Medical Sains : Jurnal Ilmiah Kefarmasian
Vol. 9 No. 4, October - December 2024
https:/ojs.ummada.ac.id/index.php/iojs

OPTIMIZATION OF HPMC IN SERUM GEL CONTAINING BUTTERFLY PEA FLOWER EXTRACT (*CLITORIA TERNATEA* L.) AS FACIAL MOISTURIZER AND IT'S PHYSICAL STABILITY

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Submitted: October 23, 2024 Revised: December 1, 2024 Accepted: December 6, 2024

ABSTRACT

Skincare refers to a series of skin treatments (epidermis) and the middle layer of the skin (dermis) aimed at protecting and maintaining the body, and is categorized as a cosmetic product. One of the most commonly used cosmetic preparations is skincare serum, which helps maintain skin elasticity and hydration. A rising trend in the industry is the development of serums, and one potential plant to be used as a safe active ingredient in cosmetics is the butterfly pea flower (*Clitoria ternatea* L), which is rich in flavonoids with antioxidant activity. The objective of this study was to determine whether butterfly pea flower extract serum can be formulated into a facial serum with moisturizing properties and to evaluate the physical stability of the serum preparation. The method used is Laboratory experiments were performed. The butterfly pea flower extract was obtained through maceration with 70% ethanol and then formulated into facial serum using different concentrations of HPMC base at 3%, 4%, and 5%. The results of serum stability tests were obtained using physical stability methods. Physical property tests included organoleptic testing (lavender scent, deep blue color, slightly thick, or serum-like texture), with stable organoleptic properties observed during storage, without any changes. Other tests showed homogeneity, with average viscosity values of F1 (783.8 mPas ± 60), F2 (2.352 mPas ± 60); and F3 (9.118 mPas ± 335). Spreadability of F1 (5.6 cm ± 0.23), F2 (3.86 cm ± 0.23), and F3 (2.68 cm ± 0.29). pH values of F1 (5.14 ± 0.05), F2 (5.16 ± 0.05), and F3 (5.14 ± 0.05), and moisture levels of F1 (60.7 ± 2.48), F2 (73.4 ± 2.74), and F3 (79.7 ± 2.97). These results indicate that Formula 2, with a 4% concentration of the HPMC base, is the best formulation and can be used as a facial moisturizer.

Keywords: Butterfly pea flower, facial moisturizer, serum, physical stability testing

INTRODUCTION

The skin is the largest part of the human body, is located on the outermost surface, and directly interacts with the environment. In daily life, the skin is continuously exposed to various products or foreign substances such as cosmetics, surrounding objects, and environmental conditions. One of the products that commonly interact with the skin is cosmetics (Putri, 2017). The primary use of cosmetics is to address skin problems such as dry skin, although some individuals may experience dry skin on specific parts of their body. Dry skin can be influenced by several factors, including dehydration, surface roughness, and hydrophilicity. Additionally, dry skin is affected by climate, age, and use of products unsuitable for skin type. Among these, skin dehydration was the most dominant. Numerous studies have focused on cosmetic products in the form of serum to create innovative

solutions to address dry skin issues (Butarbutar and Chaerunisaa, 2021). Cosmetics made from natural ingredients have been widely developed in Indonesia, and are attracting increasing market interest. The Indonesian public desires cosmetic products that can prevent premature ageing. Moisturizing cosmetics have become a trend among consumers aged ≥ 25 years as facial moisturizers. Serum (Biradar *et al.*, 2024) is a cosmetic product that has seen significant development.

Serum has the advantage of containing high concentrations of active ingredients, allowing for quicker absorption into the skin. They can provide a more comfortable feel and are easier to spread across the skin surface. The three-dimensional network formed by particles or macromolecules dissolved in the dispersion phase contributes to these beneficial properties (Elfasyari *et al*., 2019). Given the growing public interest in skincare for facial moisturization, there is a need for natural-based cosmetics that contain antioxidant active ingredients. Antioxidants are compounds capable of neutralizing reactive free radicals, rendering them relatively stable, non-reactive forms, thereby protecting the skin from the harmful effects of free radicals. One natural ingredient rich in antioxidants and commonly used in cosmetics is the butterfly pea flower (*Clitoria ternatea* L), which contains chemical compounds, such as alkaloids, anthocyanin flavonoids, tannins, terpenoids, and steroids (Marpaung, 2020). Hydroxypropyl Methylcellulose (HPMC) was selected as a binder in the gel formulations because of its ability to form stable and transparent gels (Hasriyani *et al.*, 2022). The concentration selection was based on previous research showing that certain concentrations provide optimal physical properties for topical applications. HPMC at 3% is often used as the starting point because it offers a balance between viscosity and ease of application (Eriyani *et al.*, 2021).

