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FORMULATION OF HERBAL HAIR CONDITIONER AND EVALUATION OF ITS PHYSICOCHEMICAL PARAMETERS

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1. ABSTRACT

In an era where consumers increasingly seek natural alternatives for personal care, this study introduces an innovative herbal hair conditioner meticulously crafted from a diverse array of botanical extracts and herbal infusions. Our research delves into the formulation's multifaceted approach to hair care, emphasizing its potential to not only condition but also revitalize and nourish hair from root to tip. The herbal blend encompasses a thoughtfully curated selection of plant-based ingredients renowned for their historical efficacy in promoting hair health. From the calming properties of hibiscus and the moisturizing effects of aloe vera to the fortifying elements of beetroot and almond oil, this herbal hair conditioner aims to create a harmonious synergy that addresses a spectrum of common hair concerns. Our investigation encompasses rigorous testing procedures, evaluating the conditioner's impact on hydration, manageability, and overall hair vitality. Preliminary findings suggest that the herbal formulation exhibit promising results in mitigating issues such as dryness, frizz, and damage, presenting a compelling case for its inclusion in natural hair care routines.

2. KEYWORDS: Folliculitis decalvans, Frizzy Hair, Anti oxidative, Luster, Grey Hair, Accelerated stability test.

3. INTRODUCTION

Herbal products have gained popularity in recent years, with 20-30% of the population using them. These products are complex mixtures of organic chemicals derived from various parts of plants, including leaves, flowers, stems, bark, and seeds. India, rich in medicinal plants, is

encouraged by the World Health Organization (WHO) for its low cost and safety. Herbal hair conditioners, while better in performance and safer than synthetic ones, may not be popular with consumers. A more radical approach to popularizing herbal shampoos would be to change consumer expectations from conditioners, emphasizing safety and efficacy. Formulators should educate consumers about the harmful effects of synthetic detergents and chemical additives in shampoos. ***(Sonawane et al, 2023)*** Dandruff, a common scalp disorder, affects almost half of the pubertal population, particularly males aged 20-60. It is caused by the excessive shedding of dead skin cells from the scalp, which can be a symptom of seborrhoreic dermatitis, psoriasis, fungal infection, or excoriation associated with head lice infestation. There are two types of dandruff: dry and flake (pityriasis scale) and oily (seborrhoeic scale). Dandruff sticks to the nails when the scalp is scratched. Dandruff can be caused by various factors, including excess androgenic hormone, excessive sebaceous secretion, physical irritation, chemical irritation, photosensitivity, tineacapitis, xerotic eczema, vitamin B or zinc deficiency, poor personal hygiene, or using a dirty comb. Folliculitis decalvans is a recurrent, patchy, painful scalp folliculitis that causes scarring and hair loss, similar to deforestation. It has been well-defined since the end of the nineteenth century and has been categorized into different types. (***Gautam et al, 2022).***

Recently, Smith and Sanderson named 'tufted folliculitis', where hairs emerge from an inflamed scalp in groups or tufts. This suggests that if the inflammation is superficial, the roots of hair follicles might escape the scarring and re-grow established Folliculitis decalvans, through common outlets. Tufting of hairs was described as occurring in patients with dissecting folliculitis of the scalp, and Folliculitis keloidalis. The aetiology of these conditions is still unclear, but *Staphylococcus aureus* can almost always be grown from the pustules. The persistence of *S. aureus* and the damage it causes may be due to the production of cytotoxic substances, which are referred to as 'superantigens'. These toxins bind to major histocompatibility locus proteins to form a complex that can stimulate multiple T cells but 'escape' detection by the host immune syste*m.****(Isomura et al, 2002).***

It seems possible that Folliculitis decalvans may be the result of an abnormal host response to toxins released from a straightforward infection with ***S. aureus***. Therefore, a herbal hair conditioner has been developed to resolve dandruff and inflammation in the scalp. ***(Isomura et al, 2002).***

COMPONENTS IN HAIR CONDITIONER

ALOE VERA: Aloe vera is a popular product that people use on their skin after sun exposure. This is because of its high collagen content and cooling properties. The vitamin content in aloe vera suggests that it might work to repair sun damage to your hair, too.

