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RESEARCH ARTICLE

Formulation of tomato extracts (*Solanum lycopersicum L.*) as a sunscreen lotion

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ABSTRACT

Background: Tomato (*Solanum lycopersicum* L) has sunscreen efficacy consisting of lycopene which can provide ultraviolet (UV) irradiation in sunlight and protect skin from UV B induces photodamage. **Objective**: This work aims to formulate attractive, effective, and stable sunscreen lotion from tomato extract. **Materials and Methods:** Phytochemical screening and measurement of sun protection factor (SPF) values were performed first on tomato fruit extract. Thus, lotion formulations and SPF lotion measurements have been added tomato extract. Observations of pH, viscosity, frozen liquefaction cycle to see globule size, and centrifugation were performed to see the stability of the lotion preparation, and the latter was a qualitative test for the preparation of lotions compared with the extract. **Results:** The concentration of tomato extract on sunscreen lotion which has SPF value close to SPF 15 from extract is 1% and 1.5% tomato extract with SPF value 18.84 and 22.24. Physical observation of the lotion is done by organoleptic observation, pH and viscosity measurement, centrifugation, and freezing of liquefaction and qualitative test shows a stable profile for 28 days of storage. **Conclusion**: The results showed that the sunscreen lotion produced had good physical quality for 28 days of storage.

KEY WORDS: Tomato; Sunscreen Lotion; Sun Protection Factor

INTRODUCTION

Human skin can provide the most protection against sunshine so as to prevent translucent the rays toward the body's organs, blood vessels, and bones.[1] Normal skin reactions against the presence of excessive sunlight shines are the incidence of erythema and hyperpigmentation. Ultraviolet (UV) radiation from the sun can give effect to the skin, such as the onset of burning the skin, premature aging, or other skin damage including cancer.[1] Human skin naturally already has a system of protection against the influence of the harmful rays of the sun radiation, but this has not been effective enough to overcome excessive sun radiation. Therefore, they required additional protection both physically and with use of sunscreens.

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The formulation has a great influence toward the ability of a material of a sunscreen to protect the skin from the sun's radiation sun protection factor (SPF). SPF is influenced by the type of material of sunscreen, water phase, a phase of oil, emulsification process, and other factors.[2,3] Therefore, it made preparations containing oil and study on selected lotion preparations. Based on some research, lycopene content in the fruit of tomato can be used as one of the active substances sunscreen alternatives. Lycopene is able to protect the skin from erythema and prevent skin damage induced by UV rays.[4] The effect of protection against the formation of lycopene erythema on the skin is irradiated by UV rays and also mentioned that lycopene can provide maximum absorption at a wavelength of UV rays.[5] Lycopene topically can also

provide protection against the acute effects of radiation-induced damage from UVB rays.[6] Tomato (*S. lycopersicum* L.) in Indonesia expected to be used as the source of lycopene as active compounds in sunscreen cosmetics preparations to protect the skin from the sun.

MATERIALS AND METHODS

Materials

The materials used in the study are fruit extracts of tomato (*S. lycopersicum* L.) (Lansida Herbal Yogyakarta), Tefose 63 (a mixture of polyethylene glycol (PEG) -6; Ethylene Glycol; PEG-32) (Gattefosse Menjangan-PT Sakti), cetyl alcohol (Bratachem), liquid Paraffin (Quadrant), Methylparaben (PT. Bratachem), propylparaben (Bratachem), and Aquadest.

Tools

UV spectrophotometer (Specord 200), viscometer (Brookfield DV-II + Pro), centrifugation (Hettich Eba 20), optical microscopy (Zeus), and digital pH meter (Metroohm type 744) were used.

Methods

Phytochemical screening of tomato fruit extracts

Screening of phytochemicals is done to find the secondary metabolites contained in extracts will be examined. This phytochemical screening performed on extracts of the fruit of tomato (*S. lycopersicum* L.). Screening of tomato fruit extracts includes the phytochemical examination of the polyphenol compounds, alkaloids, flavonoids, sesquiterpene and monoterpenoid, steroid and triterpenoid, tannins, saponins, and quinones.

Determination of Fruit Extracts SPF Tomato (*S. lycopersicum* L.)

