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Formulation, Development, Estimation, and Evaluation of Serum using Cabbage Extract

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Abstract

Exposure to sun and other environmental factors can lead to skin damage, which in turn causes skin aging and wrinkles on the face. To combat these negative effects, it is important to take care of skin by using products that contain beneficial ingredients. One such product is serum. Serum is formulated to deliver active ingredients to the skin more efficiently than other skincare products. Vitamin C is a vital ingredient in serum that offers numerous benefits for the skin. It helps to brighten the skin, improve its texture, and reduce the appearance of fine lines and wrinkles. Oregano oil is another essential ingredient in serums that provides numerous benefits like antioxidant, antibacterial, anti-inflammatory, etc. By combining all the beneficial benefits of these ingredients a serum was formulated. Also, various tests were carried out to estimate the vitamin C content and various evaluation parameters of serum ensuring that the product is of high quality and effective.

Keywords: Vitamin C, Ascorbic acid, Cabbage, Oregano oil, Serum, Face, Skin.

1. Introduction

Serum, a staple in cosmetology, is an essential skincare product designed to deeply penetrate the skin with its lightweight gel or lotion formula, delivering active ingredients effectively. A quality serum can enhance skin firmness, and texture, minimize pore size, and boost moisture

levels for a radiant complexion. Face serum, a potent skincare solution, effectively delivers active ingredients deep into the skin, achieving desired outcomes without resorting to harmful chemicals. These concentrated emulsions, available in both water and oil-based forms, efficiently transport active ingredients, ensuring their efficacy in skincare formulation. Introducing a few drops into daily skincare routines yields noticeable results in a month or less. This efficacy is due to the serum's small molecules, facilitating rapid penetration into the skin.1

The facial serum is packed with ingredients known for reducing the appearance of fine lines and wrinkles while enhancing the skin's barrier function, including a neuro peptide. As a serum, it's designed to be lightweight and easily absorbed, whether oil or water-based, ensuring it swiftly penetrates the skin's deeper layers. With a non-greasy finish and potent formula rich in active ingredients smooth the skin has excellent spreadability minimizes pores and boosts moisture levels. By delivering active ingredients efficiently, this serum avoids the need for harsh chemicals while providing rapid results. In essence, it's a powerhouse skincare product applied post-cleaning and pre-moisturising delivering a concentrated dose of nourishment to the skin.1

Ascorbic acid (AA) serves as an essential nutrient with cosmeceutical activity. It works by beautifying, mitigate photo-aging and skin ageing by combating oxidative stress induced by various exteral and internal factors, while also enhancing collagen gene expression and maturation.[4] It acts as an antioxidant, it shields the skin from reactive oxygen species(ROS) generated upon sunlight exposure by neutralizing them. The efficient delivery of ascorbic acid via topical preparation is crucial and wants careful evaluation, as it may change depending on formulation's nature or type.[5]

2. Materials and Methods

2.1. Materials

2.1.1. Cabbage Extract

Cabbages part of the Brassicaceae family, are widely cultivated vegetables originating from the south and western coast of Europe. They boast a rich array of healthful compounds like vitamins (A, C, K, B6), carotenoids, polyphenols (including chlorogenic and sinapic acid derivatives, and flavonoids), minerals (selenium, potassium, manganese), and nitrogen-sulfur derivatives (glucosinolates, isothiocyanates). As documented in the literature, these compounds are known for their anticarcinogenic, antimicrobial, anti-inflammatory, and antidiabetic properties.[2]

2.1.2. Oregano Oil

The essential oil extracted from Origanum vulgare L., a manner of the Lamiaceae family, has garnered attention for its potential in skin care. Originating from the Mediterranean region Europe and Asia, O. Vulgare is widely utilized worldwide, with Asia being its primary exporter. Beyond its culinary uses, this herb has a rich history in ethnomedicine and is known for its stimulating, tonic, and carminative properties. Additionally, it exhibits antimicrobial, antifungal, antiviral, analgesic, antioxidant, and anti-inflammatory effects. Notably, it has been recognized for enhancing skin penetration in transdermal drug delivery applications.[4]

Origanum vulgare oil (OVO) has the potential for topical application, particularly in anti-skin aging treatment, owing to its anti-oxidant and anti-inflammatory properties. These properties help combat free radical damage caused by reactive oxygen species (ROS), associated with aging and skin aging. OVO's main fraction includes acyclic and cyclic monoterpenes such as 1, 8-cineol, y-terpinene, linalool, and others, sesquiterpenes like β-caryophyllene, germacrene-

D, and aromatic hydrocarbons (p-cymene)[5] Antioxidant properties are attributed to carvacrol, thymol, and p-cymene, which can form chemical complexes with metal ions and free radicals.