FLAX SEED: It has an anti-oxidant property and promotes hair growth. It prevents split ends, premature greying, reduces dandruff and hair thinning by strengthening hair from roots

BEETROOT: It prevents premature balding and hair loss, smoothening effect by relieving itchy scalp, prevents dandruff and used as natural hair colour.

HIBISCUS: It is excellent for increase in hair growth activity. This flower is used for controlling dandruff. It can be used to rejuvenate the hair by conditioning.

AMLA: It enhances the absorption of calcium, helping to make healthier bones, teeth, nails, and hair. It maintains the hair colour and prevents premature greying, strengthens the hair follicles. Amla is the rich and concentrated form of Vitamin C along with tannins found among the plants... The fruit extract is useful for hair growth and reduce hair loss. Amla has antibacterial and antioxidant properties that can help promote the growth of healthy and lustrous hair.

ALMOND OIL: It is a nourishing oil which can soften and strengthen hair. It can protect hair from sun damage. The lubricating effect controls frizzy hair and heal damaged hair by hydrating it.

GLYCERINE: Glycerine is a humectant which can actually pull in moisture from the air, keeping hair hydrated and healthy. It deeply moisturises hair and removes split ends. It promotes hair growth, reduces scalp itching and repairs hair damage.

4. MATERIALS AND METHODS

4.1. COLLECTION OF MATERIALS

The sample for herbal hair conditioner like aloevera gel(26%) flax seed gel(16%), Beetroot juice(14%), Almond oil((4%), Glycerine(4%), Amla(12%), Hibiscus(12%), Carbapol and Sodium methyl paraben (12%) was collected from local market of Tiruppur.

4.2. DESCRIPTION OF HERBAL HAIR CONDITIONER

Hair conditioners are designed to improve hair manageability, decrease hair static electricity and add luster. They are used in several ways depending upon the state of hair and requirement of the individual. Herbal hair conditioner contains all the goodness of natural ingredients. Then, based on different organoleptic characteristics and physicochemical criteria like pH, the Dirt Dispersion Test, moisturising time, cleaning action, and stability testing, all of the hair conditioner formulations were assessed and analysed. Nowadays, shampoos and other conditioner products are popular among consumers.

1. ALOE VERA (*Aloe barbendensis miller)*
2. FLAX SEED **(***Linum usitatissimum linaceae)*
3. BEETROOT **(***Beta vulgari Linn.)*
4. AMLA POWDER **(***Phyllanthus emblica Linn.)*
5. HIBISCUS POWDER **(***Hibiscus rosa-sinensis***)**

4.3. TESTING OF PHYSICAL PARAMETERS

The cosmetic preparations were evaluated for their organoleptic characteristics, including colour, smell, texture, and consistency, through visual inspection and various physicochemical analyses, including pH, density, viscosity, and accelerated stability tests.

4.3.1. pH

The pH value of hair conditioner was determined using a digital pH Meter by dissolving 0.5g of gel in 50ml of sterile double distilled water and storing it for two hours, then measuring each formulation in triplicate and calculating average values.

4.3.2. CENTRIFUGATION TEST

The centrifugation test involved centrifuging 5 g of sample at 3000 rpm for 30 minutes at room temperature, revealing phase separation in cosmetic formulations, indicating instability. ***(Isnard MD et al, 2019).***

4.3.3 MECHANICAL VIBRATION TEST

The cosmetic formulation's stability is assessed through mechanical vibration movement, potentially causing phase separation, with 5g of sample being vibrated on a vortex shaker for 10 seconds.***(Robbins CR, 2002).***

4.3.4 LIGHT TEST

Cosmetic formulations were exposed to extreme light for 15 days (16 hours light and 8 hours dark), examining for physical properties like appearance, clarity, or colour. Any phase separation or colour change indicates product instability, as any changes in these properties are considered indicative of the product's instability. ***(Roy RK et al, 2007).***

4.3.5 ACCELERATED STABILITY TEST

The hair conditioner underwent accelerated stability testing for 2 weeks at 40°C and 25°C, followed by 8 days of inspection for organoleptic characteristics and pH value, assessing its colour, smell, texture, and consistency.***(Barve K et al,2016).***