The determination of the value of the extracts SPF is done using UV-vis spectrophotometer method Petro.[7] Fruit extracts of tomato taken as much as 0.4 g, 0.5 g, and 0.6 g, then diluted in a mixture of ethanol 96% Aquadest (3:1) up to 100 ml. The absorbance measured at a wavelength of 280–320 nm each multiple of 5 nm to measure the value of SPF. Afterward, area under curve (AUC) calculated every 5 nm wavelength absorption of n and absorption at a wavelength of (n-1) shared 2 multiplied by 5 (wide trapezoid). The calculated value of the log of SPF by way of dividing the total number of area under the curve is within the largest and smallest wave length. The next value is converted into the SPF logs. The SPF calculation is performed in the following way: $A = \log^{10}SPF$.[8]

Determination of Lotion Bases

Made six lotion base formula and selected the best lotion base. Design of lotion base formula is shown in Table 1.

Preparations of Sunscreen Lotion with the Addition of Tomato Fruit Extract

Prepared of two formula lotion sunscreens with added concentration variations of tomato fruit extracts into the formula based on best lotion bases of lotion according to Table 1.

The Measurement Value of SPF Lotion Preparations Containing Extracts of Tomato Fruit

Lotion preparations containing tomato fruit extracts SPF value is measured using the method of spectrophotometer UV-Vis at wavelength range of 290–320 nm. The next AUC calculated every 5 nm wavelength absorption of n and the absorption wavelength of (n−1) shared 2 multiplied by 5 (wide trapezoid). The calculated value of log of SPF by way of dividing the total number of area under the curve is within the largest and smallest wavelength. The next value is converted into the SPF logs.[9]

Physical Observation Preparations Lotion Sunscreen from Tomato Fruit Extract

Physical observation preparations made against base lotion and lotion sunscreen containing extract of the fruit of tomato by observing the changes of color, smell, and shape in organoleptic, pH, viscosity, as well as the method of freeze-thaw cycles to see the size of globule, and centrifugation to see separation of emulsion phase which is useful in predicting the time save preparations.

Evaluation of the Material of the Thin-Layer Chromatography (TLC) Using Qualitative

TLC of tomato fruit extracts and preparations lotion conducted to know the spot similarities at chromatogram as a marker that the extract is still contained in the preparations. TLC is done using: Stationary phase: Silica gel GF254, motion: Butanol phase: Acetic acid:water 4:1: 5, and detection:UV light 254 nm and 366 nm UV light.

Statistically Data Analysis

Data analysis was performed to see the influence of pH, viscosity, and freeze-thaw cycle toward a formula that is generated by the method of Random Complete Blocks Design Statistics (DBLA).

Table 1: Result of test parameter of tomato fruit extract

Parameter (%)
Moisture content (9.35)
The levels of water-soluble extract of (21.86)
Ethanol soluble pollen levels (7.12)
The gray levels total (7.84)
Levels of acid insoluble ash (0.81)

RESULTS

The Results of the Determination of Tomato Fruits Used Indicates

Test result parameter of fruit extracts including moisture content, water-soluble, material ethanol soluble, total ash, and acid insoluble ash can be seen in Table 1.

The Results of Screening of Phytochemicals Extract Tomatoes (*S. lycopersicum L.*)

Base on result of phytochemical screening of tomato extract it showed that contained the lycopene. It contains a lycopene as a derivate of terpenoid compound.

Results of Lotion Base Screening

A third of the base formula lotion made, the trio has a white color and does not smell. In 7-day retention time, there is no discoloration and odor than the base, the formula can be seen in Table 2.

Results of Determination of Fruit Extracts SPF Tomato

The result of the determination of SPF value with concentration 0.4%, 0.5% and 0.6% are presented in Table 3. It exhibited that SPF values of the extract in various concentration has ability to withstand UV rays radiation. Table 3 obtained from extracts SPF value summarizes the ability to extract to withstand UV rays.

Results of Formulation Dosage Lotion Sunscreen with the Addition of Tomato Extract

Based on the results of the determination of tomato fruit extracts SPF from Table 3, obtained concentrations of tomato fruit extracts that have SPF 15 are approaching the concentration of tomato fruit extract 0.5%.

The Results of the Measurement of the Value of SPF Lotion Preparations Containing Extracts of The Fruit of Tomato

This test aims to find out the effectiveness of the sunscreen lotion extract of tomato by calculating the SPF value lotion [Table 4]. The value of SPF lotion preparations containing extracts of the fruit of tomato can be seen in Table 5.

Physical Observation Preparations Lotion Sunscreen from Tomato Fruit Extract

Physical observation was presented in Table 6.

