storage," *Pharmaceutical Bulletin 3*. pp. 1–8, May 31, 2011.
[17] Lubrizol, "Polymer Handling and Storage," *Pharmaceutical Bulletin 3*. pp. 1–8, May 31, 2011.
[18] T. W. Schwarz and G. Levy, "A Report on the Oxidative Degradation of Neutralized Carbopol™University of California School of Pharmacy, San Francisco 22," *Journal of the American Pharmaceutical Association (Scientific ed.)*, vol. 47, no. 6, pp. 442–443, 1958, doi: https://doi.org/10.1002/jps.3030470617.
[19] M. Todica, P. Cornel, L. Udrescu, and M. Pop, "Rheological Behavior of Some Aqueous Gels of Carbopol with Pharmaceutical Applications," *Chinese Physics Letters - CHIN PHYS LETT*, vol. 27, Jan. 2010, doi: 10.1088/0256-307X/27/1/018301.
[20] L. Chen, F. Ao, X. Ge, and W. Shen, "Food-Grade Pickering Emulsions: Preparation, Stabilization and Applications," *Molecules*, vol. 25, Jul. 2020, doi: 10.3390/molecules25143202.
[21] C. Albert, M. Beladjine, N. Tsapis, E. Fattal, F. Agnely, and N. Huang, "Pickering emulsions: Preparation processes, key parameters governing their properties and potential for pharmaceutical applications," *Journal of Controlled Release*, vol. 309, pp. 302–332, 2019, doi: https://doi.org/10.1016/j.jconrel.2019.07.003.
[22] Y. Burakova, J. Shi, and J. Schlup, "Impact of Oil Composition on Formation and Stability of Emulsions Produced by Spontaneous Emulsification," *Journal of Dispersion Science and Technology*, vol. 38, Jan. 2017, doi: 10.1080/01932691.2017.1281141.
[23] D. Terescenco, C. Picard, F. Clemenceau, M. Grisel, and G. Savary, "Influence of the emollient structure on the properties of cosmetic emulsion containing lamellar liquid crystals," *Colloids and Surfaces A: Physicochemical and Engineering Aspects*, vol. 536, pp. 10–19, 2018, doi: https://doi.org/10.1016/j.colsurfa.2017.08.017.
[24] R. Pal, "Effect of droplet size on the rheology of emulsions," *AIChE Journal*, vol. 42, no. 11, pp. 3181–3190, Nov. 1996, doi: https://doi.org/10.1002/aic.690421119.
[25] T. Dapčević Hadnađev, P. Dokic, V. Krstonošić, and M. Hadnađev, "Influence of oil phase concentration on droplet size distribution and stability of oil-in-water emulsions," *European Journal of Lipid Science and Technology*, vol. 115, Mar. 2013, doi: 10.1002/ejlt.201100321.
[26] D. Terescenco, G. Savary, C. Picard, F. Clemenceau, E. Merat, and M. Grisel, "Influence of the emollient on emulsions containing lamellar liquid crystals: from molecular organization towards applicative properties," *International Journal of Cosmetic Science*, vol. 40, no. 6, pp. 565–574, Dec. 2018, doi: https://doi.org/10.1111/ics.12498.
[27] T. F. Tadros, *An Introduction to Surfactants*. De Gruyter, 2014. doi: doi:10.1515/9783110312133.
[28] M. Ferreira da Silva *et al.*, "Development and characterization of a babassu nut oil-based moisturizing cosmetic emulsion with a high sun protection factor," *RSC Advances*, vol. 10, p. 37055, Jul. 2020, doi: 10.1039/d0ra00647e.
[29] S. A. Nasrollahi *et al.*, "Comparison of linoleic acid-containing water-in-oil emulsion with urea-containing water-in-oil emulsion in the treatment of atopic dermatitis: a randomized clinical trial," *Clin Cosmet Investig Dermatol*, vol. 11, pp. 21–28, Jan. 2018, doi: 10.2147/CCID.S145561.
[30] H. Hamishehkar *et al.*, "A comparative histological study on the skin occlusion performance of a cream made of solid lipid nanoparticles and Vaseline," *Research in Pharmaceutical Sciences*, vol. 10, pp. 378–387, Oct. 2015..