2.1.3. Almond Oil

Almond oil, derived from Oleum amygdalae, stands out as a natural reservoir of healthy fatty acids antioxidants, and various phytochemicals. These essential nutrients work harmoniously to nourish and hydrate facial skin, promoting its health and suppleness. Notably lightweight, almond oil possesses rapid absorption properties, making it suitable for all skin types due to its gentle nature. Regular application of almond oil on the face can effectively mitigate photoaging, stemming from prolonged exposure to UV radiation, while also addressing various other skin conditions. Additionally, almond oil encompasses many macro and micronutrients, including proteins, carbohydrates, fats, vitamins, and minerals.

1.Vitamin E possess anti-inflammatory and antioxidant properties, aiding skin soothing and reduction of oxidative stress.

2. Vitamin A promotes cell regeneration, effectively smoothing fine lines on the face.

3. Fatty acids found abundantly in almond oil, such as oleic acid, linoleic acid, palmitic acid, and stearic acid, offer diverse benefits;

Oleic acid contributes to softening dry skin and diminishing wrinkles.

Linoleic acid exhibits anti-inflammatory properties, aiding in the acne-healing

Palmitic acid enhances the skin’s barrier function, shielding it from bacteria and allergens.

4. Zinc supports wound healing processes and maintenance of a healthy skin barrier function.[6]

2.1.4. Rosewater

Rose water is derived from the aqueous extract of Rosa damascene petals and is valued for its radical scavenging and protein denaturation properties. Its antioxidant activity, measured using the ferric reducing power assay with standard ascorbic acid, and anti-inflammatory activity, evaluated by assessing the percentage inhibition of protein denaturation with standard diclofenac sodium, underscore its therapeutic potential. Rich in polyphenolic compounds such as flavonoids, tannins, triterpenoids, and saponins, rose water owes its antioxidant and anti-inflammatory properties primarily to these phytoconstituents. [7]

2.2 Vitamin C Estimation

Standard solution – 0.25gm of ascorbic acid was dissolved in 100 ml of water → it was then diluted up to 250 ml in a volumetric cylinder.

Sample solution – Cabbage was procured from the local market leaves were separated → washed thoroughly → chopped finely → and then it was dried in a hot air oven at 80-90 degrees Celsius for 30-40 mins → after drying it was finely powdered.

Solvent (5% metaphosphoric acid – 10% acetic acid): 15gm of solid metaphosphoric acid was weighed and dissolved in a mixture of 40ml of glacial acetic acid and 450ml of distilled water in a 500ml volumetric flask by continuous stirring → The solvent prepared was filtered.

Extract – 3gm of the above-powdered cabbage was taken into a beaker.

Figure.1. drying

Figure.2 Filtering

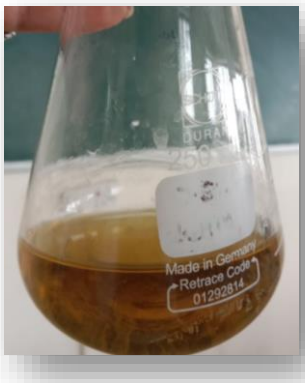


Figure.3. Cabbage extract

→ 50ml of the above solvent prepared was added into the powdered cabbage for extraction → It was kept under stirring conditions for 10 minutes Later it was filtered out using Whatman filter paper → stored in the refrigerator.[8]

2.2.1. Method 1 – Iodometric method

2.2.1.1. Reagents

1. 1% starch indicator – 0.50gm soluble starch was added in 50ml boiling water by stirring. {NOTE- Use immediately after preparing it}

2. 0.01N Iodine solution – 5gm potassium iodide + 0.268gm potassium iodate was added in 200ml water → 30ml of 3M sulphuric acid was added in the above solution → diluted up to 500ml in the volumetric cylinder.

