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Formulation and Evaluation of Sunscreen Gel Combination of Bisoctrizole and Gotu Kola Extract *(Centella asiatica (L.) Urban)*

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Abstract

Gotu kola extract has antioxidant activity and contains flavonoids that can absorb maximum wavelengths of UV radiation. Bisoctrizole is a photoprotective agent to minimize sun damage. The Sun Protection Factor value of sunscreen can be increased by combining Bisoctrizole and Gotu kola extract as sunscreen in the form of a gel. This study aims to develop a sunscreen gel from a combination of Bisoctrizole UV filter material and Gotu kola extract which has good physical properties and sun protection efficacy. Gel evaluation was carried out on organoleptic, homogeneity, adhesion, dispersion, viscosity, syneresis, pH, irritation test, stability test, and in vitro test of SPF value (UV-Visible Spectrophotometry). The results showed that the combination sunscreen gel (F5-F7) had excellent physical appearance and homogeneity, no syneresis, pH 4.96±0.01 - 5.30±0.01, viscosity 5960±106 - 9240±173 cps, spreadability 5.75±0.05 - 6.38±0.03 cm, adhesion 1.24±0.20 - 2.89±0.12 seconds, and is non-irritating. The results of the measurement of sunscreen activity showed that the SPF value of the Bisoctrizole 5% gel added with Gotu kola extract 5% (F5); 7.5% (F6); and 10% (F7), respectively, were 27.73±0.04; 34.56±0.23; and 37.31±0.36. There was a significant difference ($p<0.05$) in the room temperature gel stability test and the cycling test on pH, viscosity, and spreadability.. The highest SPF value was found in the gel combination of Bisoctrizole 5% with Gotu kola extract 10% (F7) with an increase of 55.58%. Gotu kola extract can be formulated with Bisoctrizole into a sunscreen gel with ultra photoprotective activity (SPF>15).

Keywords: Bisoctrizole, sunscreen, gel, gotu kola extract.

1. Introduction

UV radiation is responsible for the main cause of skin damage. UVB and UVA penetrate deep into the earth and have the ability to damage the skin, causing sunburn, solar keratosis, premature aging, and even skin cancer. This is the background that sunscreen product formulations need to be developed as additional protection for the skin from the adverse effects of UV radiation (Bhattacharya & Sherje, 2020). Theoretically, sunscreens reduce UV radiation damage by forming a film or layer on the surface of the stratum corneum that absorbs and/or scatters UV radiation (Sampattavanich et al., 2021). Sun protection factor (SPF) was used to

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describe sunscreen efficacy (Dutra et al., 2004; Maske et al., 2020). Bisoctrizole (INCI: methylene bis-benzotriazolyl tetramethylbutylphenol) is a sunscreen ingredient that provides extreme broad-spectrum UV protection against UVA and UVB. This material combines the benefits of organic and inorganic filters so that its mechanism as a sunscreen not only absorbs UV, but can also spread and reflect it (Benson et al., 2019; Tuchinda et al., 2006). Research related to the use of sunscreen active ingredients from natural ingredients continues to increase, one of which is gotu kola extract (Centella asiatica (L.) Urban). Gotu kola contains triterpenoid compounds such as asiaticoside, madecoside, asiatic acid, madasiatic acid, and brahmic acid (Sulastri et al., 2017). A study showed the total flavonoids from the ethanol extract of gotu kola leaves was 102.10 ± 0.08 mg/g QE (Widiyana, 2021). The chromophore group in phenolic compounds, especially the flavonoid group, is able to absorb UVA and UVB radiation so that it has the potential as a sunscreen to reduce the intensity of skin damage due to UV radiation (Salwa et al., 2020).

Gotu kola (*Centella asiatica* (L.) Urban) can be included in the formulation of cosmetic preparations for skin care because it has antioxidant, anti-inflammatory, anti-cellulite, antifungal, antibacterial, and anti-aging activities (Ratz-Lyko et al., 2016; Sulastri et al. , 2017). Based on the research, the IC_{50} value of gotu kola ethanol extract was 78.26 ppm This value proves that the antioxidant activity of the ethanol extract of gotu kola belongs to the category of strong antioxidants (Yahya & Nurrosyidah, 2020). The antioxidant activity of gotu kola is comparable to that of rosemary and sage which has been identified as having high potential to be explored as a source of natural antioxidants (Jaswir et al., 2004). Another study stated that the antioxidant activity in gotu kola (84%) was almost equivalent to that of grape seed extract (83%) and vitamin C (88%) (Chandrika & Kumarab, 2015; Hashim et al., 2011). Research on the UV protective effect of gotu kola extract showed that at a concentration of 10%, the absorbance of gotu kola extract was comparable to that of control Octyl methoxy cinnamate (OMC) and bearberry extract in protection against UVB. Research says that the gotu kola extract contains quercetin and beta-carotene (Bajpai et al., 2005). The SPF value of an emulsion containing 10% quercetin is equivalent to homosalat, and has an SPF value of 30 when combined with titanium dioxide (Choquenet et al., 2008). Meanwhile, the combination of 0.1% olive oil cream and 20% gotu kola extract showed an SPF value of 37 (Zainuddin et al., 2019).

