

Formulation and Antioxidant Activity Evaluation of Aloe Vera Gel Face Mist Using the DPPH Method

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Renny Amelia¹, Fauziyah¹, Yayan Rizikiyan¹, Muh. Yani Zamzam¹, Tomi¹.**Keywords:***Aloe vera gel;**Antioxidant;**face mist*

Skin damage may be caused by metabolic waste products, combustion processes, and free radicals, which require antioxidants both systemically and locally. One source of antioxidants can be obtained from aloe vera gel, which contains compounds such as aloin, aloesin, aloe-emodin, and tannins. This study aimed to determine whether aloe vera gel could be formulated into a face mist preparation and to evaluate the antioxidant activity of the resulting face mist formulation. One of the benefits of face mist preparations is their ability to refresh and moisturize facial skin while potentially helps reduce the impact of oxidative stress due to UV exposure. The aloe vera gel face mist formulations were prepared in varying concentrations of 30%, 35%, and 40%, followed by evaluations including organoleptic testing, pH testing, spread ability testing, homogeneity testing, and viscosity testing. Antioxidant activity was evaluated using the DPPH method with a UV-Vis spectrophotometer, using vitamin C as the reference standard. The results demonstrated that aloe vera gel could be successfully formulated into face mist preparations at concentrations of 30%, 35%, and 40%. Based on the evaluation results, including organoleptic properties, homogeneity, specific gravity, viscosity, and spread ability, all formulations met the required standards for face mist preparations. The antioxidant activity test results showed that the 30%, 35%, and 40% aloe vera gel face mist formulations with IC₅₀ values of 65.04 ppm, 64.46 ppm, and 63.66 ppm respectively were classified as strong antioxidants.



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Skin damage can impair both health and appearance. Skin deterioration may also be caused by free radicals originating from air pollution, food, various chemical substances, and ultraviolet (UV) radiation [1]. Facial skin that is frequently exposed to pollution and sunlight may experience increased free radical activity, resulting in unhealthy skin conditions and leading to various skin problems such as acne, hyperpigmentation, and dull skin [2]. Therefore,

antioxidants are required both systemically and topically to protect the skin from damage induced by free radicals.

One of the plants known to contain antioxidant compounds is aloe vera. Aloe vera gel is recognized for its effective antioxidant activity. The antioxidant active compounds identified in aloe vera gel include phenolic compounds such as aloin, aloesin, aloe-emodin, and tannins. Aloin exhibited a

^{1,2,3,4} Fakultas Farmasi, Universitas Ahmad Dahlan Cirebon Jl. Cideng Indah No. 3A, Kertawinangun, Kec Kedawung, Kabupaten Cirebon 45153

Email: r3nny3m@gmail.com

higher inhibitory activity with an IC50 value of 11.1 ppm compared to vitamin C, which showed an IC50 value of 23.7 ppm [3]. Another study also revealed that the major compounds present in aloe vera provide protective effects primarily through and anti-inflammatory mechanisms [4].

Face mist is a cosmetic preparation commonly used to refresh and moisturize facial skin, as well as to provide protection against damage caused by ultraviolet (UV) radiation [5]. One of the advantages of face mist preparations is their liquid form, which is easier to apply to facial skin compared to cream and gel formulations. This is because face mist formulations are water-based and therefore absorb more readily into the skin, whereas cream and gel bases generally contain oils that require a longer absorption time [6].

Antioxidant activity of aloe vera demonstrated that a 30% concentration exhibited an IC50 value of 46.76 ppm, which is categorized as a very strong antioxidant [7]. Based on the background described above, the authors were interested in formulating an aloe vera (Aloe vera) gel face mist preparation using various concentrations of 30%, 35%, and 40%.

