FORMULATION AND EVALUATION OF ANTIMICROBIAL HAIR GEL AND NEBULIZER SOLUTION FROM ABRUS PRECATORIUS

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Abstract: Herbal cosmetics are the preparations used to enhance the human appearance. The aim of the present research was to prepare safe medicinal formulations from herb Abrus precatorius for the purpose of treatment of alopecia and antimicrobial activity. Abrus precatorius Linn. Popularly known as Crab’s eye is a slender, woody perennial climber reported to have antioxidant, antibacterial, cytotoxic, anti-diabetic, anti-tubercular and anti-plasmodic activities. The present investigation was carried out to evaluate the hair growth promoting potentiality of aqueous extract of Abrus precatorius leaf. It is potent hair growth promoter and can be suggested to be an effective to synthesis hair growth promotor.

Keywords: Abrus precatorius Linn, Antimicrobial, Hair gel, Alopecia, Nebulizer Solution.

1. Introduction
Recently, the number of men and women who suffered from hair loss and/ or hair thinning is increasing in worldwide. Hair loss is a dermatological disorder, and the surge for discovering natural products with hair growth promoting potential is continuous [1, 2]. Hair loss or alopecia is a common patient complaint and a source of significant psychological and physical distress [3]. Many factors such as metabolism, hormones, heredity and side effects of antineoplastic and immunosuppressant drugs, have been negatively affecting the healthy growth of hair. According to one survey, androgenic alopecia on its own eventually affects approximately 50% of the world’s adult population [4, 5]. Androgens are considered to be one of the most important causes for alopecia apart from a variety of other factors [6]. Thus it is very important to develop new therapeutic materials to stop hair loss and to enhance hair growth [7]. Natural products in the form of herbal formulations are available on the market and are used as hair tonic, hair growth promoter, hair conditioner, hair- cleansing agent, antidandruff agents, as well as for the treatment of alopecia and lice infection [8].

Exercise-induced bronchoconstriction is acute airway narrowing that occurs as a result of exercise. It typically follows a modest period of high-intensity exercise, with episodes generally lasting between 30 to 90 minutes in the absence of treatment. Typical symptoms of EIB include dyspnea, chest tightness, cough, wheeze, and increased mucous production. However, symptoms alone are insufficient to identify patients with EIB [9].
A number of herbal products have been acclaimed with hair growth promoting activity [10]. The traditional system of medicine in India acclaims a number of herbal drugs for hair growth promotion [11]. *Abrus precatorius* Linn. commonly called as Rosary pea belongs to family Fabaceae. Seeds are bright scarlet-red in color with a black spot [12]. The leaves are sweet in taste contain up to 10% Glycyrrhizin, triterpene glycosides, pinitol and alkaloids such as abrine, hyphaphorine, choline and precatorine. The triterpene glycosides are abusosides A, B and C (which are highly sweet) and three glycosides based on cycloartane – type aglycone, abrutogenin. Other compounds of the leaves are triterpenes abrusgenic acid, abruslactone A and methyl abrusgenate and flavonoids vitexin, liquiritiginin-7- mono, and diglycosides and toxifolin-3- glucoside [13].

Antibiotics provide the main basis for the therapy of bacterial infections. Since the discovery of these antibiotics and their uses as chemotherapeutic agents there was a belief in the medical fraternity that this would lead to the eventual eradication of infectious diseases. However, over use of antibiotics has become the major factor for the emergence and dissemination of multi-drug resistant strains of several groups of microorganisms [14]. Plants are rich in a wide variety of secondary metabolites such as tannins, alkaloids and flavonoids, which have been found in vitro to have antimicrobial properties [15]. The antimicrobial efficacy tribute to some plants in treating diseases has been beyond belief. It is estimated that local communities have used about 10% of all flowering plants on Earth to treat various infections, although only 1% have gained recognition by modern scientists [16]. Medicinal plants were used as excellent antimicrobial agents because it poses a variety of chemical constituent is nature recently much attention has directed towards extracts and biologically active compounds isolated from popular plant species [17].

The present study is an effort to formulate and evaluate hair growth promotion and antimicrobial activity of herbal hair gel and Nebulizer Solution formulation, which include extract of *Abrus precatorius* Linn.