The selection of gel preparations in this study was based on its properties that felt lighter on the skin than lotions or creams, thus providing a comfortable and easy feeling when applied, did not clog pores, and did not interfere with skin respiration (Mukhlishah & Ningrum, 2020).

A good sunscreen is expected to block UV penetration, prevent skin damage, and is safe to use. This can be achieved by adding natural ingredients that have antioxidant activity. Based on research, antioxidants added in sunscreen formulations are proven to increase their effectiveness, namely by increasing the SPF value (Bhattacharya & Sherje, 2020; Lim et al., 2019).

The antioxidant ability of natural ingredients to ward off free radicals shows a correlation between antioxidants and the photoprotective activity of sunscreens. The existence of this relationship can be used as the basis for the use of antioxidants in pharmaceutical preparations as sunscreens (Gunarti & Fikayuniar, 2019). This is in line with the current trend of developing multifunctional cosmetics. So this study formulated a sunscreen gel combination of Bisoctrizole as a photoprotective agent with

gotu kola extract as a natural ingredient into a preparation that meets the evaluation criteria, has good efficacy and stability, and is safer for the skin.

2. Method

The ingredients to be used in the preparation of the gel include gotu kola extract (Centella asiatica (L.) Urban) (PT. Lansida Herbal, Yogyakarta, Indonesia), Bisoctrizole (BASF, Germany), Aristoflex® AVC (Clariant, Switzerland)

Bisoctrizole and gotu kola extract (Centella asiatica (L) Urban) were formulated into gel preparations as sunscreens with varying concentrations and combinations, gel without active ingredients (F0), Bisoctrizole 5% single gel (F1), single gotu kola extract gel 5% (F2), gotu kola extract gel 7.5% single (F3), gotu kola extract gel 10% single (F4), Bisoctrizole combination gel 5% and gotu kola extract 5% (F5), Bisoctrizole combination gel 5% and gotu kola extract 7.5 % (F6), a combination of 5% Bisoctrizole gel and 10% gotu kola extract (F7). Evaluation of the gel preparation was carried out by physical evaluation (organoleptic, homogeneity, adhesion, spreadability, viscosity, and syneresis), chemical characteristics (pH), irritation test stability test (cycling test), and determination of the SPF value of sunscreen gel preparations in vitro. (UV-Vis Spectrophotometry).
The research data obtained from 3 replications were collected by direct measurement and recording methods and then presented in the form of tables and graphs. The research data were compared with the standards set in the literature. The data obtained from the evaluation results were analyzed using SPSS ver.26 software to determine the significant differences in the characteristics during the storage period at room temperature, extreme temperatures (cycling test), and SPF values of formulation variations.

3. Result

Optimization Results

The composition of Aristoflex® AVC as a gelling agent is varied, other ingredients are added including glycerin, propylene glycol, DMDM hydantoin, and distilled water. Optimization is done by trial and error method to determine the gel base formula that meets the requirements of the literature.

Table 1.Gel Base Optimization Formula

Komposisi (%)	F1	F2	F3	F4	F5
Aristoflex ® AVC	0,5	0,875	1,25	1,625	2
Gliserin	5	5	5	5	5
Propilen glikol	5	5	5	5	5
DMDM Hydantoin	0,6	0,6	0,6	0,6	0,6
Akuades	Sampai 100	Sampai 100	Sampai 100	Sampai 100	Sampai 100

After knowing the concentration of the best gelling agent to make a gel base, a gel with a combination of Bisoctrizole and gotu kola extract was formulated with eight different formulations, a gel without active ingredients (F0), a single 5% Bisoctrizole gel (F1), a single 5% gotu kola extract gel (F2).), gotu kola extract gel 7.5% single (F3), gotu kola extract gel 10% single (F4), Bisoctrizole 5% combination gel and gotu

kola extract 5% (F5), Bisoctrizole combination gel 5% and gotu kola extract 7.5% (F6), a combination of 5% Bisoctrizole gel and 10% gotu kola extract (F7)

Table 2. Formula for Bisoctrizole sunscreen gel and gotu kola extract

Composition (%)	F0	F1	F2	F3	F4	F5	F6	F7
Ekstrak pegagan	-	-	5	7,5	10	5	7,5	10
Bisoctrizole	-	5	-	-	-	5	5	5
Aristoflex® AVC	2	2	2	2	2	2	2	2
Gliserin	5	5	5	5	5	5	5	5
Propilen glikol	5	5	5	5	5	5	5	5
Allantoin	-	1	1	1	1	1	1	1
DMDM Hydantoin	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Aquadest	ad 100	ad100	ad 100	ad100	ad 100	ad100	ad 100	ad100

