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"A REVIEW ON FORMULATION AND EVALUATION OF OKRA MUCILAGE BASED FRIZZ CONTROL AND ANTIDANDRUFF HAIR SERUM"

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Abstract:

Hair care has become increasingly important due to the rising prevalence of hair problems such as hair fall, dandruff, dryness, and frizz, largely caused by modern lifestyle factors including pollution, stress, and the excessive use of chemical-based products. The present study focuses on the formulation and evaluation of a natural herbal hair serum using mucilage extracted from *Abelmoschus esculentus* (okra), a plant known for its excellent moisturizing and conditioning properties.

The okra mucilage was extracted using an aqueous heating method and incorporated into three different formulations (F1, F2, and F3) at varying concentrations. Additional ingredients such as rosemary extract, almond oil, glycerol, vitamin E, and carbomer were included to enhance hair growth, nourishment, and stability of the formulation. The prepared formulations were evaluated for various physicochemical parameters including pH, viscosity, homogeneity, spreadability, texture, and patch test for skin irritation. The results indicated that all formulations were within the acceptable pH range (5.5–6) and showed good stability and safety with no signs of irritation. Among the three formulations, F3 containing the highest concentration of okra mucilage demonstrated superior performance in terms of viscosity, spreadability, smooth texture, and overall user acceptability. The serum exhibited effective frizz control and conditioning properties due to the film-forming ability of okra mucilage.In conclusion, the study confirms that okra mucilage is a promising natural ingredient for the development of herbal hair care products. The formulated serum is safe, eco-friendly, and can serve as an effective alternative to conventional synthetic hair serums.

I.INTRODUCTION

Hair plays a significant role in enhancing an individual's appearance and self-confidence, making hair care an essential part of daily grooming. However, modern lifestyle factors such as stress, pollution, poor nutrition, and excessive use of chemical-based products have contributed to common hair problems such as hair fall, dandruff, dryness, and premature greying [1].Herbal hair serums have emerged as a promising alternative to conventional synthetic products due to their minimal side effects and therapeutic benefits. These formulations typically contain plant-based ingredients such as Emblica officinalis (amla), almond oil, flaxseed, and other vitamin-rich extracts that nourish the scalp, strengthen hair follicles, and improve overall hair health [2]. Unlike traditional oils, hair serums are lightweight, non-greasy formulations that form a thin protective layer over the hair shaft, enhancing smoothness, shine, and manageability [3].

II.HAIR ANATOMY

Hair is a vital part of the human body made mainly of keratin, growing from follicles in the skin. It varies in texture and color and helps with protection, temperature regulation, and sensory functions. Hair also reflects cultural identity and health. Its condition is influenced by genetics, hormones, nutrition, and the environment. This paper reviews hair structure, common problems, and modern care and treatment methods.[4]

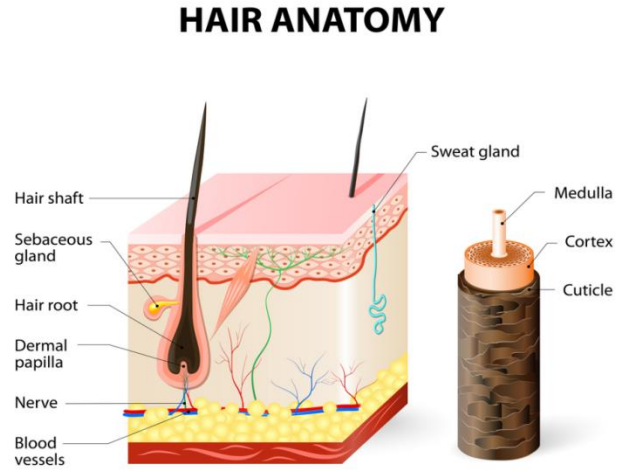

Fig. No. 1: Hair Anatomy

Human hair is composed of two primary anatomical components: the hair root and the hair shaft. Anatomy of hair is depicted in figure1.The hair root lies beneath the surface of the skin and is the living part of the hair. It is embedded in the hair follicle, a tunnel-like structure that extends into the epidermis and dermis. In contrast, the hair shaft is the visible, non-living part that protrudes above the skin's surface. It consists of keratinized dead cells and does not engage in any biochemical activity. [5]

