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Determination of Chemical and Physical Properties of Soybean as Skin Care Product

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KEYWORDS

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ABSTRACT

The uses of Hydroquinone, Alpha Arbutin and Glutathione in whitening products can the thin the skin layer and harmful for human. This study is conducted to determine the properties of soybean milk as an alternative ingredient in whitening products. The formulations of this soybean emulsion were characterized via spectroscopy and skin analysis. The major components of soy are phospholipids, such as phosphatidylcholine and essential fatty acids acts as active compounds for whitening. The soymilk is extracted from soybean and added into the emulsion with the designated amount. The skin analysis shows that the emulsion with soybean milk (Formulation 3) gives the best result with 30.2341 melanin in skin colour test and the highest value in hydration and TEWL tests.

1.0 INTRODUCTION

Melanin is a skin pigment that makes the skin, hair and eyes look darker. People with dark skin tones have melanosomes that are higher in number, larger in size, and more pigmented than those with light skin tones (Kusumawati et al., 2015). In Asian countries, the person with fair complexation is considered beautiful and attractive (Couteau & Coiffard, 2016). This encourage

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women blindly eager to consume varieties of products in order to be brighter and whiter than before. However, most of the whitening products contains Hydroquinone, Glutathione and Alpha Arbutin that can remove the top layer of skin and increasing the risk of skin cancer (Chandorkar et al., 2021) (Westerhof & Kooyers 2020). Nowadays, cosmetic consumers are more aware of the high use of chemicals in skin care products. Therefore, consumers are selective to natural and organic ingredients that are more environmentally friendly and safe to use for all ages such as soybean.

Soybean also known as Glycemic max is highly contains of protein (3.5%), fat (2.0%) ash (0.5), carbohydrates (2.9%) and almost 90% of isoflavone. Isoflavone for soymilk is Genistein, the compound that can lighten the skin through melanin synthesis pathway and inhabiting melanin production (Ikya, 2013). The highly production melanin can make the skin darken while the less production of melanin can lead to the skin (Huang et al., 2008), (Seiberg et al., 2000). Studies have shown that more protein can be extracted from soybean be beneficial to sperm and bone marrow production, muscle strength, hair growth, and have hypolipidemic and antioxidant properties and can be used to beautify the skin (Lai et al., 2012).

In this research, we studied the compatibility of soymilk as whitening skin product by determine the properties, suitability, amount and stability of soymilk as additives in skin care emulsion.

2.0 EXPERIMENTAL PROCEDURE

The soybeans are poured into a beaker containing tap water and rinsed a few times. Then, the soybeans are left soaked overnight. After overnight, the soybeans are blended together with distilled water to produce soymilk solution. The soymilk solution is strained by using muslin cloth to obtain the unprecipitated soymilk. Then, the soymilk is heated until 100℃ for 45 minutes with continuous stirring. Set it aside and let it cool to ambient temperature.

For preservation process, we followed a very strict procedure by using clean equipment, use only distilled water and also added a preservation in order to exclusion or minimization of microorganisms. In this experiment, 1.0 ml of phenoxyethanol is added to 100 ml of soymilk and mix by using stirrer. Phenoxyethanol is used because Phenoxyethanol is commonly used as a preservative in cosmetic products to limit bacterial growth. Phenoxyethanol is also used to stabilize components found in perfumes and soaps.

For the emulsification process, the formulation is separated into two portions, the oil phase and the water phase. In the oil phase, the surfactants and the petroleum jelly are heated to 70˚C and will be mixed. While in the water phase, water is heated to 70˚C. After the two portions are reached 70˚C, the oil phase is added in water phase solution. When the mixture reached homogeneity, the mixture is stirred slowly with stirrer until the temperature of the mixture drops to 35˚C. Then the samples are placed in cool places for storage. The samples are under daily observation in order to detect any changes.

To obtain a good result, five formulations had been used in this experiment. The formulations are observed for 4 weeks to monitor their stability and determine the best formulation for skin care application.