2. **OBJECTIVES**

- To formulate antimicrobial gel of *Abrus precatorius* (using extract) so as to deliver herbal drug locally for the treatment of alopecia and Nebulizer Solution for the treatment of bronchoconstriction.
- To study the evaluation test of hair gel and Nebulizer Solution for stability study.
- To standardize the both formulation.
• As it is Herbal preparation it has no or less side effects as compared to Allopathic treatment for alopecia and bronchoconstriction.

3. PLAN OF WORK

1. Literature Review.
2. Selection of Drug and Excipients.
3. Drug and Excipients Profile.
4. Formulation of Experimental Work.
   - Formulation 1 (F1) [Gel]
     a. Physical appearance
     b. Washability
     c. pH
     d. Spreadability
     e. Homogenisity
     f. Viscosity
     g. Skin irritation test
     h. Microbial assay
   - Formulation 2 (F2) [Nebulizer Solution]
     a. Clarity test
     b. Colour
     c. Odour

4. REVIEW OF LITERATURE

Anand R. Attal et al\(^{18}\), has described the traditional and medicinal uses of Abrus precatorius. He describes the general morphology, description, biochemical properties, cultivation and collection, medicinal values of Gunja. He given detail information mainly on the pharmacognostic characteristics, traditional uses, phytochemistry and pharmacological actions of the plant (2010)

Meena Prabha. P et al\(^{19}\), focused on different pharmacological uses of different organic solvent extract of dried seeds of A. precatorius. He focused on the pharmacogostic characteristics and pharmacological actions of the plant like Antimalarial, Anidiabetic, Anti-inflammatory, Immunomodulator, Nephroprotective etc. the plant also have traditional value such as aphrodisiac, remove biliousness, useful in eye diseases, cures leucoderma, itching, skin diseases and wounds (2015)

Narender Boggula et al\(^{20}\), focused on the antibacterial properties present in different extracts of dried scale seeds of Abrus precatorius. He also described about classification of Gunja in order to kingdom to species. He also mentioned the active constituents present in Gunja. He concluded that the seeds of Abrus precatorius may represent a new source of antibacterial with stable, biologically active components that can establish a scientific base for the use of this in modern medicine (2017)

Abhilasha Shourie and Kuntal Kalra et al\(^{21}\), has worked on topic Analysis of phytochemical constituents and pharmacological properties of Abrus precatorius L. They described about the antimicrobial activity wound healing properties and is a promising candidate to be used for preparation of a herbal formulation for treatment of wounds, sores and boils as claimed in folklores and traditional information. Phytochemical tests showed the presence of tannins, triterpenes, glycosides, alkaloids, antraquinones and carbohydrates in crude extracts of A.precatorius (2013)

Sandhya S. et al\(^{22}\), had studied on Potentiality of hair growth promoting activity of aqueous extract of Abrus precatorius Linn. on Wistar albino rats. She described in detail about hair growth activity of aq. extract of leaves of Abrus precatorius L. Hair growth promoting activity of aq extract Abrus precatorius was screened by considering different parameters which included time taken for covering bald patch, length of hair produced, and percentage of hair follicles (2012)

T Regupathi et al\(^{23}\), has worked on Formulation and evaluation of herbal hair gel for hair growth potential. He described in detail about methods for evaluation of hair gel including physical parameters like washability, spreadability and homogeneity. He also mentioned about stability of hair gel at varied temperature. He described how much concentration would be safe to use in formulation and later on result of physical parameters (2017)

DJ Taur and RY Patil et al\(^{24}\), described on Mast cell stabilizing and antiallergic activity of Abrus precatorius in the management of asthma. They gives information about presence of saponin, flavonoids, alkaloids and glycosides; Saponin are reported to possesses mast cell stabilizing, antiallergic and antihistaminic activities, Glycosides isolated from various plants reported to have antiasthmatic activity through several mechanisms i.e spasmylocytic activity by relaxation of tracheal smooth muscle , and antiallergic activity (2011)
5. MATERIALS AND EQUIPMENTS

