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FORMULATION AND EVALUATION OF HERBAL HAIR ROOT TOUCH-UP POWDER)

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Abstract: The present study focuses on the formulation and evaluation of a herbal hair root touch-up powder using natural ingredients such as henna, indigo, amla, bhringraj, hibiscus, and coffee. The formulation was developed as a safer and eco-friendly alternative to synthetic hair dyes for temporary grey hair coverage. Different batches were prepared and evaluated for physicochemical and cosmetic parameters including particle size, pH, flow property, spreadability, adhesion, washability, stability, and skin irritation. Among all formulations, Batch F3 showed the best results with excellent smoothness, adhesion, spreadability, stability, and natural black appearance. The study concluded that herbal hair root touch-up powder is an effective, safe, and user-friendly cosmetic preparation suitable for regular use.

Index Terms **-** Herbal Hair Root Touch-Up Powder, Henna, Indigo, Herbal Cosmetics, Grey Hair Coverage, Natural Hair Colorant, Hair Care, Eco-Friendly Formulation.

I. INTRODUCTION

INTRODUCTION

Background of Hair Care and Hair Colouring :-

Hair plays an important role in beauty, identity, and culture. It also protects the scalp and reflects health and youth. Since ancient times, people have used natural methods to care for hair, such as washing, oiling, conditioning, and colouring. Different cultures used natural ingredients like herbs, plant extracts, and minerals. For example, Indians used Amla and Bhringraj, while other cultures used henna, indigo, coffee, and herbal powders.

Earlier, natural dyes were commonly used to cover grey hair and were considered safe. Later, synthetic dyes became popular because they gave long lasting colour, but they may cause allergies and hair damage. Due to these side effects, many people are now shifting back to herbal hair products.

Hair root touch-up products help hide grey roots quickly. However, many available products still contain chemicals. Therefore, herbal root touch-up powders made from natural ingredients are gaining interest. These products are safer, eco-friendly, and suitable for regular use.

This review highlights the importance of traditional herbal knowledge combined with modern formulation methods to develop safe and effective herbal hair root touch-up products.

Concept of Root Touch-Up Products :-

Root touch-up products are quick, temporary solutions designed to cover grey or grown-out hair roots between regular hair-coloring sessions. They provide instant coloration, blend naturally with existing hair color, and help maintain a fresh, uniform appearance without the need for full hair dye application.

Importance of Herbal Hair Cosmetics :-

1. Herbal hair cosmetics are made from **natural plant ingredients**.
2. They are **safer and gentler** than chemical products.
3. They **nourish the scalp** and **strengthen hair roots.**
4. They help **reduce hair fall, irritation, and damage.**
5. They provide **long-term hair health benefits.**
6. They are **eco-friendly and cost-effective.**
7. They are **suitable for all hair types** and safe for regular use.

Role of Herbal Ingredients :-

1. Henna Powder (Lawsonia inermis)

- Strengthens hair shafts and reduces breakage
- Improves scalp health due to antifungal properties
- Enhances shine and smoothness
- Protects hair from environmental damage

2. Indigo Powder (Indigofera tinctoria)

- Maintains natural hair color and prevents dullness
- Helps protect hair from oxidative stress
- Improves hair thickness and texture

3. Amla Powder (Emblica officinalis)

- Rich in vitamin C and antioxidants
- Strengthens hair follicles and promotes hair growth
- Delays premature greying
- Improves scalp circulation and nourishment

4. Bhringraj Powder (Eclipta alba)

- Promotes hair growth and reduces hair fall
- Nourishes hair roots and strengthens follicles
- Improves blood circulation in the scalp
- Helps in preventing premature greying

5. Hibiscus Powder (Hibiscus rosa-sinensis)

- Conditions hair and improves elasticity
- Reduces dryness and split ends
- Supports healthy hair growth
- Adds natural shine and softness

