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Formulation and Evaluation of Liposomal Herbal Hair Serum Using Alkanet Root Extract

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Abstract: In recent years, hair-related problems have become a significant source of stress and depression for many individuals, primarily driven by factors such as genetics, hormonal changes, environmental influences, and the use of chemical hair products. This research paper aims in the formulation and evaluation of a herbal hair serum using Alkanna tinctoria root extract, alongside various natural ingredients, to address prevalent hair problems. Alkanet root is a natural ingredient that has many potential benefits with a rich history of traditional use. It is rich in alkannin and shikonin that promotes hair growth and has many other pharmacological actions. In recent times Herbal formulation has become more popular due to its lesser side effects when compared to synthetic products. More popularly, Hair serum is preferred by many people over hair oil due to its light weight and non-greasy nature. The herbal hair serum is developed with a focus on promoting hair growth, enhancing manageability, and minimizing side effects associated with chemical alternatives. The formulation incorporates liposomes, in which the active ingredient is encapsulated, to improve the delivery and efficacy of active ingredients. Evaluation of the herbal hair serum is conducted through physical appearance, viscosity, skin irritation tests, and antimicrobial efficacy against Malassezia globosa, demonstrated promising results, indicating that the formulated serum is safe and effective for everyday use. The results indicate that this herbal hair serum offers a nourishing approach to hair care, which could significantly benefit individuals facing hair-related challenges. This formulation represents a significant advancement in natural hair care, presenting a non-toxic alternative to conventional chemical products.

Keywords: *Alkanna Tinctoria, Hair serum, Liposomes, Hair growth, Herbal formulation.*

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I. INTRODUCTION

In recent days, hair problem has become very stressful and depression for many persons. Hair problems majorly arise due to stress, but the hair loss itself has become the major stress for humans. Hair originates in the hair follicles. Hair follicles, tiny structures nestled in the dermis layer of the skin, lie between the outermost layer (epidermis) and the underlying fat layer (subcutaneous layer). At the base of each follicle is the hair matrix, a bustling hub of activity where new hair begins to form. The living cells in the hair matrix multiply and gradually move upward. As they ascend, these cells lose moisture, dry out, and harden, transforming into the tough, protein-rich structure we know as the hair shaft. This hair shaft, composed of dead protein, is further protected by a fine outer layer—the cuticle—which is made up of overlapping, plate-like scales. Hair is located everywhere in the body except the thick skin areas such as soles and feet. In humans, the hair grows lengthy and shiny in the scalp regions. Thus, hair related problems majorly arise in the scalp only.

