RESEARCH ARTICLE

Formulation and Evaluation of Herbal Antidandruff Scalp Serum Incorporating Oils of Lemongrass, Eucalyptus and Indian Gooseberry

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ABSTRACT

Background- Dandruff is a common scalp condition caused by an imbalance in the scalp microflora leading to the overgrowth of Malassezia fungi. Although not a serious medical condition, it does cause considerable discomfort and embarrassment to those affected. Despite the availability of synthetic treatment options, India's diverse botanical heritage offers to provide hopeful alternatives based on traditional medicine practices. Some of the plants that have been tested to show efficacy in inhibiting Malassezia populations include lemongrass, eucalyptus and Indian gooseberry (amla). Utilizing the advantages of modern topical cosmetic serums, which are recognized for increasing consumer acceptance and longer contact time with treatment surface, a new formulation was created for dandruff therapy.

Objective: Utilizing the advantages of modern topical cosmetic serums, which are recognized for increasing consumer acceptance and longer contact time with treatment surface, a new formulation was created for dandruff therapy. So, the aim of the present study is to formulate an antidandruff scalp serum of three herbal drugs. The serum incorporates the oils of lemongrass, eucalyptus and amla, blending them into an o/w type emulsion which is simple to use and easy to apply, and safe.

Methods:To prepare the serum emulsion, we have combined all active essential oils together with a carrier oil and Vitamin E, then we added it to the aqeous base of water and glycerin. Emulsifying agents and other necessary excipients were also added as per the requirement. The product was then evaluated for its quality.

Results: The resultant product showed good rheological properties and was well formulated. User satisfaction is a factor that is satisfied.

Conclusion: The new method offers a safe, efficient herbal solution for dandruff, while also providing nourishment for the scalp and tackling inflammation.

Keywords: Malassezia, Antidandruff, Lemongrass, Eucalyptus, Amla, Serum, nourishment, Dandruff

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INTRODUCTION

Dandruff is a skin condition primarily affecting the scalp, and sometimes areas like the eyebrows, chin, and groin. The primary cause behind dandruff is the yeast like fungus *Malassezia*, which is typically a harmless component of the skin microbiota when present in small amounts. However, it's their overgrowth that triggers this skin condition. Although dandruff is not a life- threatening disease, nor a grievous one, it still remains one that brings about a great deal of embarrassment, self-consciousness and lack of self confidence in the affected persons. It is also one of the most common scalp disorders and a much-exploited skin disease commercially.[1]

Pathophysiology of dandruff

There are several contributing factors that lead to the overpopulation of Malassezia fungus, which otherwise dwells on the human scalp in a commensal relationship in small numbers. These include poor scalp hygiene, water loss from scalp leading to increased sebum section, increased β- endorphin secretion due to age, environmental and seasonal changes [2] as well as stress.[3] When the Malassezia increase in quantity, dominating the microbial flora of scalp, they produce enzymes such as lipase. These enzymes breakdown the triglycerides present in the sebum into free fatty acids, as a nutrient source for the microorganism. Oleic acid is also a byproduct of this process which irritates the skin and triggers inflammatory response. In addition to this, the saturation of fatty acids also increases the colonies of bad bacteria, while suppressing the growth of good bacteria. This further trigger the activation of immune responses, causing more inflammation. Release of pro- inflammatory cytokines such as interleukin- 1 (IL-1), interleukin- 6 (IL-6) and tumour necrosis factor alpha are observed [4]

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Table 1: Oil Ingredients list

Ingredient	Quantity	Use
Lemongrass oil *(Cymbopogon flexuosus)*	1.50 ml	Antidandruff, anti-inflammatory
Eucalyptus oil *(Eucalyptus globulus)*	1.00 ml	Antidandruff, relieves itching and irritation
Indian Gooseberry (amla) oil *(Emblica officinalis)*	1.50 ml	Antidandruff, scalp nourishment, antioxidant
Vitamin E	0.25 ml	Scalp nourishment, antioxidant
Jojoba oil	5.00 ml	Carrier oil, moisturizing

