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Development of Foundation Formulation From Eggshells as Anti UV Agent

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ABSTRACT

Foundation often contains anti-UV filters whether synthetic or natural. One of the natural ingredients that can be used as an anti-UV agent is eggshells because they contain calcium carbonate. This study aim to develop foundation as cosmetic preparation containing of duck eggshells and Moringa seed oil (Moringa oleifera Lam.) for anti-UV agent. The combination of duck eggshell and moringa seed oil is carried out with the hypothesis can increase the ability of the preparation to protect the skin from exposure to solar radiation. Foundation preparation were made in 6 formulas with varying concentrations of duck eggshells and moringa seed oil. Evaluation of the preparations carried out included organoleptic test, homogeneity, pH, viscosity, spreadability, and color dispersion for 28 days at room temperature, freeze thaw stability test for 6 cycles, and anti-UV activity were carried out using spectrophotometry UV-Vis. The results of the evaluation were analyzed using One-Way ANOVA method. Based on the results of physical evaluation analysis, all formulas showed stable foundation preparations. All preparations showed a non-irritative category after an irritation test on test animals (albino rabbits). Anti-UV activity with an average SPF value for F0 was 4,2±0,29 (minimal category), F1 was 18.75±1.41 (ultra category), F2 13.68±0.73 (maximum category), F3 14.00±0.46 (maximum category), F413.02±0.47 (maximum category), and F5 18.14±0.31 (ultra category).

Keywords: Eggshells, moringa seed oil, cosmetic foundation, SPF

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1. Introduction

Nowadays, there are many forms of cosmetics on the market, one of which is foundation. Foundation is a cosmetic preparation that used to improve the appearance and imperfections on the face (1). Foundation is often equipped with Sun Protection Factor (SPF) as an additional protection from ultraviolet exposure. Foundations usually contain synthetic UV filters including octyl methoxycinnamate, or oxybenzone to prevent exposure to UV radiation. However, these components have been associated with a large number of genotoxic, photoallergic, and environmental problems (2).

The efforts to replace the use of synthetic materials with natural UV filters was increased, one of which is eggshell and moringa seed oil. Eggshells contain 95% of calcium carbonate which can be utilized as an active ingredient as a sunscreen that reflects and scatters the sun's UV rays by forming an opaque layer on the skin surface (3). This is directly proportional to the Usman & Muin research (4), which states that calcium carbonate (CaCO3) obtained from chicken eggshells can be used as an active substance in sunscreen creams with chicken eggshell concentrations of 10-15% and produces UV protection categories, namely the extra category with SPF values of 6-8.

Moringa seed oil contains 79.4% to 85% oleic acid, phenols, flavonoids and tocopherols which have the potential as natural antioxidants and moisturizers to prevent dryness and skin aging and can be used as a sunscreen agent (5). Moringa seed oil (Moringa oleifera Lam.) cream preparations obtained SPF values in the range between 12-19 which fall into the maximum SPF category (5). Then in Azzahra et al research (6) which obtained the SPF value of moringa seed oil ranging from 8.54 (extra category) to 23.34 (ultra category).

Nowadays cosmetics consumers are increasingly aware of product-related issues, and are looking for products that are more natural, green, organic, and related to health concepts (7). Therefore, the development of cosmetics using natural ingredients to protect the skin from the negative effects of ultraviolet (UV) radiation has great potential for research.

Based on the description above, researchers are interested to formulating duck eggshell and moringa seed oil in the form of foundation preparations that have the ability as anti-UV and safe to use.

2. Method

Materials

Calcium carbonate from duck eggshells that obtained from food vendors in Bandung City, Moringa seed oil (Happy Green, CV. Mikaya Makmur Sejahtera, Surabaya), Sorbital monooleate (PT. Kimia Jaya Abadi), Polysorbate 80 (PT. Kimia Jaya Abadi), Triethanolamine (CV. Aloin Labora), Propanediol, Stearic Acid (PT. Wilmar Nabati Indonesia), Cetyl alcohol (PT. Wilmar Nabati Indonesia), paraffin liquid (PT. Kimia Jaya Abadi), DMDM Hydantoin (Troy Siam Co. Ltd.), Dimethicone (PT. Kimia Jaya Abadi), Virgin Coconut Oil (Naturalpedia), iron oxide color pigment (Naturalpedia), Aquadest, 96% alcohol pro analysis (PT. Smart-Lab Indonesia).