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➢ *Structure of Hair:*

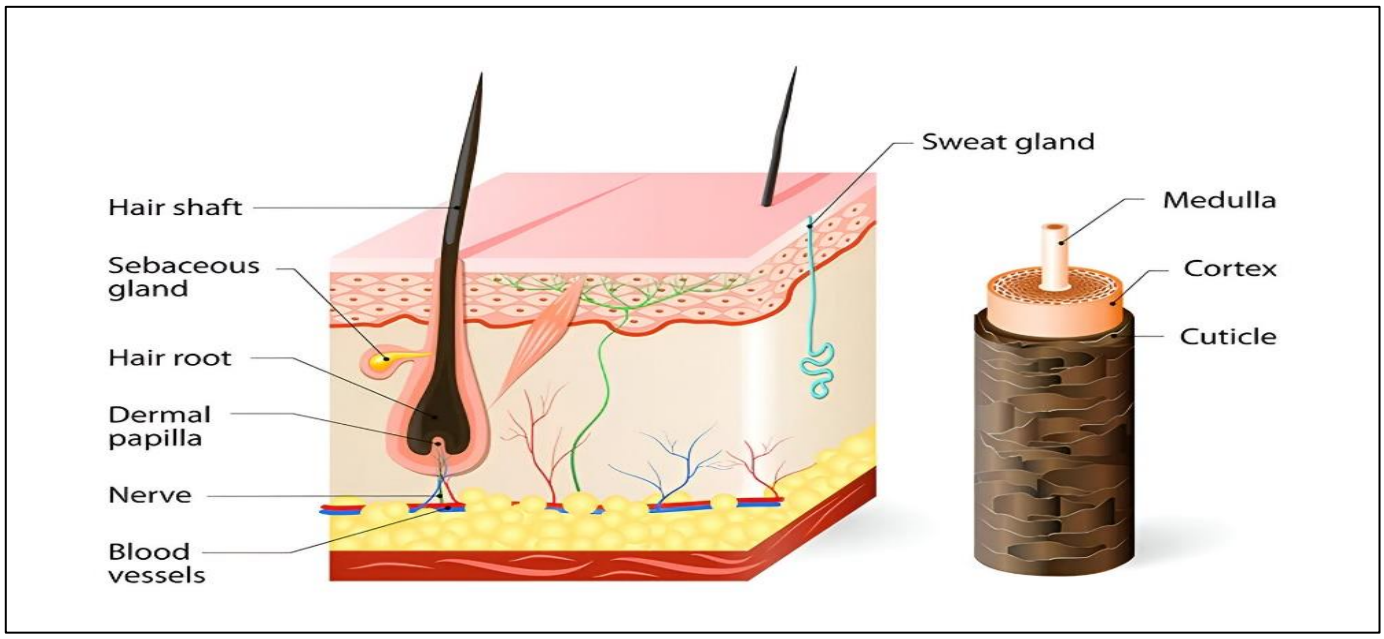

Fig 1 Structure of Hair

Hair is made of two parts: the hair shaft and the hair follicles. Hair shaft is visible part of the hair while the hair follicle is the structure that holds the hair and is located beneath the skin. The hair follicle contains dermal papilla, hair root, nerve supply and the blood supply. The growth starts form the dermal papilla and root by the rich blood supply that provides nutrients and oxygen. Poor blood supply to the hair leads to hair loss, dandruff and brittle hair.

- *Hair:*

Hair is truly remarkable. It's an integral part of our body that not only enhances our individuality but also serves vital purposes. Formed from epithelial tissue, it develops through a process called keratinization, where cells harden and transform into strands of keratin. Whether it's long and wavy, short and sleek, wild and frizzy, or smooth and shiny, hair comes in countless forms, colors, and textures, making it one of the most unique aspects of personal identity.

But hair isn't just about appearance; it plays an essential role in protecting us. It helps regulate body temperature, minimizes friction, and even shields our scalp from the sun's rays. Despite its beauty and function, we've all faced hair challenges at some point—be it dryness, breakage, or those inevitable bad hair days. Hair truly has a story of its own!

➢ *Hair Problems:*

Hair problems can arise from a variety of reasons - genetics, health conditions, environmental factors, hormonal shifts, or even the use of chemical-laden hair products. These challenges are something most people encounter at some point in life. From hair loss and premature greying to split ends, dandruff, oily strands, and an itchy scalp, hair concerns come in many forms. Even more serious conditions like alopecia are part of the complex relationship we have with our hair. Yet, every struggle reflects the unique and evolving nature of our hair's story!

- *Hair Serum:*

Now a days people are turning to natural hair care products instead of chemical ones. Recently the phrase 'Herbal hair serum' have become more well known. As an assortment of botanical extracts, vitamins, essential oils and other natural ingredients are often found in herbal hair serum.

- *Benefits of using herbal hair serum:*

✓ Gives shine to the hair.
✓ Prevents hair loss form breakage.
✓ Nourishes and makes the hair manageable.
✓ Improves hair growth.
✓ Less side effects.
✓ Non-toxic.

➢ *Liposomes:*

Liposomes are tiny, small vesicles composed of one or more lipid bilayers. Liposomes are widely used due to their high biocompatibility, stability, high drug loading efficiency.

