



EFFECT OF SURFACTANTS AND COSURFACTANTS ON THE CHARACTERISTICS OF MANGOSTEEN RIND EXTRACT HAND BODY LOTION

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ABSTRACT

The surfactants and co-surfactants combination in nanoemulsion formulations is important to obtain optimal formulations. Mangosteen rind extract has various benefits. Objective: determine the effect of a combination of surfactant (Tween 80) and Co surfactant (PEG 400) on the physical characteristics of mangosteen rind extract nanoemulsion. The research method was carried out by comparing the physical characteristics of the nanoemulsion formula of mangosteen rind extract by testing pH, viscosity and particle diameter. Three formulas were made (F1, F2 and F3) and one formula without co-surfactant as a negative control (KN). The combination of surfactant and cosurfactant provided pH, viscosity and particle diameter characteristics that were significantly different between formulas and with the negative control. The combination of surfactants and co-surfactants influences the properties of Mangosteen Rind Extract (*Garcinia mangostana* L) Hand and Body Lotion.

Keywords: cosurfactant; mangosteen rind nanoemulsion; surfactant

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INTRODUCTION

Personal care routines would be incomplete without the regular use of hand body lotions which are mostly formulated for their purpose of moisturising and protecting the skin (Mawazi et al., 2022). These products require a specific balance and interaction of parts, such as active extracts/surfactants/cosurfactants. Mangosteen Natural Extract (*Garcinia mangostana* L Rind) (Riezqa Nur Attazqiah & Ambarwati, 2021). One of the natural extracts that has attracted attention in cosmetic formulations is sourced from the rind of fruit, which comes under category called as Mangosteen Fruit (Shahaban, 2023). With its antioxydant (Mahendra et al., 2021), anti-inflammatory (Rohman et al., 2020) and antimicrobial properties (Pohan & Rahmawati, 2022), mangosteen pericarp extract holds great promise to also be used as an active ingredient in cosmetic products (Matan et al., 2024). Nanoemulsion technology is starting to be applied to cosmetic formulations to increase product effectiveness and stability (Pavoni et al., 2020). Nanoemulsion is a thermodynamically stable colloidal dispersion system, which consists of a mixture of surfactants and cosurfactants with nano sizes ranging from 20-200 nm (Atre, 2022), so that it can increase the penetration of active ingredients into the skin and extend the duration of release of the active ingredients (Choudhury et al., 2017). Research conducted by Ariyanti et al, (2023) shows that a formula in the form of nanoemulsion can increase humidity in rabbits.

However, to ensure the efficacy and stability of mangosteen rind extract in lotion formulations, surfactants and cosurfactants play a crucial role. Surfactants are molecules that reduce surface tension, facilitating the dispersion of oil and water, while cosurfactants assist in stabilizing emulsions and improving the texture and spreadability of lotions (Yuan et al., 2014). The choice and concentration of surfactants and cosurfactants can directly affect the

characteristics of the final product, such as its texture, absorption, stability, and effectiveness (Kumar et al., 2024). This study aims to investigate the effect of surfactants (tween 80) and cosurfactants (PEG 400) (Lestari et al., 2021) on the formulation characteristics of a hand body lotion containing mangosteen rind extract. Optimizing the surfactant-to-co-surfactant ratio enhances formulation stability and patient acceptability (Sari et al., 2021).