Method

Eggshells Processing

Duck eggshells with smooth and fresh surfaces were selected and washed until they were completely free of dirt and mucus, the white membrane on the inside

of the shell was removed, then soaked it for 15 minutes in 80°C water. The eggshells were dried in the sun until dry eggshells are obtained. Then the eggshells are dried again for 15 minutes in the oven at 100°C. After dried, the eggshells are ground and crushed using a blender/grinder and then passed through a 325 mesh sieve to produce a fine eggshell powder (4). Duck eggshells contained higher calcium and lower magnesium, the result obtained showed that egg shell of the plain duck has high CaCO3 content (91%) (8).

Optimization of Foundation Base

Optimization of the foundation base formulation was carried out by varying the concentration of Sorbital monooleate and Polysorbate 80 as contained in table 1. Base characterization includes organoleptic testing, homogeneity, pH, spreadability and viscosity (9). Furthermore, the best base formula was added with duck eggshell and moringa seed oil with various concentration variations.

Foundation Preparation

The foundation preparation was made by heating the oil phase and water phase in different containers. The oil phase (stearic acid, cetyl alcohol, paraffin liquid, sorbital monooleate, dimethicone, and VCO) and the water phase (propanediol, TEA, Polysorbate 80 and distilled water). Both phases were melted at 70°C. Duck eggshell powder, and iron oxide were mixed until homogeneous. The three mixtures were put into a beaker glass and then mixed with ultraturrax (RPM 3600) until homogeneous. When the temperature had dropped to room temperature, moringa seed oil and DMDM hydantoin were added while still stirring until homogeneous (4). The process of making foundation preparations is carried out with reference to the draft formula contained in table 2.

Table 1. Formulas of Foundation Base (10)

Ingredients	**Concentration (%)**		
	F1	**F2**	**F3**
Stearic acid	3	3	3
Cetyl alkohol	6	6	6
Paraffin liquid	10	10	10
Sorbital monooleat	3,25	5,5	7,75
Dimethicone	5	5	5
Polysorbate 80	7,75	5,5	3,25
Trietanolamin (TEA)	2	2	2
Propanediol	5	5	5
VCO	5	5	5
DMDM Hydantoin	0,6	0,6	0,6
Iron oxide color pigment	1	1	1
Aquadest	Ad 100	Ad 100	Ad 100

Table 2. Formulas of Foundation Preparation from Duck Egg Shell with Combination of Moringa Seed Oil (*Moringa oleifera Lam.*)

Ingredients	Concentration (%)					
	F0	**F1**	**F2**	**F3**	**F4**	**F5**
Duck eggshells	-	15	5	7,5	10	-
Moringa seed oil	-	-	10	7,5	5	15
Stearic acid	3	3	3	3	3	3
Cetyl alkohol	6	6	6	6	6	6
Paraffin liquid	10	10	10	10	10	10
Sorbital monooleat	5,5	5,5	5,5	5,5	5,5	5,5
Dimethicone	5	5	5	5	5	5
Polysorbate 80	5,5	5,5	5,5	5,5	5,5	5,5
Trietanolamin	2	2	2	2	2	2
Propanediol	5	5	5	5	5	5
VCO	5	5	5	5	5	5
DMDM Hydantoin	0,6	0,6	0,6	0,6	0,6	0,6
Iron oxide color pigment	0,45	0,45	0,45	0,45	0,45	0,45
Aquadest	Ad 100	Ad 100	Ad 100	Ad 100	Ad 100	Ad 100

Foundation Stability Test

The physical stability test was conducted using the cycling test method. The test was conducted at a low temperature of ±4°C for 24 hours and a high temperature of ±40°C for 24 hours (1 cycle). This test was carried out for 6 cycles, then changes that occurred in the preparation were observed including organoleptic test, homogeneity test, pH measurement, spreadability and viscosity measurement (11).