According to previous research, one of the natural ingredients that can be used as a moisturizer is butterfly pea flower (*Clitoria ternatea* L). It has been studied and contains various chemical compounds such as flavonoids, anthocyanins, flavonol glycosides, kaempferol glycosides, quercetin glycosides, myricetin glycosides, terpenoids, tannins, and steroids (Manjula *et al*., 2013). Anthocyanins are natural compounds with potential photoprotective properties owing to their ability to absorb UV rays and act as antioxidant flavonoids. The antioxidant activity of ethanol extracts from the butterfly pea flower (*Clitoria ternatea* L) has been studied and shown to have a good radical-scavenging capacity, with an IC_{50} value of 4 mg/5 mL. The optimum concentration of butterfly pea flower extract was determined to be 5% (Puspitasari *et al*., 2019). The antioxidant activity of butterfly pea flower extract (*Clitoria ternatea* L.) has been studied, showing a moisturizing effect of 63.6615%, with the best optimization achieved at 5% concentration of the extract (Ananda *et al*., 2024).

This research employed an experimental laboratory approach. Butterfly pea flower serum was formulated using varying concentrations of HPMC base at 3%, 4%, and 5%. The testing included organoleptic evaluation, homogeneity, viscosity, spreadability, pH, and moisture testing of serum preparation.

RESEARCH METHODS

Equipment and Materials

The tools used in this study include an analytical balance (KERN-ABS 220-4), mortar and pestle (OneMed), porcelain dishes (OneMed), object glass, pH meter (OneMed), test tubes (Iwaki), beakers (Iwaki), measuring cylinders (Iwaki), Brookfield viscometer (NDJ-8S), water bath (WTB 6 Memmert), volumetric flasks (Iwaki), oven (Memmert UN 55 53L), test tube racks, dark glass containers for maceration (Iwaki), containers for simplicia powder (Iwaki), glass stirrers (Iwaki), horn spoons, cloth wipes, filter paper (Whatman), dropper pipettes, Skin Moisture Meter (VCARE MODE SK-8), and serum containers. The materials used in this study included butterfly pea flower extract, 70% ethanol (OneMed), $FeCl_3$ (Merck), 2N HCl, magnesium, chloroform, acetic acid, H_2SO_4, HPMC (Merck), glycerin (Brataco), sodium benzoate (Merck), lavender oil, and aquades (Brataco).

Research Procedure

1. Determination

The simplicia of the butterfly pea flower used in this study was obtained from Yogyakarta and identified at the Laboratory of Gadjah Mada University in Yogyakarta.

2. Butterfly Pea Flower Extraction

The maceration method was employed to prepare butterfly pea flower extract (Clitoria ternatea L). Butterfly pea flower simplicia powder was placed in a maceration vessel. Maceration was conducted for 3 days at a ratio of 1:7.5, meaning 1.510 kg of simplicia powder was added to a vessel immersed in 11.325 liters of 70% ethanol solvent with occasional stirring (Lindawati and Ma'ruf, 2020). The maceration method was employed to prepare butterfly pea flower extract (Clitoria ternatea L). Butterfly pea flower simplicia powder was placed in a maceration vessel. Maceration was conducted for 3 days at a ratio of 1:7.5, meaning 1.510 kg of simplicia powder was added to a vessel immersed in 11.325 liters of 70% ethanol solvent with occasional stirring (Andriani and Murtisiwi, 2018).

3. Phytochemical Screening

a. Flavonoid Test

The extract was placed into a 10 gram Erlenmeyer flask, followed by the addition of ethanol until the extract was submerged, and then heated. Once the two layers formed, the upper layer was separated and mixed with magnesium powder and 1 mL of 2N HCl. A positive test was indicated by the formation of a purple-red color (Ambari *et al.*, 2022).

b. Alkaloid Test

Four grams of the Butterfly pea flower extract are added to a sufficient amount of chloroform. Subsequently, 10 mL ammonia was added. The mixture was filtered and the filtrate was placed in an Erlenmeyer flask. Next, 10 drops of 2N H_2SO_4 were added, and the mixture was shaken until two layers were formed. The upper layer was transferred to a test tube and tested using the Mayer's reagent (white precipitate). The formation of a precipitate indicates that the sample contained alkaloids (Makalalag *et al.*, 2019).

c. Tanin Test

Twenty milligrams of the extract was added to ethanol until it was fully submerged. Subsequently, 2 mL of the solution was mixed with 2–3 drops of 1% $FeCl_3$. A positive test result is indicated by the formation of a blue-black or green color for test tube I and a white precipitate for test tube II (Makalalag *et al.*, 2019).

d. Terpenoid Test

Fifty milligrams of the extract was placed in a test tube, followed by the addition of 9 mL of distilled water (aquades), and then filtered. The filtrate was dissolved in chloroform (0.5 mL) and acetic anhydride (0.5 mL), and concentrated H_2SO_4 was added. A brown or violet color at the interface of the solution indicates the presence of terpenoids, whereas a blue-green color indicates the presence of steroids (Pertiwi *et al.*, 2022).

e. Anthocyanins Test

Butterfly pea flower extract was added dropwise to 2M NaOH. The presence of anthocyanins is indicated by gradual fading of color, which occurs when exposed to light (Ambari *et al.*, 2022).