Information:
F0: gel without active ingredients
F1: Bisoctrizole 5% single gel
F2: gotu kola extract gel 5% single
F3: single 7.5% gotu kola extract gel
F4: single 10% gotu kola extract gel
F5: Bisoctrizole 5% combination gel and gotu kola extract 5%
F6: Bisoctrizole 5% combination gel and gotu kola extract 7.5%
F7: Bisoctrizole 5% combination gel and 10% gotu kola extract

Sunscreen Gel Formulation

Aristoflex® AVC was added to distilled water (75% of total used, temperature 30–40oC), expanded in a mortar until hydrated and swelled. Glycerin, propylene glycol, and DMDM hydantoin were added one by one, stirring until a smooth gel was obtained. Allantoin was dissolved in hot distilled water and put into a gel base. The gotu kola extract in various concentrations (Table IV.2) was moistened with residual propylene glycol and dissolved with distilled water, put into a gel base. Bisoctrizole was put into the mixture and homogenized. The remaining aquadest is added up to 100%. Stirring is then carried out with a homogenizer (temperature 25±2°C, RPM 1000) until homogeneous. The preparation is then put into a container, and prepared for further evaluation.

Characterization

Organoleptic Test

Organoleptic test was carried out visually by observing the color, shape and smell of the preparation.

Figure 1. Organoleptic Test

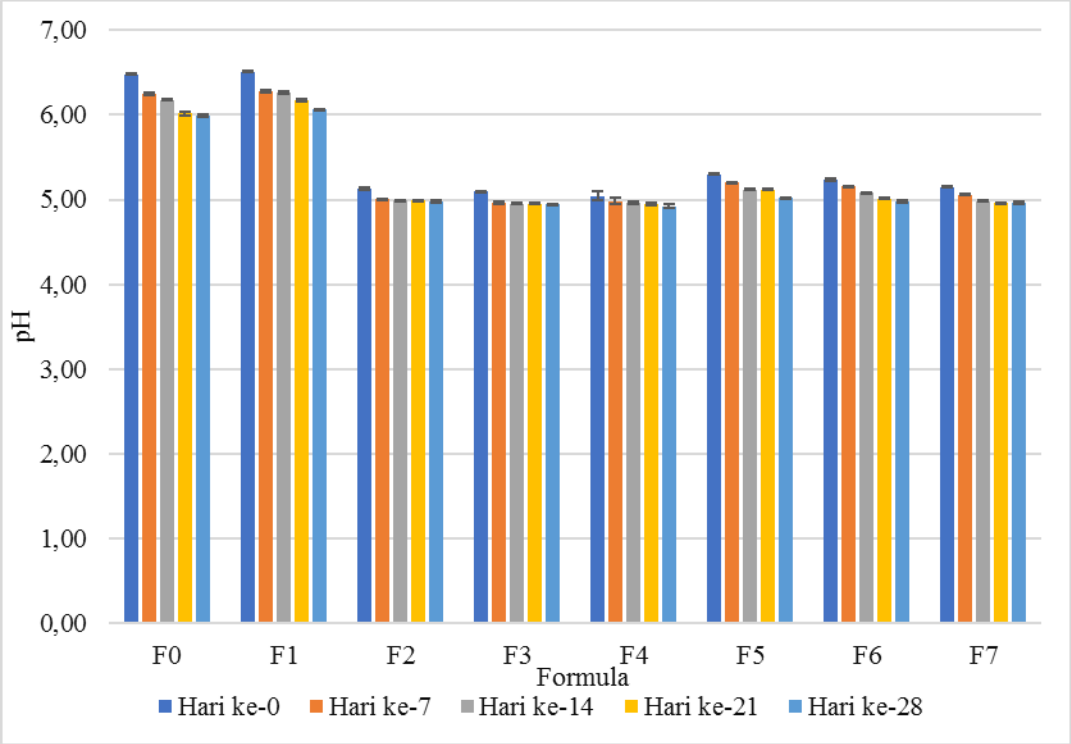
Table 2. Results of homogeneity testing for 28 days at room temperature

Hari ke-	Homogenitas							
	F0	F1	F2	F3	F4	F5	F6	F7
0	H	H	H	H	H	H	H	H
7	H	H	H	H	H	H	H	H
14	H	H	H	H	H	H	H	H
21	H	H	H	H	H	H	H	H
28	H	H	H	H	H	H	H	H

pH measurement

pH measurement for 28 days can provide a stability profile with changes in the pH of the gel at room temperature storage. The gel pH decreased every week, but was still in the skin pH range (4.5–6.5) and met the requirements based on the Indonesian National Standard (SNI) No. 16-4399-1996, namely the range of 4.5-8.0, so it is still safe to use. The pH value of the combination bisoctrizole sunscreen gel and gotu kola extract F5 was 5.02 ± 0.01-5.30 ± 0.01; the pH value of F6 is 4.98 ± 0.02-5.24 ± 0.02; and the pH value of F7 was in the range of 4.96 ± 0.01-5.15 ± 0.01 during the 28 day storage period at room temperature.

