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## Review Article

# Formulation And Evaluation of Herbal Hair Conditioner by Using Annona Squamosa Leaves (Custard Apple)

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## ABSTRACT

**Objectives:** This study aims to formulate and evaluate an herbal hair conditioner using Annona squamosa leaves and other natural ingredients known for their beneficial effects on hair health. **Methods:** Extracts of Annona squamosa, Aloe vera, Azadirachta indica (neem), Phyllanthus emblica (amla), Hibiscus rosa-sinensis, Trigonella foenum-graecum (fenugreek), and other herbs were prepared by maceration. Three formulations (F1, F2, and F3) were developed and evaluated for pH, dirt dispersion, viscosity, irritation potential, stability, moisturizing time, and organoleptic properties. **Results:** All formulations exhibited pH within the acceptable range (4–7), smooth texture, and aromatic odor. F2 showed higher viscosity and superior moisturizing properties. No irritation or stability issues were observed over six weeks at 37°C. All three formulations were effective, but F2 demonstrated the most promising overall performance. **Conclusion:** Herbal conditioners formulated with Annona squamosa and complementary botanicals show excellent safety and efficacy. These formulations, particularly F2, serve as viable natural alternatives to synthetic hair care products.

## INTRODUCTION

Hair conditioner is a hair care product used after shampooing to improve the hair's condition. Conditioning aids in protecting and revitalizing your hair. A conditioner refers to a formulation designed to enhance the quality of hair. This product is advantageous for all hair types. It functions by replenishing moisture and smoothing the hair follicle's cuticles. An herbal hair

conditioner works to prevent hair breakage, resulting in strong and shiny locks. Formulated with key ingredients such as aloe Vera and mint leaves, this herbal conditioner promotes healthy hair by keeping it clean and smooth. In simple terms, once the shampoo cleanses and eliminates oils, the conditioner adds moisture back into your hair and aids in smoothing your strands for a shiny, soft, and healthy appearance. It's similar to

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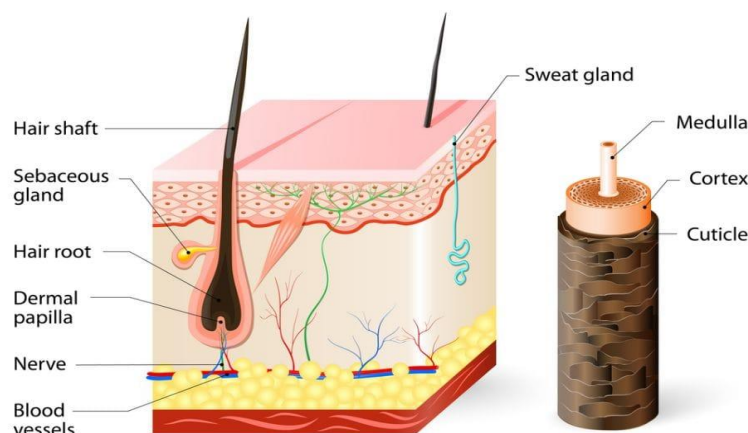
washing your face and then applying a moisturizer.

[1] Custard apple (*Annona squamosa*) leaves are known for their rich phytochemical content, including flavonoids, tannins, alkaloids, phenolic compounds, and saponins. These bioactive constituents contribute to a variety of therapeutic properties such as antioxidant, antimicrobial, anti-inflammatory, and hair growth-promoting effects in the current context, it appears unlikely that herbal hair conditioners, despite their superior performance and safety compared to synthetic alternatives, will gain popularity among consumers. A more progressive strategy for promoting herbal shampoo would involve shifting consumer expectations regarding conditioners, focusing on safety and effectiveness. Manufacturers should take an active part in informing consumers about the possible harmful

impacts of synthetic detergents and other chemical additives found in shampoos. [2]

## Anatomy of hair

The system is integrated, exhibiting distinct chemical and physical characteristics. It comprises a complex structure made up of various morphological elements that function collectively. Hair is primarily composed of keratin, a fibrous protein also present in skin and nails. It develops from the outer layer of the skin (epidermis) during fetal growth, rendering it an epidermal derivative. The process of hair growth initiates in the hair bulb, which is situated at the bottom of the follicle. This region contains actively multiplying cells that generate new hair, which is supplied with nutrients through blood vessels in the dermal papilla. [3]



**Fig 1: Anatomy Of Hair**

**The hair shaft of mammals is divided into three main regions:**

1. Cuticle
2. Cortex
3. Medulla.

**A) Cuticle:** The outermost layer, the cuticle, is made up of flat, overlapping cells resembling scales or shingles on a roof.