Irritation Test

The irritation test was carried out using the Draize skin test method in vivo using healthy albino rabbits that had no wounds or abnormalities on their skin (12). Irritation testing is done by applying the preparation about 2x2 cm on the skin of the rabbit's back. Inflammatory processes classified as skin irritation are characterized by the presence of edema (accumulation of fluid under the skin and intersitisial spaces) and erythema (redness of the skin due to increased local blood flow). Observations were made at 24 hours and continued for the next 72 hours.

Foundation Anti-UV Activity Test

Determination of the sunscreen effectiveness of the foundation preparation was carried out using a UV-Vis spectrophotometer. The preparation was weighed as much as 0.5 g and then dissolved with 25 mL of 96% ethanol pro analysis (20,000 ppm). Then sonicated for 6 minutes using a sonicator and then filtered using filter paper. Absorbance sample was analyzed every 5 nm in the wavelength range of 290 nm to 320 nm. Ethanol 96% was used as a blank. The absorbance data obtained was substituted into Mansur's SPF equation using the constant (EE x I) (Table 3) (13). The equation to determine the Sun Protection Factor value is as follows:

$$SPFspectrophotometric = CF \sum_{290}^{320} xEE(\lambda)xI(\lambda)xAbs(\lambda)$$

Description:
EE = Erythema effect spectrum;
I = Light intensity spectrum;
A = Absorbance;
CF = Correction factor (=10). (13)

Table 3. EE Constant (λ) x I(λ) (13)

λ (nm)	EE(λ) x I(λ)
290	0,0150
295	0,0817
300	0,2874
305	0,3278
310	0,1864
315	0,0837
320	0,0180
Jumlah	**1**

Data Analysis

The data analyzed were the result of the evaluation of the foundation preparations in the form of measurement pH, spreadability, viscosity, and anti-UV activity. The data obtained were presented in tabular form and adjusted to the standards in the literature (14). Data processing and further analysis using statistics were used with IBM SPSS Statistics 24 software. The results of the evaluation of the preparation were compared with the preparation on the market which has a claim SPF of 20.

3. Result

Optimization of Foundation Base

Base optimization is carried out to determine and ensure that the formula to be made can produce an optimal preparation and in accordance with predetermined requirements. In the process, base optimization was carried out by making 3 different formulas that varied sorbital monooleate and Polysorbate 80 as emulgators at concentrations F1 (3.25%:7.75%), F2 (5.5%:5.5%), and F3 (7.75%:3.25%). Based on the results of the base optimization that has been carried out, the three formulas meet all the requirements offoundation cream preparation parameters, but base 2 is chosen for further formulation because the range of viscosity and spreadability values is at the median limit among other bases.

Table 4. Result of Foundation Base Evaluation

Parameter	F1	F2	F3
Consistency	Liquid	Soft semisolid	Soft semisolid
Color	Yellowish light brown	Yellowish light brown	Yellowish light brown
Odour	Odourless	Odourless	Odourless
Homogeneity	Homogeny	Homogeny	Homogeny
pH	6,03±0,350	6,33 ±0,020	6,42 ±0,026

Viscosity (cPs)	2893,67±35,12	3256 ,67±24, 13	3296 ,33±20, 03
Spreadability (cm)	6,80±0,10	5,40 ±0,10	5,13 ±0,15
Color dispersion	Dispersed	Disp ersed	Disp ersed

Foundation From Duck Eggshell And Moringa Seed Oil (*Moringa oleifera Lam.*)

The main active ingredients used in this foundation preparation are duck eggshell powder and Moringa seed oil as an anti-UV agent. After formulation, the preparation was then physically evaluated for 28 days at storage temperature. Organoleptic tests are carried out to see the quality of the preparation based on observations using the five senses, namely seen from the shape, color and also the smell that is evenly distributed (15). Organoleptically, preparations F0, F1, F2, F3, F4 and F5 are semi-solid (cream), light yellowish brown and odorless. The difference between all formulas organoleptically is the texture, F0 and F5 have a slightly more liquid texture than the other formulas. F1 is the formula with the thickest texture.