Figure 2. Graph of measuring pH values for 28 days at room temperature

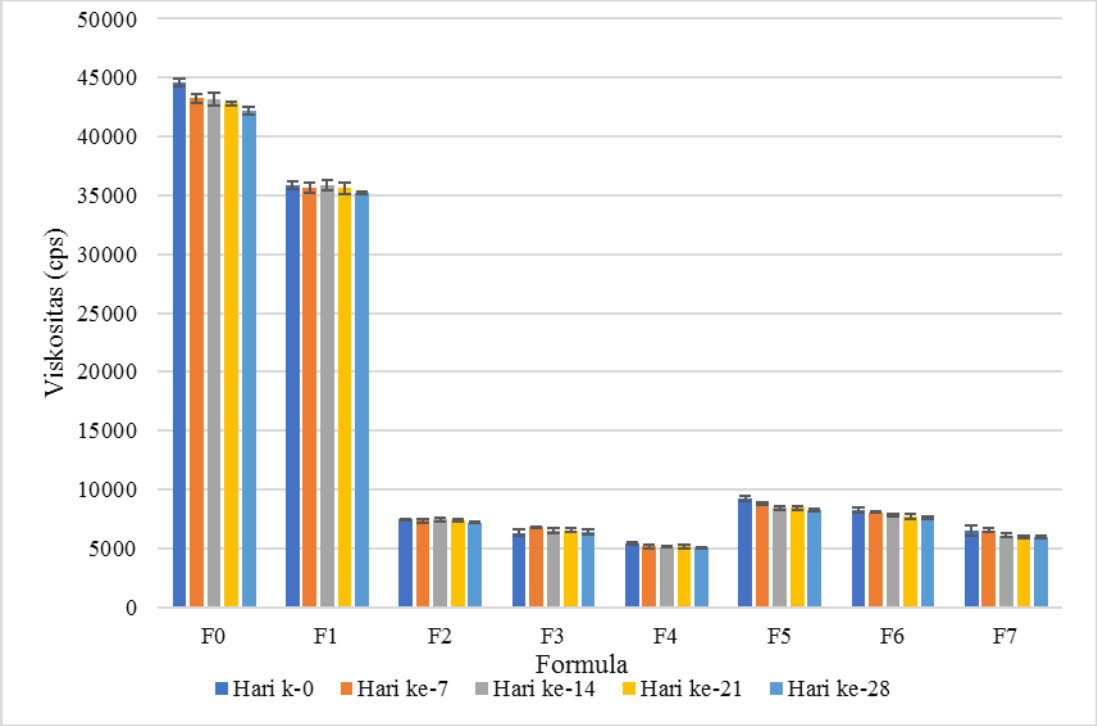


Information:
n = 3 times replication
F0 = gel without active ingredients
F1 = single 5% Bisoctrizole gel
F2 = single 5% gotu kola extract gel
F3 = single 7.5% gotu kola extract gel
F4 = single 10% gotu kola extract gel
F5 = 5% bisoctrizole combination gel and 5% gotu kola extract
6 = 5% bisoctrizole combination gel and 7.5% gotu kola extract
F7 = 5% bisoctrizole combination gel and 10% gotu kola extract

Viscosity Test

Viscosity measurements were carried out using a Brookfield DV-11 viscometer with spindle number 7 and a speed of 50 rpm. The test was carried out 3 repetitions with the aim of ensuring accuracy in measurement. The viscosity of the preparations was observed based on the results of measuring the viscosity values for 28 days at room temperature (±25°C), with measurements every week. Viscosity value of bisoctrizole and gotu kola extract was in the range of 9240 ± 173-8267 ± 122 cps; F6 is in the range of 7600±80-8347±257 cps; and F7 were in the range of 5993±103-6507±395 cps during the storage period. The viscosity value meets the viscosity requirements for good gel and sunscreen formulations, based on the Indonesian National Standard (SNI) No. 16-4399-1996 namely 2000-50,000 cps (Yulyuswarni, 2021). The results of measuring the viscosity value for 28 days at room temperature are presented in the following figure:

