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Antioxidant Activity Test from Vegetable Tomato (*Solanum lycopersicum*) and Cherry Tomato (*Solanum lycopersicum* var. Cerasiforme) in Hand and Body Cream

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Abstract

Dry, scaly, rough skin conditions accompanied by wrinkles and black spots characterize the skin that experiences premature aging. One of the causes of premature aging is free radicals. These free radicals can be overcome with natural or artificial antioxidants. Natural antioxidants are found in fruits and vegetables, one of which is tomatoes. Tomatoes in direct use are less effective, so they are made in the form of hand and body cream. Production of vegetable tomato and cherry tomato extracts fruit extraction and maceration using 96% ethanol, then concentrated with a rotary evaporator until the extract is thick. The extracts of vegetable tomatoes and cherry tomatoes were then tested for phytochemical, antioxidant activity, and identification of compounds with LC-MS, then applied to hand and body cream with a concentration of 1% and 3% with codes F0, F1, F2, F3, and F4. Hand and body cream of tomato extract are tested by measuring pH, viscosity, specific gravity, total microbial Contamination, homogeneity and testing for antioxidant activity using the DPPH method. Phytochemical test results showed that flavonoid compounds were present in both extracts. The antioxidant activity of vegetable tomato ethanol extract was obtained with an IC_{50} value of 947.81ppm, and an IC_{50} value of 473.51 ppm was obtained for cherry tomato extract. From the LC-MS analysis, the compounds contained in cherry tomatoes, namely esculeoside A and B as cytotoxic activity, dehydrotomat as an antibacterial, kaempferol-3-O-rutinoside as an antioxidant, and tomatidine as an antibiotic. Antioxidant activity of hand and body cream, hand and body cream F4 (964.05 ppm), hand and body cream F3 (1001.97 ppm), hand and body cream F2 (1033.73 ppm), hand body cream F1 (1036.61 ppm), and hand and body cream F0 (1486.14 ppm). Hand and body cream cherry tomato extract 3%, formula 4 (F4), has the highest antioxidant activity. It can be concluded that the addition of extract concentration affects the antioxidant activity value of hand and body cream. Body cream F2 (1033.73 ppm), hand body cream F1 (1036.61 ppm), and hand and body cream F0 (1486.14 ppm). Hand and body cream cherry tomato extract 3%, formula 4 (F4), has the highest antioxidant activity. It can be concluded that the addition of extract concentration affects the antioxidant activity value of hand and body cream. Body cream F2 (1033.73 ppm), hand body cream F1 (1036.61 ppm), and hand and body cream F0 (1486.14 ppm). Hand and body cream cherry tomato extract 3%, formula 4 (F4), has the highest antioxidant activity. It can be concluded that the addition of extract concentration affects the antioxidant activity value of hand and body cream.

Keywords: antioxidants, hand and body cream, vegetable tomatoes, cherry tomatoes.

1. INTRODUCTION

Skincare has become an essential thing for women. It has recently become a matter of concern because premature aging is characterized by dry, scaly, rough skin conditions and the appearance of wrinkles and black spots or spots. Two factors cause it, namely internal and external factors, such as health, endurance, stress, and hormonal changes (Internal characteristics). Humans cannot avoid this natural process. The effects can be reduced by proper, routine, and gentle facial care and stress reduction. The external factors include free radicals, sunlight, and pollutants [1]

The formation of free radicals is a mechanism that can cause skin aging [2]. Antioxidants can prevent free radicals. Antioxidants are molecules that can inhibit the oxidation of other molecules. Antioxidants are compounds that can counteract or reduce the negative impact of oxidants in the body, which work by donating one electron to oxidants that stabilize free radicals by complementing the electron deficiency of free radicals so that the activity of these oxidant compounds can be inhibited.

Antioxidants consist of synthetic and natural antioxidants. Synthetic antioxidants include Butyl Hydroxy Anisole (BHA) and Butyl Hydroxy

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Toluene (BHT). In contrast, natural antioxidants can be obtained from fruits and vegetables such as tomatoes, apples, and cauliflower [1].

Tomato is a natural antioxidant. In previous studies, phytochemical screening was carried out on tomatoes and showed that they contained alkaloids, flavonoids, tannins, saponins and polyphenols [4]. Various scientific evidence shows that the risk of chronic disease due to free radicals can be reduced by utilizing the role of antioxidant compounds such as vitamins C, E, A, carotene, phenolic acids, polyphenols, and flavonoids [3].

