Formulation And Evaluation Of Polyherbal Cream By Using *Glycyrrhiza glabra* And *Bauhinia Variegata* For Antioxidant Activity

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Abstract

Skin aging mainly results from oxidative stress caused by reactive oxygen species. These species harm skin cells and accelerate wrinkles, dryness, and pigmentation. This study aimed to examine the herbal anti-aging creams made with extracts from Glycyrrhiza glabra and Bauhinia variegata. We acquired the extracts by soaking them in water and included them in the oil-in-water cream formulations. We prepared five formulations (F1–F5) and checked their physical and chemical properties, spreadability, viscosity, pH, irritancy, and antioxidant activity using the FRAP assay. Among all the formulations, F3 showed the best characteristics. It had a pH of 5.7, good spreadability, a suitable viscosity of 17,765 cps, no phase separation, and no skin irritation. Antioxidant assay indicated that F3 had the highest reducing power at 206.96 μg Fe^{2+}/mL, showing strong free radical scavenging ability. This indicates that the herbal cream is stable, safe, and effective for anti-aging and skin protection.

Keywords: Anti-aging, Anti-oxidant activity, Skin protection, Topical formulation.

1.Introduction:

Skin aging is a gradual and complex biological phenomenon influenced by both internal and external factors. Intrinsic aging occurs naturally due to genetic and metabolic processes, whereas extrinsic aging is primarily associated with environmental exposure such as ultraviolet radiation, pollutants, and lifestyle-related stressors. Among these causes, oxidative stress is widely recognized as a major contributor to premature skin aging. It results from excessive formation of reactive oxygen species (ROS), which can damage cellular components, including proteins, lipids, and nucleic acids. Such damage accelerates wrinkle formation, reduces skin elasticity, promotes dryness, and leads to pigmentation abnormalities. Antioxidants play an essential role in minimizing oxidative damage by neutralizing free radicals. Natural antioxidants derived from medicinal plants are increasingly explored in dermatological and cosmetic preparations due to their safety profile and broad biological activity.[1] Herbal creams are topical semi-solid dosage forms that incorporate plant-derived extracts or active phytochemicals to provide therapeutic as well as cosmetic benefits. These formulations have gained substantial interest in modern cosmeceutical development due to their moisturizing, antioxidant, antimicrobial, anti-inflammatory, and anti-aging properties. Compared with synthetic cosmetic products, herbal creams are considered more biocompatible and associated with fewer adverse reactions. Previous studies have demonstrated that herbal creams can effectively deliver plant-based active compounds through the skin and improve various dermatological conditions.[2]

Plant-derived extracts in topical formulations have been shown to improve skin barrier integrity and provide multiple skin protective effects.[1, 2] Liquorice (Glycyrrhiza glabra), a well-known medicinal plant belonging to the Fabaceae family, has been extensively used in traditional medicine systems for centuries. The root of liquorice contains several biologically active compounds such as glycyrrhizin, glabridin, liquiritin, flavonoids, and phenolic constituents,

which possess significant antioxidant, anti-inflammatory, antimicrobial, and depigmenting properties. Research has shown that liquorice extract exhibits strong skin protective activity by reducing oxidative stress and suppressing melanin formation. Pastorino et al. reported that liquorice phytochemicals contribute to improved skin tone and help reduce hyperpigmentation through antioxidant and anti-inflammatory mechanisms. [2]