4.3.6. VISCOSITY TEST

The viscosity of hair conditioner formulation is crucial for its stability and product behaviour over time. The gel's viscosity was measured using a Viscometer at a controlled temperature of 25±2°C and rotation speeds in triplicate, using an adequate spindle (L4) and varying rotation speeds (1.5, 2.0, 2.5, 3.0, 4.0, and 5.0 rpm). ***(Noudeh GD et al, 2011).***

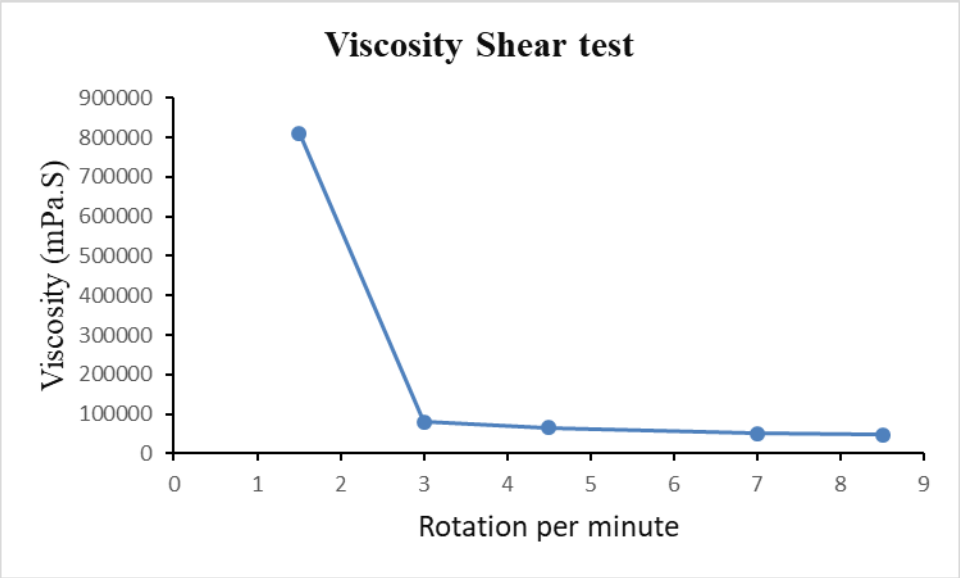

Fig 1: VISCOSITY test of Herbal Hair Conditioner.

4.3.7. ANTI-BACTERIAL ACTIVITY

The antibacterial activity of a herbal hair conditioner was tested using agar diffusion assays using *E.coli* and *S. aureus*. 100µL of sterile liquefied medium was inoculated with bacterial suspensions, placed in the plates and spreaded using an adequate spreader, and 0.2g of the cosmetic formulation was added to each plate. The plates were incubated for 24 hours at

37ºC, and the zone of inhibition was measured to observe if the cosmetic formulations inhibited microbial growth.***(Zaidan MR et al,2005).***

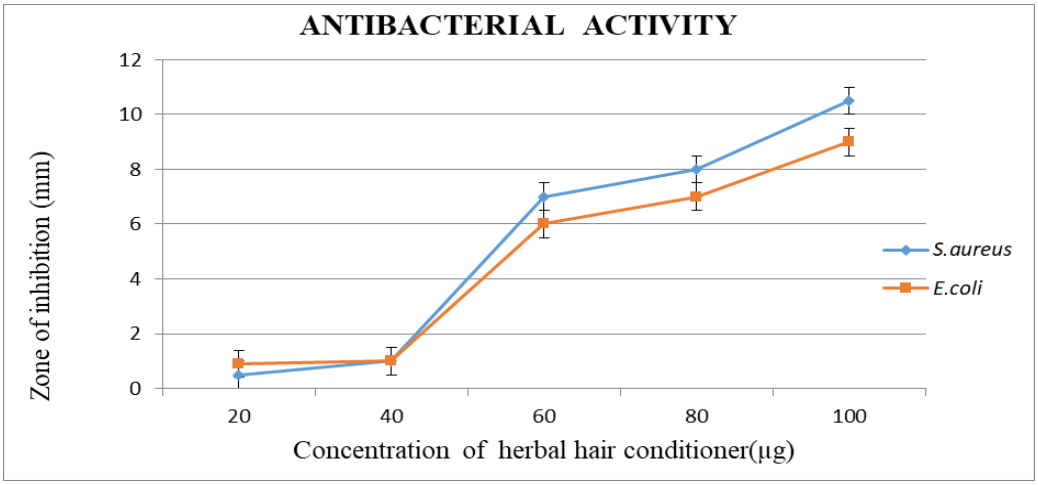

Fig 2: Antibacterial activity against two strains.

