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Formulation and Evaluation of Celery Leaf (*Apium graveolens* L.) Extract Hand Lotion with Variations of Triethanolamine and Stearic Acid Concentration as Emulgator

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Abstract

Celery (*Apium graveolens* L.) contain flavonoid compounds, saponins, tannins and essential oils which function as antibacterials. The content of celery leaf extract is known to have very strong activity in inhibiting Staphylococcus aureus bacteria with an inhibitory zone diameter of 23.2 mm. Therefore, celery leaf extract has the potential to be developed into an active substance in making hand lotion. This research aims to determine the formulation and evaluation of celery leaf extract hand lotion and determine variations in the concentration of triethanolamine and stearic acid on the physical properties of the lotion. Variations in the concentration of triethanolamine and stearic acid used in making celery leaf extract hand lotion are F1 (2% : 7%), F2 (3% : 6%), F3 (4% : 5%). Physical quality testing includes organoleptic observations, homogeneity tests, pH measurements, spreadability, stickiness and viscosity. The data obtained were tested statistically using One Way ANOVA and Kruskall-Wallis tests. The research results showed that the hand lotion had a semi-solid form, was light green in color, and had the smell of green tea essence. The lotions were homogeneous and has no coarse grains. The results of the lotion spreadability of the three formulas met the requirements, namely 5.28-6.35 cm. The adhesive power of lotions was found to be 6.23-10.29 seconds. The pH of lotions was 4.7-6.8. The viscosity of the lotions was 4184-7488 cps. Varying concentrations of triethanolamine and stearic acid have a significant effect on the physical properties of hand lotions including pH, spreadability, stickiness and viscosity.

Keywords: *stearic acid, celery leaf extract, hand lotion, triethanolamine*

1. Introduction

Atopic dermatitis or eczema is a chronic inflammatory skin disease that generally occurs on the hands, face and feet characterized by dry skin, severe itching, and recurring reddish patches. Decreased skin barrier function will increase *Staphylococcus aureus* bacterial colonies and can worsen atopic dermatitis [1]. Therefore, it is necessary to make efforts to protect the skin, especially

the arms, using cosmetic preparations that are effective as antibacterials. One of the plants that has antibacterial activity against *Staphylococcus aureus* is celery leaf.

Celery (*Apium graveolens* L.) contains chemical compounds including flavonoids, essential oils, tannins, and saponins which have antibacterial functions [2]. Celery leave extract with a concentration of 4% was known to have antibacterial activity in the very strong category against Staphylococcus aureus with an inhibition zone diameter of 22.2 mm [3]. Based on previous research, celery extract in liquid soap preparations could inhibit the growth of Staphylococcus aureus by 23.2 mm with the use of an extract concentration of 10% [4]. Therefore, celery leave extract has the potential to be used as an active antibacterial substance in the manufacture of cosmetic preparations, especially hand lotion.

Lotion is a liquid emulsion preparation consisting of water and oil phases with an emulsifier as a stabilizer. Lotion can contain one or more active ingredients. Lotions have various advantages, including being able to spread evenly, being easy to apply, and working directly on local tissue so that it is easier to achieve the expected therapeutic effect [5]. In addition, this preparation is practical for daily use and can reduce the spread of *Staphylococcus aureus* bacteria in atopic dermatitis sufferers in the skin area of the hands. The concentration of ingredients in the lotion formulation can affect the stability of the preparation. One of the important ingredients used in lotion formulation is an emulsifier.

Emulsifiers that can be used are a combination of triethanolamine and stearic acid. Triethanolamine will form a stable emulsion when combined with free fatty acids. One example of free fatty acid is stearic acid [6]. The use of variations in the concentration of triethanolamine and stearic acid is known to affect the physical properties of lotion preparations. Research conducted by Febrianto (2021) shows that the use of variations of triethanolamine and stearic acid emulsifiers in the formulation of red spinach (*Amaranthus tricolor* L.) leaf extract antioxidant lotion can affect the physical properties of the preparation including organoleptic tests, homogeneity tests, spreadability, and adhesion [7].

Therefore, it is necessary to formulate a celery leaf extract hand lotion preparation to determine the physical properties of the preparation and to determine the effect of variations in the concentration of triethanolamine and stearic acid on the physical properties of the hand lotion.