Figure 1. Organoleptic appearance of F0, F1, F2, F3, F4 and F5

Based on the homogeneity test of the foundation preparation, all formulas show homogeneous properties characterized by evenly distributed color, do not show undissolved particles and the absence of granules or coarse or fine particles visible in the cross section of the object glass. These results indicate that the preparation is homogeneous and safe to use.

The pH measurement of the foundation preparation aims to determine the safety of the foundation cream when applied to the skin, so that it does not have the potential to irritate the skin. The pH of F0 was 6,18±0,01-6,24±0,01, F1 was 6.38±0.01-6.73±0.01, F2 was 6.27±0.02-6.41±0.02, F3 was 6.26±0.02- 6.43±0.0, F4 was 6.29±0.01- 6.46±0.01 and F5 was 6.21±0.02- 6.36±0.01. The pH of all foundation formulas was in accordance with the skin pH requirement of 4.5-8 (16). The results of this pH measurement indicate that all foundation formulas are safe to use.

Viscosity measurements were carried out to see the viscosity of the foundation preparation, this test was carried out using a Brookfield DV-II + Pro viscometer with spindle number 64 and speed 60 rpm. The viscosity values of F0 were in the range of3916,33±15,82-4014,33±7,77 cPs, F1 was 5016.33±6.66-4935±33.87 cPs; F2 was 4269±11.14-3993±15.00 cPs; F3 was 4361.33±12.58- 4270.66±3.79 cPs; F4 was 4673±4.58-4561±19.08 cPs; and F5 was 4173.66±11.93- 3984.33±13.05 cPs. Based on the results obtained, all formulas are safe to use and meet the requirements for good viscosity of cream preparations, namely in the range of 2000 - 50,000 cPs (16).

The spreadability test was carried out to determine how widely the foundation spreads on the skin when it used. The results of the spreadability obtained for F0 are in the range of 5,56±0,02-5,66±0,02 cm, F1 was 6.38 ± 0.01-6.73 ± 0.01 cm; F2 was 6.27 ± 0.02-6.41 ± 0.02 cm; F3 was 6.26 ± 0.02-6.43 ± 0.01 cm; F4 was 6.29 ± 0.01-6.46 ± 0.01 cm; and F5 was 6.21 ± 0.02-6.36 ± 0.01 cm. So that the higher the concentration of eggshell powder used, the thicker the consistency and the more difficult it is to apply. This spreadability test states that all foundation results meet the requirements of 5-7 cm (9).

Foundation Accelerated Stability Test

The accelerated stability test is carried out by placing the preparation in conditions that have extreme storage temperature differences within a certain time interval (4±2°C for 24 hours and 40±2°C for 24 hours), this treatment is called a cycle. Placement at these two temperatures aims to accelerate changes that usually occur under normal conditions. This cycling test was carried out for six cycles to clarify changes in each preparation and to simulate temperature changes every year and even every day during the product storage period (17). The stability parameters observed included organoleptic, homogeneity, pH, viscosity and spreadability at each cycle.

Organoleptic test of the foundation preparation is indicated by the stability of the color, odour and texture of the preparation. The preparation is observed visually using the five senses after each cycle. Based on the observation results, the foundation cream preparation is organoleptically stable because no significant changes occur. Changes occurred only in the texture of the formula without active ingredients (F0) and the formula with moringa seed oil active substance (F5). This occurred due to extreme temperature changes.

All formulas showed homogeneous properties based on visual observation. The acceptability of this test is characterized by the absence of granules or fine particles, insoluble particles or lumps on the glass object (18).

