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Research Article

Formulation And Evaluation of Anti-Aging Cream Containing Butterfly Pea Flower and Papaya Peel Extract

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ABSTRACT

The present study aimed to formulate and evaluate an anti-aging cream containing Butterfly Pea Flower (Clitoria ternatea) and Papaya Peel (Carica papaya) extracts. The cream was prepared using the oil-in-water emulsion method and evaluated for pH, viscosity, spreadability, homogeneity, washability, irritancy, and physical appearance. The Butterfly Pea Flower and Papaya peel extracts showed antioxidant, moisturizing, and skin rejuvenating properties. Among all formulations, F2 showed the best results with ideal pH, good spreadability, smooth texture, non-greasy nature, and no skin irritation. The study concluded that the formulated anti-aging cream is safe, stable, and effective for improving skin appearance and reducing signs of aging.

INTRODUCTION

Skin aging is a complex biological process influenced by internal factors such as genetics and hormone changes, as well as external factors such

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as ultra violet radiation (UV), pollution, and lifestyles. These factors cause visible signs such as wrinkles, fine lines, drying, loss of elasticity and pigmentation. The primary mechanism of skin aging is the production of reactive oxygen species (ROS), which cause oxidative stress and damage to collagen, elastin and skin cells. [1][2][4]

Topical anti-aging creams are widely used to delay these effects by improving skin moisture, stimulating collagen synthesis and protecting against oxidative damage. In recent years, interest in cosmetics has increased due to their safety, efficacy and low side effects compared to synthetic agents. [2][4]

Butterfly pea flowers (Clitoria ternatea) are rich sources of anthocyanins, flavonoids, and phenol compounds. These bioactive elements have strong antioxidant properties that help neutralize free atoms and protect the skin from oxidative damage. The study reported significant antioxidant activity in Clitoria ternatea, supporting its use in cosmetics and dermatology [5][10][11]

Papaya peel (Carica papaya) is a natural resource largely unexploited, including enzymes such as papaya, vitamins A, C, and E, as well as phenol compounds. These components help to exfoliate, promote the circulation of skin cells, improve collagen production and improve the overall texture of the skin. The antioxidant and therapeutic properties of papaya are widely documented. [6][12][13]

The combination of butterfly pea flower and papaya peel extract in the cream can have a synergistic effect, enhance antioxidant protection, improve skin regeneration and reduce signs of aging. Consequently, the formulation and evaluation of such anti-aging creams is of great interest to modern cosmetic research.

ANATOMY OF SKIN

The skin is the largest organ of the human body and acts as a protective barrier against physical, chemical, and microbial agents. [7][9]

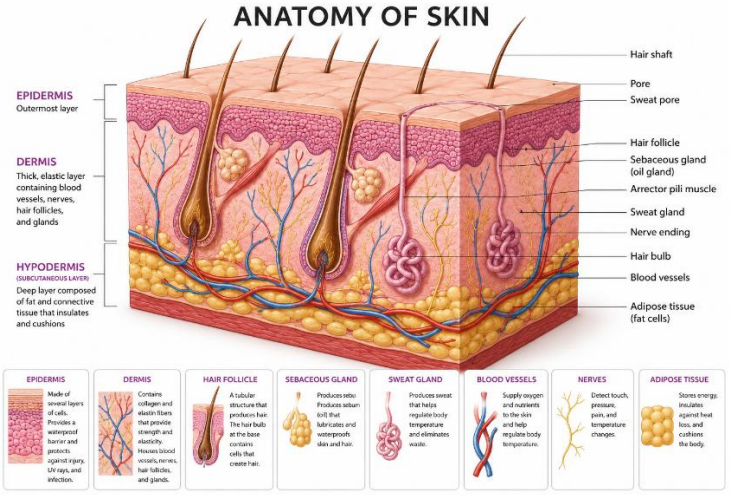

Fig No. 1

1. Epidermis

Outermost layer composed mainly of keratinocytes. Provides barrier function against environmental damage. Contains melanocytes responsible for pigmentation.

2. Dermis

Middle layer rich in collagen and elastin fibers. Provides strength, elasticity, and structural support. Contains blood vessels, nerves, and fibroblasts.

3. Hypodermis (Subcutaneous Layer)

Innermost layer composed of adipose tissue. Provides insulation, cushioning, and energy storage With aging, collagen production decreases and elastin fibers degrade, leading to loss of firmness and wrinkle formation.