Table 2: Aqueous Ingredients

Ingredient	Quantity	Use
Glycerol	30 ml	Aqueous base, Humectant
Distilled water	30 ml	Aqueous base
Polysorbate 20	01 ml	Emulsifying agent

Table 3: Other ingredients list

Ingredient	Quantity	Use
EDTA	0.05 g	Chelating agent
Methyl Paraben	0.05 g	Preservative
Xanthan gum	0.50 g	Thickening agent

Inflammation stimulates quick turnover of the epidermal cells, leading to hyperkeratotic scales. These keratinocytes and sebum produce the appearance of flaking and scaling in the form of dandruff which also shed easily.

The treatment options for dandruff include topical applications of agents like ketoconazole, selenium sulphide and zinc pyrithione due to their anti-fungal activity.[5]

Cosmetic Serum, Implications of the Term

The term 'serum' is commonly used in modern times in the skincare and cosmetic industry to refer to concentrated formulas meant to penetrate the skin rapidly, providing a powerful mix of ingredients to target typical skin issues [6]. In pharmaceutical terms, they are essentially topically applied formulations of oil in water, or water in oil type emulsions that are liquid rather than being of a cream, lotion or gel like consistency. They have low viscosity and are able to flow easily through a dropper, and spread on skin without the need to rub excessively. They have high quantity concentrations of active ingredients.

Lemongrass

The oil of lemongrass (***Cymbopogon flexuosus***) leaves contains a mixture of multiple bioactive chemical compounds. Citral, citronellal, geraniol, limonene and linalool are some of them with potential activity against dandruff causing fungus, such as antimicrobial and anti-inflammatory properties.[7]

Several researchers have explored the efficacy of lemongrass oil and its constituent compounds for their

Figure 1: Heating the phases on heating mantle and Rigorous mixing by mechanical stirring

antidandruff properties. One study conducted a randomized controlled trial on 30 volunteers in Thailand, finding considerable improvement in scalp condition after using a hair tonic containing different concentrations of lemongrass oil, with 10% concentration being the most effective in treatment.[8] Another research tested a shampoo formulation containing 2% lemongrass oil, which also demonstrated efficacy against dandruff.[9] Furthermore, studies focusing on citral, a chemical constituent of lemongrass oil, discovered its ability to inhibit *M. furfur* by inducing apoptosis the fungal cells, and activate immune responses.[10] Additionally, molecular docking studies have predicted elemol, another constituent of lemongrass oil[11], to exhibit strong antifungal activity against *M. furfur* without cytotoxic effects.[12]

Eucalyptus

The oil extracted from various plant parts of Eucalyptus (***Eucalyptus globulus***) demonstrates antibacterial, antifungal, antiseptic, antioxidant, anti-inflammatory, and anticancer effects.[13]

Eucalyptus globulus oil demonstrates significant antidandruff effects. A study discovered the inhibitory zone of *E. globulus* to be 37mm in Malassezia culture. These findings suggest the superior antidandruff action of *E. globulus* oil, potentially comparable or even superior to ketoconazole-based shampoo, a commonly used standard treatment option.[14] Similar were the findings of a research which demonstrated that *E. globulus* proved to be more effective than the antibiotic Clotrimazole in terms of their antifungal properties against *M.* furfur.[15] Moreover, another research studied the effect of *Eucalyptus citriodora* essential oil on *M. furfur*. *E. citridora* has similar phytoconstituents to *E. globulus*, and it exhibited potent antifungal activity against the dandruff causing fungi, with concentrations below 15 µl/ml completely inhibiting its growth, indicating its therapeutic efficacy against dandruff.[16]

Indian Gooseberry (Amla):

The Indian gooseberry is formally known as ***Phyllanthus emblica***, however it is also called ***Emblica officinalis*** in older botanical literature and in traditional medicine practices.[17] Amla extract has been shown demonstrate significant antifungal activity against *Malassezia furfur.*[18-20] A research found that the ethanolic and aqueous extracts of amla, particularly at 100% concentration, exhibited significant inhibitory effects against *Malassezia furfur* and *M. globose.*[21] Amla oil also exhibits high toxicity levels against dermatophytes, indicating its potential as an