Topical cream formulations containing liquorice extract displayed considerable skin brightening effects by inhibiting tyrosinase activity and melanin synthesis.[3] Moreover, moisturizing creams containing licorice extract have shown acceptable physicochemical stability, appropriate pH, good spreadability, and minimal irritation potential, confirming their suitability for cosmetic use.[4, 5] Bauhinia variegata, commonly referred to as Kachnar, is another medicinal plant widely used in traditional healthcare systems for the treatment of inflammatory and skin-related disorders. The plant contains several bioactive constituents, including flavonoids, tannins, saponins, steroids, and phenolic compounds, which are responsible for its antioxidant, antimicrobial, anti-inflammatory, and wound-healing activities. Scientific studies have demonstrated that extracts of Bauhinia variegata exhibit strong free radical scavenging potential and antibacterial activity, suggesting its usefulness in dermatological applications. Yadav et al. reported significant antioxidant and antimicrobial activity of Bauhinia variegata extracts, indicating their potential application in topical formulations.[6] Dhage et al. successfully formulated herbal gel containing Bauhinia flower extract and reported satisfactory physical stability and antimicrobial activity without causing skin irritation.[7] In addition, herbal formulations prepared using Bauhinia extracts have demonstrated wound-healing potential due to the presence of flavonoids and tannins, supporting its therapeutic importance in skin care.[8] Several studies have also confirmed the antioxidant activity of Bauhinia variegata, which contributes to tissue protection and cellular regeneration.[9, 10]

Topical cream formulations are widely accepted as effective carriers for herbal extracts because they enhance drug penetration through the skin and prolong contact time at the application site. Oil-in-water emulsions are particularly preferred in cosmetic formulations due to their non-greasy nature, easy application, and improved patient acceptability. Herbal creams also provide moisturizing benefits, improve skin texture, and protect the skin from environmental damage. Incorporation of antioxidant-rich herbal extracts into cream formulations helps in neutralizing ROS and preventing oxidative damage, thereby slowing the skin aging process and maintaining skin health.[11, 12] Assessment of antioxidant activity is crucial for determining the anti-aging efficacy of herbal formulations. The Ferric Reducing Antioxidant Power (FRAP) assay is widely used to evaluate antioxidant capacity by measuring the ability of herbal extracts and formulations to convert ferric ions into ferrous ions. This method provides reliable evidence of free radical scavenging activity and supports the validation of herbal formulations for preventing oxidative stress-related skin aging.

Therefore, the present study focuses on the formulation and evaluation of an herbal anti-aging cream containing liquorice extract and Bauhinia variegata extract. The study also aims to evaluate the physicochemical properties of the prepared formulation and determine its

antioxidant activity using the FRAP assay. The synergistic combination of these medicinal plant extracts is expected to enhance antioxidant activity and provide improved skin protective benefits, thereby contributing to the development of safe and effective herbal anti-aging cosmetic formulations.

2.Materials and Method:

2.1. Preformulation studies: [13,19]

2.1.1 Solubility studies:

Solubility of the drug is determined by dissolving 1 mg of the drug in proportions of the proposed solvents. According to the dissolving property, the solubility of the drug was determined.

2.1.2 Compatibility study:

Infrared spectra of the herb and its inclusion complexes are recorded by the potassium bromide pellet technique using a Fourier Transform Infrared Spectrophotometer. A baseline correction is made using dried potassium bromide, and the spectra of dried mixtures of drug and inclusion complexes with potassium bromide are recorded. The samples are prepared by the potassium bromide pellet press method in the wave number ranging from 4000 to 400 cm^{-1}.

2.2. Experimental investigation:

2.2.1. Preparation of In-house formulation

The bark and roots were collected, dried, and powdered separately and passed through a 100# sieve. The powder mixture was packed in airtight containers for further analysis.

2.2.2. Extraction of Liquorice and Bauhinia variegata:

The powdered roots and barks of liquorice and Bauhinia variegata were subjected to extraction using the maceration technique with water as the solvent, selected for its appropriate polarity. The extraction was carried out continuously for an extended period of 7 days upon agitation to ensure efficient recovery of phytoconstituents. Upon completion of the extraction, the solvent was evaporated to obtain the crude extract for further analysis.

Fig 1: Maceration of Liquorice and Bahuinia variegata

2.3. Formulation of cream: [14,15]

❖ **Preparation of Aqueous Phase:**

1. Accurately weigh the required quantity of distilled water into a clean beaker.
2. Add the calculated amount of Tween 80 and tragacanth to the distilled water.
3. Heat the aqueous phase to 70–75 °C with continuous stirring until a clear solution is obtained.
4. Add the *Liquorice* extract and *Bauhinia variegata* extract to the aqueous phase and stir until uniformly dispersed. Maintain the temperature at 70–75 °C.