Based on the results of measuring the pH value for 6 cycles under extreme conditions, the following results were obtained, pH F0 was in the range of 6,19±0,01-6,47±0,02, F1 was 6.63 ± 0.01-7.14 ± 0.03, F2 was 6.27 ± 0.01-6.47 ± 0.02, F3 was 6.26 ± 0.02-6.55 ± 0.02, F4 was 6.33 ± 0.04-7.07 ± 0.02, and F5 was 6.21 ± 0.03-6.50 ± 0.02. The pH of the foundation cream preparation has increased in each cycle, but is still within the range that meets the requirements of Indonesian National Standard (SNI) No. 16-4399-1996, namely the range of 4.5-8 (16).

The data obtained was then tested statistically, and the significance value of all formulas was found to be less than 0.05 ($p<0.05$), so it can be concluded that there is a significant difference in the pH value of each formula for 6 cycles. The difference in pH experienced by all formulas when they were first made (cycle 0) and after going through the cycling test (cycle 1-cycle 6) indicates that the pH of the preparation is less stable during storage at extreme temperatures.

Changes in viscosity values during the cycling test were observed to determine the effect of storage conditions with extreme temperatures on the viscosity values of the foundation preparations that had been made. Viscosity F0 was in the range of 4140,00±7,55-2886,00±6,00 cPs,

F1 was 5150,00±7,21- 6105,33±9,45 cPs, F2 was 4325,00±8,89- 3478,67±11,06 cPs, F3 was 4502,67±10,07- 3978,33±11,72 cPs, F4 was 4677,33±14,57- 5116,33±18,56 cPs, and F5 was 4236,00±12,12-3240,00±12,12 cPs. After cycling test for 6 cycles, the test results showed that there were foundation cream formulas that experienced a decrease in viscosity and some that experienced an increase.

The data obtained was then tested statistically, and the significance value of all formulas was found to be less than 0.05 ($p<0.05$), so it can be concluded that there is a significant difference in the viscosity value of each formula for 6 cycles. However, these changes are still within the range that meets the requirements according to SNI No. 16-4399-1996, which is 2000-50,000 cPs (16).

The spreadability test aims to determine the ease of use of the cream preparation when applied to the skin. The spreadability of the cream can determine the level of absorption of active substances, the higher the spreadability of the cream, the more active substances in the cream that can be absorbed by the skin. Spreadability F0 was in the range of 5,96±0,02-6,51±0,03 cm, F1 was 5,88±0,03-5,26±0,03 cm, F2 was 5,34±0,03-5,82±0,03 cm, F3 was 5,45±0,03-5,80±0,02 cm, F4 was 5,57±0,02-5,20±0,01 cm, and F5 was 5,53±0,03- 5,94±0,03 cm.

The data obtained was then tested statistically, and the significance value of all formulas was found to be less than 0.05 ($p<0.05$), so it can be concluded that there is a

significant difference in the viscosity value of each formula for 6 cycles. However, this spreadability test states that all foundation results meet the requirements, namely 5-7 cm (9).

Irritation Test

The aim of the irritation test is to determine the presence of irritating effects and to assess the safety of a substance or preparation when exposed to the skin (19, 20) The foundation preparation used in the irritation test were only the two best formulas, namely F1 (15% duck eggshell active substance) and F5 (15% moringa seed oil active substance). The skin irritation score for each control and formula was 0, indicating that no erythema occurred from the 24th hour to the 72nd hour.

Table 5. Irritation Test Result

Time	Irritation Effect	Test Group			
		Knor	KN	F1	F5
24 hour	Erythema	0	0	0	0
	Udema	0	0	0	0
48 hour	Erythema	0	0	0	0
	Udema	0	0	0	0
72 hour	Erythema	0	0	0	0
	Udema	0	0	0	0
Irritation Index				0,0	0,0

Description:

KNor= Normal group; without given any treatment

KN=Negative group; foundation base without active substance addition

F1= Formula 1 with 15% duck eggshell concentration

F5= Formula 5 with 15% moringa seed oil concentration

Erythema = Skin redness

Udema = Skin swelling

After calculating the primary irritation index, the result is 0.0 (can be seen in

table 7), therefore the foundation preparation with a combination of duck eggshell and moringa seed oil is included in the category of very mild irritant (negligible) according to the category of irritation response in rabbits (21).