2.2.1.2. Procedure

In 5ml of standard solution, 0.5ml of starch indicator was added. → it was then titrated using 0.01N iodine solution. → Readings were noted down as Burette reading.

In 5ml of sample solution, 0.5ml of starch indicator was added. → it was then titrated using 0.01N iodine solution. → Readings were noted down as Burette reading.

2.2.1.3. Endpoint

Colorless to blue colored.[9]

2.2.1.4 Observation Table

Solution	Burette Reading
Standard Solution	0.6ml
Sample Solution	0.8ml

2.2.1.5. Calculation

M1V1 = M2V2

M1: Concentration of Vit C in sample solution

M2: Concentration of Vit C in standard solution

V1: Volume of iodine solution required for sample solution

V2: Volume of iodine solution required for standard solution

M1V1 = M2V2

M1 X 0.8 = 0.25 X 0.6

M1 X 0.8 = 0.15

M1 = 0.15/0.8

M1 = 0.18 gm

2.2.1.6 Result

From the above observation, it can be concluded that in 5ml of sample solution 0.18gm of vitamin C was found.

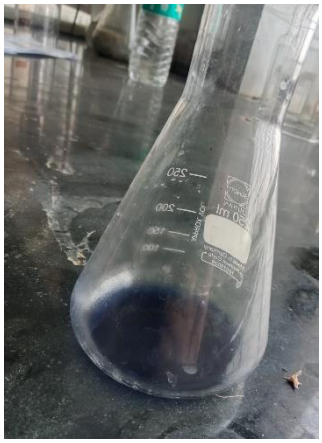


Figure.4. Standard Solution

Figure.5 Sample Solution

2.2.2. Method 2

2.2.2.1. Reagents

10% v/v sulphuric acid in water

10% w/v solution of ammonium molybdate in water

2.2.2.2. Procedure

For standard solution

In a beaker take 2ml standard solution + 2ml sulphuric acid + 4ml ammonium molybdate solution. → Now in another beaker take 4ml standard solution + 2ml sulphuric acid + 4ml ammonium molybdate solution and so on make concentrations on standard solution like 2ml, 4ml, 6ml, 8ml, 10ml, 12ml…→ keep at room temperature for 60 minutes → dilute with water to 25ml. → measure absorbance at max 650nm against reagent blank.

For sample solution,

In a beaker take cabbage juice + 2ml sulphuric acid + 4ml ammonium molybdate solution □ keep at room temperature for 60 minutes □dilute with water to 25ml □ measure absorbance at max 650nm.[10]