4. Preparation of Butterfly Pea Flower Extract Serum

The butterfly pea flower extract serum formulation (*Clitoria ternatea* L) was prepared with varying concentrations of HPMC as the gelling agent: F1 at 3%, F2 at 4%, and F3 at 5%. Butterfly pea flower extract (*Clitoria ternatea* L) was used as the active ingredient at a concentration of 5%. Glycerin served as a humectant at a concentration of 15%. Sodium benzoate was included as a preservative at a concentration of 2%. Lavender oil was added as a fragrance at 2%, and distilled water was used as the solvent to make a

total volume of 100 mL (Rahmatika, 2017). The formula for butterfly pea flower extract serum is shown in Table I.

Table I. Butterfly Pea Flower Extract Serum Formula

Materials	Function	Formulation % (b/v)		
		F1	F2	F3
Butterfly Pea Flower Extract	Active Ingredient	5	5	5
HPMC	Gelling Agent	3	4	5
Glycerin	Humectant	15	15	15
Sodium Benzoat	Preservative	0,2	0,2	0,2
Oleum Lavender	Fragrance	2	2	2
Aquadest ad	Solvent	100	100	100

5. Physical Stability Test

In this study, the stability of butterfly pea flower extract serum (*Clitoria ternatea* L) was tested using the Freeze-thaw stability method. In this test, the serum will undergo one cycle, where it is stored at 4°C for 24 hours, followed by storage at a high temperature of 40°C. This cycle was repeated for a total of 4 cycles (Tari and Indriani 2023).

a. Organoleptic Test

The organoleptic test was conducted by observing the smell, color, and texture of the formulation. Testing was carried out for each formula with three replicates (Lumentut *et al.*, 2020).

b. Homogeneity Test

One gram of serum formulation was applied to a transparent glass slide. The formulation was observed and appeared homogeneous without any visible coarse particles. This test was performed for each formula with three replicates (Lumentut *et al.*, 2020).

c. Viscosity Test

The viscosity of the cream was measured using a Brookfield viscometer (NDJ-8S) with 2 spindles. Each formulation was tested in triplicates. The serum formulation was placed in a glass beaker, the spindle was inserted, and the viscosity was measured (Pratasik *et al.*, 2019).

d. Spreadability Test

One gram of serum is placed on a glass plate and left for 1 minute. The diameter of the spread of serum was measured. A weight of 50 g was added and left for 1 minute, and the diameter of the serum spread was measured again. Additional weight was added in increments until serum spread remained constant (Pratasik *et al.*, 2019).

e. pH Test

A pH test was conducted using a pH meter. One gram of serum was diluted with 10 mL distilled water (aquades). The test was performed for each formulation with three replicates (Lumentut *et al.*, 2020).

f. Moisture Test

Fifteen panelists with normal skin moisture were selected who did not use any other products in the test area. The moisture test was conducted using a skin analyzer. The test formulation was applied to the surface of the facial skin. Before applying serum, the skin moisture level was measured using a skin analyzer. The percentage of skin moisture was determined 2 minutes after application. The resulting moisture percentage was categorized based on the following scale: Dry (0%–45%), Normal or Moist (46%–55%), Very Moist (56%–100%). The research ethics clearance number is No.585/KEPK/UDS/XI/2024 (Iskandar *et al.*, 2019).

Data Analysis

Data analysis for the formulation and physical stability testing of butterfly pea flower extract serum (*Clitoria ternatea* L) as a facial moisturizer will be conducted using descriptive analysis. Additionally, to determine the best formula and stability of this moisturizing serum, analysis was performed using SPSS (Statistical Product and Service Solutions). Subsequently, parametric testing was performed using One-Way ANOVA (Analysis of Variance (ANOVA) to analyze the data.

RESULTS AND DISCUSSION

1. Butterfly Pea Flower Determination (*Clitoria ternatea* L)

Butterfly pea flowers (*Clitoria ternatea* L) were sampled in Yogyakarta. The samples used for this determination were fresh butterfly pea plants (*Clitoria ternatea* L), which were subsequently tested for their identification accuracy. According to the results of Gadjah Mada University, the test samples obtained were butterfly pea plants (*Clitoria ternatea* L), commonly referred to by the local name "kembang telang."

2. Preparation of Butterfly Pea Flower Extract (*Clitoria ternatea* L)

The butterfly pea flower extract (*Clitoria ternatea* L) yielded an extraction yield of 20.79%. The results of butterfly pea flower extraction are presented in Table II.