Tomato (Solanum lycopersicum L.) contains bioactive compounds that are useful for human health, including carotenoids (lycopene and beta-carotene), tocopherols from tomato seed oil, tomato fibre, phenols, and various enzymes. This lycopene compound has pharmacological activity as an antioxidant. Agustina [4]. Lycopene is a natural colour-forming bright red pigment carotenoid found in tomatoes, guava, watermelon, and grapes which has been studied extensively to have strong antioxidant power and anti-cancer abilities.[5]

In this study, tomato extract will be formulated into cosmetic preparations, namely hand and body cream, with different concentrations to determine whether adding tomato extract to the antioxidant activity of hand and body cream products is affected. Antioxidant activity will be tested by the DPPH method using UV-Vis spectrophotometry because DPPH can scavenge free radicals.

2. METHODS

2.1 Tools and Materials

The tools used in this research are; UV-Vis spectrophotometer, oven, LC-MS, rotary evaporator, blender, analytical balance, pH meter, viscometer, petri dish, magnetic stirrer, thermometer, stopwatch, bath, plastic container, and glassware. The main ingredients used are vegetable tomatoes and cherry tomatoes. The ingredients used to make hand and body cream are coconut oil, cetyl alcohol, stearic acid, tween 80, dimethicone, Titanium dioxide, allantoin, Methylparaben, Propylparaben, BHT (Butyl Hydroxy Toluene), Glycerol, Propylene Glycol, Sorbitol, Aquadest. Other materials used are magnesium powder, hydrochloric acid, ethanol, amyl alcohol, iron (III) chloride, ether, Liberman-Bouchard reagent, acetic acid, concentrated sulfuric acid, DPPH (2,2 diphenyl 1 picrylhydrazyl), methanol pro analysis, media Plate Count Agar (PCA).

2.2 Preparation of Vegetable Tomato and Cherry Tomato Ethanol Extract

The extraction process of tomatoes uses maceration with ethanol. Ethanol used 96% ethanol. The extraction process was carried out by weighing 250 g of tomatoes and then mashing them. The mashed tomatoes soak in 96% ethanol for three consecutive days. The resulting liquid extract is concentrated with a rotary evaporator at low pressure at a temperature of 35-40 °C to obtain a thick extract [5]. Then the thick extract was weighed, and the % yield was calculated with the following equation:

$$\% \text{ Yield} = \frac{\text{thick extract weight (grams)}}{\text{total sample weight (grams)}} \; x \; 100\%$$

2.3 Phytochemical Screening

Phytochemical screening carried out the flavonoid test by adding HCl-ethanol. Amyl alcohol to the filtrate, the filtrate saponin test was shaken in the form of foam or not, the tannin test with $FeCl_3$ and steroids or triterpenoids added to the filtrate by adding diethyl ether, concentrated H_2SO_4 and 1 mL of glacial acetic acid (Lieberman-Bouchard test).

2.4 Testing the Antioxidant Activity of Tomato Extract by DPPH method

Weigh 0.1 g of tomato juice extract, and dissolve in ethanol p.a. until all dissolved, then put into a 100 mL volumetric flask and diluted to the mark to obtain 1000 ppm mother liquor. Then 1000 ppm mother liquor was pipetted at each concentration into a 10 ml volumetric flask, added 1 mL of 0.004% DPPH solution, diluted with pro-analyst ethanol to the mark and allowed to stand for 30 minutes and then the absorbance of the sample was measured at a wavelength of 517 nm.

2.5 Test of Antioxidant Activity of Hand and Body Cream Tomato Extract DPPH method

4 mg DPPH powder was dissolved with methanol pa, then put into a 100 mL volumetric flask, added methanol pa up to the volume limit mark, then placed in a dark bottle so that a 0.004% DPPH solution was obtained [6].

Preparation of mother liquor Hand and Body Cream by weighing 0.1 g of the sample then dissolved in ethanol pa until all dissolved, then put into a 100 mL volumetric flask and diluted to the mark. Then 1 mL of 0.004% DPPH radical solution was pipetted and diluted with ethanol p.a. until the

volume became 10 mL. The same test was carried out on the blanks. Samples were incubated at room temperature for 30 minutes. The absorption test was carried out using a UV-Vis spectrophotometer using a maximum wavelength of 517 nm.