<table>
<thead>
<tr>
<th>Serial Number</th>
<th>Materials</th>
<th>Functions</th>
<th>Manufacturer/ Supplier</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Herbal Extract</td>
<td>API</td>
<td>Medicinal Garden of KTPCOP, Osmanabad</td>
</tr>
<tr>
<td>2</td>
<td>Carbopol 940</td>
<td>Gelling Agent</td>
<td>Ozone International, Mumbai</td>
</tr>
<tr>
<td>3</td>
<td>Polyethylene Glycol</td>
<td>Solvent</td>
<td>Ozone International, Mumbai</td>
</tr>
<tr>
<td>4</td>
<td>Methyl Paraben</td>
<td>Preservative</td>
<td>Ozone International, Mumbai</td>
</tr>
<tr>
<td>5</td>
<td>Triethanolamine</td>
<td>pH Modifier</td>
<td>Ozone International, Mumbai</td>
</tr>
<tr>
<td>6</td>
<td>Glycerine</td>
<td>Solvent, Humectant</td>
<td>KTPCOP, Osmanabad</td>
</tr>
<tr>
<td>7</td>
<td>Distilled Water</td>
<td>Vehicle</td>
<td>KTPCOP, Osmanabad</td>
</tr>
</tbody>
</table>

List of Ingredients for Formulation 2 (F2)

<table>
<thead>
<tr>
<th>Serial Number</th>
<th>Materials</th>
<th>Manufacturer/ Supplier</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Herbal Extract</td>
<td>Medicinal Garden of KTPCOP, Osmanabad</td>
</tr>
<tr>
<td>2</td>
<td>Sodium Chloride</td>
<td>Ozone International, Mumbai</td>
</tr>
<tr>
<td>3</td>
<td>Sulphuric Acid</td>
<td>KTPCOP, Osmanabad</td>
</tr>
<tr>
<td>4</td>
<td>Fragrance</td>
<td>KTPCOP, Osmanabad</td>
</tr>
</tbody>
</table>

List of Equipments

<table>
<thead>
<tr>
<th>Serial Number</th>
<th>Equipments/ Instruments</th>
<th>Model Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Soxhlet Apparatus</td>
<td>J S/L, 40/38; Dolphin Labs, Pune</td>
</tr>
<tr>
<td>2</td>
<td>Electronic Balance</td>
<td>Model BX 6205 Shimadzu Asia Pacific Pvt. Ltd., Singapore</td>
</tr>
<tr>
<td>3</td>
<td>Morter- pestle</td>
<td>Rajesh Chemicals, Mumbai</td>
</tr>
<tr>
<td>4</td>
<td>Measuring Cylinder</td>
<td>Dolphin Labs, Pune</td>
</tr>
<tr>
<td>5</td>
<td>Glass Rod</td>
<td>Dolphin Labs, Pune</td>
</tr>
<tr>
<td>6</td>
<td>Tripod Stand</td>
<td>Dolphin Labs, Pune</td>
</tr>
<tr>
<td>7</td>
<td>China Dish</td>
<td>Dolphin Labs, Pune</td>
</tr>
<tr>
<td>8</td>
<td>Spatula</td>
<td>Dolphin Labs, Pune</td>
</tr>
<tr>
<td>9</td>
<td>Pair of Tongue</td>
<td>Dolphin Labs, Pune</td>
</tr>
<tr>
<td>10</td>
<td>Beaker</td>
<td>Dolphin Labs, Pune</td>
</tr>
<tr>
<td>11</td>
<td>Magnetic Stirrer</td>
<td>Dolphin Labs, Pune</td>
</tr>
<tr>
<td>12</td>
<td>Heating Mantle</td>
<td>Dolphin Labs, Pune</td>
</tr>
</tbody>
</table>

6. DRUG AND EXCIPIENT PROFILE

6.1 Drug Profile-
- a. Name:- Abrus precatorius extract
- b. Synonym:- Gunja, Jequirity, Gunchi, rosary pea, Crab's eye, etc
- c. Biological Source: - Abrus precatorius L.
- d. Family:- Fabaceae
- e. Part used:- Seed and Leaves