Table II. Extraction Yield Results of Butterfly Pea Flower (*Clitoria ternatea* L)

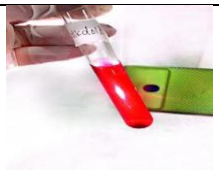
Materials	Amount of Powder	Extraction Result	% Yield (b/v)	Ekstract Result
Butterfly Pea Flower Simplicia	1.510 gram	314 gram	20.79%	Color: Blue-black Smell: Characteristic of butterfly pea flower Taste: Slightly sweet

The extraction yield of butterfly pea flowers (*Clitoria ternatea* L) was 20.79%, indicating that the flowers extracted using the maceration method produced a good extract, allowing for optimal dissolution of the bioactive anthocyanins. One of the natural pigments that contribute to the blue color of butterfly pea flowers is delphinidin glycoside anthocyanin, which is capable of producing a deep blue color in the flowers (Suryana, 2021).

3. Phytochemical Screening

Phytochemical screening is necessary to identify compounds present in butterfly pea flowers (*Clitoria ternatea* L) that have the potential to moisturize the skin. The results of the phytochemical screening are shown in Table III.

Table III. Phytochemical Screening of Butterfly Pea Flower Extract

Screening Test	Theory	Research result	Reagent	Picture	information
Alkaloids	Milky White Precipitate	Milky White Precipitate	Mayer's reagent		Positive (+)
Flavonoids	Purple-red color	Purple-red color	Mg powder, HCl 2N		Positive (+)

Tannins	Blue-black or green	Blue-black	$FeCl_3$ 1%		Positive (+)
Terpenoid	Red, orange and purple	Orange	Glacial acetic acid, H_2SO_4		Positive (+)
Antosianin	The green or blue that fades	Green with a fading color	NaOH 2M		Positive (+)

The results of the phytochemical screening of the 70% ethanol extract of butterfly pea flowers (*Clitoria ternatea* L.) using the maceration method showed positive results (+) for secondary metabolite compounds, including flavonoids, alkaloids, tannins, terpenoids, and anthocyanins. Several factors such as geographical location, temperature, climate, and soil fertility in a region significantly influence the chemical composition of a plant (Niljon and Marsiati, 2023).

4. Preparation of Butterfly Pea Flower Extract Serum

The preparation of the serum begins with the creation of a base. HPMC was developed in hot water at 80–90°C and stirred until a clear mass was formed. HPMC is used as a gelling agent to produce serum that is clear, transparent, and readily soluble in water (Pramita *et al*., 2017). Glycerin is used at a concentration of 15% to prevent water loss, thereby maintaining moisture in the formulation and preventing the serum from breaking after the evaporation of other components. Sodium benzoate served as a preservative at a concentration of 2% to inhibit the growth of microorganisms during storage. Additionally, sodium benzoate is stable in the aqueous phase and is safe for cosmetic formulations at a maximum concentration of 5%. The addition of preservatives is essential because the formulation contains a significant amount of water, which can lead to microbial contamination. Finally, the addition of lavender essential oil not only provides a calming and pleasant effect when serum is applied to the skin, but also helps prevent premature aging. Lavender oil contains antioxidants that protect the skin from free radicals, effectively diminishing fine lines and wrinkles (Rowe *et al*., 2009).

5. Physical Evaluation

a. Organoleptic Test

This test is carried out by making observations covering smell, color, and texture, which aim to guarantee the quality of a formulation that can provide an indication of damage and a decrease in the quality of a formulation after storage. The results of the organoleptic tests are presented in Table IV and Figure 1.

Table IV. Results of Organoleptic Testing for *Clitoria Ternatea* Extract Serum

Cycle of:	Test	Organoleptic Test Results		
		F1	F2	F3
0	Odor	Lavender	Lavender	Lavender
	Color	Deep Blue	Deep Blue	Deep Blue
	Texture	Liquid	Slightly Viscous	Viscous
1	Odor	Lavender	Lavender	Lavender
	Color	Deep Blue	Deep Blue	Deep Blue
	Texture	Liquid	Slightly Viscous	Viscous

	Odor	Lavender	Lavender	Lavender
2	Color	Deep Blue	Deep Blue	Deep Blue
	Texture	Liquid	Slightly Viscous	Viscous
	Odor	Lavender	Lavender	Lavender
3	Color	Deep Blue	Deep Blue	Deep Blue
	Texture	Liquid	Slightly Viscous	Viscous
	Odor	Lavender	Lavender	Lavender
4	Color	Deep Blue	Deep Blue	Deep Blue
	Texture	Liquid	Slightly Viscous	Viscous