METHOD

Materials

The tools used in this research were a skin moisture meter, particle size analyzer (Malvern Zetasizer Pro), Rion viscometer (VT-03F), pH meter (Ohaus ST 300), glassware, magnetic stirrer (Labinco L-71), digital scale (Durascale Dabe 224), soxhletizer, porcelain cup, water bath (Memert), filter paper, stopwatch, personal protective equipment, shaver, cage and test animal equipment, The materials used in this research were mangosteen rind extract, virgin coconut oil (VCO), tween 80, PEG 400, TEA, cetyl alcohol, glycerin, white vaseline, distilled water, and 96% ethanol. Mangosteen rind powder was extracted using a soxlet using 96% ethanol solvent with a ratio of 1: 7.5, heated according to the boiling point of the solvent, filtered for 2 hours at a speed of 6-8 circulations per hour. The soxhletation results obtained are then filtered and evaporated over a water bath until an extract with the desired viscosity is obtained. Nanoemulsion by mixing the oil phase and water phase with surfactants and cosurfactants. The oil phase was made by mixing (tween 80, PEG 400 and VCO) and homogenizing at a speed of 1000 rpm for ± 10 minutes until the preparation was homogeneous. Add the water phase, namely distilled water, to the oil phase mixture, stir at a speed of 1250 rpm for ± 10 minutes until a homogeneous emulsion is formed. Add TEA and glycerin and stir until homogeneous, heat to a temperature of 70°C (A). Cetyl alcohol and white vaseline are heated in a water bath at 70°C and stir until homogeneous (B). Mix mixtures A and B using a magnetic stirrer until homogeneous and a lotion mass is formed. The mangosteen rind extract added gradually stir until homogeneous. The formula composition is shown in table I with the amount of each ingredient in percent

Ingredient	Function	F1	F2	F3	KN
Mangosteen rind extract	Active Ingredient	1	1	1	1
VCO	Oil phase	4	4	4	4
Tween 80	Surfactant	20	20,50	21	20
PEG 400	Cosurfactant	11	10,50	10	-
TEA	Alkalinizing agent	2 gtt	2 gtt	2 gtt	2 gtt
Cetyl alcohol	Thickener	3	3	3	3
Glycerin	Humectan	5	5	5	5
White Petroleum	Lotion base	2	2	2	2
Water	Water phase	100	100	100	100

Data analysis

The data were analyzed using normality and variance tests (Kolmogorov-Smirnov test and homogeneity of variances). For normally distributed data, it was continued to the one-way ANOVA test with a 95% confidence level to determine the significant effect concentrations. If the results of the ANOVA test were $p < 0.05$, then analysis of post hoc Least Significance Difference (LSD) to determine the significant differences in each treatment group was performed.

RESULT

The extract yield obtained was 25.38 g from 350 g of dry mangosteen rind powder with a yield of 16.92%. Homogeneity tests showed that all formulations were homogeneous. The pH test is carried out to determine the acidity level of the preparation and whether the pH of the preparation is comparable to the pH of the skin

Table 2.
 Characteristics of nanoemulsion hand body lotion mangosteen rind extract. Data represented as a mean \pm standard deviation n=5

Formulation	pH	Viscosity (mPas)	Particle diameter (nm)
F1	4.86 \pm 0.02	226 \pm 17.07	73.65 \pm 3.18
F2	5.25 \pm 0.02	140 \pm 5.00	112.85 \pm 0.19
F3	4.96 \pm 0.03	290 \pm 11.55	120.48 \pm 0.32
KN	5.61 \pm 0.02	240 \pm 8.16	228.45 \pm 14.56

DISCUSSION

The results of observing the pH value in the mangosteen rind extract nanoemulsion handbody lotion preparation are in table II. shows that there are differences in pH in each formula with differences in concentration between surfactant and cosurfactant. The pH test data for each formula shows that all formulas fall within the normal range of skin pH values. Based on the pH statistical test using One Way ANOVA, the results showed that each formula (F1, F2, F3 and KN) had a significantly different pH value (Sig<0.05). The test was continued using Post Hoc Tukey and the results obtained were that there was a significant difference (Sig<0.05) between F1, F2, F3 and KN. The conclusion from these further tests stated that variations in the combination of tween 80 and PEG 400 had a significantly different effect on the pH results of the mangosteen rind extract nanoemulsion handbody lotion preparation. This is because surfactants are amphiphilic molecules that have hydrophobic groups (insoluble in air) and hydrophilic groups (soluble in air) (Ghosh et al., 2020). When surfactants are dissolved in air, their hydrophilic groups can interact with H⁺ or OH⁻ ions in solution (Mishra et al., 2009). For example, if the hydrophilic group is acidic (such as a carboxyl group) or basic (such as an amine group) (Nikam et al., 2018), the surfactant can affect the concentration of H⁺ ions in the environment, which in turn changes the pH (N. et al., 2022). Co-surfactants are usually used to assist the main surfactant in reducing surface tension and helping micelle formation (Taher et al., 2022). Co-surfactants are often short-chain alcohols or fatty acids, which can also influence pH through interactions with air and ions.