Advantages of Anti-Aging Cream

1. Strong Antioxidant Protection Contains flavonoids, anthocyanins, and vitamin C Neutralizes reactive oxygen species (ROS) Prevents premature aging and cellular damage. [3][5]

2. Natural Collagen Boosting Effect Promotes collagen and elastin synthesis Improves skin firmness and elasticity. Reduces fine lines and wrinkles. [3][4]

3. Gentle Exfoliation and Skin Renewal Papain enzyme from papaya peel removes dead skin cells Enhances cell turnover Improves skin smoothness and radiance. [6][12][13]

4. Improved Skin Hydration Helps retain moisture in the skin reduces dryness and roughness strengthens skin barrier function. [14][18]

5. Anti-Inflammatory Properties reduces redness, irritation, and swelling Suitable for sensitive skin conditions. [4][6]

6. Multifunctional Synergistic Effect Combination provides antioxidant + exfoliating + rejuvenating effects more effective than single herbal ingredient formulations. [4][19]

3. MATERIALS

1.Butterfiy Pea Flower Extract

Table No.1

Family	Fabaceae
Common name	Butterfly Pea Aparajita
Part Used	Flowers (main petals)
Cosmetic role	Natural antioxidant
Key constituents	Anthocyanins, Flavonoids, Phenolics

Fig No. 2

Butterfly pea flower is used in anti-aging creams mainly for its strong antioxidant activity, which protects skin from free radical damage and delays wrinkles. It helps maintain collagen and elastin, improving skin firmness and elasticity. The extract also shows anti-inflammatory and antimicrobial properties, keeping skin healthy and irritation-free. Additionally, it provides hydration and skin brightening effects, giving a smooth and youthful appearance. [5][10][11]

2. Papaya Peel Extract

Table No.2

Family	**Caricaceace**
Common name	Pawpaw
Part used	Fruits and peel
Cosmetic role	Promotes skin renewal
Key constituents	VitaminC, vitaminA, Flavonoids, Papain enzyme

Fig No. 3

Papaya peel extract is widely used in anti-aging creams due to its rich content of antioxidants, flavonoids, and vitamin C, which help neutralize free radicals and delay skin aging. It also exhibits anti-inflammatory properties, reducing skin irritation and supporting skin barrier repair. Additionally, papaya peel contains enzymes like papain that promote mild exfoliation, improving skin texture and brightness. Its antimicrobial activity further protects the skin from infections and maintains healthy, youthful skin. [6][12][13]

3. Almond oil

Table No.3

Biological source	Apis mellifera Linn
Family	Apidae
Species	Apis

Fig No. 4

Almond oil is rich in vitamins and antioxidants that nourish and protect the skin. It has anti-inflammatory properties that soothe irritation, helps reverse sun damage, provides deep moisturization. [14]

4.Bees wax

Table No.4

Source	Plant-based or Synthetic glycol
Colour	Colourless
Constituents	Propane-1,2-diol

Fig No. 5

Beeswax is a natural ingredient used as an emollient and protective agent in anti-aging creams. It forms a barrier on the skin, preventing moisture loss and improving hydration, which helps reduce wrinkles. It also contains vitamin A that supports skin repair and regeneration. Additionally, its anti-inflammatory and antioxidant properties protect the skin from damage. Beeswax also acts as a thickening agent, improving cream stability. [15][19]

5.Stearic acid

Table No.5

Biological source	Prunus amygdalus Rosaceae
Family	Rosaceae
Species	P. amygdalus

Fig No. 6

Stearic acid is a fatty acid commonly used in anti-aging creams as an emulsifier and thickening agent, helping to stabilize oil-water mixtures and improve texture. It acts as an emollient, softening the skin and reducing dryness, which can minimize the appearance of fine lines. It also supports the skin barrier, protecting against moisture loss and environmental damage. [15][16][17][18]