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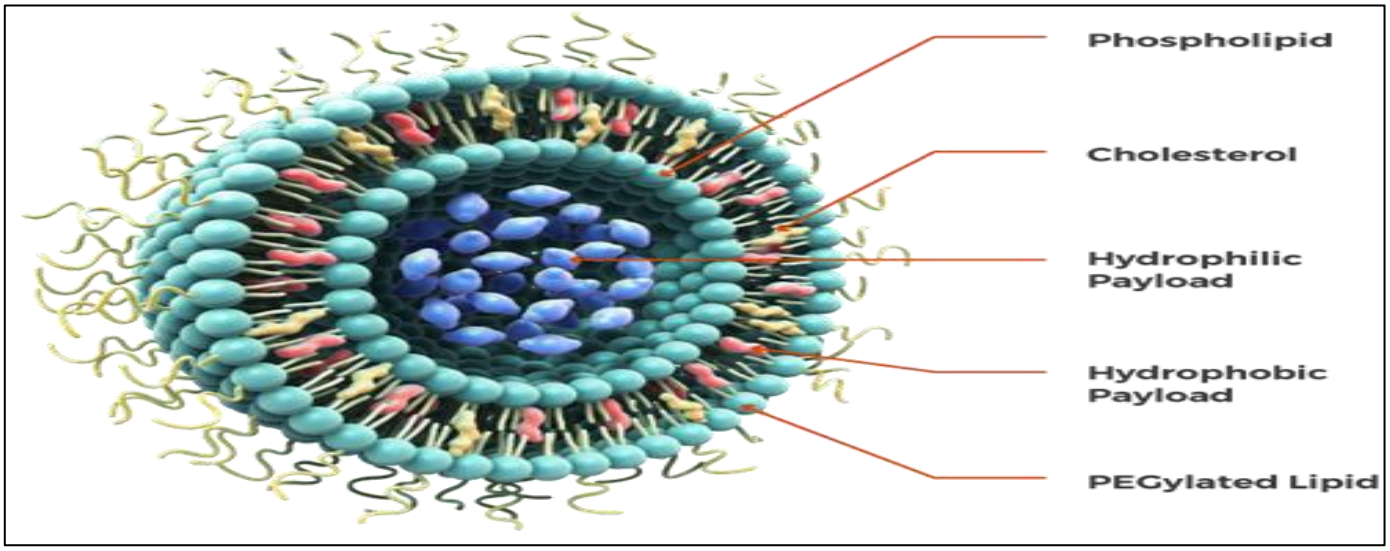

Fig 2 Structure of Liposome

Liposomes are a flexible lipid-based drug delivery method that imitates the organ's lipid bilayer system to improve drug penetration through epidermal tissue. It is less immunogenic, non-toxic, and readily broken down by enzymes. Liposomes can encapsulate drugs and deliver them to specific target tissues or cells, allowing for targeted therapy. They are used in cosmetics to enhance the penetration of active ingredients into the skin, improving their efficacy.

➢ *Alkanna Tinctoria Root:*

In our study, we have used *Alkanna tinctoria* root extract as an active ingredient for the formulation of hair serum. *Alkanna tinctoria* has many pharmacological actions such as anti-inflammatory, wound healing, anti-aging, anti-fungal, hair and nail treatment. So, formulating a hair serum with alkanet root will give more advantage towards the hair and it will be easier to use daily than compared to hair oil, which is greasy and sticky.

II. MATERIALS AND METHODS

➢ *Collection of Plant:*

The alkanet root was purchased locally in an organic store and authenticated. The root was kept for shade drying overnight.

- *Extraction of Alkanet Root:*

50g of alkanet root was kept in a tray drier for 2 hours at 70°C. After drying the root was grinded into fine particles by using waring blender4. Then the fine powder was sieved in mesh 52 and weighed.

Then the powder was extracted by maceration process. 10g of powder was macerated in 70% of ethanol and 30% of water for 24 hours. After maceration, the mixture was filtered and concentrated. The concentrate was kept at 4°C.

➢ *Other Ingredients Used in Hair Serum:*

- *Jojoba Oil:*

Jojoba oil is excellent for balancing the scalp's oil production and keeping it healthy, making it a wonderful choice for those with oily hair. It promotes hair growth, acts as emollient and also have anti-dandruff property.

Fig 3 Jojoba oil

- *Almond Oil:*

Almond oil contains vitamin E, Omega-3-fatty acid, and other essential nutrients that conditions hair, help prevent split ends and dandruff. They improve the scalp health. Applying almond oil to the hair promotes good blood flow to the roots, thus facilitating hair growth and hair strength.