Figure 3.3 Graph of Viscosity Measurements for 28 Days at Room Temperature

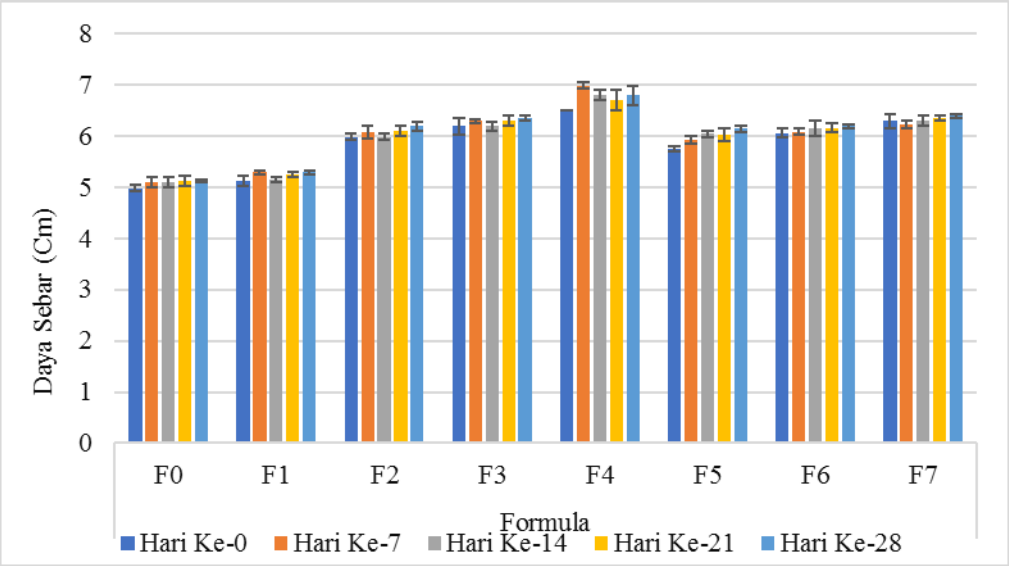


Information :
n = 3 times replication
F0 = gel without active ingredients
F1= Bisoctrizole 5% single gel
F2 = single 5% gotu kola extract gel
F3 = single 7.5% gotu kola extract gel
F4 = single 10% gotu kola extract gel
F5 = 5% bisoctrizole combination gel and 5% gotu kola extract
F6 = 5% bisoctrizole combination gel and 7.5% gotu kola extract
F7 = 5% bisoctrizole combination gel and 10% gotu kola extract

Spread Power Measurement

Measuring the spreading power of the sunscreen gel preparation was carried out by measuring the diameter of the spread of the preparation with the addition of 0; 50; 100; 150; and 200 g. Spread power measurement data is represented in Figure VI.5. and is attached in Appendix 12. Based on the observations, the spreadability of F5 was in the range of 5.75 ± 0.05-6.13 ± 0.06 cm; F6 is in the range of 6.05 ± 0.09-6.18 ± 0.03 cm; and F7 is in the range of 6.22 ± 0.08-6.38 ± 0.03 cm. This value meets the spreadability requirements, where the required spreadability of the gel is 5-7 cm in diameter (Hanip et al., 2021). Spreadability describes the ability of the gel to spread on the skin surface. When the preparation is easily applied, the contact area of the active substance with the skin will be greater along with the ease with which the preparation can be applied, so that its efficacy is more optimal. Spreadability is affected by viscosity, in which the ability to spread increases if there is a decrease in viscosity. This is due to the breakdown of the polymer bonds in the preparation which ultimately results in an increasingly dilute preparation (Febriani et al.,2020)

Figure 3.4. Graph of Spreadability Measurements for 28 Days at Room Temperature



Information:
n = 3 times replication
F0 = gel without active ingredients
F1= Bisoctrizole 5% single gel
F2 = single 5% gotu kola extract gel
F3 = single 7.5% gotu kola extract gel
F4 = single 10% gotu kola extract gel
F5 = 5% bisoctrizole combination gel and 5% gotu kola extract
F6 = 5% bisoctrizole combination gel and 7.5% gotu kola extract
F7 = 5% bisoctrizole combination gel and 10% gotu kola extract

Syneresis Test

Based on observations of gel syneresis for 72 hours of storage at 10 ± 2°C, it showed that syneresis did not occur in all sunscreen gel formulas. This is evidenced by the absence of water from the gel preparation. The loss of water is considered as a loss of gel mass, which will be compared with the initial mass of the gel. The sunscreen gel in this study has gel stability based on syneresis testing. This is due to the use of a gelling agent (Aristoflex® AVC) with a concentration of 2% which can bind water more optimally. Based on research (Thahir & Wahyuni, 2021) syneresis can occur if the concentration of the gelling agent used is too small so that it is unable to optimally bind water and cause water release. The longer storage time can increase the potential for syneresis because during that time the aggregation between the polymer chains of the gel-forming material continues to occur. This aggregation is due to the movement of the polymer chains in the gel system.

Table 3.3. Syneresis Test Results

Jam ke-	Sineresis (%)							
	F0	F1	F2	F3	F4	F5	F6	F7
0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0
72	0	0	0	0	0	0	0	0
Rata-rata	0	0	0	0	0	0	0	0

Information:
F0: gel without active ingredients
F1: Bisoctrizole 5% single gel
F2: single 5% gotu kola extract gel
F3: single 7.5% gotu kola extract gel
F4: single 10% gotu kola extract gel
F5: combination gel Bisoctrizole 5% and gotu kola extract 5%
F6: combination gel Bisoctrizole 5% and gotu kola extract 7.5%
F7: combination gel Bisoctrizole 5% and gotu kola extract 10%

Determination of SPF Value
The determination of the SPF value was carried out using the UV-Vis spectrophotometric method in vitro, with 96% pro-analyzed ethanol as a blank. The absorbance value of the preparation was measured, then substituted into the Mansur equation.