2.6 Hand and body cream formulation

Table 1 shows the formula of hand and body cream.

Table 1. Hand and body cream formula

Material Name	Formulation				
	F0	F1	F2	F3	F4
Vegetable tomato extract	0	1	3	0	0
Cherry tomato extract	0	0	0	1	3
Alkyl Acrylates Crosspolymer	0.25	0.25	0.25	0.25	0.25
Propanodiol	2.5	2.5	2.5	2.5	2.5
Disodium tetra EDTA	0.1	0.1	0.1	0.1	0.1
Panthenol	1	1	1	1	1
Triethanolamine	0.2	0.2	0.2	0.2	0.2
Stearic acid	5	5	5	5	5
Dimethicone	0.6	0.6	0.6	0.6	0.6
Alkyl benzoate	3	3	3	3	3
Cetearyl alcohol	3.3	3.3	3.3	3.3	3.3
Sunflower Oil	3	3	3	3	3
Isohexadecane	4.5	4.5	4.5	4.5	4.5
Ceramide	0.25	0.25	0.25	0.25	0.25
BHT	0.1	0.1	0.1	0.1	0.1
Phenoxyethanol	0.8	0.8	0.8	0.8	0.8
deodorizer	0.2	0.2	0.2	0.2	0.2
Aquades	100	100	100	100	100

Information :
F 0; 1; 2; 3; 4 is a cream formula without the addition of tomato extract, 1% and 3% vegetable tomato extract and 1% and 3% cherry tomatoes.

2.7 Evaluation of Tomato Extract Hand and Body Cream

2.7.1 Organoleptic Test

The organoleptic test on the product included a preference test for colour, aroma, viscosity and the impression of stickiness on the skin. This test is subjective, and the panelists who carried out the test were random panelists totaling 55 people who were untrained panelists.

2.7.2 pH measurement

The pH value was measured using a calibrated pH meter [10].

2.7.3 Emulsion Stability

About fifty grams of emulsion/sample (hand and body cream sample) are in a pot. The containers and materials were put in an oven at 50^{o}C for one month. Observations were made by checking the homogeneity, pH and viscosity.

2.7.4 Density measurement

$$\text{Density} = (b-a) / 30$$

a = Weight of the weighing bottle which is clean and dry
b = Weight of bottle
30 is the number listed on the weighing bottle.

2.7.5 Viscosity Measurement

The viscosity was measured with a calibrated Brookfield viscometer [7].

2.7.6 Microbial Contamination

The sample was diluted with sterile diluent to 10^{-3} and then homogenized. One ml of each sample dilution was pipetted into sterile Petri dishes in duplicate, and then 12-15 ml of liquid Plate Count Agar (PCA) media was poured. The petri dish was shaken slowly until the sample was well mixed. The mixture was allowed to solidify and then put in an incubator (35±1 ^{o}C) in an inverted position for 48 hours. The number of microbial colonies in one gram or one ml of the sample is calculated by multiplying the average number of colonies on the plate by the dilution factor used.

2.8 Data analysis

Analysis of data to see changes in levels, used the calculation of efficiency (%). The test of significant differences between treatments will be analyzed using the statistical analysis method ANOVA (Analysis of Variance) then Duncan's further test will be used.

3. RESULTS AND DISCUSSION

3.1 Preparation of Vegetable Tomato and Cherry Tomato Ethanol Extract

Tomato 250 g was macerated with 96% ethanol and then put in a rotary evaporator until the extract was thick. The choice of 96% ethanol as a solvent because the alcohol group is a safe universal organic solvent that is better and safer than methanol or other alcohol groups and is expected to attract polar, semi-polar or non-polar compounds.

The thick vegetable tomato extract obtained was 18.14 grams. The yield of vegetable tomato extract was 7.24%. Thick cherry tomato extract obtained as much as 15.11 grams. The yield of cherry tomato extract was 6.04%

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3.2 Phytochemical Test of Vegetable Tomato and Cherry Tomato Extract

Table 2 shows that cherry tomatoes are positive for flavonoids, saponins, and tannins, while vegetable tomatoes only contain flavonoids.