6.Cetyl Alcohol

Table No. 6

Source	Coconut or Plam oil
Colour	White waxy flakes
Constituents	Hexadecanol

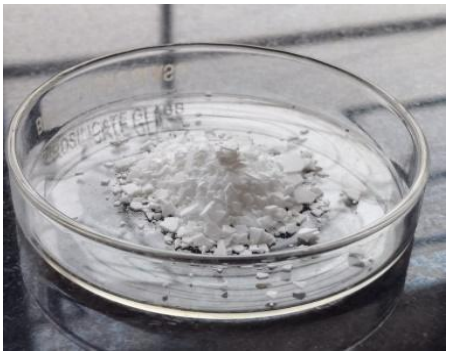

Fig No. 7

Cetyl alcohol is a fatty alcohol used in anti-aging creams as an emollient, emulsifier, and thickening agent. It helps to soften and smooth the skin, improving hydration and reducing dryness that can lead to fine lines. It also stabilizes formulations by maintaining the oil-water balance and enhancing cream consistency. Additionally, it supports the skin barrier, preventing moisture loss and improving overall skin texture. [15][16][18]

7.Liquid Paraffin

Table No.7

Source	Derived for petroleum
Colour	Colourless
Constituent	Mainly a mixture of saturated hydrocarbons

Fig No. 8

Liquid paraffin (mineral oil) is widely used in anti-aging creams as an occlusive moisturizer, forming a protective layer on the skin that reduces transepidermal water loss and keeps skin hydrated. This improves skin smoothness and helps reduce the appearance of fine lines and wrinkles. It is non-irritating, stable, and effective for dry or sensitive skin, supporting the skin barrier function. [15][19]

8.Glycerine

Table No.8

Source	Derived From plant oils such as coconut or plam oil
Colour	Colourless
Constituents	Glycerol

Fig No. 9

Glycerine (glycerol) is a powerful humectant used in anti-aging creams that attracts and retains moisture in the skin, improving hydration and elasticity. This helps reduce dryness and the appearance of fine lines and wrinkles. It also strengthens the skin barrier and provides a smooth, soft texture. [15][18]

9.Propylene glycol

Table No.9

Source	Plant-based or Synthetic glycol
Colour	Colourless
Constituents	Propane-1,2-diol

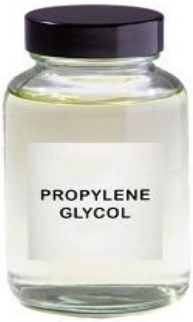

Fig No. 10

Propylene glycol is used in anti-aging creams as a humectant and penetration enhancer, helping the skin retain moisture and improving the absorption of active ingredients. It keeps the skin hydrated, smooth, and soft, which helps reduce the appearance of fine lines and dryness. It also acts as a solvent, improving formulation stability. [20]

10.Methyl Paraben

Table No. 10

Source	Synthetic (chemically prepared from p-hydroxybenzoic acid).
Colour	White Powder
Constituents	Methyl ester of p-hydroxybenzoic acid.

Fig No. 11

Methyl paraben is widely used in anti-aging creams as a preservative, preventing the growth of bacteria and fungi and thereby increasing product shelf life. It helps maintain the safety and stability of the formulation without affecting its efficacy. It is effective at low concentrations and is generally well tolerated in cosmetic use. [21]

11.Propyl Paraben

Table No.11

Source	Synthetic (derived from p-hydroxybenzoic acid).
Colour	White Crystalline Powder
Constituents	Propyl ester of p-hydroxybenzoic acid.

Fig No. 12

Propyl paraben is used in anti-aging creams as a preservative, helping to prevent the growth of bacteria and fungi and thus extending the product's shelf life. It is especially effective against molds and yeasts and is often used with methyl paraben for broader antimicrobial protection. It maintains the stability and safety of the formulation without affecting its performance. [21]

12.Triethanolamide

Table No.12

Source	Derived from petrochemical feedstocks
Colour	Clear, viscous liquid
Constituents	1-tertiary amine group,3-hydroxyl group

Fig No. 13

Triethanolamine is used in anti-aging creams as a pH adjuster and emulsifying agent, helping to stabilize formulations and maintain suitable skin pH. It reacts with fatty acids (e.g., stearic acid) to form stable emulsions, improving cream texture and consistency. This ensures better application and uniform distribution of active ingredients on the skin. [15][18]

13. Carbopol 940

Table No.13

Source	Synthetic polymer derived from acrylic acid
Colour	White ,fluffy powder
Constituents	Acrylic acid polymer

Fig No. 14

Carbopol 940 is a synthetic high-molecular-weight polymer used as a thickening and gelling agent in anti-aging cream formulations. It improves viscosity, stability, smooth texture, spreadability, and helps maintain uniform consistency of the cream. [15][17][18]

14.Distilled Water

Table No.14

Source	Purified water
Colour	Colourless
Constituents	H_2O

Fig No. 15

Uses: Solvent and vehicle for aqueous ingredients in cream formulation.