4.3.8 ANTI-OXIDANT ACTIVITY

The antioxidant activity of the extract was determined in terms of hydrogen donating or radical scavenging ability using the stable radical DPPH (2,2-Diphenyl-1-picrylhydrazyl) Samples and Standard (ascorbic acid) were taken in various concentrations and the volume was adjusted to 1000 mL with methanol. About 3 mL of a 0.1 Mm methanolic solution of DPPH˙ was added to the aliquots of samples and mixed well. Negative control was prepared by adding 1000 mL of methanol in 3 mL of 0.1 Mm methanolic solution DPPH. The tubes were allowed to stand in dark for 30 minutes at room temperature. The absorbance of the sample was measured at 517 nm against the blank***.(Deng J et al, 2011).***

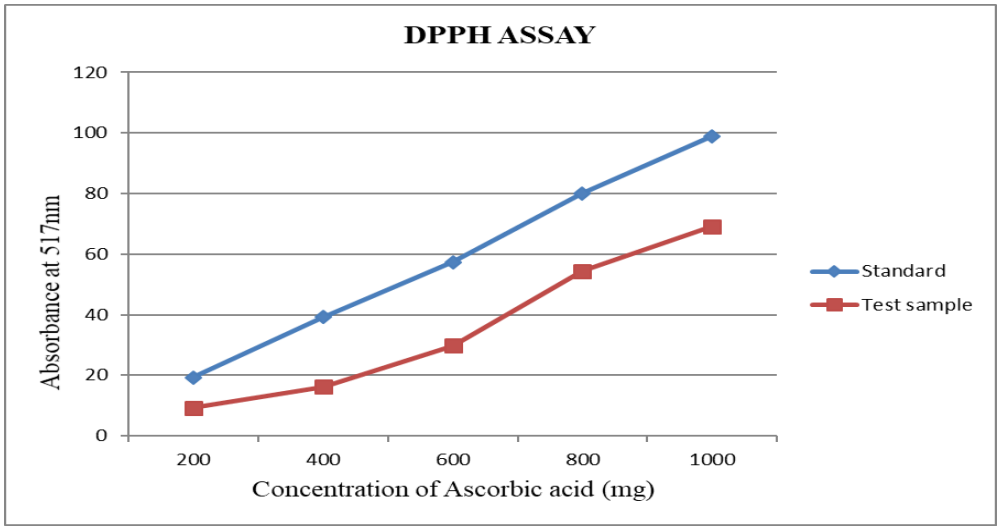

Fig 3: DPPH assay for herbal hair conditioner.

4.3.9. CYTOTOXIC ACTIVITY

The MTT assay involves the conversion of the water-soluble yellow dye MTT [3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide] to an insoluble purple formazan by the action of mitochondrial reductase. Formazan is then solubilized and the concentration determined by optical density at 570 nm. The result is a sensitive assay with excellent linearity up to ~10^6 cells per well. As with the alamarBlue assay, small changes in metabolic activity can generate large changes in MTT, allowing one to detect cell stress upon exposure to a toxic agent in the absence of direct cell death. The assay has been standardized for adherent or non adherent cells grown in multiple wells. The protocol uses a standard 96-well plate. This can be scaled up, however, to suit a different plate format. Plate 500–10,000 cells per well in a 96-well plate. The assay has good linearity up to 10^6 cells***(Kumar P et al,2018).***