2.2.2.2. Observation Table

For standard solution

Concentration	absorbance
2	0.3
4	0.6
6	0.94
8	1.01
10	1.48
12	1.61

For sample solution

Concentration	Absorbance
Unknown	1.44

2.2.2.4. Calibration Curve

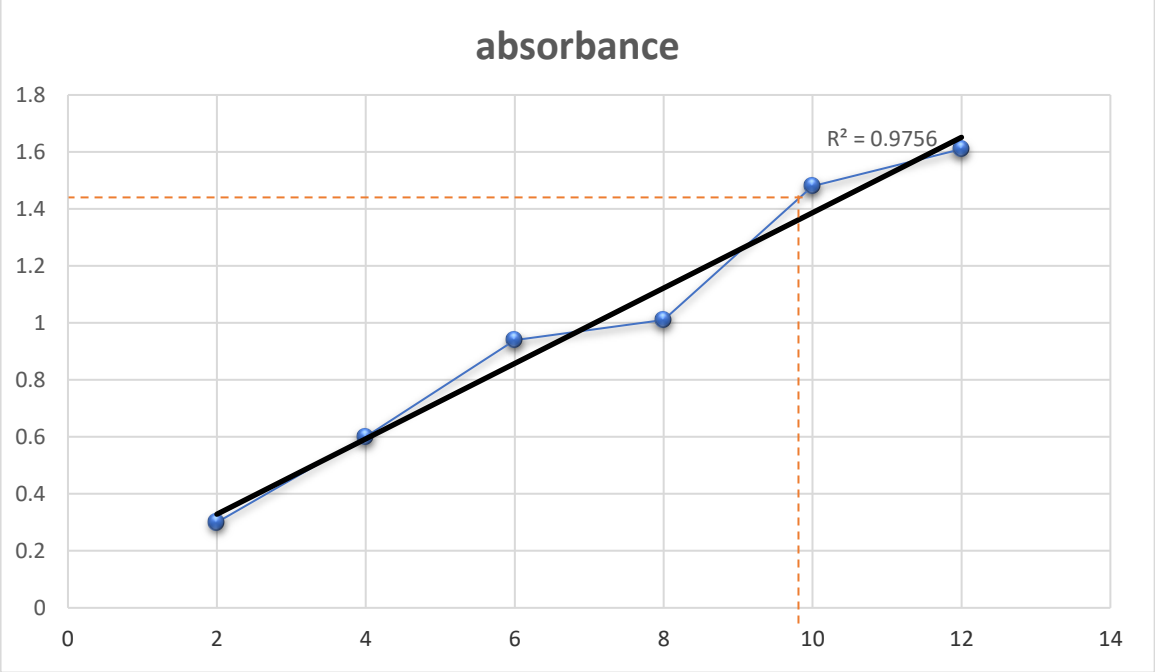


Figure. 6. Calibration Curve

2.2.2.5. Result

Using a calibration curve it was found that at an absorbance of 1.44, the concentration of the given sample is 9.8, or it can be said that a concentration of approximately 9.8mcg/ml of ascorbic acid was found in the sample. (Cabbage).

Figure.7. Sample Solution

Figure.8. Standard Solution

2.2.3. Method 3 - Paper chromatography

Stationary phase- Whatman filter paper was used as a stationary phase.

Mobile phase: n-butanol: acetic acid: water [4:1:5]

Detection reagent: Ammonical silver nitrate solution

2.2.3.1. Procedure

The Whatman filter paper was taken → A baseline was drawn from the bottom → Spotting of the sample was done using a capillary tube → The paper was placed into the chamber in the mobile phase. After a sufficient run of the solvent the paper was removed and kept for drying → After drying it was sprayed with DNPH → later it was dried and Rf was measured.[11]

2.2.3.2. Inference

Experimental values obtained in the sample solution of cabbage extract demonstrated the presence of dehydroascorbic acid. The Rf value showed a tailing

2.2.4. Method 4 – Thin Layer Chromatography

Stationary phase – Silica gel plates

Mobile phase – Toulene: ethanol: acetone: acetic acid [14:4:1:1]

2.2.4.1. Procedure

Silica gel plates were taken → A baseline was drawn from the bottom → Spotting of the sample was done using a capillary tube → The plate was placed into the chamber in the mobile phase. After a sufficient run of the solvent, the plate was removed and kept for drying → After drying it was sprayed with DNPH → later it was dried and Rf was measured.[12]

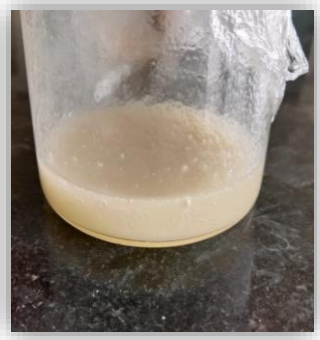
2.2.4.2. Inference

Experimental values obtained in the sample solution of cabbage extract demonstrated the presence of dehydroascorbic acid. The separation was good enough and the Rf value was falling between the range of – 0.68

The Rf value of the Standard solution fell between the range – 0.64

2.3. Formulation Table

Sr no.	Ingredients	F1	F2	F3	Category
1	Cabbage extract	5.5ml	7ml	3.5ml	Vitamin C
2	Oregano oil	0.9ml	1.5ml	0.8ml	Antioxidant
3	Almond oil	0.3ml	0.3ml	0.3ml	Antiwrinkle
4	Lavender oil	0.2ml	0.2ml	0.2ml	Perfume
5	CMC	0.1gm	0.1gm	0.1gm	Emulsifier
6	Sodium benzoate	0.0005gm	0.0005gm	0.0005gm	Preservative
7	Glycerine	2.5ml	2.5ml	2.5ml	Moisturizer
8	Rose water	Q.s (15ml)	Q.s (15ml)	Q.s (15ml)	Toner