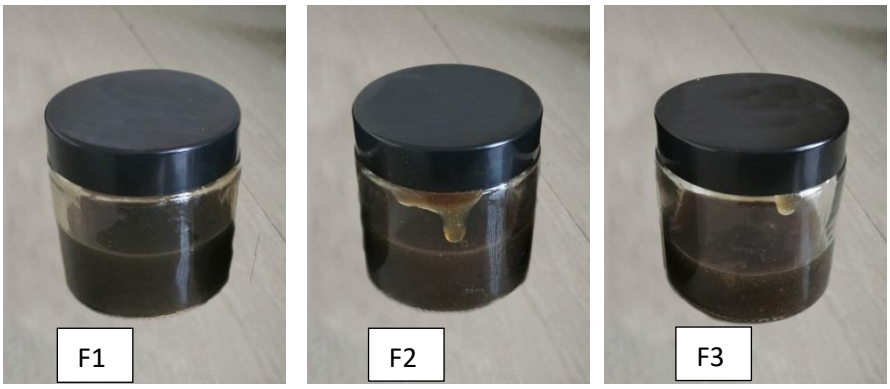


Figure 1. Organoleptic Results of *Clitoria ternatea* Extract Serum

In this study, the texture of the serum varied among F1, F2, and F3 owing to the differences in HPMC base concentrations, with F1 at 3%, F2 at 4%, and F3 at 5%. The serum extract of Clitoria ternatea showed no changes in odor, color, or texture during the 28-day storage period. It can be concluded that the serum formulation exhibited no significant changes and remained stable throughout the storage duration.

b. Homogeneity Test

This test aims to assess the quality of a good formula, as it indicates that the extract is evenly dispersed within the base material, ensuring that the formulation contains a uniform amount of extract. The results of the homogeneity test before and after the stability test can be seen in Table V.

Table V. Homogeneity Test Result of *Clitoria ternatea* Extract Serum

Specifications	Cycle	Homogeneity Test (28 Days)			Remarks
		F1	F2	F3	
Homogenous color and there is no small particle (Anna *et al.*, 2017)	0	Homogeneous	Homogeneous	Homogeneous	Meet the requirements
	1	Homogeneous	Homogeneous	Homogeneous	Meet the requirements
	2	Homogeneous	Homogeneous	Homogeneous	Meet the requirements
	3	Homogeneous	Homogeneous	Homogeneous	Meet the requirements
	4	Homogeneous	Homogeneous	Homogeneous	Meet the requirements

The results of the homogeneity test of the three formulations indicated that all formulations of butterfly pea flower extract serum (*Clitoria ternatea* L) exhibited homogeneous characteristics. They were considered homogeneous because the color

appeared uniform, with no lumps or differing particles present in the serum preparation.

c. Viscosity Test

This test was conducted to determine the viscosity of butterfly pea flower extract serum (*Clitoria ternatea* L). Testing was performed using a viscometer at a speed of 60 rpm with 2 spindles. The results of the viscometer tests are presented in Table VI and Figure 2.

Table VI. Results of Viscosity Test for Butterfly Pea Extract Serum

Specifications	Cycle	Viscosity Test (mPas)			*P Score*
		F1	F2	F3	
4000-40.000 mPas (Pratasik *et al.*, 2019)	0	690	2.300	8.550	0.001
	1	760	2.310	9.130	
	2	810	2.320	9.200	
	3	819	2.380	9.300	
	4	840	2.450	9.410	
Mean ± SD		783,8 ± 60	2.352 ± 60	9.118 ± 335	

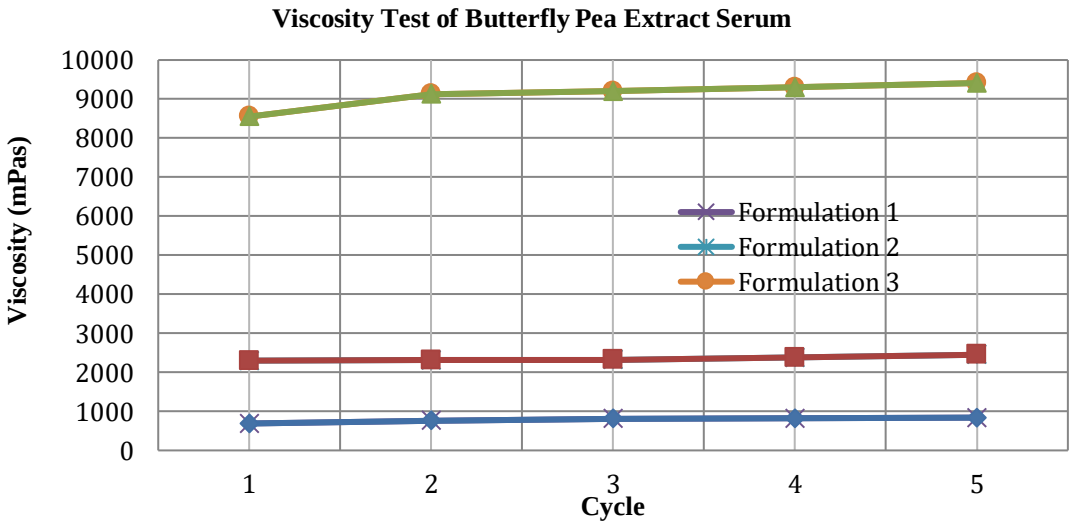


Figure 2. Viscosity Test Graph of Butterfly Pea Flower Extract Serum

Based on Table VI, the results of the viscosity test observations showed that the average value and standard deviation of F2 (2.352 ± 63) met the viscosity test specification requirements, with a good range of 2,000 – 4,000 cp (Pratasik *et al.*, 2019). The average value and standard deviation of F1 (783.8 ± 60) tended to be low and did not meet the specifications because of the low concentration of HPMC. Suspended particles cause a decrease in viscosity, meaning that the fewer suspended particles there are, the lower the solution concentration and viscosity. Meanwhile, the average value and standard deviation of F3 (9,118 ± 335) tended to be high and did not meet the specifications because of the high concentration of the solution, which trapped air bubbles during serum production (Slamet *et al.*, 2020).