6.2 Macroscopical Characteristics:
LEAVES
Leaves resemble tamarind leaves having 20-40 leaflets. The leaves which are sweet in taste contain up to 10% Glycyrrhizin, triterpene glycosides, pinitol and alkaloids such as abrine, hypaphorine, choline and precatorine. The triterpene glycosides are abusosides A, B, and C, (which are highly sweet) and three glycosides based on cycoiocone-type aglycone, abrutogenin. Other compounds of the leaves are triterpenes abruginic acid, abrulsactone A and methyl abrusgenate and flavonoids vitexin, liquiritginin-7-mono- and diglycosides and toxifolin-3-glucosides.
Colour: Dark Green
Odour: Typical
Taste: Sweet
SEEDS
The seeds yield alkaloids, a fixed oil, steroids, lectine, flavonoids, and anthocyanins. The alkaloids of the seeds are abrine, hypaphorine, choline and precatorine. The oil content of seed is only 2.5%, which is rich in oleic acid and linoleic acids. β-sitosterol, stigmasterol, 5α-cholanic acid, abricin, and cholesterol are the steroids present. The colour of the seed is due to glycosides of abranin, pelargonidin, cyaniding, and delphinidin. A sapogenin, abrisapogenol J, sophoradiol, its 22-O-acetate, hederagenin methyl ether, kaikasaponin III methyl ester, flavones such as abrectorin and aknone are the other constituents of the seeds. Lectines are the chief constituents of the seeds, the principal ones being abrin. Lectins are both toxic (abrin) and non toxic (abrus agglutinin). Abrins are denoted by abrin a, b, c and d and consist of one large β-polypeptide chain (MW. 35,000) and short α-polypeptide chain joined by disulphide bond.

Colour: Red colored seeds have black spot on their tips.
Odour: Characteristics
Taste: Bitter

6.3 Uses:

a. **Leaves**: Leaves are used as aphrodisiac, tonic, removes biliousness, useful in eye diseases, cures leucoderma, itching, skin diseases and wounds. In addition they also cure fevers, stomatitis, head complaints, asthma, thirst, tuberculous glands and caries of teeth. When leaves are steeped in warm mustered oil and applied over the seat of pain in rheumatism much benefit will be derived. The juice of the fresh leaves, mixed with some blend oil, applied externally, seems to relieve local pain. Powdered leaves mix with sugar given in case of leucoderma and menorrhagia. The leaves also used as diuretic, diarrhoea, gastritis, heart diseases, kidney diseases, insomnia, Cancer and CNS sedative.

b. **Seeds**: Internally, the seeds are described as poisonous and useful in affections of the nervous system, and externally, in skin diseases, ulcers, affections of the hair. The seeds reduced to a paste are recommended to be applied locally in sciatica, stiffness of the shoulder joint, paralysis, and other nervous diseases. In white leprosy, a paste composed of the seed and plumbago root is applied as stimulant dressing. In alopecia a paste of the seed is recommended to be rubbed on the bare scale. The seeds are used as purgative, but in large doses are acrid poison, given rise to symptoms resembling those of
cholera. Taken internally by women, the seed disturbs the uterine functions and prevents conception. Reduced to a paste they are used for contusion and inflammation [5]. The root also used as diuretic, diarrhoea, gastritis, heart diseases, kidney diseases, insomnia, Cancer and CNS sedative.[18]

7. Excipient for Herbal Hair Gel (F1)

7.1 Carbopol – 940:-
a. Synonym:- Carbomer, Polyacrylic acid (PAA).
b. Chemical name/ IUPAC name: - Poly (acrylic acid).
c. Emperical formula: - (C_{2}H_{4}O_{2})n.
d. CAS No. : - 57916-92-4.
e. Chemical structure :

f. Functional category :- As a polymer, coating agent.
g. Description:-
i. Colour:- White (solid) or colourless (liquid).
ii. Odour:- Odourless or mild acidic.
iii. Melting point : - 12.5 ºC.
iv. Solubility:- Soluble in ether, chloroform, acetone, ethanol.
v. Appearance:- White fluffy powder.
vi. pH:- 5.5 – 8.0 for a 1 % w/w aqueous solution.

h. Application in pharmaceutical formulation: - As an opacifier.

7.2 Polyethylene Glycol:-
b. Chemical name/ IUPAC name:- poly(oxyethylene).
c. Chemical formula: - C_{2n}H_{4n+2}O_{n+1}.
d. CAS Number:- 25322-68-3

e. Chemical Structure:

g. Description:-
i. Colour:- Colourless
ii. Odour:- Odorless
iii. Melting Point: -59 ºC
iv. Appearance:- Colourless liquid
v. pH: - 3.6–10.0

h. Application in pharmaceutical formulation: - As a solvent, plasticizer, surfactant, ointments, and suppository base, and tablet and capsule lubricant.
7.3 Methyl Paraben:-

b. Chemical name/ IUPAC Name: Methyl 4-hydroxybenzoate
c. Chemical formula: C₈H₈O₃
d. CAS Number: 99-76-3
e. Chemical Structure:

![Chemical structure of Methyl Paraben]

f. Functional category: Anti-fungal agent
g. Description:
   i. Colour: White
   ii. Odour: Odourless
   iii. Taste: Tasteless
   iv. Melting point: 125 to 128 °C.
   v. Solubility: Soluble in water, benzene (slightly soluble), carbon tetrachloride (slightly soluble), ethanol, ether, acetone, DMSO, methanol, warm oil, and warm glycerol
   vi. Appearance: Colorless crystals or white crystalline powder
   vii. pH: 3 to 8.
h. Application in pharmaceutical formulation: As a preservative.

7.4 Triethanolamine:

a. Synonym: Trolamine
b. Chemical name/ IUPAC name: 2,2',2''-Nitrilotri(ethan-1-ol)
c. Chemical formula: C₆H₁₅NO₃
d. CAS No.: 102-71-6

e. Chemical structure:

![Chemical structure of Triethanolamine]

f. Functional category: As a pH adjuster
g. Description:
   i. Colour: Colourless
   ii. Odour: Ammoniacal
   iii. Melting Point: 21.60 °C
   iv. Solubility: Soluble in water
   v. Appearance: Colourless liquid
   vi. pH: 5 to 9
h. Application in pharmaceutical formulation: As a buffer and a surfactant.
7.5 Glycerine: -
   a. Synonym: Glycerin, glycerol.
   b. Chemical name/ IUPAC name: Propane-1,2,3-triol.
   c. Chemical Formula: C₃H₈O₃.
   d. CAS No.: 56-81-5.
   e. Chemical structure:

   ![Chemical structure of Glycerine]

   f. Functional Category: As a moisturizer, Osmotic laxative.
   g. Description:
      i. Colour: Colourless
      ii. Odour: Odourless
      iii. Taste: Sweet
      iv. Melting point: 17.8°C
      v. Solubility: Water-soluble
      vi. Appearance: Colorless hygroscopic liquid
      vii. pH: 7-7.5
   h. Application in pharmaceutical formulation: As a humectant, moisturizer, etc.

8. Excipients for Nebulizer Solution (F2)
8.1 Sodium Chloride: -
   a. Synonym: Salt, Halite, Table salt.
   b. Chemical name/ IUPAC name: Sodium chloride.
   c. Chemical formula: NaCl.
   d. CAS No.: 7647-14-5.
   e. Chemical structure:

   ![Chemical structure of Sodium Chloride]

   f. Functional category: As an emetic, preservative and a flame retardant.
   g. Description:
      i. Colour: Colourless
      ii. Odour: Odourless
      iii. Taste: Salty
      iv. Melting point: 800.7°C
      v. Solubility: Soluble in water, methanol, ethanol, ammonia, formic acid, etc
      vi. Appearance: Colorless cubic crystals.
      vii. pH: ≈7
   h. Application in pharmaceutical formulation: Osmotic agent, preservative, etc.
8.2 Sulphuric Acid:-

b. Chemical name/ IUPAC name: - Sulfuric acid
c. Chemical Formula: - \(\text{H}_2\text{SO}_4\)
d. CAS No.: - 7664-93-9
e. Chemical Structure:

f. Functional category: - Cleaning of metals, removal of impurities from oil, manufacturing of chemicals – nitric acid, hydrochloric acid, synthesis of dye, drugs, detergents, explosives, etc.
g. Description: -
   i. Colour: - Colourless
   ii. Odour: - Odourless
   iii. Melting Point: - 10.31°C
   iv. Solubility: - Soluble in water.
v. Appearance: - Clear, colorless liquid
vi. pH: - 2.75
vii. Application in pharmaceutical formulation: - used as a solvent, as an acidifying agent.