Results and Discussion

Plant Determination

Plant determination aims to verify the authenticity and identity of the plant material to ensure that the selected plant is indeed the intended species. Therefore, errors in the collection of research materials can be avoided. The results of the plant determination conducted at the Laboratory of Mathematics and Natural Sciences, Padjadjaran University No 12/HB/04/2025, confirmed that the plant used in this study was Aloe vera belonging to the family Xanthorrhoeaceae.

Preparation Evaluation

In this study, aloe vera gel was formulated into a face mist preparation to facilitate application

and to enhance the comfort and effectiveness of the active ingredients when applied to facial skin. The face mist formulation was prepared using three different concentrations, namely 30% (FI), 35% (FII), and 40% (FIII). This evaluation was conducted to ensure that the face mist product met the required pharmaceutical preparation standards and was safe for application on the skin.



Figure 1. Face Mist Preparation Containing Aloe Vera Gel. From left to right: Base, 30% (FI), 35% (FII), and 40% (FIII).

Organoleptic and Homogeneity Tests

The organoleptic test was conducted to evaluate the physical appearance of the face mist preparation using visual observation to assess the color, odor, and form of the preparation.

The results of the organoleptic evaluation of the aloe vera gel face mist preparation demonstrated that the formulation possessed satisfactory physical characteristics. The organoleptic evaluation demonstrated that the base formulation was clear with a characteristic PVP odor, while formulations FI, FII, and FIII exhibited a yellowish-green color, a characteristic aloe vera odor, and a liquid dosage form. Furthermore, all formulations showed homogeneous characteristics without the presence of visible particles.

The preparation exhibited a yellowish-green color resulting from the addition of the active ingredient, where higher concentrations in the formulation produced a more intense color. The tested face mist preparation also exhibited a characteristic fresh aloe vera aroma with a slightly herbal scent, corresponding to the active ingredient used. Based on the homogeneity test results, the aloe vera face mist preparation showed good homogeneity, as indicated by the absence of visible particles in the formulation.

pH Test

The pH evaluation of the aloe vera gel face mist preparations demonstrated varying pH values from the base formulation to FIII (**Table 1**); however, all formulations remained within the acceptable pH range for facial skin, namely 4.5–6.5. The differences in pH among the formulations were influenced by

variations in the concentration of the active ingredient and the addition of triethanolamine (TEA) as a pH-adjusting agent. Preparations with excessively acidic pH may cause skin irritation, such as itching and redness, whereas overly alkaline conditions may lead to skin dryness [8].

Evaluation of Spray Dispersion Ability

The results (**Table 2**) of this study demonstrated that all formulations, from the base preparation to FIII, exhibited good spray dispersion ability, with spray diameters ranging within the acceptable standard of 5–7 cm [9]. An increase in the concentration of the formulation resulted in a reduced spray dispersion capacity due to the higher viscosity of the preparation, which consequently produced a lower spray spread.

Table 1. Results of the pH Test of Aloe Vera gel Face Mist

Formula	pH			Mean± SD
	Replication			
	1	2	3	
Base	5,64	5,63	5,62	5,63±0,01
FI	5,59	5,52	5,55	5,53±0,03
FII	5,41	5,38	5,37	5,38±0,02
FIII	5,20	5,21	5,23	5,21±0,01

Table 2. Result of Evaluation of Spray Dispersion Ability of Aloe Vera gel Face Mist

Formula	Spray Dispersion Ability (cm)			Mean± SD
	Replication			
	1	2	3	
Base	6,9	6,88	6,5	6,76±0,09
FI	6,33	6,275	6,20	6,26±0,09
FII	6,175	6,13	6,05	6,11±0,04
FIII	5,96	5,75	5,625	5,77±0,04

Specific Gravity

Based on table 3, the specific gravity values of the formulations, from the base preparation to FIII, were found to comply with the required standard for pharmaceutical preparations. The acceptable

standard range for specific gravity is 0.7–1.2 g/mL [10]. The specific gravity of the preparations was influenced by the increasing concentration of aloe vera gel used in the formulations. Higher concentrations of aloe vera gel resulted in higher specific gravity values of the face mist preparations.