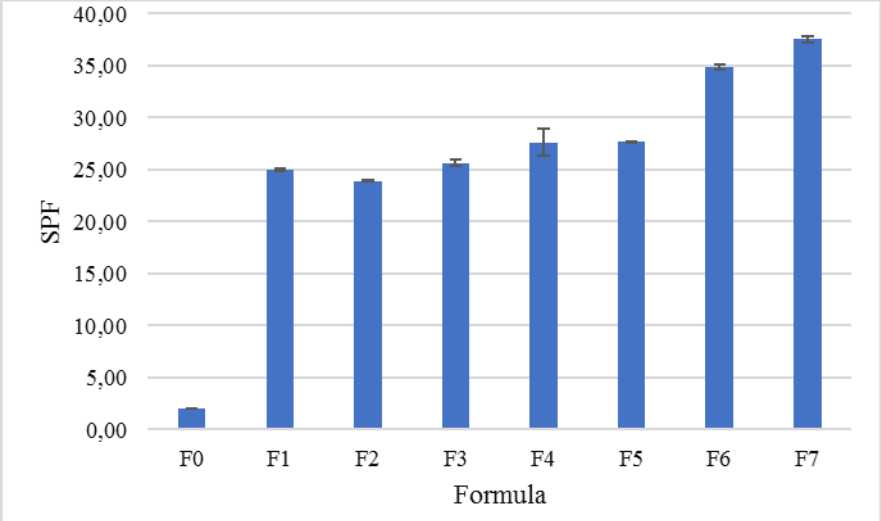
Table 3.4. Result of Determination of SPF (Sun Protection Factor) Value of Sunscreen Gel

Formula	Average±SD	Information
F0	1,99±0,00	Minimal
F1	24,85±0,11	Ultra
F2	23,98±0,08	Ultra
F3	25,89±0,31	Ultra
F4	26,87±1,28	Ultra
F5	27,73±0,04	Ultra
F6	34,56±0,23	Ultra
F7	37,31±0,36	Ultra

Information :

n = 3 times replication

Figure 3.8. Chart of Determination of SPF (Sun Protection Factor) Value of Sunscreen Gel



Information:
F0 = gel without active ingredients
F1= Bisoctrizole 5% single gel
F2 = single 5% gotu kola extract gel
F3 = single 7.5% gotu kola extract gel
F4 = single 10% gotu kola extract gel
F5 = 5% bisoctrizole combination gel and 5% gotu kola extract
F6 = 5% bisoctrizole combination gel and 7.5% gotu kola extract
F7 = 5% bisoctrizole combination gel and 10% gotu kola extract

4. Discussion

Characterization

The five gel base optimization formulas have been evaluated to determine the physical characteristics of the gel base which will then be formulated together with the active ingredients. The results of gel base optimization (Table VI.2) show that the five formulas have similar physical characteristics from the organoleptic aspect, namely in the form of a semi-solid gel, clear or colorless, odorless, has a soft texture and gives a cool impression when applied to the skin. The five gel base formulas met the homogeneity criteria by indicating that there were no coarse grains or lumps. The value of pH, viscosity, spreadability and adhesion of F2-F5 is a gel base that meets the requirements for semi-solid preparations.

Based on the results of the optimization of the gel base, the formula used to be formulated with active ingredients is F5 with a composition of 2% Aristoflex® AVC and 5% glycerin. F5 has met the criteria of a good semisolid and gel preparation. In addition, one of the properties of the material used is gotu kola extract which is thick and acidic (pH = 4.98). Based on the Aristoflex® AVC Technical tip, this acidic environment can reduce the viscosity of the preparation due to the nature of Aristoflex® AVC which can experience a decrease in viscosity due to polymer cleavage by acid.

Aristoflex® AVC concentration as a gelling agent is in the range of 0.5-2.0%.

The use of Aristoflex® AVC as a gel base added with about 5% glycerin can make a gel with a cloudy appearance more transparent and does not leave a color residue (Maharai et al., 2020). Therefore, optimization of the gel base was carried out to obtain the best suitable base formulated with the active ingredient bisoctrizole and thick gotu kola extract.