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2. Method

d. Materials and Tools

The materials used were celery (*Apium graveolens* L.) simplicia, glycerin, triethanolamine, lanolin, alcohol, paraben, stearic acid, propyl citric acid, methyl paraben, 70% ethanol, green tea essence, and distilled water. Meanwhile, the tools used were adhesive strength tester, thermometer, blender, stirring rod, horn spoon, petri dish, clamp, moisture analyzer, funnel, beaker, watch glass, mortar, stamper, pH meter, rotary evaporator, maceration jar, analytical balance, and Brookfield viscometer.

e. Plant Determination

Celery plant determination was carried out at the Laboratory of the Center for Research on Traditional Medicinal Plants (BBPTOOT) Tawangmangu.

f. Celery Leaf Extract Preparation

Small pieces of celery leaf simplicia as much as 500 grams were put into a maceration container with 70% ethanol with a ratio of 1:7. The maceration process was carried out for 3x24 hours with stirring at least once a day and continued with remaceration for 2x24 hours. The macerate results were evaporated with a rotary evaporator at a temperature of 60°C, then continued with thickening using waterbath at a temperature below 50°C until it forms a thick extract, then weighed and stored in a tightly closed container.

g. Phytochemical Screening

1) Flavonoid Detection

A total of 250 mg of extract was dissolved using 5 mL of ethanol, then heated for 5 minutes in a test tube. Then 0.2 grams of magnesium was added. The results showed positive flavonoids if a dark red color was obtained for 3 minutes [8].

2) Saponin Detection

Saponin test was done by Forth method, by inserting 2 mL of sample into a test tube then adding 10 mL of aquadest and shaking for 30 seconds, observing the changes that occur. Positive saponin test was indicated by the formation of stable foam of 1-10 cm for 30 seconds.

3) Tannin Detection

Celery leaf extract as much as 0.1 grams was mixed with 5 mL of distilled water and heated over a water bath. The mixture was filtered and 2 drops of 1% ferric chloride

($FeCl_3$) were added to the filtrate and observed, if the solution turned dark green indicating the presence of tannins [9].

h. Hand Lotion Preparation

Table 1. Celery Leaf Extract Hand Lotion Formula

Materials	Formula			Function
	F1 (%)	F2 (%)	F3 (%)	
Celery leaf extract	10	10	10	Active Substance
Triethanolamine	2	3	4	Emulgator
Stearic Acid	7	6	5	Emulgator
Lanoline	3	3	3	Emollient
Cetyl alcohol	5	5	5	Thickener
Glycerin	8	8	8	Humectant
Methyl paraben	0,1	0,1	0,1	Preservative
Propyl paraben	0,1	0,1	0,1	Preservative
Citric acid	1	1	1	Acidifying Agent
Green tea essence	qs	qs	qs	Fragrance
Distilled water	ad 100	ad 100	ad 100	Solvent

Oil phase ingredients such as lanolin, paraben, stearic acid, propyl, and acetyl alcohol were dissolved at a temperature of 65°C-75°C in a water bath. Meanwhile, water phase ingredients such as methyl paraben, glycerin, distilled water, and trieta nolamin were dissolved separately at a temperature of 65°C to 75°C. After all phases are dissolved, the water phase was added little by little to the oil phase in a mortar while stirring continuously to form an emulsion. Then the mixture was added with celery leaf extract (as an active ingredient). Finally, the lotion preparation was packaged in a container and the physical properties of the preparation were tested.

i. Physical Evaluation of Hand Lotion

1) Organoleptic Test

The organoleptic test aims to determine the physical appearance of the hand lotion preparation, carried out by visually observing the texture, color, and odor of the preparation.

2) Homogeneity Test

Homogeneity testing was carried out by applying the sample to a transparent tool or glass, the preparation was homogeneous if there were no coarse particles [10].

3) pH Test

pH test was carried out using pH meter. Measurement was done by dipping the pH meter electrode into each hand lotion formula, and the pH value of the preparation will appear automatically on the pH meter [1].

4) Spreadability Test

The spreadability test was carried out by placing a 0.5 gram sample on the top of a scaled glass and covering it with the same glass. Then a constant load of 50-250 grams was given, each additional load was waited for 1 minute and then the diameter of the spread of the hand lotion was measured (carried out at certain times periodically).

5) Adhesive Power Test

A total of 0.5 grams of hand lotion was placed on a glass object measuring 2 x 2 cm, then covered with another glass object. A load of 0.5 kg was placed on the glass object for 5 minutes. Then the glass object was attached to the test equipment and the load of 80 grams was released and the time required for the two glass objects to be released was recorded.

6) Viscosity Test

The viscosity measurement of this hand lotion used a Brookfield viscometer with spindle number 4. The viscosity test of the preparation was carried out by inserting 100 mL of lotion into a glass beaker then lowering the spindle until it was immersed in the preparation. Then the lotion preparation will be read after pressing "start" and waiting for the results to appear on the tool display automatically.