Foundation Anti-UV Activity Test

After measuring the physical stability of the foundation preparations, SPF values foundation preparation (Formula 0-Formula 5) were measured then the results were compared with the foundation preparation on the market with a claim of SPF 20. The effectiveness of sunscreen preparations is based on determining the SPF price which describes the ability of sunscreen products to protect the skin from erythema. The SPF price can be determined in vitro and in vivo (22). In this study, SPF measurements of samples were carried out in vitro using UV-VIS spectrophotometry with a wavelength of 290-320 nm (UV B).

The test samples, namely foundation preparations (F0-F5) were dissolved with 96% p.a ethanol. Each test sample was dissolved until a concentration of 20,000 ppm was obtained. Then the absorbance of the samples was measured using a UV-Vis spectrophotometer in the wavelength range of 290-320 nm. The absorbance obtained was then substituted into the Mansur equation (13). The results of the calculation of the SPF value of F0-F6 showed in Table 6.

Table 6. SPF (Sun Protection Factor) Value of Duck Egg Shell Foundation and Moringa Seed Oil

Formula	Average±SD	Description
F0	4,20±0,29	Minimal
F1	18,75±1,41	Ultra
F2	13,68±0,73	Maximal
F3	14,00±0,46	Maximal
F4	13,02±0,47	Maximal
F5	18,14±0,31	Ultra
SP	20,26±0,78	Ultra

Description:
SP = Foundation preparations on the market with Claim SPF 20
F0 = Foundation without active ingredients
F1 = Foundation with 15% duck eggshells
F2 = Foundation with a combination of 5% duck eggshells and 10% moringa seed oil
F3 = Foundation with a combination of 7,5% duck eggshells and 7,5% moringa seed oil
F4 = Foundation with a combination of 10% duck eggshells and 5% moringa seed oil
F5 = Foundation with 15% moringa seed oil

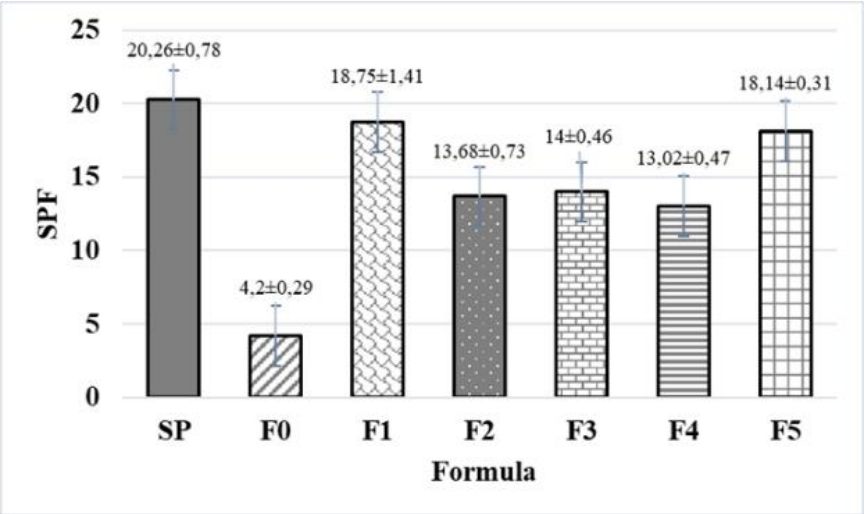

Figure 2. Graphics of SPF (Sun Protection Factor) Value of Foundation from Combination Duck Egg Shell and Moringa Seed Oil

Based on the results of the anti-UV activity test, showed that the SPF value of foundation preparations from duck eggshell ingredients with a combination of moringa seed oil F1, F2, F3, F4, and F5 respectively was 18.75 ± 1.41 (ultra category), 13,68±0,73 (maximal category), 14,00±0,46 (maximal category), 13,02±0,47 (13,02±0,47) and 18,14±0,31 (ultra category).