Organoleptic test

The results of organoleptic observations were carried out to see the visual appearance of the bisoctrizole and gotu kola extract sunscreen gel preparations and to show the stability of color, aroma, and shape at room temperature storage (25℃). The preparations were observed using the five senses every week for 28 days. Based on the results of the organoleptic test, the combination of bisoctrizole and gotu kola extract (F5-F7) sunscreen gel has a light green color. This color is produced by mixing the color of single gotu kola extract (F2-F4), which is dark olive green with white Bisoctrizole (F1). This Bisoctrizole combination can improve the appearance of single gotu kola gel preparations (F2-F4) which are dark olive green in color due to the high concentration of the extract used. The more concentration of gotu kola extract used, the darker the green color. Even though it looks cloudy visually, it doesn't leave any color residue when applied to the skin. The aroma of the bisoctrizole combination sunscreen gel and gotu kola extract (F5-F7) is the characteristic aroma of the extract which is influenced by the concentration of the extract. Meanwhile, the overall dosage form of the formula is semi-solid.Uji Homogenitas

Berdasarkan pengamatan terhadap homogenitas sediaan, seluruh formula menunjukkan sifat yang homogen ditandai dengan tidak adanya butiran kasar maupun partikel halus yang terlihat pada penampang kaca objek. Gel tabir surya dikatakan homogen karena tidak menunjukkan butiran kasar atau partikel tidak terlarut, tersebarnya warna secara merata, dan tidak terdapat gumpalan-gumpalan ketika sediaan dioleskan pada kaca objek. Artinya, semua sediaan gel yang dibuat memiliki susunan yang homogen.

pH measurement

The factor that affects the pH value of the preparation tends to be acidic, namely the pH of the extract used. The content of flavonoids in the extract tends to be acidic (Markham, 1988). Centella asiatica extract has a pH of 4.98, and is stable in an atmosphere with a weakly acidic to neutral pH (Puttarak et al., 2016). The pH value of the preparation which tends to be acidic is more or less influenced by the pH of the extract used as the active ingredient, where the greater the concentration of the extract, the more acidic the pH of the preparation. Meanwhile, changes in pH values during the storage period can be affected by temperature, poor storage conditions, other substances or excipients in preparations that react with each other, and oxidation due to contact with CO2 in the environment (Putra et al., 2014).

Data on pH test results for 28 days of single Bisoctrizole sunscreen gel (F1) and a combination of Bisoctrizole and gotu kola extract (F5-F7) were analyzed statistically. In the early stages, the normality test (Shapiro-Wilk) and homogeneity (Levene's test) were carried out. Based on the significance value obtained $p < 0.05$, so the data is not normally distributed, meanwhile the homogeneity test shows all significance values are more than 0.05, meaning that the data variation is homogeneous. Therefore, data analysis was performed using the Kruskal-Wallis Non-Parametric statistical test with a 95% confidence level. The results obtained were a significance value

of less than 0.05 ($p < 0.05$) for F1, F5, F6, and F7, so it can be concluded that there was a significant difference in the pH value of each formula during the 28 day storage period at room temperature. Post-Hoc follow-up tests were carried out on F1, F5, F6, and F7 to see the differences per day. Significant differences in the pH value of Formula 1 during storage at room temperature occurred on day 0 to days 21 and 28. Formula 5 showed significant differences on day 0 to days 14, 21, and 28; and between day 7 and day 28. Meanwhile, significant changes in Formula 6 occurred between day 0 and day 21 and 28; as well as the 7th day with the 28th day. Formula 7 has a difference

Viscosity Test

The viscosity of the sunscreen gel changed during the storage period at room temperature. One of the factors that influence these changes is the use of the active ingredient gotu kola extract which is thick and acidic. Based on Aristoflex® AVC Technical tip, this acidic atmosphere can reduce the viscosity of the preparation due to the nature of Aristoflex® AVC which can experience a decrease in viscosity due to cleavage of polymeric acids on long storage. Other factors that trigger changes in viscosity include uncontrolled temperature, less tight packaging which causes the preparation to absorb moisture from the environment. These conditions increase the volume of water in the preparation which will reduce the viscosity value. The effect of the thick extract composition also causes a decrease in viscosity (Safitri et al., 2016), where observations show that the greater the concentration of gotu kola extract added, the lower the viscosity value of the resulting preparation.

Viscosity test results for 28 days of single Bisoctrizole sunscreen gel (F1) and a combination of Bisoctrizole and gotu kola extract (F5-F7) were statistically analyzed. As an initial step, the normality test (Shapiro-Wilk) and homogeneity (Levene's test) were carried out. Based on the significance value of the normality test obtained, $p < 0.05$, so the data is not normally distributed, meanwhile the homogeneity test shows all significance values are more than 0.05, meaning that the data variation is homogeneous. Data analysis was then performed using the Kruskal-Wallis Non-Parametric statistical test with a 95% confidence level. The result obtained is that the F1 significance value is more than 0.05, meaning that there is no significant difference and has a stable viscosity. The significance values of F5, F6, and F7 were less than 0.05 ($p<0.05$), so it could be concluded that there was a significant difference in the viscosity values of each formula during the 28 day storage period at room temperature. Post-Hoc follow-up tests were carried out on F5, F6, and F7 to see the differences per day. Significant differences in the viscosity values of Formula 5 during room temperature storage occurred on day 0 to day 14, 21 and 28; and between day 7 and day 28. Formula 6 showed a significant difference on day 0 with day 21 and 28; and between day 7 and day 28. While Formula 7 has a significant difference between day 0 and day 21 and 28; and the 7th day with the 21st and 28th days.