Table 2. Phytochemical Test of Tomato Extract and Cherry Tomato Extract

No	Compound Group	Test Sample Name	
		Vegetable Tomato	Cherry Tomatoes
1	Flavonoids	+	+
2	Tannins	-	+
3	Saponins	-	+
4	Steroids	-	-
5	Triterpenoids	-	-

3.3 Identification of Compounds by LC-MS

Table 3 shows that the compounds contained in the tomato extract are Esculeoside A and B, which have cytotoxic activity, dehydrotomatin as an antibacterial, Kaemferol-3-O-rutinoside as an antioxidant, and tomatidine as an antibiotic.

Table 3. Results of Compound Identification with LC-MS

No	Retention Time (minutes)	MS data m/z	Molecular formula	Compound Components
1	4.92	1228.5942	$C_{56}H_{93}NO_2$	Esculeoside B
2	5.13	1078.5438	$C_{51}H_{83}NO_{23}$	Dehydrotomatin
3	5.60	1270,6045	$C_{58}H_{95}NO_{29}$	Esculeoside A
4	6.13	595.1665	$C_{27}H_{30}O_{15}$	Kaempferol-3-o-rutinoside
5	8.79	414.3367	$C_{27}H_{43}NO_2$	Tomatidine

3.4 Tomato Extract Antioxidant Activity Test

The antioxidant activity test was carried out using the DPPH method. DPPH is a stable free radical used to evaluate free radical scavenging in natural materials.

The DPPH absorbance value obtained can be determined from the percentage value of the DPPH radical inhibitor (% Inhibition). The value of % inhibition can be determined from the value of IC_{50} (Inhibitory Concentration). The IC_{50} value is a number that indicates the concentration of the extract (mg/L), which can inhibit the oxidation process by 50%. The smaller the IC_{50} value, the higher the antioxidant activity [8].

Antioxidant activity of vegetable tomato ethanol extract with IC_{50} value of 947.81 and cherry tomato extract obtained IC_{50} value of 473.51. With this IC_{50} value, it can be said that the cherry tomato ethanol extract sample has more significant antioxidant activity than vegetable tomatoes because it has a lower IC_{50} value.

3.5 Hand and Body Cream Formulation of Vegetable Tomato Extract and Cherry Tomato

The experiment was carried out according to a predetermined formulation. The cream product is formulated with tomato extract, which has been previously tested to contain antioxidant activity. The use of antioxidants in cosmetic products is not limited. It was determined that the concentration and type of extract used as an experimental design for the application of vegetable tomato extract and cherry tomato extract as a substitute was 1% vegetable tomato extract (F1), 3% vegetable tomato extract (F2), 1% cherry tomato extract (F1) F3), 3% cherry tomatoes (F4) and there is cream without extract (F0).

3.6 Antioxidant Activity Test Hand and Body Cream Vegetable Tomato Extract and Cherry Tomato

Table 4. The results of statistical tests with one-way ANOVA show a significant difference between hand and body IC50 for each formulation.

Sample	IC value$_{50}$
F0	1511,1150 ± 35,31998 b
F1	1064,0650 ± 38,82723 b
F2	1041.3700 ± 11.31371 b
F3	1005.8900 ± 5.54372 a
F4	967,6800 ± 5,13360a
p	0.000

Table 4 shows the results of statistical tests with one-way ANOVA show a significant difference between hand and body IC_{50} for each formulation. The probability value is 0.000 ($p<0.05$). Duncan's other test results on IC_{50} found that F4 was significantly different from F0, F1 and F2 but not significantly different from F3. These results indicate that the activity value of the extract is directly proportional to the addition of tomato extract. Cherry tomatoes have a higher antioxidant activity value than vegetable tomatoes, and hand and body cream with code F4 has the greatest activity compared to F0, F1, F2 and F3. F4 is a

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hand and body cream with 3% cherry tomato extract.

3.7 Evaluation of Hand and Body Cream Vegetable Tomato Extract and Cherry Tomato

3.7.1 Organoleptic Test

From the results of the one-way ANOVA statistical test for organoleptic tests of colour, aroma, viscosity, and sticky impression on the hand and body cream of each formulation, it can be concluded that there is no significant difference between each formulation because each variable has a P-value > 0.05.

3.7.2 Homogeneity Test

The results obtained from the tests that have been carried out show that all hand and body cream formulas are homogeneous with an even cream appearance. The test results must show a homogeneous arrangement. The ingredients used to manufacture hand and body cream must be evenly dispersed in the preparation [9].