a. Structure of hair root

The hair root forms the foundation of hair growth and contains several essential structures that support its function. The hair follicle is a tube-like depression in the skin that encloses the root and anchors the hair into the scalp. At the base of this follicle lies the hair bulb, a rounded structure where actively dividing cells generate the hair strand through a process called keratinization. Below the bulb is the dermal papilla, a cone-shaped structure containing capillaries and nerve endings that supply the nutrients and signals necessary for hair growth. Attached to the follicle is the arrector pili muscle, a small involuntary muscle that causes the hair to stand upright when it contracts commonly referred to as goosebumps. Additionally, sebaceous glands are connected to the follicle and secrete sebum, an oily substance that keeps the hair and scalp moisturized and protected. [6]

b. Structure of the Hair Shaft

The hair shaft is made up of three concentric layers, each contributing to the hair's physical characteristics. The cuticle is the outermost layer and consists of transparent, overlapping scale-like cells that protect the inner layers. It plays a key role in determining the shine, smoothness, and overall resistance to damage. Beneath the cuticle is the cortex, which comprises about 90% of the hair's mass. This layer contains densely packed keratin fibers and melanin, which provide strength, elasticity, and natural color to the hair. At the core of the shaft is the medulla, the innermost layer, typically present only in coarse or thick hair. The medulla's function remains largely unclear and is often absent in finer hair types. [7]

III.PLANT PROFILE AND INGREDIENTS

Fig. No. 2: Okra Fruit

a.Classification of Okra Plant

Okra, commonly known as lady's finger, is an important vegetable crop belonging to the family Malvaceae. Its scientific classification follows the standard taxonomic hierarchy used in plant systematics.

b.Taxonomic Classification[8]

Table No. 1: Taxonomic Classification of Okra Plant

Rank	Classification
Kingdom	Plantae
Subkingdom	Tracheobionta (vascular plants)
Superdivision	Spermatophyta (seed plants)
Division	Magnoliophyta (angiosperms)
Class	Magnoliopsida (dicotyledons)
Order	Malvales
Family	Malvaceae
Genus	Abelmoschus
Species	Abelmoschus esculentus
scientific name	Abelmoschus esculentus

c.Botanical Description[9]

1. Habit

Okra is an annual herbaceous plant, usually erect, branched, and covered with fine hairs (pubescent). It grows well in tropical and subtropical regions.

2. Root System

- Taproot system with lateral branches
- Moderately deep-rooted, providing drought tolerance

3. Stem

- Erect, cylindrical, green or reddish
- Covered with soft hairs (pubescence)
- May be branched or unbranched depending on variety

4. Leaves

- Simple, alternate, petiolate
- Shape: cordate (heart-shaped), palmately lobed (3–7 lobes)
- Surface: hairy on both sides
- Petiole: long (up to ~15 cm)

5. Inflorescence

- Solitary axillary flowers

- Large and showy

6. Flowers

- Bisexual (hermaphrodite)
- Color: yellow with a dark red/purple center
- Epicalyx present (typical of Malvaceae)
- Diameter: about 4–8 cm

7. Fruit

- Type: Capsule (loculicidal)
- Shape: elongated, tapering, often 10-angled pod
- Size: about 10–25 cm long
- Surface: slightly hairy
- Contains mucilage (slimy substance)

8. Seeds

- Numerous, round to oval, dark-colored
- Rich in oil and protein

d.Geographical Description[10]

Abelmoschus esculentus (okra) is believed to have originated in tropical Africa (Ethiopia region). It is widely distributed and cultivated in tropical and subtropical regions such as India, Africa, Southeast Asia, and parts of America. It grows best in warm climates (25–35°C) with well-drained soils and moderate rainfall.

e.Phytochemical Constituents[10]