❖ **Preparation of Oil Phase:**

1. Accurately weigh the required quantity of virgin coconut oil into a separate beaker.
2. Heat the oil phase to 70–75 °C until it becomes completely liquefied. Maintain the oil phase at the same temperature as the aqueous phase.

❖ **Emulsification:**

1. Slowly add the oil phase into the aqueous phase (for O/W cream) with continuous stirring.
2. Stir the mixture using a stirrer for 10–15 minutes. Continue stirring until a uniform, creamy emulsion is formed.

❖ **Cooling and Homogenization:**

1. Reduce the stirring speed gradually and allow the cream to cool to room temperature. Continue gentle stirring during cooling to prevent phase separation.
2. Homogenize if required to improve texture and consistency.

❖ **Final Adjustment and Storage:**

1. Check the pH of the cream (ideal range: 5.5–6.5).
2. Transfer the prepared cream into a clean, airtight container. Label and store at room temperature for further evaluation.

Ingredients	**F1**	**F2**	**F3**	**F4**	**F5**
Liquorice	0.25 g	0.5 g	0.75 g	1g	1.25g
Bauhinia variegata	1.25g	1g	0.75g	0.5g	0.25g

Distilled water	13.855ml	18.19ml	19.4ml	24.25ml	16.165ml
Tween 80	6.93ml	6.06ml	9.7 ml	8.085 ml	8.085ml
Virgin coconut oil	27.715ml	24.25ml	19.4ml	16.165ml	24.25 ml

Table 1: Plant extracts and their composition of chemicals in Herbal Cream[14]

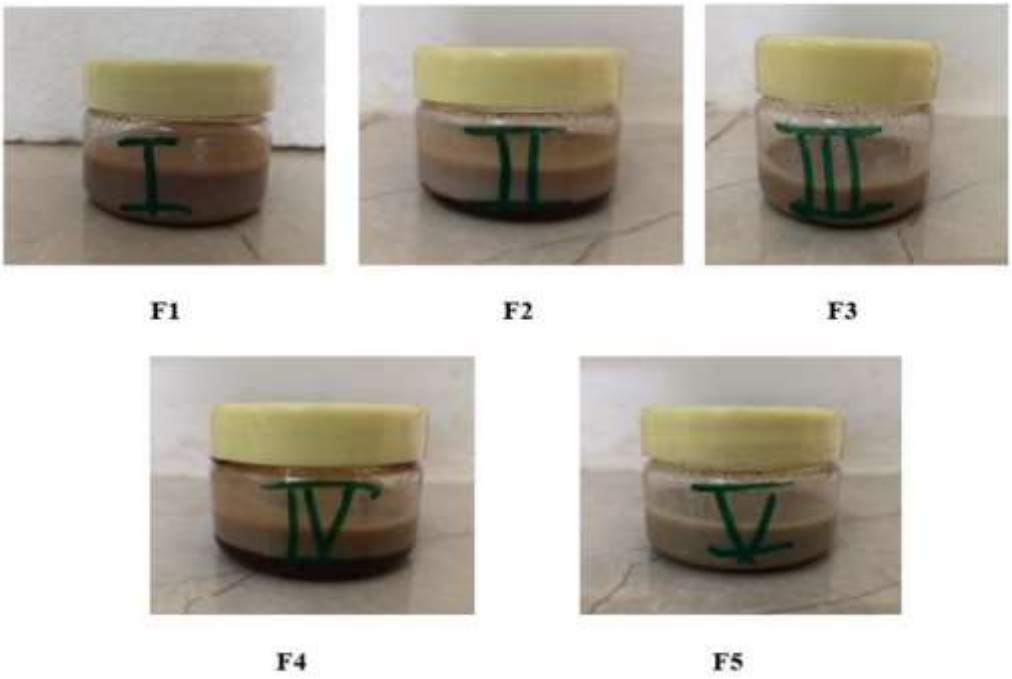

Figure 2: Formulated Herbal Creams

2.4. Evaluation of cream: [15,16]

Evaluation

Formulated herbal creams were further evaluated by using the following physical parameters like colour, odour, consistency and state of the formulation.