**B) Cortex:** Located beneath the cuticle, the cortex forms the thickest part of the hair strand. It is composed of tightly packed keratin proteins and is responsible for the hair's strength, texture, and color.

**C) Medulla:** The medulla is the innermost, often hollow layer of the hair shaft. It is more Prominent in thick or coarse hair and may be absent in fine or light-colored hair.

## Types of hair conditioner

**1. Deep Conditioners/Hair Masks:** These are thick and rich in cationic surfactants that bind to hair structure, helping to restore moisture and reduce breakage. They are typically applied for extended periods (30–45 minutes)

**2. Leave-In Conditioners:** Lightweight and formulated with unsaturated fatty acid chains, these prevent tangling and add smoothness without weighing the hair down. They are especially useful for curly or kinky hair types

**3. Rinse-Out Conditioners:** The most common type, usually applied after shampooing. They are formulated to complement specific shampoo types

**4. Hold Conditioners:** Containing cationic polyelectrolyte polymers, these help style hair by holding it in place, similar to light hair gels

**5. Cleansing Conditioners:** These newer formulations combine amphoteric and cationic surfactants, serving as either a shampoo alternative or a pre-shampoo treatment for damaged or curly hair. [4]

## Plant profile

Table No 1: Plant Profile

| Plant name                                         | Biological source                                                                                             | Chemical constituent                                                 | Benefits for hair                                                                                          |                                                                                                |
|----------------------------------------------------|---------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|
| <b>1.Custard apple leaves</b><br>(Annona squamosa) | It consists of fruit, seeds and leaves of Annona squamosa linn.<br>Family - Annonaceae                        | Rich in phenolic compounds, flavonoids, and annonaceous acetogenins. | Antioxidant properties that can help strengthen hair follicles and promote hair growth <sup>[5]</sup>      | <br>Fig 2. |
| <b>2.Hibiscus flower</b><br>(Rosa- sinensis)       | It consists of the dried flowers or other plant hibiscus rosa-sinensis linn.<br>Family - Malvaceae            | Flavonoids, anthocyanins, and mucilage.                              | Promotes hair growth, prevents hair fall, and conditions the hair, making it soft and shiny <sup>[5]</sup> | <br>Fig 3 |
| <b>3.Neem</b><br>(Azadirachta indica)              | – It consists of the dried leaves, bark, seed, or oil obtain from azadirachta indica A.<br>Family – Maliaceae | azadirachtin, nimbin, and nimbidin                                   | Effective against dandruff, promotes scalp health, and prevents hair thinning <sup>[6]</sup>               | <br>Fig 4 |

|                                                  |                                                                                                                                                            |                                                                                                      |                                                                                                         |                                                                                               |
|--------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|
| <b>4. Curry</b><br>(Murraya<br>koenigii)         | it consists of<br>fresh or dried<br>leaves of the<br>plant murraya<br>koenigii (linn)<br><br>Family –<br>Rutaceae                                          | Carbazole<br>alkaloids,<br>flavonoids, and<br>essential<br>nutrients such<br>as calcium and<br>iron. | Strengthen hair<br>shafts, reduce<br>hair fall, and<br>treat dandruff.<br>[7]                           | <br>Fig 5  |
| <b>5. Amla</b><br>(Embilica<br>officinalis)      | It consist of dried<br>or fresh fruits of<br>Embilica<br>officinalis<br>Gaertn.<br>Family –<br>Phyllanthaceae                                              | Vitamin C,<br>tannins, and<br>flavonoids.                                                            | Strengthens hair<br>follicles,<br>promotes hair<br>growth, and<br>prevents<br>premature<br>graying. [8] | <br>Fig 6  |
| <b>6. Fenugreek seed</b><br>(foenum-<br>graecum) | It consist of the<br>dried seed of<br>Trigonella<br>foenum- graecum<br>Family –<br>Fabaceae                                                                | Rich in<br>proteins,<br>nicotinic acid,<br>and lecithin.                                             | Enhances hair<br>growth, prevents<br>dandruff, and<br>adds shine to the<br>hair. [9]                    | <br>Fig 7  |
| <b>7. Aloe Vera</b><br>(Ghrirkumari)             | – Aloe is dried<br>juice collected by<br>incision, from<br>bases of leaves of<br>various species<br>of aloe, aloe<br>barbadensis.<br>Family -<br>Liliaceae | Vitamins A, C,<br>E, B12, folic<br>acid, and<br>choline.                                             | Soothes the<br>scalp, conditions<br>hair, and<br>reduces<br>dandruff <sup>[10]</sup>                    | <br>Fig 8 |

## MATERIAL AND METHOD

### Extraction process (maceration)

1. All plant material should shade dry (coarse powder)
2. Use ethanol: water or water alone depending on desired extract
3. Place the powdered drug in a clean conical flask or maceration jar. Add solvent and close tightly.
4. Stir thoroughly and allow the mixture to stand for 7 days at room temperature, with occasional shaking (at least once daily).
5. After the 7 days filter the mixture and concentrate it.