Based on the viscosity statistical test using One Way ANOVA, the results showed that each formula (F1, F2, F3 and KN) had a significantly different viscosity value (Sig<0.05). The test was continued using Post Hoc Tukey and the results obtained were that there was a significant difference (Sig<0.05) between F1, F2, F3 and KN. The conclusion from these further tests stated that various combinations of Tween 80 and PEG 400 had a significantly different effect on the viscosity results of the mangosteen rind extract handbody lotion nanoemulsion preparation (Mardiyanto et al., 2024). The use of a single surfactant in the preparation of nanoemulsion handbody lotion can increase the viscosity of the preparation, while the addition of cosurfactant results in an interaction between Tween 80 and PEG 400 which results in a decrease in the viscosity of the preparation. The interaction between tween 80 and PEG 400 as a surfactant and cosurfactant can reduce the viscosity value of the preparation, namely tween 80 has an effect on increasing the viscosity value while the interaction between tween 80 and PEG 400 has an effect on decreasing the viscosity value preparation (Miksusanti et al., 2023)

Varying combinations of Tween 80 and PEG 400 had significantly different effects on the particle size diameter results. showed that the combination of surfactant and cosurfactant concentrations had significantly different particle size diameters for each formula (Sig<0.05). The test was continued using Post Hoc Tukey and the results obtained were that there was a significant difference (Sig<0.05) between F1, F2, F3 and KN. Surfactants have the capacity to decrease the interfacial pressure between the oil stage and the water stage in an emulsion. By

diminishing interfacial pressure, surfactants permit the oil stage to be scattered into littler beads, coming about in littler molecule sizes in nanoemulsions. Co-surfactants help the most surfactant by encourage bringing down the interfacial pressure or stabilizing the micelles shaped (Li & Friberg, 1982). A combination of surfactants and co-surfactants is regularly essential to realize a sufficient interfacial pressure to make exceptionally little and steady nanoparticles. After little beads are shaped, the surfactant encompasses the beads and shapes a defensive layer that avoids the beads from recombining into bigger beads (Yati et al., 2018). This surfactant layer steric or electrostatic soundness, depending on the sort of surfactant utilized. Co-surfactants can reinforce this layer by filling the crevices between surfactant particles, giving extra solidness that decreases the chance of little beads recombining (coalescence) (Pavoni et al., 2020). This makes a difference keep up a little and uniform molecule measure over a longer.

CONCLUSION

The combination of surfactants and co-surfactants influences the properties of Mangosteen Rind Extract (*Garcinia mangostana* L) Hand and Body Lotion.