Based on Figure 2, observations made during the viscosity test showed that the serum thickened over the 28-day storage period. The increase in viscosity was caused by the expansion of polymers in the preparation, resulting in an increased density of the bonds between polymers during storage, which made the serum thicker each day. Another factor that could cause the serum to thicken is insufficient

airtight packaging, allowing the serum to absorb moisture from the outside and increasing the water volume in the serum (Ida and Noer, 2012).

Next, a serum preparation analysis was conducted using a normality test, where the P-value was found to be 0.1 > 0.005, indicating that the data were normally distributed, allowing for the continuation of testing with a homogeneity test to ensure the observed data were homogeneous. The results showed a P-value of 0.2 > 0.005, confirming that the data were homogeneous. Subsequently, an Athat NOVA test was performed to examine the effect of HPMC on the viscosity test. The results showed a P-value of 0.00 < 0.05, indicating significant differences, thus concluding that HPMC influenced the viscosity test results. From these results, HPMC affects viscosity. The higher the concentration of HPMC, the higher the viscosity value.

d. Spreadability Test

This test was conducted to determine the formulation of the preparation when applied, as it can affect drug absorption and release rate of the active ingredient at the site of application (Elfasyari, 2019). The results of the spreadability tests are presented in Table VII and Figure 3.

Table VII. Spreadability Test Results of Butterfly Pea Flower Extract Serum

Specification	Cycle	Spreadability Test (Cm)			*P Score*
		F1	F2	F3	
3–5 cm (Juliantoni *et al.*, 2020)	0	5,3	4,0	3,0	0.005
	1	5,2	4,1	2,8	
	2	5,1	3,9	2,7	
	3	5,0	3,8	2,6	
	4	4,7	3,5	2,2	
Mean ± SD		5,6 ± 0,23	3,86 ± 0,23	2,68 ± 0,29	

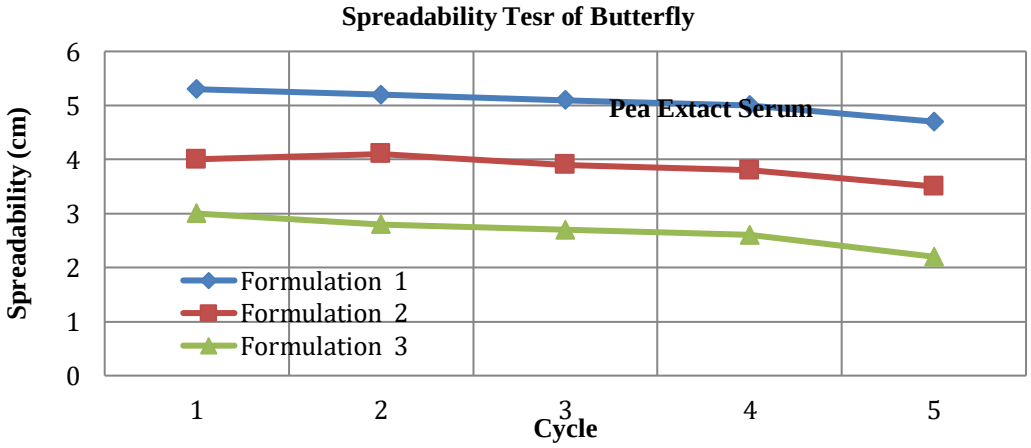


Figure 3. Spreadability Test of Butterfly Pea Flower Extract Serum

Based on the observations in Table VII, the spreadability test results show that the average value and standard deviation for F1 are 5.06 ± 0.23, meeting the specifications for the spreadability test, with a good spreadability range of 5–7 cm (Anna *et al.*, 2017). The average value and standard deviation for F2 were 3.86 ± 0.23, and for F3 were 2.68 ± 0.29, indicating that their spreadability did not meet the specifications. This is due to the differences in the HPMC concentration, which shows that as the HPMC content increases, the spreadability decreases. This

reduction in spreadability correlates with the increase in serum viscosity; if the pressure applied is the same for each serum formulation test, the thicker the preparation, the lower its ability to spread (Slamet *et al*., 2020).

Based on Figure 3, the spreadability test observation graph shows a decrease from day 7 to day 28. The reduction in spreadability was influenced by the HPMC base, which absorbed the solvent and retained the liquid by forming a compact liquid mass. The more HPMC used, the more liquid is retained and bound by the HPMC, resulting in a thicker serum liquid, which means increased viscosity and decreased spreadability (Hasriyania *et al.*, 2022).