**Table no 2: Material for extraction**

| Sr.no | Plant Name           | Quantity |
|-------|----------------------|----------|
| 1.    | Custard apple leaves | 20 g     |
| 2.    | Hibiscus flower      | 5 g      |
| 3.    | Neem leaves          | 5 g      |



|    |                     |       |
|----|---------------------|-------|
| 4. | Curry leaves        | 5 g   |
| 5. | Amla (dried powder) | 7.5 g |
| 6. | Fenugreek seeds     | 7.5 g |



Fig.9 maceration process



Fig.10 Filtrate



Fig. 11 Extract

### Formulation of herbal hair conditioner

**Table 3. Formulation of herbal hair conditioner**

| Sr.no                         | Ingredients    | F1     | F2     | F3     | Role                           |
|-------------------------------|----------------|--------|--------|--------|--------------------------------|
| <b>Part (1) Aqueous phase</b> |                |        |        |        |                                |
| 1                             | Plant extract  | 7 g    | 7 g    | 7 g    | Medicinal agent                |
| 2                             | Aloe Vera gel  | 5 g    | 5 g    | 5 g    | Conditioning agent             |
| 3                             | Glycerin       | 1.5 g  | 1.5 g  | 1.5 g  | Humectant                      |
| 4                             | Citric acid    | 0.15 g | 0.15 g | 0.15 g | PH maintenance                 |
| 5                             | Tragacanth gum | 0.6 g  | 0.35   | 0.4 g  | Stabilizer, viscosity enhancer |
| 6                             | Methyl paraben | Q S    | Q. S   | Q S    | Preservatives                  |
| 7                             | Rose water     | Q. S   | Q. S   | Q. S   | Perfume                        |
| <b>Part (2) oil phase</b>     |                |        |        |        |                                |
| 8                             | Tween 40       | 0.25 g | 0.5 g  | 0.75 g | Emulsifier & surfactant        |
| 9                             | Coconut oil    | 2 g    | 2 g    | 2 g    | Softening agent                |
| 10                            | Almond oil     | 1.5 g  | 1.5 g  | 1.5 g  | Strengthening agent            |

|    |               |        |        |        |                             |
|----|---------------|--------|--------|--------|-----------------------------|
| 11 | Castor oil    | 1.5 g  | 1.5 g  | 1.5 g  | Enrichment of scalp         |
| 12 | Vitamin E oil | 0.15 g | 0.15 g | 0.15 g | Antioxidant and moisturizer |

## Formulation procedure

### Step -1 (preparation of Aqueous phase)

1. Weigh the required quantities of material
2. Dissolve citric acid and Tragacanth gum in rose water.
3. Add glycerin and aloe Vera gel into the above solution and stir until a uniform mixture is obtained.
4. Add the plant extract gradually while stirring.
5. Add methyl paraben as a preservative.

### Step -2 (Preparation of Oil Phase)

1. Weigh and mix the ingredients
2. Heat oil phase gently to about 60–70°C to ensure proper mixing and activation of the emulsifier (Tween 40).

### Step- 3

1. Heat the aqueous phase separately to the same temperature (60–70°C).
2. Slowly add the oil phase into the aqueous phase with continuous stirring using a magnetic stirrer.
3. Continue stirring until the mixture cools down to room temperature. Homogenize the final product for 5–10 minutes for better consistency and smooth texture.
4. Add rose water to adjust fragrance and final volume.



**Fig.5 Hair Conditioner**

## Evaluation of herbal hair conditioner

### 1. Organoleptic evaluation

Visual inspection methods are used to evaluate the organoleptic properties of herbal hair conditioner. The color, Odor, texture, state etc.

### 2. PH Test:

Soak the pH strip in the herbal hair conditioner solution and wait for the color change. Determine the pH by comparing the color of the pH strip to the color of chart. <sup>[11]</sup>

PH of hair strand: 3.6 to 5.5

PH of hair conditioner: 3 to 7

### 3. Dirt dispersion method

Two drops of conditioner were added to a large test tube containing 10 ml of distilled water, one drop of Indian ink was added, and the test tube was capped and shaken 10 times. The amount of ink present in the foam was rated as none, light, medium, or heavy. <sup>[12]</sup>

### 4. Stability testing:

Store the herbal hair conditioner at 37°C for 6 weeks and observe changes in color and viscosity.