1.Colour:

The cream's color was determined via visual inspection. The results were shown in table 9.

2.Odour:

It was discovered that the cream's odor was characteristic. The result was shown in table 9.

3.State:

The state of the cream was examined visually. The cream was semisolid in state, and results were shown in table 9.

4.Consistency:

The formulation was examined by rubbing cream on hand manually. The cream having a smooth consistency.

5.pH:

Prepared herbal cream was measured by using a digital pH meter. The solution of cream was prepared by using 100 ml of distilled water and set aside for 2 hours. pH was determined three times, and the average value was calculated. Results were shown in table 13.

6.Spreadability:

The spreadability of the formulated cream was measured by placing samples in between two slides and then compressing them to a uniform thickness by placing a definite weight for a definite time. The specified time required to separate the two slides was measured as spreadability. The lesser the time taken for separation of two slides, the better the spreadability in table 11.

7.Viscosity:

Viscosity was measured with spindle number 63 in a Brookfield viscometer. The speeds taken are 10, 20, and 100 RPM. The formulated cream was directly immersed into the cream, and viscosity was measured, and values were recorded in centipoise. The result was shown in table 12.

8.Washability:

A portion of cream was applied over the skin of the hand and allowed to slow under the force of flowing tap water for 10min. The time when the cream completely removed was noted in table 10.

9.Homogeneity:

Homogeneity and texture were tested by pressing a small quantity of the formulated cream between the thumb and index finger. The consistency of the formulation and presence of coarse particles were used to evaluate the texture and homogeneity of the formulation. Result noted in table 10.

10.After feel:

Emollience, the amount of residue left after the application of a fixed amount, and the slipperiness of the cream were checked. Results were found for every formulation of specific in table 10.

11.Irritancy test:

Label an area on the dorsal surface of the left hand. Irritants, erythema, and eczema were tested and reported at regular intervals of time up to 24 hours, if any result was noted in table 10.

2.5. Antioxidant activity: [17,18]

2.5.1. Preparation of reagents:

• 0.2M phosphate buffer (pH 6.6): 8 g of sodium chloride, 0.2 g of potassium chloride, 1.44 g of disodium hydrogen phosphate, and 0.24 g of potassium dihydrogen phosphate were taken in a 1000 ml standard flask, and 800 ml of distilled water was added, and the pH was adjusted to 6.6 using hydrochloric acid, and the volume was adjusted with deionized water.
• Potassium ferricyanide (1%): 1 g of potassium ferricyanide was dissolved in 100 ml of deionized water.
• Trichloroacetic acid (10%): 10 grams of trichloroacetic acid were dissolved in 100 milliliters of deionized water.
• Ferric chloride (0.1%): 100 mg of ferric chloride was dissolved in 100 ml of deionized water.
• Ascorbic acid (0.1%): 1 milligram of ascorbic acid was dissolved in 1 milliliter of water.

2.5.2. Method:

Different formulations of the herbal cream were mixed with 2.5 ml of 0.2 M sodium phosphate buffer (pH 6.6) and 2.5 ml of potassium ferricyanide [$K_3Fe(CN)_6$] solution.

- The reaction mixture was vortexed and then incubated at 50°C for 20 minutes using a vortex shaker.
- After the incubation, 2.5 ml of 10% trichloroacetic acid was added to the mixture, and it was centrifuged at 3000 rpm for 10 minutes.
- The supernatant (2.5 ml) was combined with 2.5 ml of deionized water and 0.5 ml of 0.1% ferric chloride.
- The colored solution was measured with a UV spectrophotometer at 700 nm against the blank, and the reducing power of the samples was compared with the reference standard.