Viscosity

Viscosity is defined as the measure of the thickness or resistance of a liquid to flow. A preparation with excessively high or low viscosity may affect its ability to flow properly and to be dispensed effectively. Preparations with very low viscosity tend to drip during facial application,

resulting in reduced retention on the skin surface [8]. The results presented in **Table 4**, demonstrated that all formulations, from the base preparation to FIII, fulfilled the required viscosity standards. Furthermore, increasing the concentration of aloe vera gel in the formulation resulted in higher viscosity values. The acceptable viscosity requirement for face mist preparations is <150 cP [5].

Table 3. Results of Specific Gravity Test of Aloe Vera gel Face Mist

Formula	Specific Gravity (g/ml)			Mean± SD
	Replication			
	1	2	3	
Base	1,0033	1,0037	1,0033	1,0035±0,0002
FI	1,0026	1,0024	1,0026	1,0025±0,0001
FII	1,0029	1,0029	1,0029	1,0029±0,0000
FIII	1,0037	1,0037	1,0037	1,0037±0,0000

Table 4. Results of the Viscosity Test of Aloe Vera Gel Face Mist

Formula	Viscosity (cp)			Mean± SD
	Replication			
	1	2	3	
Base	1,1306	1,0569	1,3065	1,1646±0,1282
FI	2,2210	2,2102	2,5849	2,3387±0,2132
FII	2,3758	2,3779	2,7966	2,5167±0,2423
FIII	2,5267	2,4418	2,7085	2,5590±0,1362

Antioxidant Activity Test

The antioxidant activity test in this study was conducted using a UV-Visible spectrophotometer with the DPPH Assay method. The DPPH method is widely used for measuring antioxidant activity because it is simple, rapid, cost-effective, and can be easily applied in laboratory analysis. This method is based on the reduction of DPPH free radical solution by antioxidant compounds present in certain plants. The principle involves the donation of hydrogen atoms (H) from antioxidant compounds to DPPH radicals. This process reduces DPPH radicals into non-radical compounds, which can be observed through a color change from purple to yellow.

In the aloe vera gel face mist preparation, antioxidant activity was observed by evaluating the decrease in

the purple color intensity of the DPPH solution added to both the sample and the standard solution. The reduction in DPPH color intensity by antioxidant compounds is proportional to the number of electrons captured or hydrogen atoms absorbed.

The parameters used in the DPPH method include the percentage of inhibition (% inhibition) and the IC₅₀ value, which represents the concentration of a compound required to inhibit 50% of free radical activity. A lower IC₅₀ value indicates stronger antioxidant activity [11]. Prior to determining the IC₅₀ value, the maximum wavelength was identified to determine the wavelength at which the DPPH solution exhibited maximum absorbance using a UV-Visible spectrophotometer. The maximum wavelength determination was carried out by measuring

methanol within the wavelength range of 400–800 nm using a UV-Visible spectrophotometer [12]. In this study, the maximum wavelength obtained was 515.5 nm.

Based on the **table 5**, the IC₅₀ value obtained for the positive control, namely vitamin C, showed an average value of 4.15 ppm, which can be categorized as having very strong antioxidant activity. Meanwhile, aloe vera gel demonstrated an average IC₅₀ value of 41.54 ppm, indicating very strong antioxidant activity. Furthermore, FI exhibited an IC₅₀ value of 65.04 ppm, FII showed 64.46 ppm, and FIII demonstrated 63.66 ppm. Therefore, it can be concluded that all three aloe vera gel face mist formulations possessed strong antioxidant activity. Increasing the concentration of aloe vera gel in the formulation resulted in lower IC₅₀ values, indicating stronger antioxidant activity. The reduction in the antioxidant activity of Aloe vera gel in the formulated preparations containing 30%, 35%,

and 40% Aloe vera gel was attributed to the dilution of the active constituents, as these formulations contained lower concentrations than the crude Aloe vera gel (100% concentration).