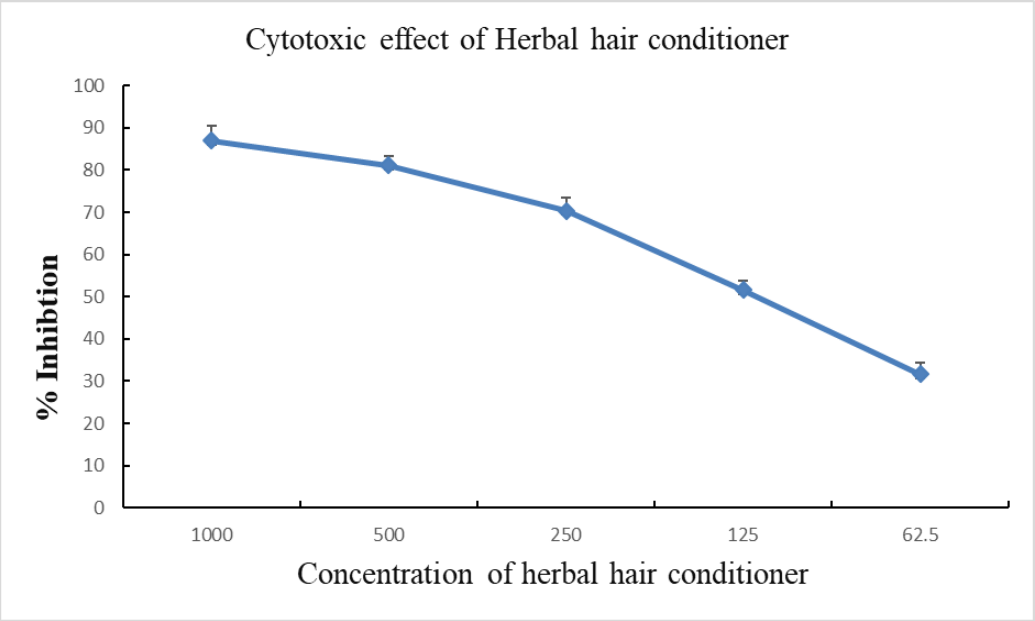

Fig 4: Cytotoxicity test of herbal hair conditioner.

5. RESULT AND DISCUSSION

The various evaluation parameters of herbal hair conditioner are Organoleptic evaluation, physiochemical analysis, anti-bacterial, anti-oxidant, cytotoxicity and cell viability assays.

5.1 ORGANOLEPTIC EVALUATION

5.1.1. COLOUR

Deep purple in colour.

5.1.2. ODOUR

Undefined smell.

5.2 PHYSIOCHEMICAL EVALUATION

After the successful physiochemical analysis the demonstrated results are as follows.

5.2.1 pH DETERMINATION

The pH value of hair conditioner formulation stored at different conditions was determined using a digital pH Meter. pH is 5.6, Hence, the prepared gel is suitable for topical application**.**

5.2.2. CENTRIFUGATION TEST

Formulations were centrifuged at 25°C for 30 minutes, and no phase separation was observed, indicating good gel stability. This test is crucial for understanding gel properties.

5.2.3. MECHANICAL VIBRATION TEST

Vibration during transportation may affect the stability of the formulations, causing a separation of the phases of emulsions, solidification of suspensions, alteration of viscosity, among others.

After being submitted to the vibration test, none of the cosmetic formulations exhibited phase separation, which evidenced their physical stability.

5.2.4. LIGHT TEST

In order to evaluate the behaviour of formulations towards light, they were exposed to day light source with photoperiodicity (16 hours of day and 8 hours of dark) during 2 weeks. After the end of the period of testing, they were visually inspected and no change occurred in the herbal hair conditioner.

5.2.5. ACCELERATED STABILITY TEST

The hair conditioner was subjected to accelerated stability testing for 2 weeks at a temperature of 40º ± 2°C and 25±2°C respectively. No changes in colour, texture and odour were observed.

5.2.6. VISCOSITY TEST

The hair formulation's viscosity remained stable during testing, with a decrease in viscosity with increasing shear rate, indicating non-Newtonian flow (shear thinning). This behaviour is

common in cosmetic formulations and suggests an interesting spreadability due to the decrease in viscosity.

6. CONCLUSION

The gel conditioner contains herbal ingredients that condition hair from the scalp, last longer than chemical conditioners, and soothe the scalp from inflammation and microbial infections. It also stimulates hair growth and enhances colour and texture. The conditioner is biodegradable and non-toxic to the environment. It has sufficient hair conditioning ability and viscosity properties, influencing attributes like shelf life, beauty, transparency, easy packaging removal, expansion, and consistency. The conditioner also contains antioxidants to prevent sun damage. However, the cytotoxicity level is a concern due to the amount of parabens used in the formulation. The formulation can be further reduced to reduce cytotoxicity.

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