3.Result and discussion:

3.1 Solubility studies:

Solubility studies revealed that both Liquorice and Bauhinia variegata extracts were slightly soluble in distilled water, soluble in ethanol and methanol, and insoluble in chloroform.

3.2 FTIR Studies:

Drug-excipient compatibility is checked by comparing the IR-spectra of pure drug, excipients,physical mixture of drug and excipients. There is no significant changes in the functional group between the spectra are seen. So this has been confirmed that there is no interaction between the drug and excipients.

3.2.1 Glycyrrhiza glabra:

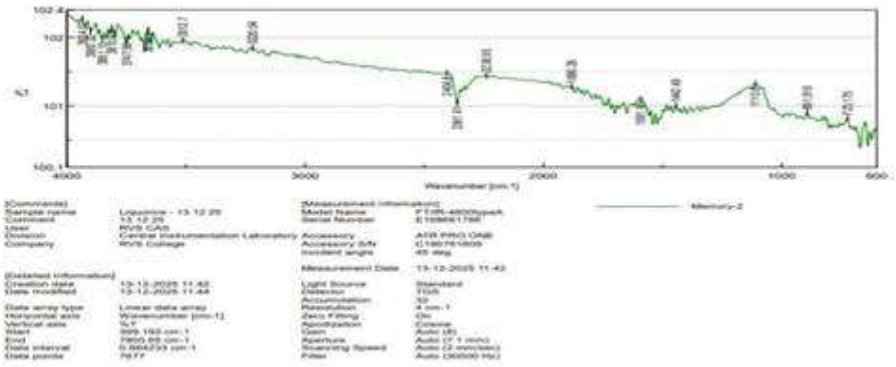

Fig 2: FT-IR Spectrum Glycyrrhiza glabra

Functional group	Type of vibration	Characteristic Absorption(cm^{-1})	Test Absorption(cm^{-1})
O-H	Stretching	3200-3600cm^{-1}	3658.3
C-H	Stretching	2800-2900cm^{-1}	2361.41
C=C	Stretching	1450-1600cm^{-1}	1591.95

Table 2: FT-IR Spectrum of Glycyrrhiza glabra

3.2.2 Bauhinia variegata:

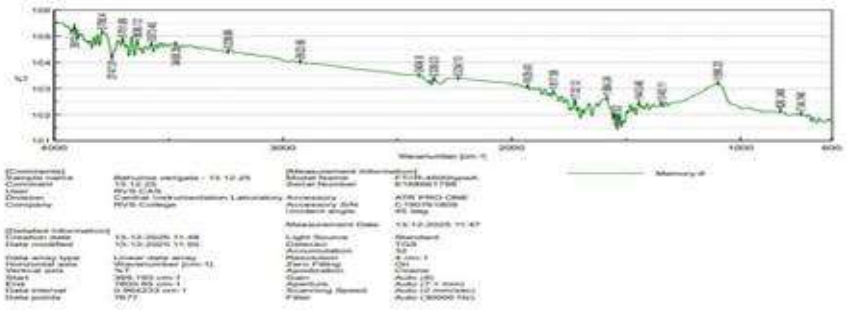

Fig 3: FT-IR Spectrum of Bauhinia variegata

Functional group	Type of vibration	Characteristic Absorption(cm^{-1})	Test Absorption(cm^{-1})
O-H	Stretching	3200–3600cm^{-1}	3747.01
C-H	Stretching	2800-2900cm^{-1}	2339.23
C=C	Stretching	1400-1600cm^{-1}	1538.92

Table 3: FT-IR Spectrum of Bauhinia variegate

3.3 Physiochemical properties:

Physicochemical properties of cream have a significant impact on its efficacy and application on skin. Physicochemical properties of herbal cream which was prepared are listed in table 5.