9. EXPERIMENTAL WORK

Preparation of Herbal Hair Gel (F1)
Table No. 04: Formula for Hair Gel (F1)

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Name of contents</th>
<th>Quantity of content (100ml)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Abrus precatorius Leaf Extract (Aqueous)</td>
<td>1 ml</td>
</tr>
<tr>
<td>2</td>
<td>Carbopol 940</td>
<td>0.25 gm</td>
</tr>
<tr>
<td>3</td>
<td>Polyethylene Glycol</td>
<td>2 ml</td>
</tr>
<tr>
<td>4</td>
<td>Methyl Paraben</td>
<td>0.08 gm</td>
</tr>
<tr>
<td>5</td>
<td>Triethanolamine</td>
<td>1.2 ml</td>
</tr>
<tr>
<td>6</td>
<td>Glycerin</td>
<td>2 ml</td>
</tr>
<tr>
<td>7</td>
<td>Distilled water</td>
<td>q.s.</td>
</tr>
</tbody>
</table>

9.1 Method of Extraction: -
1. The plant material collected was cleaned, shade dried and powdered.
2. Leaf powder weighing 250gm was defatted with petroleum ether and then exhaustively extracted with water at 60°C to obtain the crude aqueous extract by using Soxhlet apparatus.
3. It was then concentrated at 40°C on heating mantle to obtain a concentrated mass.

9.2 Method of Preparation
1. Measured quantity of Methyl paraben, Glycerin and weighed quantity of Polyethylene glycol were dissolved in 35 ml of water in beaker and were stirred at high speed using mechanical stirrer.
2. Then Carbopol 940 was added slowly to the beaker containing above liquid while stirring.
3. Add the concentrated extract slowly with continuous stirring.
4. Neutralized the solution by slowly adding triethanolamine solution with constant stirring until gel is formed.
5. Transferred to a suitable container and stored it.
10. Evaluation of Herbal Hair Gel (F1)
a. Physical evaluation:
Physical parameters such as colour, appearance, and consistency were checked
b. Washability:
   Formulation was applied on the skin and then ease and extent of washing with water were checked manually.
c. pH:
The pH of the prepared polyherbal hair gel in distilled water (10% v/v) was evaluated by placing drop of solution on a piece of pH paper and compare the paper with the pH scale.
d. Spreadability:
   Spreadability of gel was measured with glass slide apparatus, excess of gel was placed between two slides and 1kg weight was placed on slide for 5 min to compress the sample to uniform thickness, time in seconds to separate two slides was taken as measure of spreadability
   \[ S = \frac{W \times l}{t} \]
   Where,
   \( S \) = spreadability (g cm/ sec)
   \( W \) = weight on upper slide (g)
   \( l \) = length of slide (cm)
   \( t \) = time taken in sec
e. Homogeneity:
The developed gels was tested for homogeneity by visual inspection after the gel have been set in the container spread on glass slide, for the appearance, tested for the presence of any lumps, flocculates or aggregates.
f. Skin Irritation:
The skin irritation was carried out on human volunteers. For formulated gel, five volunteers were selected and 1.0g of formulated gel was applied on an area of two square inch to the back of the hand the volunteers were observed for lesions or irritation.
g. Microbial Assay:
The antimicrobial activity of gel formulations was determined by modified agar well diffusion.

**Method:**
Keep open petri plates with exposure to air of previously molten agar media, shake well to disperse equally and immediately pour in a sterile plates allow to solidify taking care that the thickness of layer is uniform and incubated for 24 hours at 22-27°C n method.

**Procedure for activity:**
Keep open petri plates with exposure to air of previously molten agar media, shake well to disperse equally and immediately pour in a sterile plates allow to solidify taking care that the thickness of layer is uniform. Two wells were prepared in each agar plate. Pour the standard solution in one plate with 50ug/ml concentration. In another plate prepared formulation is transferred into the well with 50 ug/ml concentration. Plates are kept for incubation for 24 hrs at 22- 27°C.

11. **Preparation of Nebulizer Solution (F2)**

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Name of Content</th>
<th>Quantity of Content (5ml)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Herbal Extract (Ethanolic)</td>
<td>4 ml</td>
</tr>
<tr>
<td>2</td>
<td>Sodium Chloride</td>
<td>0.9 gm</td>
</tr>
<tr>
<td>3</td>
<td>Dil. Sulfuric Acid</td>
<td>q.s. for pH adjustment</td>
</tr>
<tr>
<td>4</td>
<td>Fragrance</td>
<td>q. s.</td>
</tr>
</tbody>
</table>

11.1 Method of extraction:-
1. Dried *Abrus precatoris* were ground to coarse powder.
2. The powder was extracted with ethanol as a solvent.
3. By the process of soxhlation for 6 hours for the preparation of extract.