Next, serum preparation analysis was conducted using a normality test to ensure that the observed data were normally distributed. The test results showed a P-value of 0.6 > 0.005, indicating that the data were normally distributed, allowing for the continuation of testing with a homogeneity test to ensure that the observed data were homogeneous. The results showed a P-value of 0.8 > 0.005, confirming that the data were homogeneous. Subsequently, ANOVA was performed to examine the effect of HPMC on the spreadability test. The results showed a P-value of 0.00 < 0.05, indicating significant differences, thus concluding that HPMC influenced the spreadability test results. The HPMC concentration significantly affects the viscosity, which in turn affects the spreadability. Increasing the HPMC concentration caused the viscosity to increase and the spreadability to decrease.

e. pH Test

This test was conducted from cycles 0 to 4 using a pH meter. The results of serum pH tests are shown in Table VIII and Figure 4.

Table VIII. pH Test Results of Butterfly Pea Flower Extract Serum

Specification	Cycle	pH Test			*P Score*
		F1	F2	F3	
4,5 – 6,5 (Pratasik *et al.*, 2019)	0	5,1	5,1	5,1	0.006
	1	5,1	5,1	5,1	
	2	5,1	5,2	5,2	
	3	5,2	5,2	5,2	
	4	5,2	5,2	5,1	
Mean ± SD		5,14 ± 0,05	5,16 ± 0,05	5,14 ± 0,05	

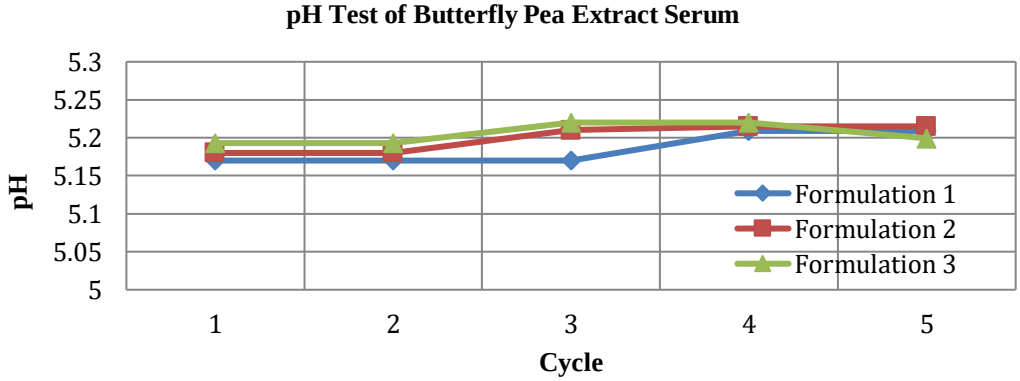


Figure 4. pH Test of Butterfly Pea Flower Extract Serum

As shown in Table VIII, the average value and standard deviation for F1 were 5.14 ± 0.054, for F2 are 5.16 ± 0.054, and for F3 are 5.14 ± 0.054, respectively. Thus, it can be concluded that the pH test results met the specified requirements. The

purpose of conducting the pH test was to demonstrate that the pH of the formulation was appropriate according to the topical pH specification of 5–6.5 (Anna *et al*., 2017), and to assess the stability of the formulation's pH during preparation and storage. The importance of the pH test in the formulation is to ensure that the pH is not too acidic, which can cause skin irritation, and not too alkaline, which can lead to dryness and itching on both the facial and hand skin (Yacobus *et al*., 2019).

Based on Figure 4, the results of the pH test showed that the variation in HPMC did not affect the pH of the preparation and remained stable during the fourth cycle of storage. Next, a serum preparation analysis was conducted using a normality test, where the P-value was found to be 0.006 > 0.005, indicating that the data were normally distributed, allowing for the continuation of testing with a homogeneity test to ensure the observed data were homogeneous. The results showed a P-value of 1.0 > 0.005, confirming that the data were homogeneous. Subsequently, ANOVA was performed to examine the effect of HPMC on the pH test. The results showed a P-value of 0.8 < 0.05, indicating no significant differences, thus concluding that HPMC does not influence the pH test results. The preparation can still be said to be good in terms of increasing comfort when used on skin. This is because the pH of HPMC is neutral. Therefore, whatever concentration is used will produce the same pH.

f. Moisture Test

This study aimed to determine whether the serum preparation of butterfly pea flower extract (*Clitoria ternatea* L.) with different concentrations of HPMC F1 (3%), F2 (4%), and F3 (5%) can effectively moisturize the face, and at which concentration the moisture level is optimal. The results of the facial moisture test of butterfly pea flower serum (*Clitoria ternatea* L.) with different concentrations of HPMC F1 (3%), F2 (4%), and F3 (5%) at room temperature (25°C) are presented in Table IX and Figure 5.