Physical properties	F1	F2	F3	F4	F5
Colour	Brown	Brown	brown	Brown	Brown
Odour	Characteristic	Characteristic	Characteristic	Characteristic	Characteristic
Appearance	Semi solid	Semi solid	Semi solid	Semi solid	Semi solid

Table 4: Physiochemical properties of cream

Discussion: Formulated F3 showed acceptable colour, characteristic odour,and semi solid appearance indicating good physical acceptability of the formulation.

3.4 Evaluation parameters:

Evaluation	F1	F2	F3	F4	F5
Phase separation	No	No	No	Yes	No
Irritancy	No	No	No	No	No
Washability	Yes	Yes	Yes	Yes	Yes
After feel	Emollient	Emollient	Emollient	Emollient	Emollient
Homogeneity	Yes	Yes	Yes	No	Yes

Table 5: Phase separation, Irritancy, Washability, After feel, Homogeneity results

Discussion: Formulation 3 did not show any phase separation, did not produce any irritancy, easily washable, and exhibited an emollient after feel overall indicating good physical stability of the cream.

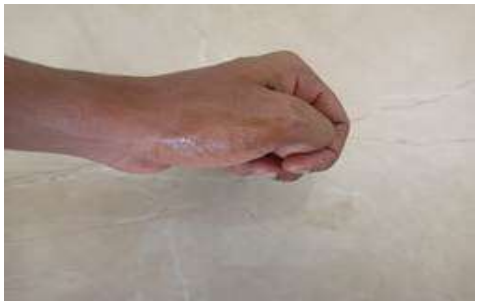

Fig 4: Irritancy

3.5 Spreadability:

The consistency and texture of cream determine its feel and spreadability on the skin. A cream with smooth and easily spreadable texture enhances appealing for use on skin. Spreadability results noted in table 11**.**

Formulation	Spreadability
F1	6.56 g.cm/s
F2	13.12 g.cm/s
F3	5.25 g.cm/s
F4	10.5 g.cm/s
F5	7.5 g.cm/s

Table 6: Spreadability

Discussion: Formulation3 (5. 25g.cm/s) showed satisfactory spreadability indicating ease for application on the skin.

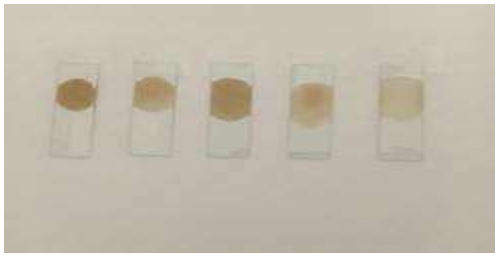

Fig 5: Spreadability

3.6 Viscosity:

Brook field viscometer was used. The cream sample was placed on the sample holder of the viscometer and allowed to settle for min and the viscosity measured at a rotation speed of at room temperature. Viscosity results are noted in table 12.

Formulation	Viscosity
F1	13565 cps
F2	3870 cps
F3	17765 cps
F4	5850 cps
F5	11250 cps

Table 7: Viscosity

Discussion: Formulation 3(17765cps) exhibited suitable viscosity for topical application consistency and stability of the formulation.

Fig 6: Viscometer

3.7 pH:

The pH of the developed cream base was measured on a standardized digital pH meter at room temperature by taking an adequate amount in a 50ml beaker. The pH was measured three times and average was calculated. Results are noted in table 13.

Formulation	pH
F1	5.9
F2	6.2
F3	5.7
F4	5.2
F5	5.6

Table 8: PH

Discussion: Formulation 3 showed a pH 5.7, which is close to the normal skin pH,indicating good skin compatibility.

Fig 7: pH meter

3.8 Antioxidant activity:

The antioxidant activity of the test sample was assessed using the ferric chloride reducing assay. This assay measures the ability of antioxidants in the sample to reduce ferric ions (Fe^{3+}) to ferrous ions (Fe^{2+}), leading to the formation of a coloured complex. A higher absorbance value reflects greater reducing power and, consequently, stronger antioxidant activity. Ascorbic acid was used as the standard reference antioxidant for comparison.