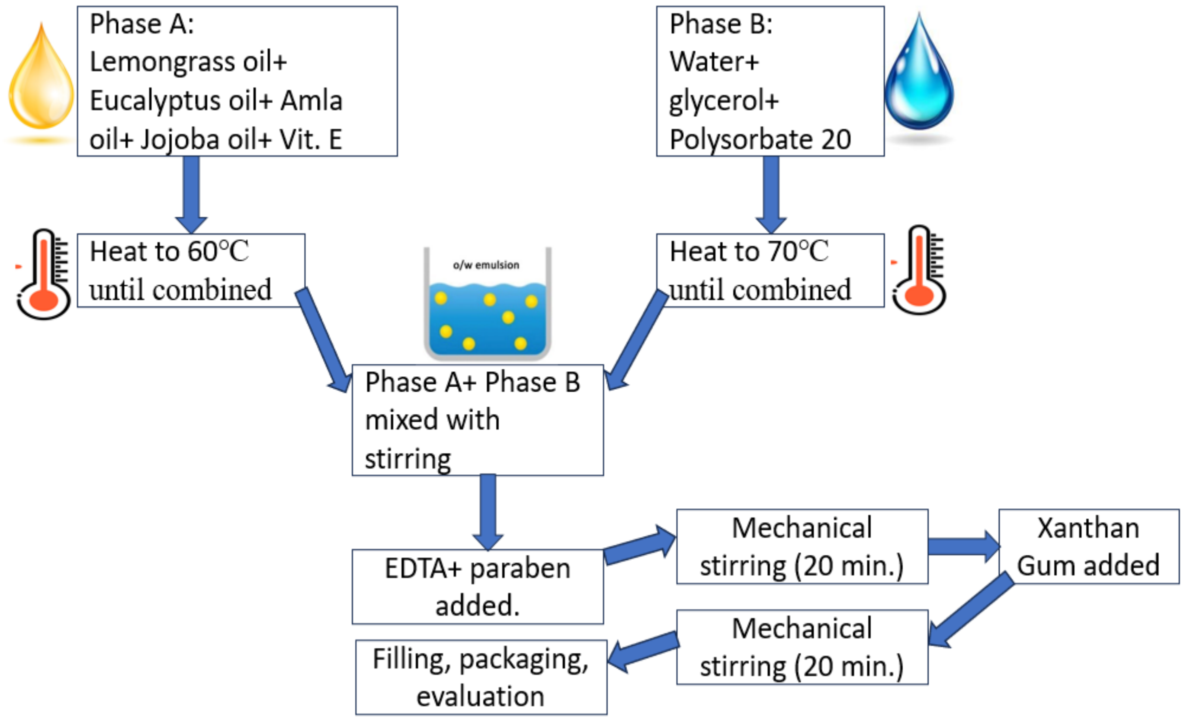

Figure 2: Flow chart of serum preparation procedure

effective herbal treatment for various skin and hair infections.[22]

Amla is rich in vitamin C. Amla powder is a crucial component of hair tonics, helping to promote better coloration and growth.[23] It strengthens the roots, maintains color, and enhances shine. Applying amla oil to hair roots enhances hair growth.[24] Reduced baldness and hair loss is the most widely used application. This characteristic results from the tannins in the form of tannic acid, iron, gallic acid, ellagic acid, and antioxidant material, which prevents dandruff-related free radical damage to hair follicles.[25]

MATERIALS AND METHODS

Materials

Lemongrass ***(Cymbopogon flexuosus)*** oil was obtained from AG Industries, Noida, India. Eucalyptus *(Eucalyptus globulus)* oil was sourced from Organic Nilgiris, bearing their trademark. Amla *(Emblica officinalis)* oil was acquired from RV Essential, New Delhi, India.

For preparing 80 ml of serum, following is the list and quantity of each of the component. Ingredients required to prepare Phase 'A' (oil phase) are listed in Table 1 Ingredients required to prepare Phase 'B' (Aqueous phase) are listed in Table 2.