Observations of the pH Value

The results of the measurement of pH lotion preparations contain the extracts of tomato fruits during the 28 days of storage [Figure 1]. It can be known that formula is pH lotion base tends to be normal and lotion formula containing tomato extract has the pH tends to sour.

Results of Viscosity Measurement

The results of viscosity measurements were shown in Figure 2. It can be aware that the third formula lotion viscosity changes storage for 28 days but tends to be stable. This viscosity changes along with changes in consistency.

Table 2: Formulation of lotion bases

Materials	Formula		
	F1 (%)	F2 (%)	F3 (%)
Tefose 63 (PEG-6, etilen glikol, PEG-32)	3	3	3
Parafin cair	18	18	18
Setil alkohol	1	2	3
Metil paraben	0.05	0.0	0.05
Propil paraben	0.05	0.05	0.05
Aquadest ad	100	100	100

PEG: Polyethylene glycol

Table 3: Result of SPF determination of tomato fruit extract

Concentration of extract (%)	SPF
0.4	10.04
0.5	17.74
0.6	33.13

SPF: Sun protection factor

Table 4: Formulation of sunscreen lotion with adding a tomato fruit extract

Materials	Formula	
	F1 (%)	F2 (%)
Tefose 63 (PEG-6, Etilen glikol, and PEG-32)	3	3
Parafin liquid	18	18
Cetiyl alkohol	2	3
Metil paraben	0.05	0.05
Propil paraben	0.05	0.05
Tomato extract	1	1.5
Aquadest ad	100	100

PEG: Polyethylene glycol

Table 5: Test results SPF lotion with tomato extract

Formulation	SPF
F1	18.84
F2	22.24

F1: Lotion with tomato extract 1%, F2: Lotion with tomato extract 1.5%, SPF: Sun protection factor

Results of Freeze-thaw Cycle Test

The results of the testing phase with lotion separation method of freeze-thaw cycles are described with globule lotion size checks on each of the six cycles of freeze thaw, as compared to the size of globule lotion stored at room temperature [Figure 3].

Result of Centrifugation Test

The results of the testing phase with lotion separation method of centrifugation are carried out with lotion state examination after centrifuged with speed, 3000, 2500, and 3750 rpm. Inspection results were summarized in Table 7.

Result of Qualitative Analysis of Lotion

The results of the evaluation of qualitative material using TLC were shown in Figure 4. The observation is done with TLC of tomato fruit extracts and preparations containing tomato extract lotion to notice any changes before and after done formulations.[10]

DISCUSSION

Tomatoes contain extracts of polyphenolic, flavonoids, monoterpenoid and sesquiterpene, and saponins. It contains a lycopene as a derivate of terpenoid compound. Base on structure of lycopene, its showed as potent compound as strong antioxidant.

The formula chosen is the second formula due to a thick consistency easy flow. Formulas 1 and 3 are not selected because formula 1 shows the lotion is too dilute, and formula 3 is too thick so it is difficult to apply, the data can be seen in [Table 2].

A good SPF value for a preparation is above 15, because it is the minimum SPF 15 sunscreen effectively which

Table 6: Formulation of sunscreen lotion tomato extract

Formulation lotion	Consistency	Color	Smell
F1	K^+	Kr	Bk
F2	K	Kr^+	Bk

F1: Lotion sunscreen with the addition of tomato fruit extract 1%, F2: Lotion sunscreen with the addition of tomato fruit extract 1.5%, K: Lumpy easy flow (+ describing viscosity), KR: Beige (color density levels describe +), BK: Peculiar smell

Table 7: Result of centrifugation test

RPM	F0	F1	F2
2500	-	-	-
3000	-	-	-
3750	-	+	+

F0: Lotion formula without the tomato fruit extracts, F1: Lotion sunscreen with the addition of tomato fruit extract 1%, F2: Lotion sunscreen with the addition of tomato fruit extract 1.5%, (−): Not separate into 2 phases, (+): Split into 2 phases, RPM: Rotary perminute