4. FORMULATION TABLE [15-19,24-27]

Table No.15

Sr. No	Ingredients	Uses	Quantity		
			F1	F2	F3
1.	Papaya peel extract	Enzymatic exfoliation,anti aging	0.75ml	0.50ml	1.25ml
2.	Butterfly pea extract	Antioxidant,anti-wrinkle	0.50ml	0.125ml	0.75ml
3.	Stearic acid	Emulsifier	2.50g	2.50g	2.50g
4.	Cetyl alcohol	Co-Emulsifier	0.75g	0.75g	0.75g
5.	Beeswax	Consistency agent	1.00g	1.00g	1.00g
6.	Liquid paraffin	Oil phase	2.35ml	2.35ml	2.35ml
7.	Almond oil	Oil phase	1.35ml	1.35ml	1.35ml
8.	Glycerin	Humectant	1.20ml	1.20ml	1.20ml
9.	Propylene glycol	Penetration enhancer	0.75ml	0.75ml	0.75ml
10	Triethanolamide	Neutralizer	0.95ml	0.95ml	0.95ml
11.	Methyl paraben	Preservative	0.045g	0.045g	0.045g
12.	Proply paraben	Preservative	0.005g	0.005g	0.005g
13.	Carbopol 940	Viscosity enhancer	0.125g	0.125g	0.125g
14.	Distilled water	Vehical	12.0ml	12.2ml	11.5ml
	Total quantity		25g	25g	25g

5. METHOD OF PREPARATION [17,18,24-27]

❖ **Preparation of Papaya Peel Extract**

- **Step1 :** Collection of Raw Material :
  → Collect fresh, ripe papaya peels.
- **Step 2 :** Washing:
  → Wash the peels thoroughly with clean water to remove dirt and contaminants.
- **Step 3 :** Drying
  → Pat dry using a clean cloth to remove surface moisture.
  → Ensure no excess water remains.
- **Step 4 :** Size Reduction
  → Cut the peels into small pieces for easy grinding.
- **Step 5 :** Grinding (Without Water)
  → Transfer the pieces into a blender.
  → Blend without adding water until a thick paste is formed.
- **Step 6 :** Filtration / Extraction :
  → Transfer the paste into a muslin cloth or fine filter.
  → Squeeze to extract the liquid.
- **Step 7 :** Collection of Extract :
  → Collect the filtrate in a clean container.
  → This liquid is pure papaya peel extract.

❖ **<u>Steps of formulation</u>**

- Phase A – Oil Phase Ingredients: Stearic acid ,Cetyl alcohol ,Beeswax, Liquid paraffin ,Almond oil ,Propyl paraben (oil-soluble)

➤ Procedure: Take all Phase A ingredients in a beaker Heat to 70–75°C Stir until all ingredients melt completely → clear oil phase

- Phase B – Aqueous Phase Ingredients: Distilled water ,Glycerin, Propylene glycol, Methyl paraben (water-soluble)

➤ Procedure: Take Phase B ingredients in another beaker Heat to 70–75°C Stir until methyl paraben dissolves completely

- Phase C – Thickener Phase (Important)
- Ingredient: Carbopol 940

➤ Procedure: Take small amount of distilled water (from Phase B) Sprinkle Carbopol slowly with continuous stirring Allow to hydrate and swell (10–15 min)

Do NOT heat directly Ensure lump-free smooth dispersion

- Step 4: Combine Phases:

Add Phase C (Carbopol dispersion) → into Phase B (Maintain temperature at ~70°C)

Slowly add Phase A → into Phase B with continuous stirring Forms oil-in-water emulsion

- Step 5: Neutralization & Thickening

Add Triethanolamine slowly.

Functions: Forms TEA-stearate (emulsifier)

Neutralizes Carbopol → gel formation → viscosity increase

- Step 6: Cooling Phase: Continue stirring and cool to ~40°C
- Step 7: Add Active Ingredients

Add: Papaya peel extract (liquid) ,Butterfly pea extract (liquid) Mix gently

- Step 8: Magnetic Stirring

Continue mixing the cream using a magnetic stirrer at 500 rpm for 10–15 minutes.