REFERENCES

- Ariyanti, A., Masruriati, E., Setyowati, D., & Nurulita, F. (2023). Analysis of Moringa Leaf Nanoemulgel (*Moringa Oleifera* L.) and Aloe Vera as A Moisturizer for Male Rabbits in New Zealand. *Indonesian Journal of Global Health Research*, 5(3), 433-440. <https://doi.org/10.37287/ijghr.v5i3.2057>
- Bakri, D., Muhtadi, M., & Wikantyasning, E. (2023). Formulation and Characterization of Nanoemulsion from Traditional Extracts for Antidiabetic. *Indonesian Journal of Global Health Research*, 5(3), 441-448. <https://doi.org/10.37287/ijghr.v5i3.2035>
- Choudhury, H., Gorain, B., Pandey, M., Chatterjee, L. A., Sengupta, P., Das, A., Molugulu, N., & Kesharwani, P. (2017). Recent Update on Nanoemulgel as Topical Drug Delivery System. *Journal of Pharmaceutical Sciences*, 106(7), 1736–1751. <https://doi.org/10.1016/j.xphs.2017.03.042>
- Ghosh, S., Ray, A., & Pramanik, N. (2020). Self-assembly of surfactants: An overview on general aspects of amphiphiles. *Biophysical Chemistry*, 265(July), 106429. <https://doi.org/10.1016/j.bpc.2020.106429>
- Kumar, S., Wadhwa, K., Pahwa, R., Ali, J., & Baboota, S. (2024). Screening of surfactant mixture ratio for preparation of oil-in-water nanoemulsion: A technical note. *Journal of Applied Pharmaceutical Science*, 14(10), 121–127. <https://doi.org/10.7324/japs.2024.180648>
- Lestari, S. R., Gofur, A., Fajaroh, F., Maslikah, S. L., Annisa, Y., & Malek, N. A. N. N. (2021). Self-nanoemulsifying drug delivery system (SNEEDS) for improved bioavailability of active compound on single clove garlic: Optimization of PEG 400 and glycerol as co-surfactant. *AIP Conference Proceedings*, 2353(May 2023). <https://doi.org/10.1063/5.0052638>
- Li, G. Z., & Friberg, S. E. (1982). Surfactant/cosurfactant association and emulsion stability. *Journal of the American Oil Chemists Society*, 59(12), 569–572. <https://doi.org/10.1007/BF02636326>

- Mahendra, J., Sharma, V., Mahendra, L., Janani, M., Hussain, S. T., Janarthan, S., & Dave, P. H. (2021). Mangosteen (*Garcinia mangostana*): Compositional profile and usage in cancer molecular docking studies. *Onkologia i Radioterapia*, 15(12), 42–47.
- Mardiyanto, Mohadi, R., Fithri, N. A., & Kurniawan, G. (2024). Optimization of Nanoemulsion Formula Containing Erythromycin with VCO and Varying Concentrations of Tween-80 and PEG-400. *Science and Technology Indonesia*, 9(3), 697–709. <https://doi.org/10.26554/sti.2024.9.3.697-709>
- Matan, N., Kongchoosi, N., Sinthupachee, A., & Chaidech, P. (2024). Nutritional and bioactive compound analysis of mangosteen fruit in hill and flat land plantations, during both the season and off-season, in provinces along the Gulf of Thailand and the Andaman Sea. *NFS Journal*, 36(June), 100182. <https://doi.org/10.1016/j.nfs.2024.100182>
- Mawazi, S. M., Ann, J., Othman, N., Khan, J., Alolayan, S. O., Al Thagfan, S. S., & Kaleemullah, M. (2022). A Review of Moisturizers; History, Preparation, Characterization and Applications. *Cosmetics*, 9(3), 1–19. <https://doi.org/10.3390/cosmetics9030061>
- Miksusanti, Apriani, E. F., & Bihurinin, A. H. B. (2023). Optimization of Tween 80 and PEG-400 Concentration in Indonesian Virgin Coconut Oil Nanoemulsion as Antibacterial against *Staphylococcus aureus*. *Sains Malaysiana*, 52(4), 1259–1272. <https://doi.org/10.17576/JSM-2023-5204-17>
- Mishra, M., Muthuprasanna, P., Prabha, K. S., Rani, P. S., Babu, I. A. S., Chandiran, I. S., Arunachalam, G., & Shalini, S. (2009). Basics and potential applications of surfactants - A review. *International Journal of PharmTech Research*, 1(4), 1354–1365.
- N., S., CHANDRAKALA, V., & SRINIVASAN, S. (2022). Review on: Effect of Oil, Surfactant and Cosurfactant on Microemulsion. *International Journal of Current Pharmaceutical Research*, 14(4), 23–27. <https://doi.org/10.22159/ijcpr.2022v14i4.2011>
- Nikam, T. H., Patil, M. P., Patil, S. S., Vadnere, G. P., & Lodhi, S. (2018). Nanoemulsion: A brief review on development and application in Parenteral Drug Delivery. *Advance Pharmaceutical Journal*, 3(2), 43–54. <https://doi.org/10.31024/apj.2018.3.2.2>
- Pavoni, L., Perinelli, D. R., Bonacucina, G., Cespi, M., & Palmieri, G. F. (2020). An overview of micro- and nanoemulsions as vehicles for essential oils: Formulation, preparation and stability. *Nanomaterials*, 10(1). <https://doi.org/10.3390/nano10010135>
- Pohan, J., & Rahmawati, F. (2022). The effect of mangosteen pericarp (*Garcinia mangostana* Linn) extract on inhibits the growth of bacteria *Escherichia Coli* ATCC 25922 and bacteria *Staphylococcus Aureus* ATCC 25923. *International Journal of Research in Pharmacy and Pharmaceutical Sciences*, 7(2), 29–38. www.pharmacyjournal.in
- Riezqa Nur Attazqiah, & Ambarwati, N. S. S. (2021). Studi Literatur: Pemanfaatan Ekstrak Kulit Buah Manggis (*Garcinia mangostana* L.) Untuk Perawatan Kulit Wajah. *Jurnal Tata Rias*, 11(1), 101–110. <https://doi.org/10.21009/11.1.12.2009>
- Rohman, A., Arifah, F. H., Irnawati, Alam, G., Muchtaridi, & Rafi, M. (2020). A review on phytochemical constituents, role on metabolic diseases, and toxicological assessments of underutilized part of *Garcinia mangostana* L. fruit. *Journal of Applied Pharmaceutical Science*, 10(7), 127–146. <https://doi.org/10.7324/JAPS.2020.10716>