Table 1 Formulation

	Formulation				
	1	**2**	**3**	**4**	**5**
Initial weight (g)			20 g		
Soy milk added (ml)	0.1	0.2	0.5	0.8	1.0
Stir duration			15 minutes		
pH	5.6	5.6	6.0	6.6	6.8

3.0 RESULTS AND DISCUSSION

Table 2 shows the emulsification composition of lotion base which before adding soymilk. This is the best composition for distilled water, tween 80, petroleum jelly and olive oil. There are five formulations that use the same composition of lotion base before adding soymilk. For the better calculation, there are percentages that shown the percent of material contained in a mixture.

Table 2 Composition of lotion base

Material	Weight, (g)	Weight Percent, (%)
Distilled water	9.16 g	45.8 %
Tween 80	4.84 g	24.2 %
Olive oil	4.50 g	22.5 %
Petroleum Jelly	1.50 g	7.5 %
Total	20.00 g	100.0 %

There are seven types of the sample have been used in the determination of pH of the sample which are the soy milk, lotion base, and five formulation samples.

Table 3 Result pH of the sample

Sample	pH reading
Soy milk	7.0
Lotion base	5.6
Formulation 1	5.6
Formulation 2	5.6
Formulation 3	6.0
Formulation 4	6.6
Formulation 5	6.8

Table 3 shows the pH result for natural soy milk at 7 which is neutral. Meanwhile for the lotion base, the pH is quite low at 5.6. However, the value is still suitable for human skin use. The suitable pH values for the human face and body are in the range of 5.5. to 7.5. Therefore, most cosmetic products produced comply with this pH value. For some cases involving sensitive and problematic skin, the acid and alkali pH values will vary according to the suitability of the user's skin condition. It is useful for normalizing skin conditions during disease, where the pH shifts to an alkaline environment (Paine et al., 2001). For the pH of five formulation, it could be concluded that the more quantity of soy milk added into solution, the pH of mixture will increase. But until the F5, the pH reading is 6.8 and it is still suitable for skin and cosmetic product (Iovine et al., 2011)

Table 4 shown the result of observation for four (4) weeks for stability and solubility test. All the samples are dissolved in water and there are no color changes to all the samples. For stability test, F4 and F5 shows two layers are occurred due to the composition water in soymilk (Nováčková, 2021). Thus, the increasing amount of soymilk can cause the formation of unstable layer in the mixture.

Table 4 Observation, Solubility & Stability Test

Sample	F 1	F 2	F 3	F 4	F 5
Soymilk added	0.1 ml	0.2 ml	0.5 ml	0.8 ml	1.0 ml
pH	5.6	5.6	6.0	6.6	6.8
Dissolve in water	yes	yes	yes	yes	Yes
Color change	no	no	no	no	no
Layer	no	no	no	yes	Yes
Duration	1-4 week				
Temperature	At room temperature				

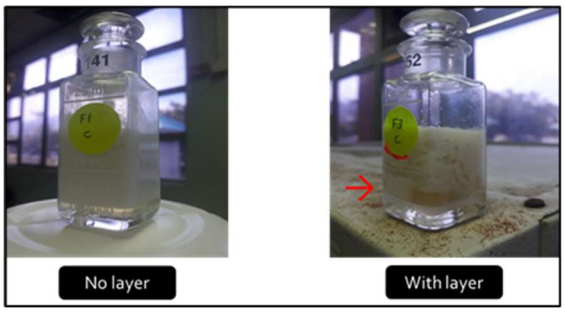

Figure 1 Layer presence

Stable : √ Unstable : X

For UV-vis analysis, there are only F1, F2 and F3 are selected based on stability test. The F4 and F5 samples are not efficient because it formed unstable and heterogenous composition. The UV Vis Spectroscopy had been set up between 200-400 nm wavelength. All of the samples show the absorbance values started at 250 nm and ended at 400 nm which is the range of UV absorption for UVB at 280-315 nm (Issa et al., 2000).