Okra contains:

- Mucilage (polysaccharides)
- Flavonoids (quercetin, isoquercetin)
- Phenolic compounds
- Vitamins (Vitamin C, A, folate)
- Minerals (Ca, K, Mg)
- Seed oil rich in unsaturated fatty acids

f.Cosmetic / pharmaceutical properties

Fig. No. 3: Okra Mucilage

The fruit of okra (Abelmoschus esculentus) possesses significant cosmetic and pharmaceutical properties due to its rich composition of bioactive compounds. In cosmetics, okra is valued for its natural mucilage, which acts as an excellent moisturizer, providing hydration and improving skin softness and elasticity. Its antioxidant compounds, such as flavonoids and vitamin C, help protect the skin from oxidative damage, thereby reducing signs of aging like wrinkles and fine lines. Okra extracts are also used in hair care products to condition the scalp, promote hair growth, and add shine due to their nourishing and smoothing effects. In the pharmaceutical field, okra exhibits antidiabetic, anti-inflammatory, antimicrobial, and antioxidant activities, largely attributed to its phenolic compounds, polysaccharides, and dietary fiber. It has been studied for its role in regulating blood glucose levels, improving digestive health, and supporting cardiovascular function. These combined properties make okra a valuable ingredient in both therapeutic formulations and natural cosmetic products[11]

IV.MATERIAL AND METHOD

a.Collection And Authetification Of Plant

Fresh pods of abelmoschus esculentus (okra) were collected from the local market of shahada ,Nandurbar. The plant material was selected based on its freshness, green color , and absence of any physical damage or microbial contamination.The collected plant material was thoroughly washed with distilled water to remove adhering dirt and impurities and was then used for futher processing.The plant was authenticated by a qualified botanist from department of botany, P.S.G.V.P.M's Arts, science and commerce college, shahada, dist.- Nandurbar.

b.Materials

Table No. 2: Ingredients and there Role

INGREDIENTS	ROLE
Okra mucilage	Frizz control
Rosemary	Hair growth
Almond oil	Carrier oil
Vitamin E	Antioxidant
Tween80	Emulsifer
Carbomer 940	Thickener & stabilizer
EDTA	Chelating agent
Sodium benzoate	Perservative
Citric acid	Ph adjustment
Rosewater	Frangrance
Distilled water	Vehicle
Triethanolanine	Improve texture and stability
Glycerol	Humecant

c.Chemicals:- the following are the chemicals used is the following of okra mucilage hair serum Disttiled water ,Carbomer,Tween 80, glycerol, vitamin E ,EDTA, sodium benzonate ,Triethanolamine.

d.Equipment:

Digital Weighing balance, Brokkfeild viscometer.

e.Preparation of plant extract

Extraction of okra mucilage:

Fresh pods of *Abelmoschus esculentus* were washed thoroughly with distilled water to remove dirt and impurities. The pods were then sliced into small pieces and soaked in distilled water in a suitable ratio (approximately 1:10 w/v).

The mixture was heated at about 60–70°C for 1–2 hours with continuous stirring to facilitate the release of mucilage into the aqueous medium. After extraction, the mixture was cooled and filtered through muslin cloth to remove insoluble plant material.The filtrate containing mucilage was obtained[12]



Fig. No. 4: Extraction process of okra mucilage

Extraction of rosemary extract

Leaves of Rosmarinus officinalis were collected, washed, and air-dried at room temperature to remove moisture. The dried leaves were then ground into a coarse powder.The powdered material was subjected to solvent extraction using ethanol or methanol (commonly 70–80%) in a suitable ratio. The mixture was heated or kept under continuous stirring for several hours (typically 4–6 hours) to facilitate the extraction of active compounds such as phenolics and flavonoids.After extraction, the mixture was filtered using filter paper to separate the liquid extract from plant residues. The filtrate was then concentrated using a rotary evaporator or by gentle heating to remove the solvent.The concentrated extract was further dried to obtain a semi-solid or powdered rosemary extract and stored in airtight containers for further use.[13]

f.Method of Preparation[14]

Step 1: Preparation of Gel Base

Carbomer 940 was accurately weighed and dispersed in distilled water with continuous stirring to avoid lump formation. The dispersion was allowed to hydrate for 20–30 minutes. Subsequently, EDTA and sodium benzoate were added to the hydrated dispersion and mixed thoroughly to obtain a uniform base.