## 5. Moisturizing time determination:

Appropriately sized 1 g of hair ball, 20 cm<sup>3</sup> size were placed on the surface of 60 ml of various diluted conditioners and the complete sinking time of ball in the conditioner was measured. [2]

## 6. Irritation test

In this test 1-2 ml of the product was applied to the dorsal side of the left hand and observed for 2 hours any sign of redness, irritation, and inflammation.

## 7. Viscosity

Viscosity is measured by pouring the formulations from one beaker to another and its fluidity and pourability were measured.

# RESULT AND DISCUSSION

## 1. Organoleptic evaluation

Visual inspection methods are used to evaluate the organoleptic properties of herbal gel. The color, odor, texture and state of herbal gel shown in Table

**Table no observation of organoleptic properties**

| Sr.no | Evaluation Test | F1         | F2         | F3         |
|-------|-----------------|------------|------------|------------|
| 1.    | color           | brown      | Brown      | brown      |
| 2.    | odor            | Aromatic   | Aromatic   | Aromatic   |
| 4.    | State           | Semi-solid | Semi-solid | Semi-solid |

## 2. PH determination

The pH of all prepared formulations ranged from. The pH of the prepared herbal hair conditioner formulation was considered to be acceptable to avoid the risk of irritation when Application to the skin. The results were shown in Table No.

**Table no.5 observation of pH**

| Formulation no | pH  |
|----------------|-----|
| F1             | 4-7 |
| F2             | 5-6 |
| F3             | 5-7 |

## 2. Dirt dispersion test

The amount of ink present in the foam was rated as none, light, medium, or heavy.

**Table no .6 observation of Dirt dispersion**

| Formulation no | Observation |
|----------------|-------------|
| F1             | Light       |
| F2             | Light       |

|    |       |
|----|-------|
| F3 | Light |
|----|-------|

## 3. Stability testing

Stability of hair conditioner at 37°C for 6 week was observed. Slightly change in F1, F2 colour, where the F3 are stable and no change in color.

**Table no.7 observation of stability**

| Formulation no | Observation |
|----------------|-------------|
| F1             | No change   |
| F2             | No change   |
| F3             | No change   |

## 4. Moisturizing time determination

Sinking time of the ball hair in the conditioner was measured. 6 to 15 minutes are required to sink for silky, smooth hairs.

**Table no.8 moisturizing time determination**

| Formulation no | Observation |
|----------------|-------------|
| F1             | 7 to 15 min |



|    |             |
|----|-------------|
| F2 | 6 to 13 min |
| F3 | 6 to 15 min |

## 5. Irritation test

Product was applied to the dorsal side of the left hand and observed. There was no irritation observed.

**Table no.9 observation of irritation**

| Formulation no | Observation   |
|----------------|---------------|
| F1             | No irritation |
| F2             | No irritation |
| F3             | No irritation |

## 6. Viscosity testing

The viscosity of sample was determined by pouring from one beaker to another.

**Table no. 10 observation of viscosity**

| Formulation no. | Observation    |
|-----------------|----------------|
| F1              | Viscous        |
| F2              | Highly viscous |
| F3              | Viscous        |

The herbal hair conditioners created in this research exhibited encouraging traits regarding safety, effectiveness, and ease of use. The integration of various plant extracts enhanced the versatility of the formulations, delivering moisturizing, strengthening, and anti-dandruff properties. All samples maintained a pH level within the suggested limits for hair care products, indicating a minimal risk of irritation. The moisturizing duration and viscosity of F2 suggest a more effective emollient and conditioning impact. The absence of irritation further confirms the formulations' compatibility with dermatological use. The mild dirt removal demonstrates the gentle cleansing ability, making these products suitable for everyday application. In summary, F2 displayed slightly better results in viscosity and moisturizing effectiveness, although all three formulations were found to be acceptable.

## Conclusion

The current research effectively created and assessed herbal hair conditioners utilizing natural extracts recognized for their beneficial effects on hair. All three formulations demonstrated stability, safety, and efficacy, with formulation F2 displaying the most favorable results regarding viscosity and hydration capability. These results indicate that herbal conditioners can be practical substitutes for chemical-based products, in accordance with the increasing consumer preference for natural and environmentally friendly personal care options.

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