6. Coffee / Tea Powder

- Stimulates hair follicles due to caffeine content
- Improves scalp circulation
- Strengthens hair strands and reduces shedding
- Enhances natural hair color appearance

7. Kaolin Clay

- Cleanses scalp by absorbing excess oil and impurities
- Helps maintain a healthy scalp environment
- Prevents clogged hair follicles

8. Talc

- Maintains dryness and reduces scalp moisture buildup
- Improves smoothness and comfort on the scalp
- Helps in even distribution of formulation

9. Gum Acacia

- Forms a protective coating on hair strands
- Prevents moisture loss
- Improves hair smoothness and manageability
- Supports longer retention of active ingredients

Scope of the Review :-

This review focuses on the formulation and evaluation of **Herbal Hair Root Touch-Up Powder**, emphasizing the use of natural plant-based ingredients for safe and temporary hair color coverage. It covers raw materials, formulation methods, physicochemical evaluation, safety aspects, and performance parameters such as color retention and ease of application. The review also highlights advantages over synthetic dyes, consumer acceptability, and future scope in herbal cosmetic development.

Overall, this review aims to integrate traditional herbal knowledge with modern formulation techniques to support the development of a safe, effective, and eco-friendly herbal hair root touch-up powder.

Anatomy & Physiology of Hair :-

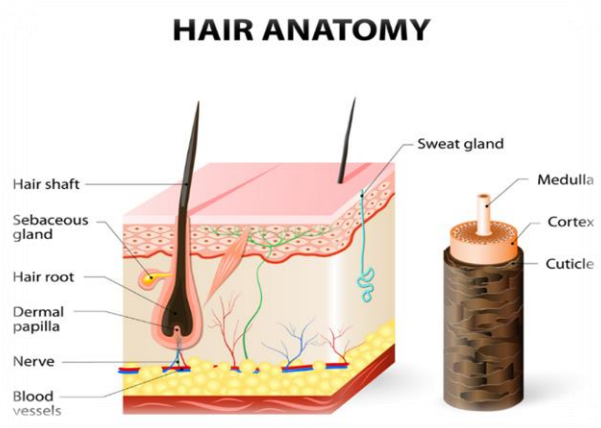
Structure of Hair Strand :-

A hair strand is made up of three main layers:

1. **Cuticle** –
   The outermost layer. It is made of tiny, overlapping cells like roof shingles.
   It protects the hair and gives shine.

2. **Cortex** –
   The middle layer and the thickest part.
   It contains **pigment (melanin)** that gives hair its color and provides strength and elasticity.

Medulla –
The innermost, soft, spongy layer (not present in all hair types).
It helps in overall thickness and shine



Structure of Hair Strand

Structure of Hair Follicle :-
The **hair follicle** is a tiny tubular structure in the skin that produces hair. It has several parts:

1. **Hair Bulb** – The base of the follicle where cells divide to form the hair. It contains the **dermal papilla**, which supplies nutrients for hair growth.
2. **Hair Matrix** – The actively dividing cells above the dermal papilla that form the hair shaft.
3. **Inner Root Sheath** – Surrounds and shapes the growing hair shaft.
4. **Outer Root Sheath** – Provides support and protection to the follicle.
5. **Sebaceous Glands** – Produce oil (sebum) to keep hair and scalp moisturized.
6. **Arrector Pili Muscle** – Tiny muscle that makes hair stand up ("goosebumps").

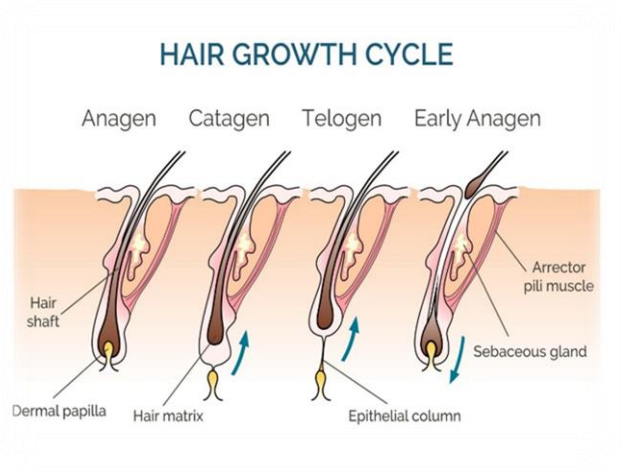
Hair Growth Cycle :-
Hair grows in a repeating cycle with three main phases:

1. **Anagen (Growth Phase)** – Hair actively grows. This phase lasts **2–6 years** for scalp hair.
2. **Catagen (Transition Phase)** – Hair stops growing and the follicle shrinks. This lasts about **2–3 weeks**.
3. **Telogen (Resting Phase)** – Hair rests before falling out naturally. This phase lasts around **3 months**.

After telogen, the follicle re-enters anagen, starting a new hair growth cycle

Factors Affecting Hair Pigmentation :-
Hair color is mainly determined by **melanin**, a natural pigment produced by melanocytes in the hair follicle. Several factors can influence hair pigmentation:

1. **Genetics** – The main factor; determines natural hair color and the age of greying.
2. **Age** – Hair loses melanin over time, causing grey or white hair.



Hair Growth Cycle

3. **Hormones** – Changes during puberty, pregnancy, or thyroid disorders can affect pigment production.

4. **Nutrition** – Deficiencies in vitamins (B12, D) and minerals (iron, copper, zinc) may lead to premature greying.

5. **Stress** – Can indirectly affect hair pigment by impacting overall health and oxidative balance.

6. **Environmental Factors** – Sunlight, pollution, and chemicals can damage melanocytes and alter hair color.

7. **Medical Conditions & Drugs** – Certain illnesses or medications may cause changes in pigmentation.

Causes of Premature Greying :-

Premature greying occurs when hair loses its natural color earlier than usual. The main causes include:

1. **Genetics** – Family history can make greying start early.

2. **Vitamin & Mineral Deficiencies** – Lack of B12, iron, copper, and zinc affects hair pigmentation.

3. **Oxidative Stress** – Free radicals damage pigment-producing cells in hair follicles.

4. **Hormonal Changes** – Thyroid problems or hormonal imbalances can trigger early greying.

5. **Medical Conditions** – Conditions like vitiligo or anemia may contribute.

6. **Lifestyle Factors** – Stress, smoking, and poor diet can speed up greying.

7. **Chemical Exposure** – Excessive use of hair dyes or harsh chemicals may weaken hair pigmentation.

2.7 Herbal vs. Synthetic Hair Colorants :-

Hair colorants are widely used cosmetic products intended to alter or restore hair color. They may be classified broadly into **herbal (natural)** and **synthetic (chemical)** hair colorants. Both categories differ significantly in their composition, mechanism of action, safety profile, efficacy, environmental impact, and consumer acceptance. A comparison of these two classes helps in understanding the need for safer, herbal-based alternatives such as herbal hair root touch-up powders.

➢ **1 Herbal Hair Colorants :-**

Herbal hair colorants are derived from plant sources that contain natural pigments, dyes, or color-enhancing compounds. These substances may be used individually or in combination to impart color, improve hair texture, and promote scalp health.

Key features of herbal colorants:

a) Natural Pigments :-

Herbs such as *Lawsonia inermis* (Henna), *Indigofera tinctoria* (Indigo), coffee, tea, hibiscus, amla, bhringraj, and beetroot contain tannins, flavonoids, anthocyanins, and other phytochemicals that produce color naturally.

b) Gentle on Hair and Scalp :-

Herbal dyes generally do not penetrate deeply into the hair cortex. Instead, they bind superficially, forming a protective coating that enhances shine and texture without severe chemical reactions.

c) Additional Hair Benefits :-

- Reduces hair fall
- Strengthens hair follicles
- Provides conditioning effect
- Improves hair thickness and gloss

d) Limitations :-

- Limited shade range (mostly browns, reds, and blacks)
- Requires multiple applications for darker or more intense results
- Color longevity is moderate compared to synthetic dyes
- Results may vary depending on hair type and preparation method

➢ **2 Synthetic Hair Colorants :-**

Synthetic (chemical) hair colorants are made from artificial dyes, intermediates, and oxidizing agents. They are categorized into permanent, semi-permanent, and temporary hair dyes.