Step 2: Incorporation of Okra Mucilage

The extracted okra mucilage was incorporated into the gel base in varying concentrations according to the formulation (F1–F3). The mixture was stirred gently to maintain uniformity and prevent air entrapment.

Step 3: Preparation of Oil Phase

Almond oil and vitamin E were mixed together, followed by the addition of Tween 80 as a solubilizing agent. This mixture was stirred until a clear and homogeneous oil phase was obtained.

Step 4: Emulsification and Addition of Excipients

The oil phase was slowly added to the aqueous gel base with continuous stirring to form a uniform emulsion. Glycerol, rosemary extract, and rose water were then incorporated sequentially with constant mixing.

Step 5: Neutralization and Gel Formation

Triethanolamine was added dropwise to the formulation with continuous stirring until a transparent gel was formed. Neutralization of carbomer resulted in increased viscosity and stabilization of the formulation.

Step 6: pH Adjustment

The pH of the formulation was adjusted to the desired range (5.5– 6) using citric acid to ensure compatibility with scalp and hair.

g.Formula

Table No. 3: Formula For Okra Mucilage Hair Serum

Ingredients	F1	F2	F3
Okra mucilage	5ml	7ml	9ml
Rosemary extract	3ml	3ml	3ml
Carbomer 940	0.5 gm	0.5 gm	0.5 gm
Almond oil	2ml	2ml	2ml
Tween 80	2ml	2ml	2ml
Glycerol	2ml	2ml	2ml
Vitamin e	0.5ml	0.5ml	0.5ml
EDTA	0.5 gm	0.5 gm	0.5 gm
Sodium benzonate	0.5gm	0.5gm	0.5 gm
Rose water	10ml	10ml	10ml
Triethanolamine	1 drop	2-3 drops	2-4 drops
Citic acid	1 -2drops	1-2 drops	2-4 drops
Distilled water	q.s	q.s	q.s

V.IDENTIFICATION AND EVALUATION[15]

Fig. No. 5: Performed identification tests for okra mucilage

1. **Fehling's Test**
- **Procedure:** Mix Fehling's A & B, add sample, heat.
- **Observation:** Brick-red precipitate.
- **Inference:** Reducing sugars present.

2. **Benedict's'Test**
- **Procedure:** Add Benedict's reagent to sample, heat in water bath.
- **Observation:** Green → yellow → orange → brick-red precipitate.
- **Inference:** Presence of reducing sugars.

3. **Ninhydrin Test**
- **Procedure:** Add ninhydrin solution, heat gently.
- **Observation:** Purple/blue color.
- **Inference:** Amino acids present.

4. **Millon's'Test**
- **Procedure:** Add Millon's reagent, heat.
- **Observation:** Red coloration.
- **Inference:** Tyrosine-containing proteins present.

5. **Biuret Test**
- **Procedure:** Add NaOH, then a few drops of $CuSO_4$ solution.
- **Observation:** Violet color.

- **Inference:** Proteins present.

6. Ruthenium Red Test

- **Procedure:** Add ruthenium red solution to sample.
- **Observation:** Pink/red color.
- **Inference:** Mucilage present.