The SPF results of F2-F5 foundation preparations with a combination of duck eggshell and moringa seed oil show lower values. This can be caused by the interaction of the two ingredients in the preparation system, or the interaction with excipients which causes a decrease in the anti-UV activity of the two active substances in the preparation. Statistical analysis was conducted to see if there was a significant difference in the SPF value of foundation creams from eggshell ingredients and moringa seed oil (F1-F5) with the control foundation preparation with SPF on the market (SP).

Statistical tests were carried out using the One-Way Anova method and then further tests, namely the Post-Hoc Test, were carried out to determine the differences in the SPF of each formula tested statistically. Based on the results of the analysis, there is a significant difference between F1 with F2, F3, F4 and SP with F2, F3, F4 and F5 which is indicated by a significance value <0.05. Meanwhile, for SP with F1 and F1 with F5 there is no significant difference because the significance value is less than 0.05. It can be seen in Table 6 that the SPF value of foundation cream made from 15% eggshell (F1) and 15% moringa seed oil (F5) is not significantly different from the SPF value of foundation preparations on the market which has a claimed SPF value of 20.

4. Discussion

This study aims to determine the characteristics and physical stability of a foundation preparation formula from duck eggshells with a combination of moringa seed oil as an anti-UV agent. The combination of these two ingredients aims to develop an environmentally friendly foundation cream formulation that utilizes unused materials, namely duck eggshells and the use of natural

ingredients, namely moringa seed oil, which provides protection against UV radiation as well as natural antioxidant, anti-aging and anti-inflammatory properties.

Foundation base optimization using a combination of sorbital monooleate and Polysorbate 80 emulgators with variations in concentration F1 (3.25%:7.75%), F2 (5.5%:5.5%), and F3 (7.75%:3.25%). Emulgator is the most crucial factor in the formulation of this foundation cream preparation. Sorbital monooleate and Polysorbate 80 are emulgators commonly combined in the formulation of cream preparations that can unite the water phase and oil phase in the preparation. Mixed emulgators are often more effective than single emulgators. Especially oil-in-water type emulsions will be more easily stabilized by using a combination of lipophilic and hydrophilic surfactants, such as sorbital monooleate and Polysorbate 80 (23).

Base optimization is carried out to determine and ensure that the formula to be made can produce an optimal preparation and in accordance with predetermined requirements. Based on the results of the base optimization that has been carried out, the three formulas meet all the requirements offoundation cream preparation parameters, but base 2 is chosen for the next formulation because the range of viscosity and spreadability values is at the median limit among other bases. This is because in the next formulation, the base will be added with active substances, namely calcium carbonate from duck eggshell and moringa seed oil, so it is feared that the preparation will be too liquid if base 1 is chosen and will be too thick if base 3 is chosen.

The accelerated stability test is carried out by placing the preparation in conditions that have extreme storage temperature differences within a certain time interval (4 ± 2 ° C for 24 hours and 40 ± 2 ° C for 24 hours), this treatment is called a cycle. Placement at these two temperatures aims to accelerate changes that usually occur under normal conditions (17). The stability parameters observed included organoleptic, homogeneity, pH, viscosity and spreadability in each cycle. The acceptability of this stability test is that the preparation is said to be stable if it has the ability to maintain the specifications applied throughout the storage and use period and still has the same characteristics as the first condition made (24).

a. Organoleptically, preparations F0, F1, F2, F3, F4 and F5 are semi-solid (cream), light yellowish brown and odorless. The difference between all formulas organoleptically is the texture, F0 and F5 have a slightly more liquid texture than the other formulas. F1 is the formula with the thickest texture.
b. Based on the homogeneity test of the foundation preparation, all formulas show homogeneous properties characterized by evenly distributed color, do not show undissolved particles and the absence of granules or coarse or fine particles visible in the cross section of the object glass. These results indicate that the preparation is homogeneous and safe to use.
c. The pH measurement of the foundation preparation aims to determine the safety of the foundation cream when applied to the skin, so that it does not have the potential to irritate the skin. Changes in the pH value of the

preparation during storage indicate a lack of stability of the preparation, this can cause the product to be damaged during storage. Changes in pH can be influenced by changing storage temperatures, preparation containers that are less impermeable or of poor quality where basic salts from glass containers can decompose and react with the preparation, this can increase acid or base levels (25).