3. Result and Discussion

a. Plant Determination Results

The results of celery plant determination showed that the plant belongs to the *Apiaceae* family with the species name *Apium graveolens* L. This determination proves that the celery leaves used are celery plants of the *Apium graveolens* L. species.

b. Result of Celery Leaf Extract Preparation

Celery leaf extract was made using the maceration method with a ratio of 1:7. The maceration process was carried out for 3x24 hours, then re-maceration was carried out with the same solvent for 2x24 hours and filtered to obtain the macerate. The macerate obtained was then evaporated on a water bath at a temperature below 50°C to prevent damage to the active substance. The water content obtained from the thick celery leaf extract met the requirements, which was 16.79%. The requirements for water content for thick extracts are 5%-30% [11]. The characteristics of the celery leaf extract that had been made had a thick texture, had a blackish green color, and had a distinctive celery odor. The thick celery leaf extract obtained was 115.76 grams and the extract yield was 23.152%.

c. Phytochemical Screening Results

Table 2. Phytochemical Screening Results

Detection	Result	Parameters
Flavonoid	(+) Yellow	Dark red, brown or yellow
Tanin	(+) Blackish green	Dark green
Saponin	Constant foam 1 cm high for 2 minutes	Stable foam 1-10 cm high for 2 minutes

Based on the results of the phytochemical test, celery leaf extract showed positive flavonoids, tannins, and saponins. The results of the flavonoid test showed positive results, indicated by the presence of yellow in the celery leaf extract. Flavonoid compounds form complex compounds with extracellular and dissolved proteins that cause damage to the cell membrane of bacteria and the release of intracellular compounds [12].

The results of the tannin test showed positive results, indicated by the formation of a blackish green color in the preparation. The blackish blue color is produced from hydrolysis tannins while the blackish green comes from condensation tannins. It is estimated that there is a reaction between $FeC1_3$ and one of the hydroxyl groups in the tannin compound during the process of adding reagents to the sample [8].

The results of the saponin test showed positive results, indicated by the presence of stable foam with a height of 1 cm for 30 seconds. Saponins contain glycosyl which is useful as a polar group and its non-polar groups are triterpenoids and steroids. The active

properties of the polar and nonpolar groups cause when shaken using saponin water to form, for example. The nonpolar group in the micelle structure will face inward while the polar group will face outward. This test can see how the sample's ability to form foam.

d. Results of Physical Properties of Hand Lotion

The purpose of the physical evaluation of celery leaf extract hand lotion with variations of triethanolamine and stearic acid is to determine the quality of the cream produced with variations in emulsifier concentration. Physical evaluation of hand lotion preparations includes: organoleptic tests, homogeneity, pH, adhesion, spreadability, and viscosity.

1) Organoleptic Test Results

Table 3. Organoleptic Test Results

Formulas	Odor	Color	Consistency
F1	Green tea	Blackish Green	Semi Solid
F2	Green tea	Blackish Green	Semi Solid
F3	Green tea	Blackish Green	Semi Solid

The results of the three hand lotion formulas showed a consistent semisolid lotion form, but there were differences between the three formulas, namely in their consistency and viscosity. The light green color of the lotion preparation is the result of the celery leaf extract content. The three formulas have a green tea odor due to the addition of essence. Based on the results of the organoleptic test, it can be seen that the differences in triethanolamine and stearic acid variations affect the form or consistency of the lotion preparation, where the function of stearic acid in addition to being an emulsifier also functions as a thickener. Therefore, the higher the concentration of stearic acid, the thicker the texture of the resulting preparation.

2) Homogeneity Test

This test aims to find out and see how the ingredients in the lotion preparation are mixed. The three celery leaf extract hand lotion formulas show a homogeneous preparation. This is indicated by the absence of coarse grains in the preparation that meets the homogeneity requirements, namely being homogeneous and having no coarse grains. Homogeneous preparations have good quality because they indicate the

even dispersion of the medicinal ingredients to the base material so that there is the same amount of medicine in each part of the preparation.

3) pH Test

Table 4. pH Test Results

Formulas	pH ± SD
F1	4,7±0,266
F2	5,3±0,250
F3	6,8±0,112

Based on Table 4., shows that the lotions in F1, F2, F3 have a good pH for the skin and meet the parameters. Triethanolamine has a pH of 10.5 which is a weak base while stearic acid has a weak acid pH value of 6.5, so that it can reduce the very high alkalinity level in triethanolamine [6]. All hand lotion formulas have a pH that meets the pH requirements for lotion preparations, namely between 4-7.5 with reference to SNI 16-4952-1998 [13]. The pH of hand lotion greatly affects the skin when applied, if the pH of the hand lotion is too acidic it will cause skin irritation while the pH of the preparation that is too high can cause dry skin. Based on the results of Kruskal-Wallis statistical tests, the sig. value <0.05 was obtained, which means that the variation in the concentration of triethanolamine and stearic acid used in the celery extract hand lotion formulation had a significant effect on the pH value of the preparation.