Ensure proper emulsification and uniform distribution of all ingredients.

Avoid excessive speed to prevent formation of air bubbles and foam.

A smooth, homogeneous cream is obtained after complete mixing.

- Step 9: Final Adjustments: Check pH (5.5 – 6.5) Adjust if required
- Step 10: Filling: Transfer into clean container Store in cool, dry place.

6. EVALUATION PARAMETERS [23-33]

1. **Physical Appearance [27][31]**
   Instrument: Visual inspection
   Purpose: To check colour, odour, texture, and homogeneity
   Acceptable Range: Smooth, uniform cream without lumps or phase separation
   Procedure: Observe formulation visually under normal light.

2. **pH Test [23][28]**

   Instrument: Digital pH meter.
   Purpose: To determine skin compatibility.
   Acceptable Range: 5.5–7.0Procedure: Disperse 1 g cream in 10 mL distilled water and measure pH

3. **Viscosity [17][18][29]**

   Instrument: Brookfield Viscometer.
   Purpose: To determine consistency and flow property.
   Acceptable Range: Uniform semisolid viscosity.
   Procedure: Measure viscosity using suitable spindle at specific rpm.

4. **Spreadability [30]**

   Instrument: Glass slides and weight.
   Purpose: To determine ease of spreading.
   Acceptable Range: Good spreadability with less time.
   Procedure: Place cream between glass slides and measure spreading time.

5. **Homogeneity [17][18]**

   Instrument: Visual inspection.
   Purpose: To check uniformity of formulation.
   Acceptable Range: Uniform smooth texture.
   Procedure: Rub cream between fingers and observe particles or roughness.

6. **Washability [31]**

   Instrument: Water and visual observation.
   Purpose: To determine ease of removal from skin.
   Acceptable Range: Easily washable.
   Procedure: Apply cream on skin and wash with water.

7. **Irritancy Test [32]**

   Instrument: Visual observation.
   Purpose: To determine skin irritation potential.
   Acceptable Range: No redness, itching, or irritation.
   Procedure: Apply cream on skin for 24 h and observe reactions.

8. **Stability Study [33]**

   Instrument: Refrigerator.
   Purpose: To evaluate formulation stability during storage.
   Acceptable Range: No colour change or phase separation.
   Procedure: Store at different temperatures and observe changes periodically.

9. Smear Test [27][31]

Instrument: Glass slide/Skin surface.
Purpose: To determine greasiness and after-feel.
Acceptable Range: Smooth and non-greasy smear.
Procedure: Apply cream and observe film formation and texture.

7. RESULT AND DISCUSSION

1. 1.Physical Appearance [27,31]

Fig No. 16

Table No.16

Sr.No	Parameters	F1	F2	F3
1.	Colour	Bluish White	Bluish White	Bluish White
2.	Odour	Pleasant Fregrance	Pleasant Fregeance	Pleasant Fregrance
3.	Appearance	Good	Great	Better

Discussion: From the above observation table we can conclude that F2 have ideal physical characteristics.

2.PH determination

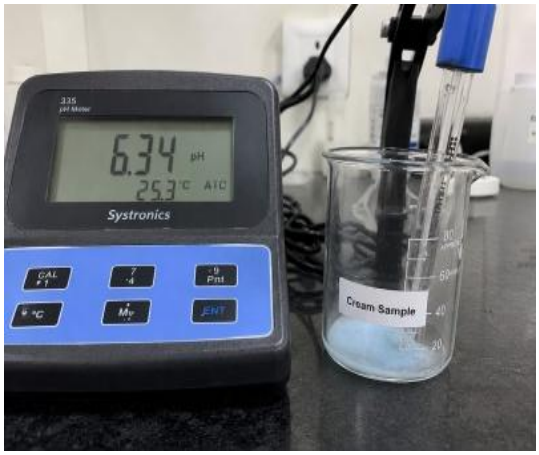

Fig No. 17

Table No.17

Sr.No	Parameter	F1	F2	F3
1.	pH	6.66	6.34	7.1

Discussion: All formulations showed pH values in the range of 6.66–7.1, which are within the normal skin pH range (5.5-7.0). This indicates that the formulations are non-irritant and suitable for topical application. F2 exhibited an ideal pH closest to that of normal skin.