Wavelength, (nm)	Absorbance			
	Base	Formulation 1	Formulation 2	Formulation 3
255.5	0.600	0.620	0.680	0.800
285.2	0.778	0.800	0.879	0.910
362.7	0.023	0.070	0.217	0.251
364.5	0.027	0.068	0.215	0.249
382.6	0.017	0.061	0.205	0.230
389.8	0.015	0.058	0.203	0.228
396.1	0.015	0.059	0.202	0.220

From the graph, all three samples show the absorption wavelength between 255.5 – 396.1 nm that is the range of UVB absorption. The highest absorbance value is 0.91 at the wavelength of 272.2 nm for Formulation 3. From the graph, all three samples show the absorption wavelength between 255.5 – 396.1 nm that is the range of UVB absorption (Wang et al., 2020). The highest absorbance value is 0.91 at the wavelength of 272.2 nm for Formulation 3. For ultra violet-vis analysis, a high absorption value indicates that more of the particular type of wavelength is absorbed. In this study, when soy milk is added in the formula, it will act as a barrier layer of the skin from UVB rays and at the same time help keep the skin from sunburn and skin diseases (Chiari et al., 2014).

The hydration test is done to determine the ability to moisturize the skin after it has been applied. Table 5 has shown that the value between before and after is increasing.

Table 6 Result of hydration on sample

Sample	Before (uS)	After (uS)
Formulation 1	120.3772	143.1135
Formulation 2	120.3772	143.7621
Formulation 3	120.3772	164.2392

The skin functions as a barrier that prevents the evaporation of such essential elements as water, ions and amino acids. The role of a moisturizing skin care product is to act on skin surface to physically limit water loss or to act at the cellular level via different biological action models: reinforcement of the barrier function and of epidermal differentiation, restoration of skin lipids, stimulation of hygroscopic, endogenous factors which is water retention, improvement of cellular exchanges in solutes and in water (Smijs & Pavel, 2011). The initial value for skin hydration is 120.3772 *u*S and the value was increasing upon applying the Formulation. From the result, Formulation 3 gives the biggest difference value due to the highest amount of soy milk in sample (Knowland et al., 1993).

The skin colour test was carried out and the melanin (pigmentation) values were recorded based on an active colour detecting chip. Melanin is the pigmentation index of the skin. This measurement is used for the estimation of pigment level in the skin. The higher the values, the more level of pigment is in the skin. The melanin measurement was concluded that fairer skin will be obtained when the melanin content was decrease (Diane et al., 2020).

Table 7 Result of skin colour

Sample	Before (melanin)	After (melanin)
Formulation 1	34.1403	32.0234
Formulation 2	34.1403	31.9872
Formulation 3	34.1403	30.2341

Table 7 shows the differences of value between before and after the test testing. By applying the Formulation onto the skin, the melanin values were decreasing. Formulation 1 shows the smallest difference while Formulation 3 gives the biggest differences value with 34.1403 before and decrease to 30.2341 after the test. It shows that the amount of soymilk added into the Formulation gives a different value for each test. The Formulation with the highest amount of soymilk gives a better result in order to whiten the skin. It can be concluded that, the addition of soymilk can lower the melanin value and make the skin look brighter (Stiller et al., 2004).

4.0 CONCLUSION

In this project, soymilk can be as an active ingredient in skin care products based on the UV-vis and skin analysis. The UV Vis analysis stated that the formulation with highest amount of soymilk, gives highest absorbance in UVB wavelength. In addition, the properties of soymilk also can make the skin looks brighter due to its skin colour result. Besides, Formulation 3 with the highest amount of soymilk also gives a better result in hydration proves that by adding a lot of soy milk in the formula will give better analysis results.

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REFERENCES

Chandorkar N., Tambe S., Amin P. & Madankar C. H. (2021). Alpha Arbutin as a Skin Lightening Agent: A Review. International Journal of Pharmaceutical Research (13) 2

Chiari, B. G., Trovatti, E., Pecoraro, É., Corrêa, M. A., Cicarelli, R. M. B., Ribeiro, S. J. L. & Isaac, V. L. B. (2014). Application of several novel natural antioxidants to inhibit oxidation of tree peony seed oil. Industrial Crops and Products, 52, 389–393.