Other ingredients are listed in Table 3

Methods

First, in a clean beaker, all the ingredients of Phase A (oil Phase) were added in measured quantity. In another clean beaker, Phase B was prepared by adding water, glycerol and Polysorbate 20. This was the aqueous phase. Both phases were heated separately but simultaneously. Phase A is heated up to 60°C and Phase B up to 70°C until all the ingredients of each phase is uniformly combined. This was done on a heating mantle. Next, the Phase B was added dropwise into Phase A with constant and rigorous stirring with a glass rod. EDTA and Methyl Paraben were added to the mixture. Using a mechanical stirrer, the mixture was stirred at 100rpm for 20 minutes. After this, Xanthan gum was added little by little with constant stirring to prevent lump formations.The emulsion mixture was further stirred with mechanical agitator for at 100rpm for 20 minutes for uniform dispersion of all the ingredients and to achieve an optimal consistency.Then the serum is ready and is added to a clean bottle, the pump for dispensing is placed and a cap is used to secure the contents of the bottle.Using a mechanical stirrer, the mixture was stirred at 100rpm for 20 minutes. After this, Xanthan gum was added little by little with constant stirring to prevent lump formations. The emulsion mixture was further stirred with mechanical agitator for at 100rpm for 20 minutes for uniform dispersion of all the ingredients and to achieve an optimal consistency. Then the serum is ready and is added to a clean bottle, the pump for dispensing is placed and a cap is used to secure the contents of the bottle.

Evaluation procedure

The prepared herbal anti-dandruff hair serum was evaluated by following parameters.

Colour: Visual observation of the colour, colour uniformity and opacity was carried out in natural light.

Emulsion homogeneity: Visual inspection of the serum was done to check of oily and aqueous phase are well combined or not, or if they are being separated. Lumps we also looked for by this method.

Emulsion texture: The serum was applied to skin to make observations regarding its texture.

Patch test: A small quantity of serum was applied to 5 volunteers' skin and left on for a few hours to determine if any irritation , Itching, Redness, Swelling is caused.

Figure 3: scalp serum

Table 4: Patch Test

S.no	Parameter	Result
1.	Swelling	Nil
2.	Redness	Nil
3.	Irritation	Nil
4.	itching	Nil

Table 5: Stability test

S. No	Parameter	Result
1.	Change in color	Nil
2.	Change in odour	Nil
3.	Change in texture	Nil
4.	Change in appearance	Nil

Sensory evaluation: Sensory characteristics of the serum upon intended application, like odour, greasiness, easy of application, and skin feel were noted

pH test: pH meter of 'HPG SYSTEMS 3 Point Calibration Microprocessor Based pH Meter G-2020' type was used. First it was calibrated using distilled water, then the pH of the serum formulation was determined by dipping the electrode tip in it.

Viscosity Test: Brookfield Viscometer by Ametek of model number 'DV1MRVTJ0' was used. The general rule of this viscometer is that viscosity range is inversely proportional to the spindle size as well as the rotation speed. Accordingly, spindle number 6 was chosen to run at 100 rpm for 2 minutes.

Spreadability Test: 1g of serum was applied to a smooth surface. A second smooth surface was placed on top, and uniform weight of 125g was applied. After 1 minute, the diameter covered by the spread serum was measured and area of the spread circle was calculated. Formula used was

$Si = d^2 \times \pi/4$

where 'Si'= Spreading area (mm^2) depending on mass, and 'd'= spreading area diameter (mm)[26]

Stability Studies: The powdered formulation was stored for some time under different temperatures (35 ˚C and 40˚C) and humidity conditions, and the change in the physical properties was observed.

RESULTS

The antidandruff serum was formulated successfully with the above-mentioned procedure and filled into a bottle with a dispensing pump as shown in figure 3. The key aspects of the serum were evaluated based on the above parameters. The test results were also satisfactory for a scalp serum intended for topical application.

Colour: Uniform, pearly opalescent color indicating that the particle size of the dispersed phase is 0.05 to 0.1 microns. It also has a slight lustre.