3.Viscosity

Fig No. 18

Table No.18

Sr.No	Parameters	F1	F2	F3

1.	Consistency	Moderate	Excellent	High
2.	Viscosity	Lower Viscosity, more flowable	Optimum viscosity with good spreadability	Less uniform texture
3.	Appearance	Good	Excellent	Satisfactory

Discussion: The viscosity value observed for F2 was found to be most suitable for cosmetic cream formulation, providing balanced consistency and ease of application.

4.Spreadabilty

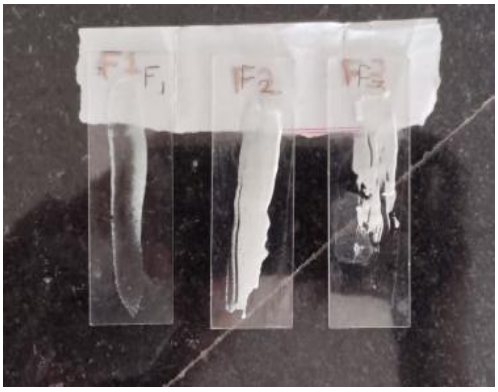

Fig 19

Table No.19

Sr.No	Parameter	F1	F2	F3
1.	Spreadabilty	Spreads easily	Spreads well	Spreads well

Discussion: The spreadabilty of the formulations decreased in the order F2 > F1> F3. F2 showed the best spreadabilty, suggesting a smoother texture and easier application, likely due to a balanced oilto-emulsifier ratio. Good spreadabilty is crucial for uniform sunscreen coverage and pleasant skin feel.

5.Washibility

Fig No. 20

Table No.20

Sr.No	Parameter	F1	F2	F3
1.	Washibilty	Good	Excellent	Moderate

Discussion: Formulation F2 was easily washable, indicating proper emulsification and stability of the formulation. F1 and F3 required more effort to wash off, possibly due to higher oil content or lower emulsifier efficiency. An easily washable formulation improves user comfort and acceptability.

6.Irritancy test:

Fig No.21

Table No.21

Sr.No	Parameter	F1	F2	F3
1.	Irritancy	Nil	Nil	Mild

Discussion: No signs of redness or itching were observed for F2 and F1, indicating they are non-irritant to the skin. Mild irritation in F3 might be due to a higher concentration of certain essential oils or actives. Thus, F2 is considered safe for regular use.

7.Smear Test:

Fig No. 22

Table No.22

Sr.No	Parameter	F1	F2	F3
1.	Appearance	Thick and greasy	Smooth and uniform	Slightly rough
2.	Easy to Application	Greasy	Non-greasy	Average
3.	Smear Type	Satisfactory	Excellent	Good

Discussion: All formulations, F2 showed the best performance due to its smooth texture, uniform smear, non-greasy nature, and excellent spreadability. F3 showed moderate properties, while F1 was comparatively thicker and greasy, making application difficult. Therefore, F2 was considered the optimized and most acceptable formulation.

8.Homogeneity:

Table No.23

Sr.No	Parameter	F1	F2	F3
1.	Homogeneity	Good	Excellent	Not Good

Discussion: All formulations were homogeneous, but F2 showed the best uniformity with no visible lumps or phase separation. Good homogeneity ensures consistent distribution of active ingredients and stability over storage.

8. DISCUSSION

The present study successfully formulated and evaluated an anti-aging cream containing Butterfly Pea Flower and Papaya Peel extracts. The formulations showed satisfactory physicochemical properties and were suitable for topical application. The Butterfly pea Flower and Papaya Peel extracts provided antioxidant, moisturizing, exfoliating, and skin rejuvenating effects due to the presence of anthocyanins, flavonoids, vitamins, and papain enzyme.

Among all formulations, F2 showed the best overall performance with ideal pH, excellent spreadability, smooth texture, good homogeneity, easy washability, optimum viscosity, and non-irritant nature. The balanced concentration of extracts and excipients in F2 contributed to better stability and user acceptability compared to F1 and F3.

The results indicate that the combination of Butterfly Pea Flower and Papaya Peel extracts has significant potential in cosmetic preparations for reducing signs of aging such as dryness, roughness, and fine lines. Therefore, the formulated anti-aging cream can be considered a safe, stable, and effective skincare formulation for improving skin appearance and maintaining healthy skin.

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