Key features of synthetic colorants :-

a) Strong and Long-Lasting Color :-

Synthetic dyes penetrate the hair shaft and chemically alter melanin, offering a wide palette of shades and lasting coverage, including complete coverage of grey hair.

b) Chemical Composition :-

- Paraphenylenediamine (PPD)
- Paratoluenediamine (PTD)
- Ammonia
- Hydrogen peroxide
- Resorcinol

c) Faster and More Predictable Results :-
Formulations are standardized, providing consistent outcomes across different hair types.

d) Limitations / Safety Concerns :-

- Can cause scalp irritation, dermatitis, allergic reactions
- Overuse leads to hair dryness, brittleness, and weakening
- Long-term use may raise concerns related to carcinogenicity of certain aromatic amines
- Environmental pollution due to chemical residues in wastewater

Material and Method

➢ **1. Henna (Lawsonia inermis):-**
Botanical Name: *Lawsonia inermis*

Family: Lythraceae

Common Names: Henna, Mehndi

Plant Type: Small shrub or tree, 2–6 m in height

Origin: Native to North Africa, West Asia, and South Asia

Parts Used: Leaves (primarily for dye), occasionally stems and roots

Active Constituents: Lawsone (natural dye), flavonoids, tannins, coumarins

Traditional Uses: Hair coloring, conditioning, treating dandruff, cooling effect on scalp

Modern Application: Natural hair dye, herbal cosmetic formulations, and root touch-up powders

Henna (Lawsonia inermis)

Indigo (Indigofera tinctoria) :-

- **Botanical Name:** *Indigofera tinctoria*
- **Family:** Fabaceae
- **Common Names:** True indigo, Neel, Indian indigo
- **Description:** A small shrub with pinnate leaves and pinkish-purple flowers. The leaves are the main source of natural blue dye.
- **Active Constituents:** Indigotin (main coloring compound), flavonoids, tannins
- **Uses in Hair Care:** Provides natural darkening effect on hair, covers grey hair, improves hair shine and texture
- **Other Benefits:** Anti-inflammatory, antimicrobial, and scalp-nourishing properties
- **Preferred Form:** Leaf powder or paste for hair coloring

Indigo (Indigofera tinctoria) :-

- **3.Coffee :-**

Scientific name: *Coffea arabica, Coffea robusta*
Family: Rubiaceae
Description:
Coffee is a small evergreen shrub or tree with shiny green leaves and white fragrant flowers. It produces red berries called coffee cherries, which contain the coffee beans.
Parts Used:
Roasted or ground coffee beans.
Active Constituents:

- Natural pigments (brown tannins)
- Caffeine
- Polyphenols

Benefits in Hair Formulations:

- Gives a natural brown color
- Enhances shine
- Acts as an antioxidant
- Helps darken grey roots temporarily

Coffee

4. Amla (Emblica officinalis) :-

Botanical Name: *Emblica officinalis* / *Phyllanthus emblica*

- **Common name:** Amla, Indian Gooseberry
- **Family:** Phyllanthaceae
- **Parts used:** Fruit (mainly), leaves, seeds

Chemical Constituents:
Rich in Vitamin C, tannins, gallic acid, ellagic acid, flavonoids.