Fig 4 Almond oil

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- *Olive Oil:*

It helps reduce hair loss by preventing the hormone dihydrotestosterone, or DHT, from binding to the scalp. It is an fantastic natural moisturizer that helps to hydrate and nourish the hair. Additionally, it conditions the hair, minimise breakage, split ends and frizz.

Fig 5 Olive Oil

- *Grapeseed Oil:*

Grapeseed oil is a lightweight, nutrient-rich oil packed with flavonoids known as procyanidin oligomers, which are potent antioxidants. This incredible oil not only enhances hair by adding shine, strength, and moisture but is also embraced as a natural remedy for baldness. Additionally, it is known to help reduce dandruff and soothe conditions like dermatitis, making it a versatile choice for healthier hair and scalp care.

Fig 6 Grapeseed oil

- *Vitamin E:*

Vitamin E is an incredible nutrient that plays a vital role in promoting healthy hair and a well-nourished scalp. Its potent antioxidant properties work to restore the hair's protective barrier, bringing back its natural shine and locking in essential moisture. This helps to reduce breakage and shields the hair from everyday damage. Moreover, Vitamin E stimulates blood circulation to the hair follicles, encouraging faster and healthier growth. It's truly a fantastic companion for maintaining strong, vibrant, and beautiful hair!

Fig 7 Vitamin E

- *Orange Peel Extract:*

Orange peel extract is rich in Vitamin C, antioxidants, and essential minerals that support hair growth while helping to delay premature greying. It has also been used in hair serums as a preservative and to balance pH levels, making it a versatile ingredient for both hair care and nourishment.

Fig 8 Orange Peel Extract

- *Lavender Oil:*

It has a calming and divine fragrance. It can keep the scalp health with its antifungal and anti-inflammatory properties. It is Used to treat dry scalp, stimulate hair growth, and reduce cradle cap and moisturize, repair, and strengthen hair follicles.

Fig 9 Lavender Oil

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- *Aloe Vera:*

Aloe vera is an excellent all-natural remedy for a variety of hair issues. Dandruff, oily hair, and encouraging healthy hair development are some of the problems it can help with. Loaded with water, minerals, and enzymes, it helps to strengthen hair, nourish the scalp, and promote durable, healthy growth.

Fig 10 Aloe Vera

Table 1 Ingredients for Hair Serum Formulation

S.NO	Ingredients	Uses
1.	Jojoba oil	Anti-dandruff, promotes hair growth
2.	Almond oil	Moisturize, conditioner
3.	Olive oil	Reduce split ends and enhance shine
4.	Grape seed oil	Powerful hydrator and strengthen hair strands
5.	Lavender oil	Fragrance
6.	Orange peel extract	Ph adjuster
7.	Vitamin E	Improves blood circulation

➢ *Formulation:*

- *Preparation of Liposome:*

Table 2 Ingredients for liposome formulation

S.NO	Ingredients	Quantity
1.	Lecithin	1000mg
2.	Cholesterol	250mg

✓ Add 1000mg of Lecithin and 250mg of cholesterol in a 100ml round bottom flask containing 20ml of 70% ethanolic extract of Alkanet root.
✓ Gently heat the mixture at 60°C with occasional stirring until the mixture is homogenous.
✓ After complete dissolution, allow the mixture to evaporate to form a thin layer.
✓ 20 ml of water is added to the thin layer for the rehydration of liposomes. Then shake the flask for 30 mins until the thin layer dissolves. The mixture contains liposomes and excess water. This was separated by centrifugation method at 3000 RPM for 30 mins.
✓ The precipitated pellet was observed under optical microscope with 40X lens. The liposomes formation is clearly observed.