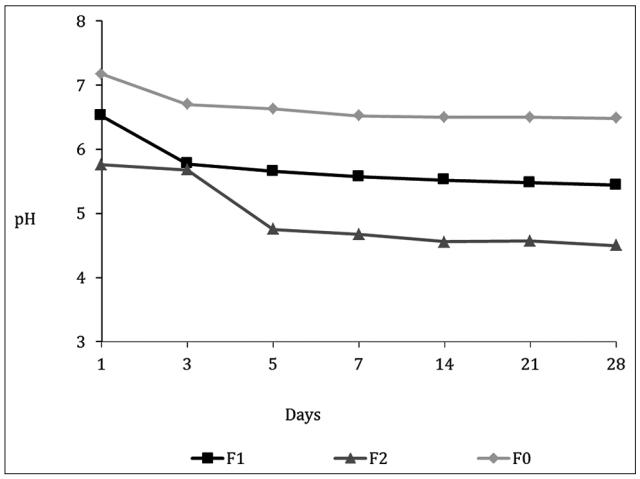

Figure 1: Result of pH observation of lotion during 28 days

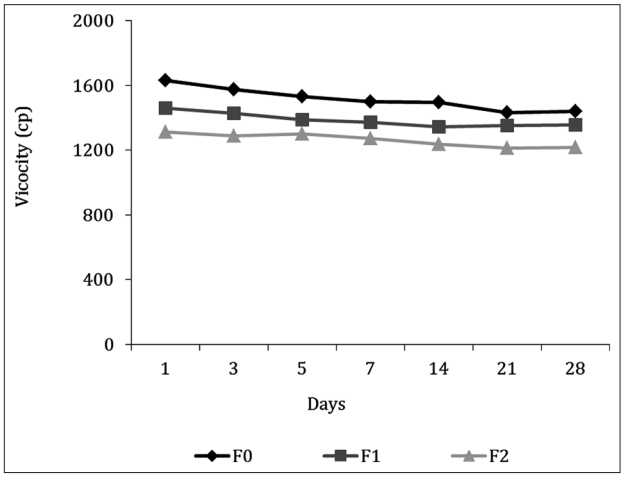

Figure 2: Viscosity of lotion during 28 days

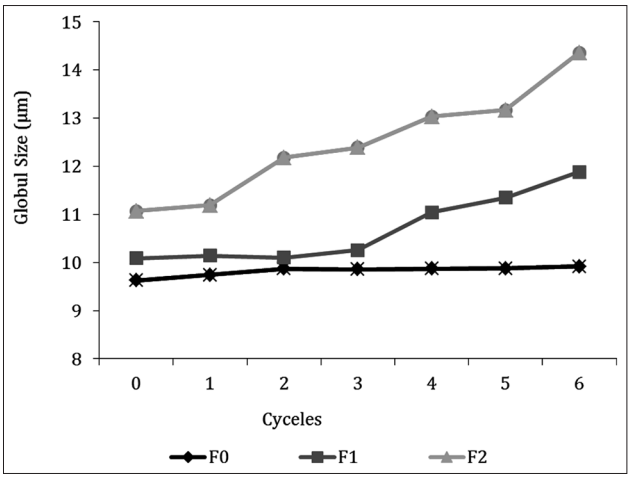

Figure 3: Result of size measurement globule lotion during 6 cycle freeze thaws

can hold as much as 95% of UVB ray's radiation from reaching the skin.[11] By the reason of such preparations, lotion sunscreen made and optimized with a value of above SPF 15, i.e., containing extract of the fruit of the tomato with a concentration of 0.5%.

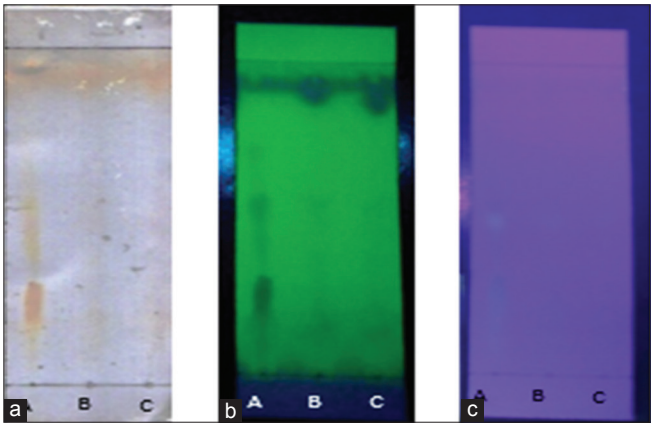

Figure 4: Chromatogram of extract and lotion. (a) Detection at visible, (b) detection at UV 254nm, (c) detection at UV 366nm, a - extract tomato, b - lotion with 1% extract tomato (F1), c - lotion with 1.5% extract tomato (F2)

Based on data, Table 4 created two formulations of lotion sunscreens with the addition of tomato fruit extracts as much as 2 and 3 times, i.e., 1%; and 1.5. When viewed from the observations in Table 6, the addition of tomato fruit extracts changes color and lotion becomes creamy young and changing viscosity. The more extract the tomatoes added the more dilute lotion.