Emulsion homogeneity: No signs of phase separation are lump formation even after leaving the formulation undisturbed for 1 week. The emulsion is homogeneously dispersed.

Emulsion texture: Emulsion is very soft, smooth, without any lumpiness or grittiness.

Patch test: No irritation, Swelling, itching, redness or pain caused. Results of patch test are shown in Table 4.

Sensory perceptions

Odour: It's strong odour a mixture of camphoraceous scent and lemon- like scent. Overall, it smells fresh, earthy, cool and tangy.

Figure 4: pH test, Viscosity test, Spreadability test

Greasiness: It is not sticky, heavy and greasy. It's very light weight.
Easy to apply to skin. Minimal tackiness. A small amount can be easily spread to cover large areas of skin without extensive rubbing. It doesn't stick to hair base and is easy to glide over the entire scalp area.
Skin feel: Doesn't feel heavy or oily on skin. Leaves a very slight cooling sensation of skin immediately after application. There is also a notable shiny appearance to skin that it imparts which disappears after approximately 15 minutes as the aqueous base evaporates and the oils are absorbed into the skin.
pH test: pH of the formulation was determined by pH meter and it was found to be 5.04 which is good for scalp.
Viscosity test: Viscosity of herbal hair serum was determined by Brookfield Viscometer and it was reported to be 2460 cP at 23.6°C
Spreadability test: Spreadability test was done to ensure the spread ability, the formulated serum was found to be easily spreadable. Spreadability of the prepared Hair serum was 1734.065 ±50.00 mm^2 which shows that the hair serum is easily spreadable.
Stability Studies: The results of Stability studies are shown in table 5.

DISCUSSION

The synthesized anti-dandruff herbal hair scalp serum formulation is loaded with the goodness of three natural herbs i.e. Amla, Eucalyptus, Lemongrass along with the active phyto-constituents. In this research, we successfully formulated a polyherbal antifungal scalp serum.The emulsion serum shows a homogenous, opalescent hue, indicating that the particle size of the dispersed phase is from 0.05 to 0.1 microns. Moreover, it has a slight lustre. The formulation shows no signs of instability and phase separation after being left undisturbed for weeks and remains evenly distributed. There are also no signs of lumps or grittiness and the serum is very smooth in consistency.Upon conducting a patch test in 5 volunteers, no skin irritation, redness, itching or any discomfort were reported.The results of patch test are shown in table 4. The organoleptic evaluation of the formulation was also examined using sensory organs like eyes, nose.The odour was reported to be pleasing and characteristic, Color was pearly opalescent. The texture of the formulation was fine and smooth without any grittiness. consistency with light weight and nom- greasy with easy application on skin. The serum imparts a slight cooling sensation to skin after its application. pH of the formulation was 5.04 when tested using a pH meter which is ideal considering the slightly acidic natural pH or human scalp skin. Brookfield viscometer measured the viscosity of the serum to be 2460 cP at 23.6°C. The spreadibility of the serum was also calculated, and determined to be about 1734.065 ±50.00 mm^2. Spreadability test was done to ensure the spread ability, the formulated serum was found to be easily spreadable. The formulation is simple to formulate, has excellent rheological properties and is easy to apply, and provides a good user experience. It has 3 different herbs addressing the same concern for better synergistic effect. Additionally, the formulated serum showed promising moisturizing and soothing effects on the scalp.

CONCLUSION

This research builds on current understanding of the effectiveness of herbal drugs to combat dandruff, by creating a synergistic combination of three herbal components designed for use on the scalp. By adding these natural herbal oils to a scalp serum, we provide a simple and efficient option instead of traditional antifungal remedies, with the additional benefits of using non- synthetic ingredients and a minimal chance of adverse effects. The developed herbal scalp serum has important implications for treating fungal scalp infections and enhancing scalp health. The multi-faceted approach doesn't just focus on the root fungal causes, but also tackles issues like dryness, itching, and inflammation, offering thorough treatment for people with scalp issues. Additionally, the serum's natural and safe ingredients make it appropriate for use over an extended period of time, providing a lasting remedy for promoting scalp hygiene and avoiding frequent infections.

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