Based on the results of this study, all formulations were categorized as having strong antioxidant activity. A previous study conducted reported that aloe vera gel exhibited an IC₅₀ value of 41.48 ppm [13], while another research obtained an IC₅₀ value of 46.76 ppm [7]. These differences may be attributed to variations in instruments, materials, or laboratory techniques used in the studies. The aloe vera utilized in this study was derived from the whole leaf, which contains aloin, the major antioxidant compound predominantly found at the base of the leaf. This compound was retained in the face mist preparation, resulting in a yellowish-green color and contributing to the preservation of antioxidant activity

Table 5. Antioxidant Activity of Aloe Vera Gel Face Mist

Sample	Concentration (X)	Abs		% Inhibition (Y)	IC ₅₀
		Blangko	Sample		
Vitamin C	1 ppm	0,988	0,920	6,84	4,15 ± 0,17 (Very Strong)
	3 ppm		0,680	32,14	
	5 ppm		0,368	62,68	
	7 ppm		0,103	89,47	
Extract of aloe vera gel	20 ppm	0,988	0,901	8,55	41,55 ± 0,19 (Very Strong)
	25 ppm		0,814	17,60	
	30 ppm		0,711	27,79	
	35 ppm		0,616	37,48	
FI	20 ppm	0,988	0,913	6,98	65,04 ± 2,44 (Strong)
	30 ppm		0,837	15,21	
	40 ppm		0,730	26,04	
	50 ppm		0,626	36,63	
FII	20 ppm	0,988	0,913	7,55	64,46 ± 1,45 (Strong)
	30 ppm		0,828	16,15	
	40 ppm		0,734	25,70	
	50 ppm		0,626	36,63	
FIII	20 ppm	0,988	0,909	7,95	63,66 ± 1,03 (Strong)
	30 ppm		0,822	16,76	
	40 ppm		0,728	26,27	
	50 ppm		0,619	37,27	

Conclusion

Aloe vera gel at concentrations of 30%, 35%, and 40% was successfully formulated into face mist preparations. The aloe vera gel face mist formulations at concentration 40% gives the best antioxidant activity with IC50 values of 63.66 ppm and exhibited good physicochemical properties with an acceptable dosage form

Materials and Methods

Preparation of Face Mist Extract

simplicia used was Aloe vera. The aloe vera samples were obtained from Indramayu and washed thoroughly under running water. Subsequently, the basal and apical parts of the aloe vera leaves were removed. The leaves were then peeled into two sections, and the aloe vera gel was sliced using a knife. The gel was washed again, homogenized using a blender, and filtered to obtain the filtrate in the form of aloe vera gel. The filtrate was then stored in a refrigerator for 30 minutes to eliminate foam formation.

Preparation of Face Mist Formulation

Table 5. Formulation of Aloe Vera Gel face mist

Ingredient	FI	FII	FIII
Extract of aloe vera gel	30%	35%	40%
Glycerin	1%	1%	1%
Polyvinylpyrrolidone (PVP)	2%	2%	2%
Methyl Paraben	0,02%	0,02%	0,02%
Triethanolamine (TEA)	0,05%	0,05%	0,05%
Aquadest	Ad 100 mL	Ad 100 mL	Ad 100 mL

Each ingredient was accurately weighed. PVP was transferred into a beaker glass and dissolved in a small amount of distilled water while being stirred using a glass rod until completely dissolved. Subsequently, methyl paraben and glycerin were

placed into a separate beaker glass and dissolved with a small amount of distilled water until a homogeneous mixture was obtained.

Aloe vera gel at concentrations of 30%, 35%, and 40% was then added, followed by the addition of a small amount of distilled water and stirred until homogeneous. Thereafter, TEA was gradually incorporated while the mixture was continuously stirred using a magnetic stirrer to achieve homogeneity. After a homogeneous preparation was obtained, the remaining distilled water was added gradually, and the final formulation was transferred into spray bottles [5].