d. Viscosity measurements were carried out to see the viscosity of the foundation preparation. The decrease and increase in viscosity experienced by the preparation occurs due to extreme changes in texture. In the cycling test, the preparation is placed in freeze conditions with a temperature of 4 ± 2 ° C and thaw conditions of 40 ± 2 ° C. In freeze conditions, the viscosity of the preparation will increase or thicken because in this process there will be a narrowing of the water phase space because the water phase freezes and water crystals will form with a tight and more regular structure. Meanwhile, in the thaw process the viscosity of the preparation will decrease because the crystals will melt and will return to the system. Hot temperatures are able to re-enlarge the distance between particles, so that the force between particles decreases (17).

e. The spreadability test was carried out to determine how widely the foundation spreads on the skin when it used. The spreadability of the cream can determine the level of absorption of active substances, the higher the spreadability of the cream, the more active substances in the cream that can be absorbed by the skin. The ability to spread a preparation will increase if there is a decrease in viscosity, this is because the polymer bonds in the preparation are broken which ultimately causes the preparation to dilute (18).

f. The aim of the irritation test is to determine the presence of irritating effects and to assess the safety of a substance or preparation when exposed to the skin (19, 20). In the treatment of formula 1 and formula 5 at the 24th hour until the 72nd hour did not cause erythema, but at the observation of the 48th hour the rabbit's skin looked dry and dried up at the 72nd hour. The dryness of the skin that occurs is thought to be due to the presence of ingredients that have the potential to cause dry skin. Triethanolamine (TEA) can cause several reactions including allergies, dry skin or hair. This shows that the possibility of dryness in rabbits is caused by TEA contained in the preparation formula. However, the concentration of TEA in the formula is still within the required range according to the FDA, which should not be more than 5% (26).

g. The energy required for UV rays to causesunburn on sun-protected skin, compared to unprotected skin, is known as the Sun Protection Factor (SPF) value. The results of the calculation of SPF values based on the Mansur equation, F1 containing powder from 15% duck eggshells produced an SPF of 18.75 (ultra-

h. protection category), while F5 containing 15% moringa seed oil produced an SPF of 18.14 (ultra-protection category). The anti-UV properties produced by duck eggshell powder are due to calcium

carbonate which is a constituent of eggshells that can reflect and dissipate UV radiation. This is directly proportional to the research (4;27) which states that the cream from the active ingredient of purebred chicken eggshells produces an SPF value of 7.25-12.57.

Meanwhile, according to (28). Moringa plants (*Moringa oleifera Lam.*) contain tannins, steroids and triterpenoids, flavonoids, saponins, interquinones and alkaloids which are antioxidants. Moringa seeds contain 35-40% oil which has activity as an antioxidant, antiaging, and skin lightener. Flavonoids contained in moringa seed oil have photoprotective abilities. The amount of flavonoids produced by plants is considered an important factor in plant protection against ultraviolet radiation (29). The maximum UV wave uptake by flavonoids is at 230-295 nm and 300-560 nm which are within the absorption range of UVA and UVB rays. Therefore, this proves that the flavonoid group can be used as a natural active ingredient sunscreen that can absorb ultraviolet radiation (1).

Based on the results of this study, it is known that the formula using a combination of duck eggshell and moringa seed oil produces a smaller SPF value compared to the formula with a single active substance of duck eggshell and moringa seed oil. This can be caused by the interaction of the two ingredients in the preparation system, or the interaction with excipients which causes a decrease in the anti-UV activity of the two active substances in the preparation.

5. Conclusion

Based on the results obtained from this study, it was found that duck eggshell with a combination of Moringa seed oil (*Moringa oleifera Lam.*) was successfully formulated as a foundation cream preparation, all the evaluation results met the requirements of the cream preparation. Duck eggshell foundation cream preparation with a combination of Moringa seed oil (*Moringa oleifera Lam.*) showed anti-UV activity with maximum protection to ultra, but after going through the cycling test stability test there were significant changes ($p<0.05$) and safe to use.

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