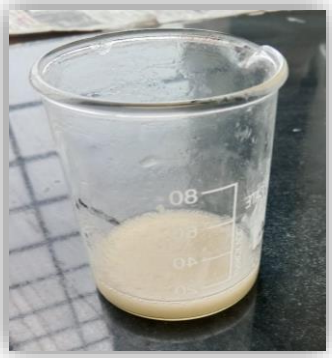


Figure.9. Formulation F1 **Figure.10. Formulation F2** **Figure.11. Formulation F3**

2.3. Method of preparation[13]

All the ingredients were grouped on the basis of their solubilities in aqueous and oil phases.

↓

Oil-soluble ingredients were dissolved in one beaker (Oregano oil, Almond oil, Lavender oil)

↓

Water-soluble ingredients were dissolved in another beaker (Cabbage extract, Glycerine, CMC, Sodium benzoate)

↓

The mixture was slightly heated in a water bath.

↓

Oil phase ingredients were slowly poured into water-soluble ingredients by constant stirring on a magnetic stirrer to obtain a water-based biphasic emulsion.

↓

As a result, serum was prepared

3. Result

3.1 pH

pH meter was calibrated using a phosphate buffer solution. 1ml of serum was taken into a beaker and 50ml of distilled water was added to it. Later pH was checked by using a pH meter. [14] pH was found to be 4.22

Figure.12. pH reading

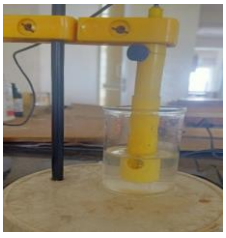


Figure.13. pH meter

3.2. Homogeneity

A volume of 1 ml of serum was subjected to a homogeneity test to ensure its uniformity. The test involved visual inspection and tactile examination by rubbing the sample between the fingers. The results of this test were accurate and reliable.

3.3. Appearance

To determine the quality and appearance of the serum, it was evaluated based on its appearance, color, roughness, and uniformity.

3.4. Spreadability

1 ml of serum was applied to the hand of the human body to check its spreadability.

3.5. Stability Testing

The serum samples were subjected to 2 different storage conditions for testing purposes. Specifically, they were kept at a temperature of 40^{o}C +/- 2^{o}C for a period of 30 days, and also at room temperature. The formulation was then monitored at five different time points, namely on days 0, 6, 12, 18, 24. The results of the test were reliable and accurate.

3.6. Skin Irritation Test

1ml of serum was rubbed on the hand and kept for 3min. No irritation occurred.

3.7. Observation Table

Sr. no.	Test	F1	F2	F3
1.	Color	Pale yellow	Pale yellow	Pale yellow
2.	Odor	Characteristic	Characteristic	Characteristic
3.	Texture	Smooth	Smooth	Smooth
4.	pH	4.01	4.22	4.85
5.	Spreadability	Spreadable	Spreadable	Easily Spreadable
6.	Homogeneity	Homogenous	Homogenous	Homogenous
7.	Skin Irritation Test	No irritation	No irritation	No irritation

4. Conclusion

The primary goal of this study was to create a serum that could provide multiple benefits to the skin. In particular, the serum was formulated to nourish the skin, while also offering antioxidant and antiwrinkle properties. To achieve this, cabbage extract was chosen as a source of vitamin C which is known for its ability to brighten and even out skin tone. Additionally, oregano oil was utilized as a source of antioxidants, which help to neutralize free radicals that can damage the skin over time. The serum was tested carefully to ensure that it met all necessary requirements for a quality skincare product. The pH level was found to be within the ideal range, which is important for maintaining the skin's natural balance. In terms of appearance, the serum had a pleasing texture and was easy to apply. Its consistency was smooth and even, which made it important to ensure that its beneficial properties remained effective for as long as possible.

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