Evaluation of Face Mist Preparation

Organoleptic Test

The organoleptic test was conducted through visual observation, including the evaluation of color, odor, and texture

Homogeneity Test

The homogeneity test was performed to observe the presence of particles or substances that were not uniformly mixed. The test was carried out by placing a certain amount of the preparation onto a glass slide for observation

pH Test

The pH measurement was conducted using a pH meter. Prior to use, the pH meter was calibrated using distilled water, dried, and standardized with buffer solutions of pH 4 and pH 7.

Specific Gravity Test

The determination of specific gravity was carried out in each cycle using a clean and dry pycnometer. The empty pycnometer was weighed (W1), then filled with distilled water and weighed again (W2). After the distilled water was discarded and the pycnometer was dried, the face mist sample was added and weighed (W3). The specific gravity of the sample was calculated by comparing the mass of

the sample to the mass of water occupying the same volume using the following equation:

$$P = \frac{(w3 - w1)}{(w2 - w1)} \times \rho_{water}$$

W1 = weight of the empty pycnometer,

W2 = weight of the pycnometer filled with distilled water,

W3 = weight of the pycnometer containing the sample,

ρ_{water} = density of water (g/mL).

Acceptable specific gravity range for spray preparations is 0.7–1.2 g/mL [10].

Viscosity Test

The viscosity test was conducted to determine the flow rate of liquid preparation. A solution that flows easily is considered to have low viscosity, whereas a solution that flows with difficulty is considered to possess high viscosity. In this study, the viscosity test was carried out by introducing the face mist preparation into an Ostwald viscometer. The standard viscosity value for face mist preparations is less than 150 cP [14].

Spray Dispersion Test

The spray dispersion test of the face mist preparation was performed by spraying the formulation onto a mica plastic surface from a distance of 5 cm. The diameter of the dispersion area was then measured using a ruler. A good spray dispersion diameter ranges from 5–7 cm [15].

Antioxidant Activity Assay

Preparation of DPPH Stock Solution

A 100 ppm DPPH solution was prepared by accurately weighing 5 mg of 2,2-Diphenyl-1-picrylhydrazyl (DPPH) and dissolving it in 50 mL of methanol p.a in a volumetric flask [16]

Determination of Maximum Wavelength

The blank solution was prepared by mixing 4 mL of DPPH solution with 2 mL of methanol p.a. The absorbance of the blank solution was then measured

at a wavelength of 517 nm using a UV-Visible spectrophotometer [16].

Determination of Operating Time

The blank solution containing 4 mL of methanol and 2 mL of 100 ppm DPPH solution was measured at the previously determined maximum wavelength until a stable absorbance value was obtained.

Antioxidant Activity Test of Aloe Vera Face Mist

A total of 4 mL from each concentration of 20 ppm, 30 ppm, 40 ppm, and 50 ppm of the Aloe vera face mist preparation was mixed with 2 mL of DPPH solution. The mixtures were shaken until homogeneous and incubated for 30 minutes. Subsequently, the absorbance of each solution was measured at the maximum wavelength using UV-Visible spectrophotometry.

Vitamin C Assay

A total of 4 mL from each concentration of 1 ppm, 3 ppm, 5 ppm, and 7 ppm of Vitamin C solution was mixed with 2 mL of DPPH solution. The mixtures were shaken until homogeneous and incubated for 30 minutes. Thereafter, the absorbance of each solution was measured at the maximum wavelength using UV-Visible spectrophotometry.

Data Analysis

Descriptive data analysis was obtained from the results of organoleptic evaluation and homogeneity testing. The results of these tests were subsequently described and interpreted to draw conclusions. Quantitative data obtained in this study included the results of pH testing, spray dispersion testing, specific gravity testing, and viscosity testing, in which the conclusions were determined based on the standard values of each testing parameter.

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