VI.EVALUATION PARAMETERS

a.Physical evaluation

- Colour : visual inspection was used to determine the serum
- Odour: the serum possesses a mild, characteristic fragrance
- Texture: physical examination of the serum was carried out to evaluate smoothness and uniformity
- Consistency: evaluated by manually rubbing the serum on the skin to check spreadability and thickness

b.Homogeneity

The extract was uniformly distributed throughout the formulation, indicating good homogeneity.on visual inspection, no lumps or particulate matter were Observed

c.Determination of pH

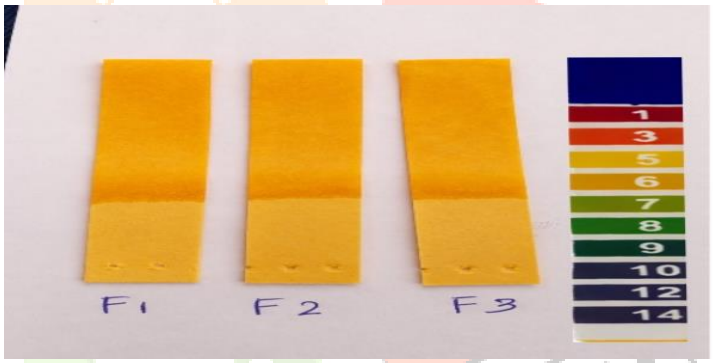

Fig.No. 6: pH determination on ph paper

Procedure: the pH paper deep in solution Approximately 1ml of serum was accurately weighed and dissolved in 50 ml of distilled water. The pH was measured and since skin in slightly acidic the serum pH Was maintained between 5.5 and 6.

d.Determination of spreadability

Fig.No. 11: spreadability on glass slide

Procedure: Spredability was measured using a spreadability apparatus.About 1gm of serum was placed between two glass plates (7 cm length). A known weight was applied,and the time taken for the upper plate to move a specific distance was recorded.

Formula:

S=m x1/t
Where:
S= Spreadability (g.m cm/sec)
m = Weight tied to upper plate (g)
1=length of glass plate (cm)
t = Time taken (sec)

e.Patch Test

Patch testing was carried out on sensitive skin areas such as behind the ears or inner elbow . A small amount of serum was applied on 1 cm of skin and observed after 24 hours for any irritation or allergic reaction. The test was repeated,and absence of irritation indicated the formulation was safe.

VII.RESULT AND DISCUSSION

a.Physical Evaluation

Table No. 4: Physical Evaluation Test

FORMULATION	F1	F2	F3
Colour	Yellow	Pale yellow	Dark yellow
Odour	Characteristic	Characteristic	Characteristic
Texture	Smooth	Slightly smooth	smooth
Consistency	Slightly slimy	Watery	Light weight & smooth

b.pH, viscosity, homoginecity, and spreadability test results

Table No. 5: pH, viscosity, homoginecity, and spreadability test

Parameter	F1	F2	F3
PH	Acidic ph (6)	Acidic ph (5.5)	Acidic ph (5.6)
Homogenecity test	Good	Lumpy	Unifrom
Viscosity	0.18kg/ms	0.16kg/ms	0.20kg/ms
Spreadability test	Easily spreads	spreads	Easily spreads

Figure no 12:- performed viscosity on brokkfeild viscometer

CONCLUSION

The present study successfully formulated and evaluated a natural hair serum using mucilage extracted from okra (Abelmoschus esculentus) in three different batches with varying mucilage concentrations .Among the three batches, with mucilage content 5ml,7ml,9ml variation in mucilage content significantly influenced the physicochemical properties, stability, spreadability, and overall performance of the serum. The batch with an higher concentration of okra mucilage (9ml) showed the best balance of viscosity, ease of application, and stability .All formulations demonstrated noticeable frizz control due to the film-forming and moisturizing properties of okra mucilage. Additionally, the presence of natural ingredients contributed to anti-dandruff activity, making the serum effective in reducing scalp dryness and flaking.

Comparative evaluation indicated that:

- Lower mucilage concentration resulted in less effective frizz control.
- Higher mucilage concentration improved conditioning , spreadability and texture.
- The higher concentration batch provided the best overall performance in terms of frizz reduction, smoothness, and user acceptability.

Thus, it can be concluded that okra mucilage is a promising natural polymer for developing herbal hair serums with frizz-controlling and anti-dandruff properties. The formulated serum is safe, eco-friendly, and can serve as an effective alternative to synthetic hair care products.

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