Couteau C. & Coiffard L. (2016). Overview of Skin Whitening Agents: Drugs and Cosmetic Products. Cosmetics (3) 27

Diane B., Nelson R. N., MPH., Mitchell S.& Wortzman (2020). Evaluation of skin barrier and hydration effects of a new rebalancing moisturizing treatment cream in a human epidermal skin model. Journal of the American Academy of Dermatology. 83 (6) AB218

Huang Z. R., Hung C.F., Lin Y.K. (2008). In vitro and in vivo evaluation of topical delivery and potential dermal use of soy isoflavones genistein and daidzein. Int J Pharm 364(1): 36-44

Ikya J, Gernah D, Ojobo H. (2013). Effect of cooking temperature on some quality characteristics of soy milk. Adv J Food Sci Technol; 5(5): 543-6

Iovine, B, Iannella ML, Gasparri F, Monfrecola G. & Bevilacqua, M. A. (2011). Synergic Effect of Genistein and Daidzein on UVB-Induced DNA Damage: An Effective Photoprotective Combination. Journal of Biomedicine and Biotechnology. 692846

Issa, T.S., Philippe, B., Raymond, H., Michel, H.& Jacques, D. (2000). Improved kinetic parameter estimation in pH-profile data treatmen. Int. J. Pharm. 198. 39

Knowland, J., McKenzie, E. A., McHugh, P.J., & Cridland, N. A. 1993. Sunlight-induced mutagenicity of a common sunscreen ingredient FEBS Letters, 324(3), 309–313

Kusumawati L A I, Dewi E N A, Xenograf O C, Rifrianasari K, Hidayat M A. 2015. Tyrosinase Inhibition Assay and Skin Whitening Cream Formulation of Edamame Extract (Glycine Max) Journal of Pharmacognosy and Phytochemical Research. 7(6).1167-1171

Lai J.,Xin C., Zhao Ya., Feng B., He C., Dong Y., Fang Y.& Wei S. (2012). Study of Active Ingredients in Black Soybean Sprouts and Their Safety in Cosmetic Use. Molecules. 17, 11669-11679

Nováčková, A., Sagrafena, I., Pullmannová, P., Paraskevopoulos, G., Dwivedi, A., Mazumder, A., Růžičková, K., Slepička, P., Zbytovská, J. & Vávrová, K. (2021). Acidic pH Is Required for the Multilamellar Assembly of Skin Barrier Lipids In Vitro. Journal of Investigative Dermatology. 141(8) 1915-1921

Paine C, Sharlow E, Liebel F. (2001). An alternative approach to depigmentation by soybean extracts via inhibition of the PAR-2 pathway. J Invest Dermatol:116(4): 587–95

Seiberg M, Paine C, Sharlow E. (2000). Inhibition of melanosome transfer results in skin lightening. J Invest Dermatol; 115(2):162–7.

Smijs, T. G., & Pavel, S. (2011). Titanium Dioxide and Zinc Oxide Nanoparticles in Sunscreens: Focus on Their Safety and Effectiveness. Nanotechnology, Science and Applications, 4(1), 95–112

Stiller, S., Gers-Barlag, H., Lergenmueller, M., Pflücker, F., Schulz, J., Wittern, K. P., & Daniels, R. (2004). Investigation of the stability in emulsions stabilized with different surface modified titanium dioxides. Colloids and Surfaces A: Physicochemical and Engineering Aspects, 232(2-3)261-267

Wang, J., Li, M., Zhang, J., Lv, Y., Li, X. & Guo. S. (2021). Effects of high-temperature pressure cooking on cold-grind and blanched soymilk: Physico-chemical properties, in vitro digestibility and sensory quality. Food Research International. 149. 110669

Westerhof W. & Kooyers T J. 2020. Hydroquinone and its analogues in dermatology – a potential health risk. Journal of Cosmetic Dermatology (4) 55-59