11.2 Procedure:
1. Weighed Sodium chloride accurately on electronic balance.
2. Taken 4 ml of ethanolic herbal extract.
3. Dissolved sodium chloride by using stirrer within herbal extract.
4. Checked the pH of the solution by using pH paper.
5. Adjusted the pH above 5 using sulfuric acid.
6. Added the fragrance for masking the odour.
7. Transferred to a suitable container and stored it.

![Fig. No. 08: Nebulizer Solution](image)

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*Fig. No. 08: Nebulizer Solution*
12. Evaluation of Nebulizer Solution
   a. Clarity Test:
      Clarity testing is carried out to check the particulate matter in the sample. In this test transparent particles or white particles observed against the black background and the black or dark particles observed against the white background.
   b. Physical evaluation:
      Physical parameters such as colour, appearance, and consistancy were checked.
   c. pH:
      The pH of the prepared polyherbal hair gel in distilled water (10%v/v) was evaluated by placing drop of solution on a piece of pH paper and compare the paper with the pH scale.

13. RESULT AND DISCUSSION

For Formulation Herbal Hair Gel (F1)

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Evaluation Tests</th>
<th>Result Obtained</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Physical evaluation</td>
<td>Pale yellow in colour</td>
</tr>
<tr>
<td>2</td>
<td>Colour</td>
<td>Pale yellow in colour</td>
</tr>
<tr>
<td>3</td>
<td>Appearance</td>
<td>Smooth</td>
</tr>
<tr>
<td>4</td>
<td>Consistency</td>
<td>Good</td>
</tr>
<tr>
<td>5</td>
<td>Washability</td>
<td>Good</td>
</tr>
<tr>
<td>6</td>
<td>pH</td>
<td>7</td>
</tr>
<tr>
<td>7</td>
<td>Homogeneity</td>
<td>No lump</td>
</tr>
<tr>
<td>8</td>
<td>Skin irritation</td>
<td>No irritation</td>
</tr>
<tr>
<td>8.1</td>
<td>Antimicrobial activity for Aerobic bacteria</td>
<td>8.1</td>
</tr>
</tbody>
</table>

Fig. No. 09: Zone of Inhibition of Standard Sample

Fig. No. 10: Zone of Inhibition of Test Sample
Herbal hair gel is used to treat alopecia and stimulate the hair growth. The advantages of herbal cosmetic are there non-toxic nature, reduce allergic reactions and time tested usefulness of many ingredients.

The prepared herbal anti-microbial hair gel was evaluated for different parameters. It showed pale yellow in colour and smooth in appearance and having good washability and homogeneity, pH7, and also it enhances the natural health of hairs and make them shiny. It also shows the antimicrobial activity.

The Nebulizer Solution used to treat bronchoconstriction. The advantage of Nebulizer Solution is lesser side-effects, local activity and avoid first pass metabolism. The formulation was found safe and have slight yellowish with characteristic odour. The pH was suitable for inhalation. The results obtained are good and further optimization study is required for finding its effectiveness.

14. CONCLUSION

A herbal hair gel (formulation F1) was prepared by using aqueous extract of Abrus precatorius leaves. It shows good properties like appearance, neutral pH and good spreadability. The preliminary evaluation tests are carried out which are possible in our lab notes in result. The formulation found satisfactory results. This formulation has antimicrobial and hair growth promoting property.

The nebulizer solution (formulation F2) was prepared by using ethanolic extract of Abrus precatorius seeds and evaluated for the organoleptic properties. The formulation F2 shows good stability and is useful for its bronchodilation effect. The overall conclusion is that both the formulations F1 and F2 showed better results.

15. SUMMARY

Gunja is an evergreen shrub having many biological activities. The active components responsible for hair growth promotion, antimicrobial, anti-inflammatory, bronchodilator activity, etc. It is used for a variety of medical procedure like treatment of topical infection, inflammation, bronchoconstriction due asthma and COPD.

Thus, topical delivery can be suitable to produce hair growth promotion activity. Gunja hair gel formulated using carbopol 940, Polyethylene Glycol, Methyl Paraben, Triethanolamine and glycerin. These are selected due to their activities on skin function. Tokushima J Exp Med 9: 37-59.

The gel was evaluated for its colour, feel, appearance, pH and spreadability and Nebulizer Solution was evaluated for pH, colour, odour and clarity test. The tests were performed manually. The pH was determined by the pH paper. Further optimization studies are required for finding its benefits on humans as cosmetic product and Neuliber Solution.

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