- Sari, A. I., Herdiana, Y., Raya, J., & Sumedang Km 21 Jatinangor, B. (2021). Review: Formulasi Nanoemulsi Terhadap Peningkatan Kualitas Obat. *Farmaka*, 16(1), 247–254.
- Shahaban, S. O. (2023). A review: Mangosteen an untapped source of bioactive. ~ 1619 ~ The Pharma Innovation Journal, 12(7), 1619–1628. www.thepharmajournal.com
- S. M., W., Leliqia, N., & C.I.S, A. (2013). Optimasi Komposisi Span® 60 Dan Tween® 80 Sebagai Emulgator Terhadap Stabilitas Fisik Dalam Formulasi Cold Cream Ekstrak Kulit Buah Manggis (*Garcinia mangostana* L.). *Jurnal Farmasi Udayana*, . Retrieved from <https://ojs.unud.ac.id/index.php/jfu/article/view/5760>
- Taher, S. S., Al-Kinani, K. K., Hammoudi, Z. M., & Ghareeb, M. mohammed. (2022). Co-surfactant effect of polyethylene glycol 400 on microemulsion using BCS class II model drug. *Journal of Advanced Pharmacy Education and Research*, 12(1), 63–69. <https://doi.org/10.51847/1H17TZQGYI>
- Yati, K., Amalia, A., & Puspasari, D. (2018). Effect of Increasing Concentrations of Tween 80 and Sorbitol as Surfactants and Cosurfactans Against the Physical Stability Properties of Palm Oil Microemulsion. *Advanced Science Letters*, 23(12), 12506–12509. <https://doi.org/10.1166/asl.2017.10803>
- Yuan, C. L., Xu, Z. Z., Fan, M. X., Liu, H. Y., Xie, Y. H., & Zhu, T. (2014). Estudio sobre las características y el daño de los tensioactivos. *Journal of Chemical and Pharmaceutical Research*, 6(7), 2233–2237.