Based on Table 5, note that required more concentration of extract in preparations lotion SPF values to achieve relatively the same as SPF of extract so that it can be said to occur the decrease in value of SPF. It can be caused by the presence of the influence of formulation against the effectiveness of preparations in the absorption of UV light. In addition, treatment of samples in the set up for the measurement of SPF can also be influential in the decline of SPF. SPF decline is not significant and still exists within the range of values that are still accepted. Table 5 also shows that F1 has a value closest SPF 15 because F1 and F2 have a value >15.[12]

The pH of the third formula lotion decline, however, tends to be stable. Changes that occur at pH during storage can be caused by external and internal factors. External factors include temperature and humidity, while internal factors are the characteristics of an extract of his relative pH which is acidic, but pH lotion sunscreen preparations being made still fall into the range of pH for preparations, namely lotion ranged between 4 and 7.5.[12] It is known that there is a difference in pH due to the influence of the treatment. Lotion stated with different concentration extract experienced significant pH change. Further test results from the Newman-Keuls noted that noticeable changes in the pH are between F2, F1, F0, F2, and F1 with F0.

Changes allegedly caused by some influential factors, such as changes in room temperature. Increased storage temperature can interfere with the binding of water phase and oil phase and also increases the motion of the dispersed phase of globule. Besides other factors influencing viscosity change, lotion is pH. The drop in pH at lotion causing a decrease in viscosity well. The increased addition of extract will lower the viscosity. The viscosity of lotion must be in the range of 500cp–5000 cp.[13] The results of the calculation of statistically. It is known that there is a difference in viscosity due to the influence of the concentration of the extract.

Lotion storage at two different temperatures or freeze-thaw cycles to see temperature influence against segregation lotion. Freeze-thaw cycle is a cycle of freeze-melt where a material is stored at a temperature between the two cycles, namely, 4°C and 40°C.[13,14] It can be noted an increase in the size of the dispersed phase globule after experiencing cycles of freeze-thaw compared to room temperature. This can occur due to the influence of the addition of extracts affecting stability, and existence of lotion increases and decreases storage temperatures which caused ties between the particles tend to form size and stretchable globule. However, the size of globule lotion still meet size globule, i.e. the size of globule for emulsion is 1–100 μm.[15] From the results of a calculation in the analysis, the conclusion is that there is a difference between globule size F2, F1, and F0, with $\alpha = 95\%$ and 99%. This means that there is a difference in the size of globule lotion real due to the influence of the concentration of the extract between F0, F2, F2 by F1, F0, and F1.

The use of the method of centrifugation in looking at the separation phase emulsion is very useful for predicting the time save of a material.[16] If an emulsion persists centrifuged at 3,750 rpm in 5 hours will show resistance to the effects of gravity for approximately 1 year. On conversion, then obtained that centrifugation speed with 2500 rpm for 5 h is equivalent to the effect of gravity is approximately 8 months, while for the speed 3000 rpm, is equivalent to the effect of gravity is approximately 10 months. Table 7 can be seen that the third formula lotion is not experiencing the separation with the method of centrifugation at 2500 and 3000 rpm speed, but separate into 2 phases at 3750 rpm. This indicates that the preparations have a physical quality that is stable but not quite stable when stored for 1 year.[17]

A TLC results from tomato fruit extracts and lotion containing extract tomato fruit were observed using UV 254 nm 366 nm, UV, and the results showed a pattern of spots and the same Rf value on all three. This shows the lack of change in the compound after and before the formulated extract.

CONCLUSION

Results of research conducted can be concluded that the extract of the fruit of tomato (*S. lycopersicum* L.) has effectiveness as sunscreen on the concentration of 0.5% which has SPF 17.74. Extracts can be formulated with either on formula 1 or formula 2 with lotion sunscreen compositions containing emulsifying agent (mixture of PEG-6, ethylene glycol, and PEG-32), paraffin liquid, cetyl alcohol, distilled water, as well as methylparaben preservatives as where two

formula lotion sunscreen contains 1% (F1) and 1.5% (F2) of tomato, and fruit extracts SPF value 18.84 and 22.24. Lotion formula sunscreen that is produced has a good physical quality during storage 28 days, and therefore, preparations lotion sunscreen containing 1% and 1.5% of the tomato fruit extracts can be used as sunscreen topically.

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