Spreadability Test

Based on statistical analysis of the data from the spreadability test, the distribution of the data was not normal ($p<0.05$) after being tested with the normality test (Shapiro-Wilk), but the data had a homogeneous variance ($p>0.05$) based on the homogeneity test (Test Levene's). Therefore, data analysis was performed using the Kruskal-Wallis Non-Parametric statistical test with a 95% confidence level.

The results obtained were that the significance values of F6 and F7 were more than 0.05 (p>0.05), meaning that there was no significant difference and they had a stable spreadability. The significance values of F1 and F5 were less than 0.05 (p<0.05), so it could be concluded that there were significant differences in the spreadability values of each formula during the 28 day storage period at room temperature. Post-Hoc follow-up tests were carried out on F1 and F5 to see the differences per day. Significant differences in the viscosity values of Formula 1 during room temperature storage occurred on day 0 to day 7 and 28; 14th day with 7th and 28th day. Meanwhile Formula 5 showed a significant difference between day 0 and 14th, 21st and 28th day.

Determination of SPF Value

The calculation results based on the Mansur equation, F1 which contains Bisoctrizole produces an SPF value of 24.85. The addition of gotu kola extract by 5% on F5 increased the SPF value by 15.64% to 27.83, SPF F6 after adding 7.5% gotu kola extract increased by 44.12% to 34.56, and SPF F7 increased by 55.58 % to 37.31. These results indicate that the addition of natural ingredients increases the SPF value. The higher the concentration of the extract, the SPF value will increase. This is directly proportional to research (Hashim et al., 2011) which states that the higher the concentration of gotu kola extract, the higher the protection power against UVB absorbance because the more triterpene components it contains.

The observed SPF property of Centella asiatica extract was also due to the presence of UV absorbing compounds such as flavonoids. Flavonoids are a group of naturally occurring polyphenolic compounds characterized by a flavan core. The amount of flavonoids produced by plants is considered an important factor in protecting plants against ultraviolet radiation (Lim et al., 2019). The maximum absorption of UV waves by flavonoids is 230-295 nm and 300-560 nm which are in the absorption ranges of UVA and UVB rays. This proves that flavonoids can be used as natural active ingredients in sunscreens that can absorb UV radiation (Dianursanti et al., 2020). The chromophore groups in phenolic compounds, especially the flavonoid group, are able to absorb UVA and UVB radiation, so they have the potential to reduce the intensity of skin damage (Salwa et al., 2020). The addition of natural ingredients that have antioxidant activity to UV filters can work synergistically as sunscreens, with complementary mechanisms. Antioxidants work on the surface of the skin as a filter that absorbs or reflects UV radiation, and also works both on the surface and in the deep layers of the skin, and fights oxidative stress, thus providing fuller and stronger sun protection.

Statistical analysis was carried out to see if there was a significant difference in the SPF value of the combination sunscreen gel (F5-F7) and the single Bisoctrizole sunscreen control (F1). The normality test (Shapiro-Wilk) and homogeneity (Levene's test) were carried out as an initial step. The results showed that the data were not normally distributed and were not homogeneous with a significance value of p<0.05. Therefore, data processing was continued with the non-parametric Kruskal-Wallis statistical test, with a significance result of 0.016 or p <0.05, which means that there were significant differences in the SPF values of sunscreen gels F1, F5, F6, and F7.

A follow-up test, namely the Post-Hoc Test was then carried out to find out the differences in each SPF formula that was statistically tested, especially against the F1 control, namely Bisoctrizole single

sunscreen gel. Based on the results of the analysis, there are differences between F1 and F6, F1 and F7, and F5 and F7 which are indicated by a significance value of <0.05. Meanwhile, for F1 and F5, F5 and F6, and F6 and F7 there were no significant differences because the significance value was less than 0.05. This shows that the addition of an extract of 7.5% in F6 and 10% in F7 has a significant effect on increasing the SPF value of sunscreen gel.

5. Conclusion

The combination of Bisoctrizole and Centella asiatica (L.) Urban extract can be formulated into a stable sunscreen gel based on organoleptic parameters and homogeneity of adhesion and syneresis. There were significant differences in the parameters of pH, viscosity, and spreadability, but all of the evaluation results were in the good range of sunscreen gel preparations.

Addition of gotu kola extract (Centella asiatica (L.) increases the SPF value of sunscreen preparations containing single Bisoctrizole (SPF 24.85 ± 0.11). Addition of gotu kola extract as much as 5% produces an SPF value of 27.73 ± 0. 04 (increased 15.64%), the addition of 7.5% extract resulted in an SPF value of 34.56 ± 0.23 (increased (44.12%), and the addition of 10% extract resulted in an SPF value of 37.31 ± 0.36 (increased by 55.58%) The increase in SPF value is directly proportional to the concentration of the extract.Sunscreen gel combination of Bisoctrizole and gotu kola extract (Centella asiatica (L.) Urban) provides ultra category protection.

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