Benefits for Hair:

- Strengthens hair roots
- Prevents greying
- Provides natural shine
- Acts as an antioxidant
- Helps improve hair pigmentation

Role in Hair Root Touch-Up Powder:

Amla enhances color adherence, supports natural darkening of hair, and improves hair health

Amla (Emblica officinalis)

5. Bhringraj :-

- **Scientific name:** *Eclipta alba* / *Eclipta prostrata*
- **Family:** Asteraceae
- **Common names:** Bhringraj, False Daisy
- **Parts used:** Leaves and whole plant
- **Key components**: Alkaloids, flavonoids, wedelolactone
- **Benefits for hair:**
  - ✓ Helps darken hair
  - ✓ reduces greying
  - ✓ strengthens roots
  - ✓ promotes hair growth
- **Why used in formulation:** Acts as a natural coloring and nourishing herb for improving hair pigment and shine

Bhringraj

7. Hibiscus :-

Scientific name: *Hibiscus rosa-sinensis*
Common names: Hibiscus, China rose, Gudhal
Family: Malvaceous
Description:
Hibiscus is a flowering shrub with bright red, pink, or yellow flowers. The plant has glossy green leaves and grows well in warm tropical climates.
Useful parts:
Leaves and flowers
Key phytochemicals:
Anthocyanins, flavonoids, natural pigments, amino acids, vitamin C
Benefits in hair formulations:

- Acts as a natural colouring agent (gives reddish tint)
- Strengthens hair roots
- Reduces hair fall
- Conditions and softens the hair
- Promotes hair growth

Why it is used in root touch-up powder:
Hibiscus adds natural color, improves shine, and supports healthy hair without causing irritation.

Hibiscus

Functional Excipients - (Binders, Fillers, Absorbents)

➢ Functional excipients are extra ingredients added to the herbal hair root touch-up powder to improve its texture, stability, and ease of use.

- **Binders**:
  These help the powder stick properly to the hair roots.
  Examples: Gum acacia, gum tragacanth.

- **Fillers**:
  These increase the bulk of the powder and make it easy to apply.
  Examples: Talc, starch.

- **Absorbents**:
  These help control oil and moisture on the scalp, so the powder stays longer.
  Examples: Kaolin clay, bentonite clay.

Method of Preparation

Formulation Flow Chart :-

SELECTION OF HERBAL INGREDIENTS

↓

COLLECTION & AUTHENTICATION

↓

DRYING OF HERBS (Shade Drying)

↓

GRINDING INTO FINE POWDER

↓

SIEVING (60–120 mesh for uniform particle size)

↓

PRE-FORMULATION STUDIES OF HERBAL POWDERS
(Organoleptic tests, flow properties, moisture content)

↓

SELECTION OF EXCIPIENTS
(Binders, absorbents, fillers, stabilizers)

↓

WEIGHING OF ALL INGREDIENTS

↓

BLENDING / MIXING OF POWDERS
(Geometric dilution method to ensure uniform mixing)

↓

ADDITION OF FRAGRANCE (optional)

↓

FINAL BLENDING & SIEVING

↓

PACKAGING OF FORMULATION

↓

EVALUATION OF FORMULATION
(Flow properties, covering efficiency, adhesion, stability)

↓

FINAL PRODUCT APPROVED

Formulation Table

Sr. No.	Ingredient	Function	Batch F1 (10 g)	Batch F2 (10 g)	Batch F3 (10 (10g)
1	Henna powder	Natural colorant	3.0 g	2.5 g	2.0 g
2	Indigo powder	Darkening agent	1.5 g	2.5 g	3.0 g
3	Amla powder	Color enhancer & conditioner	1.0 g	0.8 g	0.7 g

4	Bhringraj powder	Hair strengthening agent	0.8 g	0.9 g	0.8 g
5	Hibiscus powder	Conditioning & mild tint	0.7 g	0.5 g	0.4 g
6	Coffee powder	Brown pigment	0.5 g	0.8 g	1.0 g
7	Kaolin clay	Absorbent & smoothness	1.2 g	1.0 g	0.9 g
8	Talc	Filler & spreadability	0.9 g	0.7 g	0.8 g
9	Gum Acacia	Binder & adhesion	0.4 g	0.3 g	0.4 g
	Total		10 g	10 g	10 g

Method

Step 1: Weigh All Ingredients :-

Ingredient
1. Henna powder
2. Indigo powder
3. Amla powder
4. Bhringraj powder
5. Hibiscus powder
6. Coffee powder
7. Kaolin clay
8. Talc
9. Gum Acacia

➢ **Step 2: Dry Sieving of Powders**

Pass each powder separately through an #80 mesh sieve to obtain fine and uniform particles.