4) Spreadability Test

Table 5. Spreadability Test Results

Formulas	Spreadability ± SD (cm)
F1	5,28±0,098
F2	5,77±0,251
F3	6,35±0,360

Based on Table 5., hand lotion F1, F2 and F3 had met the requirements of comfortable spreading power parameters for the skin and each of the formulas had a different spreading power value. Stearic acid used in celery leaf lotion preparations is

used as a thickener, meaning that the greater the concentration of stearic acid added, the lower the spreading power will be and the more concentration of TEA added, the thinner the preparation will be so that the spreading power is higher. A comfortable lotion preparation to use is a preparation that has a spreading power of 5-7 cm [14]. Based on the results of the statistical test with one-way ANOVA, the sig. value was obtained <0.05, which means that the variation in the concentration of triethanolamine and stearic acid used in the celery extract hand lotion formulation had a significant effect on the spreadability of the preparation.

5) Adhesive Power Test

Table 5. Adhesive Power Test Results

Formulas	Adhesive Power ± SD (seconds)
F1	5,28±0,098
F2	5,77±0,251
F3	6,35±0,360

The requirement of a good adhesion test on a lotion preparation is more than 4 seconds [14]. Based on Table 4, hand lotion F1, F2, F3 had met the requirements. The higher the concentration of stearic acid added, the denser the celery leaf extract lotion preparation will be where the adhesion values F1 to F3 have a shorter time. Based on the results of statistical tests with one-way ANOVA, the sig. value <0.05 was obtained, which means that the variation in the concentration of triethanolamine and stearic acid used in the celery extract hand lotion formulation had a significant effect on the adhesive power of the preparation.

7) Viscosity Test

Table 6. Viscosity Test Results

Formulas	Viscosity ± SD (cPs)
F1	7466±286.04
F2	5557±399.64
F3	4184±1135.7

Based on Table 6., hand lotions F1, F2, and F3 have met the requirements for good viscosity parameters, namely 2000-50000 cPs. The higher the concentration of stearic acid, the higher the viscosity of the hand lotion. This happens because stearic acid is not only useful as an emulsifier, but also as a thickener so that if the concentration is higher, the viscosity will increase. In accordance with the theory of Sheskey *et al.* (2017), that triethanolamine as an emulsifier in the water phase has hygroscopic properties so that the greater the concentration of triethanolamine, the thinner the preparation will be [15]. According to the theory of Zurkarnain *et al.* (2013) Viscosity is directly proportional to adhesive power while with spreadability, viscosity has an inverse relationship [16]. The higher the viscosity value, the higher the adhesive power and the lower the spreadability. Based on the results of the statistical test with Kruskal-Wallis, the sig. value was obtained <0.05, which means that the variation in the concentration of triethanolamine and stearic acid used in the celery extract hand lotion formulation had a significant effect on the viscosity of the preparation.

4. Conclusion

The conclusion of this study was that the formulation of celery leaf extract hand lotion (*Apium graveolens* L.) with a comparison between triethanolamine and stearic acid variations in formula 1 (2%: 7%), formula 2 (3%: 6%), and formula 3 (4%: 5%) had met all the requirements for evaluating physical properties. In addition, there was a significant effect between variations in the concentration of stearic acid and triethanolamine as an emulsifier on the physical evaluation of celery leaf extract hand lotion preparations (*Apium greaveolens* L.) including pH, adhesion, spreadability, and viscosity tests.

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6. References

[1] V. S. Putri, V. Hadi, A. D. Nuryani, & A. Ambarwati, "Effect of Cocamidopropyl Betaine (CAPB) Concentration on Physical Characteristic of Basil Leaves (Ocimum Basilicum L.) Essential Oil Facial Wash," Medical Sains : Jurnal Ilmiah Kefarmasian, vol. 9, no. 2, pp. 477-485, 2024.

[2] Kusnad & E. T. Devi, "Isolasi Dan Identifikasi Senyawa Flavanoid Pada Ekstrak Daun Seledri (Apium Graveolens L.) Dengan Metode Refluks," PSEJ (Pancasakti Science Education Journal), vol. 2, no. 1, pp. 56–67, 2017.