3.7.3 pH test

The pH value of the topical preparation should not be too acidic because it can irritate, and it should not be too alkaline because it can cause scaly skin and dry skin [10]. The pH results of the hand and body cream extracts of vegetable tomatoes and cherry tomatoes were 5.05, complied with SNI 16-4399-1996 (4.5-8). It can be seen that the extracts of vegetable tomatoes and cherry tomatoes affect the pH to become more acidic.

3.7.4 Specific Weight Test

The results showed that hand and body cream products without adding vegetable tomato extract and cherry tomatoes with 1% and 3% tomato hand and body cream products and 1% and 3% cherry tomato hand and body cream products did not show any significant difference.

The results of the hand and body cream analysis for each treatment also showed that the specific gravity value was still in the range of quality requirements based on SNI 16-4399-1996, which was in the range of 0.95-1.05.

3.7.5 Viscosity Test

Viscosity affects the ability of the preparation to spread and adhere to the skin surface. The higher the viscosity (the thicker) the preparation, and the more its ability to apply on the skin's surface will decrease. In contrast, the ability to adhere to the skin will increase, and vice versa. The viscosity results of each formula meet the standardSNI16-4399-1996 of a skin moisturizer requirement.

3.7.6 Emulsion Stability

Stability testing in this study was carried out by testing the storage temperature. Hand and body cream products are stored in the oven at ± 105 °C for 30 days. On the 30th day, the pH value, viscosity, and specific gravity were tested. The results of the observations showed a change with decreasing values of viscosity, pH and specific gravity but still met the requirements of SNI 16-4399-1996.

Table 5 shows the results of the overall hand and body cream of vegetable tomato extract and cherry tomatoes.

Table 5. Overall results of hand and body cream vegetable and cherry tomato extracts

No	Parameter	Sample					SNI
		F0	F1	F2	F3	F4	
1	Antioxidant Hand and Body Cream	395,908	493.869	726.526	553,045	946,938	-
2	Color organoleptic test	3.7091	3,8000	3.3091	3.7636	3.5091	
3	Aroma organoleptic test	3.5273	3.0727	3.3636	2.9818	3.1455	
4	Viscosity organoleptic test	3.4909	3.2545	3.1091	3.3636	3.3273	
5	Organoleptic Test Sticky Effect	3.4727	3.3636	3.2909	3.3818	3.4364	
6	pH value	6.8	6.01	6.26	5.47	5.05	4.5-8.0
7	Density (g/ml)	1.0133	1.0333	1.0267	1.0267	1.0067	0.95-1.05
8	Viscosity (cPs)	49,000	48,500	50,000	38.000	46,000	2,000 - 50,000
9	Microbial contamina-tion	< 10	< 10	< 10	< 10	< 10	< 102

3.7.7 Microbial Contamination

Table 6 shows the testing of microbial contamination on products is one of the analyzes that makes the product feasible or unfit for consumption or use. This test is carried out to determine the number of microorganisms in a material. The microbial contamination results from each hand and body cream formulation did not show any bacterial growth, so the results were written as < 10 colonies/g because using a 10^1 dilution. The results from all formulations met the requirements for microbial Contamination in SNI

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16-4399-1996, namely <10^2 colonies/g.

Table 6. Microbial Contamination Test

Sample	Microbial Contamination (colonies/g)	SNI Standard 16-4399-1996
F0	< 10	< 10^2
F1	< 10	
F2	< 10	
F3	< 10	
F4	< 10	

4. CONCLUSION

IC_{50} value from cherry tomato ethanol extract and vegetable tomato ethanol extract are 473.51 ppm and 947.51 ppm respectively. Vegetable tomato ethanol extract contains flavonoid secondary metabolite compounds, while cherry tomato ethanol extract contains flavonoid, tannin, and saponin secondary metabolite compounds. Based on the IC_{50} value, the highest sample antioxidant activities were hand and body cream F4 (964.05 ppm), hand and body cream F3 (1001.97 ppm), hand and body cream F2 (1033.73 ppm), hand body cream F1 (1036.61 ppm), and hand and body cream F0 (1486.14 ppm). The compound that the identification of cherry tomato ethanol extract using LC-MS was esculeoside A and B as cytotoxic activity, dehydrotomatin as antibacterial, Kaemferol-3-O-rutinoside as an antioxidant, and tomatidine as an antibiotic.

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