❖ *Purpose*

- Removes lumps
- Improves smoothness
- Ensures uniform mixing

Dry Sieving of Powders

➢ **Step 3: Mixing of Herbal Powders**

Transfer henna, indigo, amla, bhringraj, hibiscus, and coffee powder into a clean mortar or mixing bowl. Mix thoroughly using geometric dilution method.

❖ *Purpose*

- Uniform distribution of colorants
- Proper blending of herbal ingredients

➢ **Step 4: Addition of Base Powders**

Add kaolin clay and talc slowly into the herbal mixture and mix uniformly.

❖ *Purpose*

- Improves spreadability
- Gives smooth texture
- Enhances absorbent property

Addition of Base Powders

➢ **Step 5: Addition of Binder**

Add gum tragacanth gradually and triturate properly to obtain good adhesion and uniform consistency.

❖ *Purpose*

- Improves adherence to hair roots
- Prevents powder dusting

Addition of Binder

➢ **Step 6: Final Blending**

Blend the entire mixture for 5–10 minutes until a smooth, homogeneous powder is obtained.

❖ *Observation*

- Fine texture
- Uniform -black color
- Free-flowing powder

Final Blending
Final Prepared Product

- Color: black
- Texture: Fine and smooth
- Odor: Characteristic herbal odor
- Nature: Free-flowing powder suitable for hair root touch-up

Evaluation Parameters

1. Organoleptic Evaluation

2. Particle Size Determination

3. pH Determination

4. Bulk Density

5. Tapped Density

6. Angle of Repose

7. Moisture Content

8. Washability Test

9. Spreadability Test

10. Skin Irritation Test

11. Adhesion Test

12. Flow Property

13. Stability Study

14. Ash Value

15. Microbial Limit Test

- **1. Organoleptic Evaluation**

Procedure

Observe the prepared powder visually and manually for:

- Color
- Odor
- Texture
- Appearance

- **2. Particle Size Determination**

Procedure

Pass the powder through #80 mesh sieve and observe particle uniformity.

- **3. pH Determination**

Procedure

- Dissolve 1 g powder in 10 mL distilled water.
- Measure pH using digital pH meter.

- **4. Bulk Density**

Procedure

- Fill powder into measuring cylinder.
- Record occupied volume before tapping.

Formula

$$\text{Bulk Density} = \frac{\text{Weight of Powder}}{\text{Untapped Volume}}$$

➢ **5. Tapped Density**

Procedure

- Tap the measuring cylinder 100 times.
- Record final volume.

Formula

$$\text{Tapped Density} = \frac{\text{Weight of Powder}}{\text{Tapped Volume}}$$

➢ **6. Angle of Repose**

Procedure

- Allow powder to flow through funnel onto flat surface.
- Measure height and radius of powder heap.

➢ **7. Moisture Content**

Procedure

- Dry sample in hot air oven at 105°C.
- Record weight loss.

➢ **8. Washability Test**

Procedure

- Apply powder on hair strands.
- Wash with normal water/shampoo.

➢ **9. Spreadability Test**

Procedure

- Apply powder using puff or brush.
- Observe ease of spreading on hair roots.

➢ **10. Skin Irritation Test**

Procedure

- Apply small amount on skin patch.
- Observe for redness or irritation after 24 hours.

➢ **11. Adhesion Test**

Procedure

- Apply powder on hair roots.
- Observe adherence after combing.