Table IX. Facial Moisture Test Results of Butterfly Pea Flower Extract Serum

Specification	Cycle	Moisture Test			Remarks	Sig*
		F1	F2	F3		
56–100% very moisture (Iskandar *et al*., 2019)	0	62,6	76,3	83,2	Meet the requirements	P 0.000< 0.05
	1	62,3	75,2	81,7	Meet the requirements	
	2	61,9	74,7	80,6	Meet the requirements	
	3	60,2	70,7	77,1	Meet the requirements	
	4	56,6	70,3	76,3	Meet the requirements	
Mean		60,7±2,48	73,4±2,74	79,7±2,97		

**Shapiro Wilk Test : P>0,05 : normal distribution data*
** One way ANOVA : P<0,05 (0,000)*

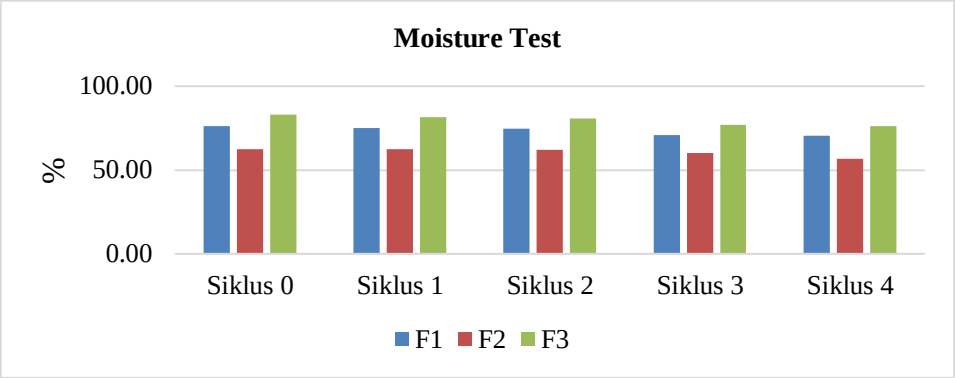


Figure 5. Facial Moisture Test Results of Butterfly Pea Flower Extract Serum

Based on Table IX, the results of the facial moisture test are displayed directly as percentages (Wirasti, 2018). The percentage results of facial moisture from the application of facial serum obtained a range of values for normal or moist skin (46%–55%) and very moist (56%–100%) (Iskandar *et al*., 2019). The results of the acial moisture test after the application of butterfly pea flower extract serum (*Clitoria ternatea* L.) with HPMC as a gelling agent in F1 (3%), F2 (4%), and F3 (5%) at room temperature (25°C) for one month indicate that all three formulations could provide good moisture to the facial skin. The flavonoid content in butterfly pea flowers (*Clitoria ternatea* L.) serves as an antioxidant that moisturizes by utilizing hydroxyl groups, which bind water in the stratum corneum, making the skin fresher and more hydrated (Ayu, 2020).

As shown in Figure 5, the results of the facial moisture test after the application of butterfly pea flower extract serum (*Clitoria ternatea* L.) were different for each formula, with F1 (3%), F2 (4%), and F3 (5%) achieving percentages of 60.7%, 73.4%, and 79.7%, respectively, all falling within the very moist scale (56%–100%). The differences in the results for F1, F2, and F3 were due to the varying concentrations of HPMC as a gelling agent in butterfly pea flower extract serum. The concentration of HPMC can influence the viscosity of serum preparations. Higher concentrations of HPMC increase the adhesion of the serum, allowing it to adhere to the skin longer, which facilitates greater absorption of the active ingredients in the serum and improves skin moisture (Sugiyono *et al.*, 2014).

The results of the normality and homogeneity tests of the facial moisture data showed that the data were normally distributed and homogeneous (p-value > 0.05). The one-way ANOVA test indicated a significant difference among formulas 1 (3%), 2 (4%), and 3 (5%) (p-value=0.000). Therefore, it can be concluded that the differences in HPMC concentration in the butterfly pea flower extract serum (*Clitoria ternatea* L.) preparation affect the ability of the serum to moisturize the face. From the physical stability test, it was stated that F1 and F3 had spreadability that did not meet the specifications compared to F2. An HPMC concentration (4%) is the best choice for the preparation of butterfly pea flower extract serum. This formula is not only effective in moisturizing, but also has good stability, making it an ideal choice for cosmetic products.

CONCLUSION

This study concluded that butterfly pea flower extract with HPMC variation can be formulated into a serum preparation, with an HPMC concentration of 4% (F2) as the most stable preparation. The results of the stability test of the serum preparation in moisturizing the face with HPMC variation of 4% (F2) is better because the physical stability test of F2 meets the specifications compared to F1 and F3. The suggestion that can be made after the research is to develop butterfly pea flower extract as an active cosmetic ingredient, especially in making attractive serum preparations and having optimal test results.

ACKNOWLEDGMENT

Thanks to LLDIKTI Region VII for providing research funds under contract number 109/85.PG.02.04.PL/2024; 079/SP2H/PT/LL7/2024; 01/KPE-PTA/LPPM/UAM/VI/2024, Anwar Medika University for providing the facilities for research implementation, and to the lecturers of the S1 Pharmacy program at Anwar Medika University and the students who assisted in the smooth conduct of this research.

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