Formulation	**Absorbance at 700nm**	**FRAP Value (µg Fe^{2+}/mL)**
Ascorbic acid(std)	0.833	100
F1	1.257	150.90
F2	1.386	166.39
F3	1.724	206.96
F4	0.824	98.92
F5	1.124	134.93

Table 9: Antioxidant activity for cream

Discussion: The antioxidant activity of the herbal cream formulations was evaluated using the Ferric Reducing Antioxidant Power (FRAP) assay. The method is based on the reduction of ferric ions (Fe^{3+}) to ferrous ions (Fe^{2+}) by antioxidants present in the samples, which was measured spectrophotometrically at 700 nm.

Among all the formulations, F3 showed the highest FRAP value (206.96 µg Fe^{2+}/mL), indicating maximum antioxidant activity. This was followed by F2 (166.39 µg Fe^{2+}/mL) and F1 (150.90 µg Fe^{2+}/mL). F5 showed moderate antioxidant activity, whereas F4 exhibited the lowest FRAP value (98.92 µg Fe^{2+}/mL), which was almost similar to the standard.

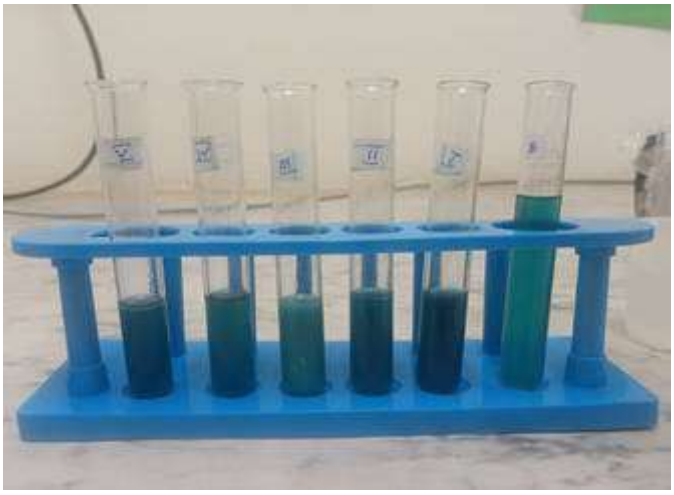

Fig 8: Test samples for Antioxidant activity

4.Conclusion

The present study was pointed out with the object of preparing the herbal face cream that improves the skin's moisture, emollient, and nourishment. Herbal face cream was formulated with the aqueous extract of liquorice and Bauhinia variegata, which are commonly used for skin brightening and anti-aging. The main challenge lies in the selection of natural material that can be rationally justified and comparable to that of synthetic material. In the present study our aim is to develop an herbal face cream that would be natural. We formulated an herbal face cream by using plant extracts, which are commonly used traditionally and lauded for their skin antioxidant activity. All the ingredients used to formulate herbal face creams are safer, and their use can greatly reduce skin aging and skin elasticity.

The herbal face cream was prepared by the trituration method and further evaluated for various evaluation parameters. The herbal face creams show a good physical appearance with a brown colour, smooth consistency, pleasant odour, and semi-solid state. In this study five formulations of cream were prepared. Among the five formulations, we considered formulation 3 to be a good formulation. The following points are the justification for the formulation of 3 as best.

- The pH of the formulation F3 was found to be 5.7.
- The spreadability of the optimized formulation F3 was found to be 5.25 g·cm/s.
- The viscosity of the optimized formulation F3 was found to be 17765 cps.
- The formulation F3 was not observed to have any phase separation.
- The formulation F3 is easily washable with tap water.
- The after feel test for the optimized formulation F3 was found to be good.
- The formulation F3 shows no irritation.
- The formulation F3 has no greasiness.

Overall, the produced polyherbal cream(F3) has good physicochemical qualities, stability, skin compatibility, and substantial antioxidant activity. The research supports the potential use of

Glycyrrhiza glabra and Bauhinia variegata extracts in the development of safe, efficacious, and natural anti-aging cosmeceutical formulations.

Conflict of Interest: None

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