➢ **12. Flow Property**

Procedure

Evaluate free-flowing nature during pouring and handling.

➢ **13. Stability Study**

Procedure

Store formulation at:

- Room temperature
- Accelerated temperature

Observe changes for 30 days.

➢ **14. Ash Value**

Procedure

- Incinerate powder in silica crucible.
- Measure remaining ash.

➢ **15. Microbial Limit Test**

Procedure

- Culture sample on nutrient media.
- Observe microbial growth.

Result

Evaluation Results of Herbal Hair Root Touch-Up Powder

1. Organoleptic Evaluation

Parameter	Batch F1	Batch F2	Batch F3 (Optimized)
Color	Dark Brown	Brownish Black	Deep Natural Black
Odor	Mild Herbal	Pleasant Herbal	Pleasant Herbal

Texture	Slightly Coarse	Smooth	Very Smooth & Fine
Appearance	Free flowing powder	Uniform powder	Uniform silky powder
Feel on Application	Moderate smoothness	Smooth	Excellent smoothness

2. Particle Size Determination

Batch	Average Particle Size
F1	145 µm
F2	120 µm
F3	95 µm

3. pH Determination

Batch	pH
F1	6.1
F2	6.4
F3	5.5

pH Determination

Bulk Density

Batch	Bulk Density (g/mL)
F1	0.42
F2	0.46
F3	0.50

Tapped Density

Batch	Tapped Density (g/mL)
F1	0.55
F2	0.58
F3	0.60

Angle of Repose

Batch	Angle of Repose
F1	34°
F2	31°
F3	28°

Moisture Content

Batch	Moisture Content (%)
F1	5.8%
F2	4.9%
F3	3.8%

Washability Test

Batch	Spreadability
F1	Moderate
F2	Good
F3	Excellent uniform spreading

Washability Test

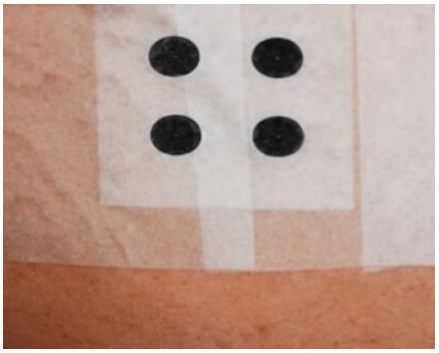
9. Spreadability Test

Batch	Spreadability
F1	Moderate
F2	Good
F3	Excellent uniform spreading

Spreadability Test

Skin Irritation Test

Batch	Result
F1	No irritation
F2	No irritation
F3	No irritation



Skin Irritation Test

Adhesion Test

Batch	Adhesion Property
F1	Moderate adhesion
F2	Good adhesion
F3	Excellent adhesion on hair roots

Adhesion Test

Flow Property

Batch	Flow Character
F1	Fair
F2	Good
F3	Excellent free-flowing property

Flow Property

Stability Study

Batch	Stability Result (30 Days)
F1	Slight color variation observed
F2	Stable
F3	Highly stable with no significant change

Ash Value

Batch	Ash Value (%)
F1	8.5%
F2	7.8%
F3	7.2%

Fig – 7: Ash Value

Microbial Limit Test

Batch	Result
F1	Within acceptable limit
F2	Within acceptable limit
F3	Within acceptable limit

OBSERVATION: -

Batch F3 showed the best overall evaluation results due to higher indigo and coffee content, balanced absorbents, improved adhesion, finer particle size, and superior flow properties.

- **Packaging and Storage**

Transfer the prepared powder into a clean, dry, airtight container and store in a cool, dry place away from moisture.

Conclusion

Batch	Overall Performance
F1	Acceptable formulation
F2	Improved formulation
F3	Optimized batch with best smoothness, adhesion, spreadability, flow property, stability, and natural black appearance

Batch F3 showed the best overall evaluation results due to higher indigo and coffee content, balanced absorbents, improved adhesion, finer particle size, and superior flow properties.

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