[3] K. Khaerati & Ihwan, "Uji Efek Antibakteri Ekstrak Etanol Herba Seledri (Apium graveolens Linn.) Terhadap Escherichia coli dan Staphylococcus aureus dan Analisis KLT Bioautografi," *Jurnal Biocelebes*, vol. 5, no. 1, pp. 1978–6417, 2011.

[4] S. Idawati, A. Suhada, R. A. Fardani, & S. Arini, "Antibacterial activity test of celery leaf (Apium graveolens) extract liquid hand soap against Staphylococcus aureus," *Jurnal Pijar Mipa*, vol. 18, no. 1, pp. 98–104, 2023.

[5] Tranggono & F. Latifah, "*Buku Pegangan Ilmu Pengetahuan Kosmetik edisi kedua*," Jarkarta: Gramedia Pustaka Utama, 2018.

[6] D. Saryanti, D. Nugraheni, N. Sindi Astuti, & I. Pertiwi, "Optimasi Karbopol dan HPMC dalam Formulasi Gel Antijerawat Nanopartikel Ekstrak Daun Sirih (Piper Betle Linn)," *Jurnal Ilmiah Manuntung*, vol. 5, no. 2, pp. 192–199, 2019.

[7] Y. Febrianto, N. P. Santari, & W. Setiyaningsih, " Formulasi Dan Evaluasi Handbody Lotion Ekstrak Daun Bayam Merah (Amaranthus Tricolor L.) Dengan Variasi Konsentrasi Trietanolamin Dan Asam Stearat Sebagai Emulgator," *Jurnal Farmasi & Sains Indonesia*, vol. 4, no. 1, pp. 29–35, 2021.

[8] M. Sangi, M. R. J. Runtuwene, & H. E. I. Simbala, "Analisa Fitokimia Obat Di Minahasa Utara." *Chemistry Progres*, vol. 1, no. 1, pp. 47–53, 2008.

[9] Ramadanil, Damry, Rusdi, Hamzah, B., & Zubair, M. S. (2019). Traditional usages and phytochemical screenings of selected Zingiberaceae from central Sulawesi, Indonesia. *Pharmacognosy Journal*, *11*(3), 505–510.

[10] V. S. Putri, S. Sugiyanti, A. O. T. Dewi, "Formulasi Dan Evaluasi Fisik Sediaan Gel Ekstrak Sirih Cina (Peperomia pellucida L. Kunth) Dengan Variasi Carbopol Sebagai Gelling Agent," Jurnal Farmasindo, vol. 7, no. 1, pp. 7-13, 2023.

[11] Y. P. Utami, A. H. Umar, R. Syahruni, & I. Kadullah, "Standardisasi Simplisia dan Ekstrak Etanol Daun Leilem (Clerodendrum minahassae Teisjm. & Binn.). *Journal of Pharmaceutical and Medicinal Sciences*, vol. 2, no. 1, pp. 32–39, 2017.

[12] R. A. P. N. I. Sari & Supartono, and S. Mursiti, "Lotion Ekstrak Daun Sirsak (Annona muricata L .) sebagai Antibakteri," *Indonesian Journal of Chemical Science*, vol. 6, no. 3, pp. 190–194, 2017.

[13] H. Eliska, T. Gurning, A. C. Wullur, & W. A. Lolo, "Formulasi Sediaan Losio Dari Ekstrak Kulit Buah Nanas (Ananas Comosus L. (Merr)) Sebagai Tabir Surya," *Pharmacon*, vol. 5, no. 3, pp. 110–115, 2016.

[14] A. M. E. Salendra, P. V. Y. Y. Yamlean, & W. A. Lolo, "Pengaruh Konsentrasi Basis Gel Ekstrak Etanol Daun Tapak Kuda (Ipomoea Pes-Caprae (L.) R. Br.) Terhadap Aktivitas Antibakteri pada Staphylococcus aureus," *Pharmacon Jurnal Ilmiah Farmasi*, vol. 7, no. 3, pp. 220–229, 2018.

[15] P. J Sheskey, W. G. Cook, & C. G. Cable, "*Handbook of Pharmaceutical Excipients Eighth edition*," pp. 468–472, 2017.

[16] A. K. Zurkarnain, M. Susanti, & A. N. Lativa, "Stabilitas Fisik Sediaan Lotion O/w dan W/o Ekstrak Buah Mahkota Dewa sebagai Tabir Surya dan Uji Iritasi Primer pada Kelinci," *Trad. Med. J.*, vol. 18, no. 3, pp. 141-150, 2013.