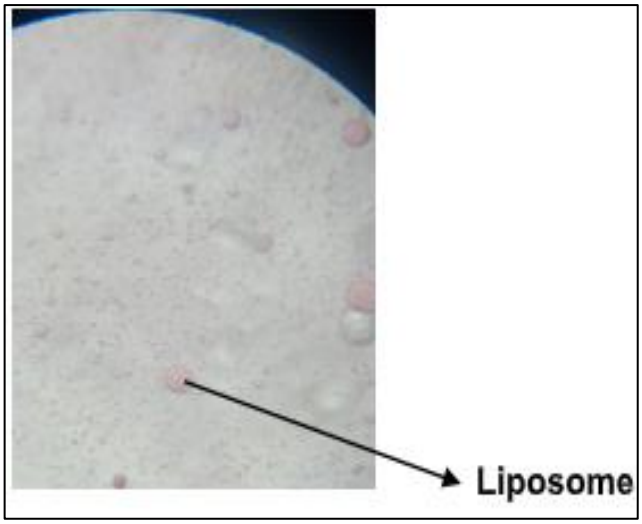

Fig 11 Liposome Observed Under Optical Microscope

➢ *Incorporation of Liposomes with Serum:*

- *Step* 1

Solution A: Mix jojoba oil, Almond oil, Grape seed oil, Olive oil and vitamin E in a beaker. Mix them using magnetic stirrer

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- *Step* 2

Solution B: In another beaker add Liposome, orange peel extract and Aloe vera extract and mix well.

- *Step* 3

Add solution B in solution A and heat the mixture gently for 15 mins. Then add 3 drops of lavender oil. Allow the mixture to cool to room temperature by keeping them undisturbed.

- *Step* 4

Store the formulated herbal hair serum in an amber colored container.

Table 3 Formulation Table for Hair Serum

S.NO	Ingredients	Quantity (60ml)
1.	Liposomes	10ml
2.	Orange peel extract	2.5ml
3.	Aloe vera	2.5ml
4.	Jojoba oil	15ml
5.	Grapeseed oil	7.5ml
6.	Almond oil	10ml
7.	Olive oil	10ml
8.	Vitamin E	2.5ml
9.	Lavender oil	3 drops

➢ *Evaluation:*

- *Physical appearance:*

The physical appearance, colour, odour, texture and transperancy of the formulated herbal hair serum were tested.

- *Homogeneity:*

The herbal hair serum was applied to a dry, clean glass slide and examined under light to detect the presence of coarse particles or determine its homogeneity. A visual inspection was conducted to check for uniformity and identify any lumps, floccules, or aggregates.

- *Viscosity:*

Viscosity of the formulation is determined by Brookfield Viscometer at 100rpm, using spindle type model S6 4.5 ml of the serum. The serum will place in a big mouth container with the spindle dipped in it for about 5 minutes before the measurement.

- *Skin irritation test:*

It is carried out by applying small amount of hair serum on skin and tested for any redness or itching on the skin after 2 hours.

- *Spreadability:*

It was measured by a parallel plate process. One gram of hair serum was compressed in between two horizontal plates. The spread diameter was measured after 1 min. Spreadability was measured by using the formula:

$$S=ML/T$$

- *Where,*

✓ S= Spreadability.
✓ M= Weight in the pan.
✓ L=Length moved by the glass slide.
✓ T=Time taken to separate the slides completely.

➢ *Antimycotic activity:*

The anti-microbial test was carried out against fungus Malassezia globosa, which causes dandruff in the human scalp. The sabourauds dextrose agar plate was prepared and 3 well was created using with the help of sterile borer, then fill one cavity with standard drug (Ketoconazole) and another cavity was filled with hair serum. Plates were incubated at 37°C for 24 hours.

➢ *Determination of PH:*

The pH meter was first calibrated using pH 4 and pH 7 buffer solutions. After calibration, the electrode was immersed in the hair serum and left for a few minutes until the pH reading stabilized.

➢ *Evaluation of Liposomes:*

➢ *Observing under optical microscope:*

After centrifugation the pellet formed at the bottom was diluted with orange peel extract (buffer) and observed under 40X lens using optical microscope.

➢ *Scanning Electron Microscope:*

The liposome size and structure were observed under scanning electron microscope.

➢ *Encapsulation efficiency:*

Encapsulation efficiency is the percentage of a drug that is trapped inside liposomes. It is a key factor in liposome formulation because it indicates the amount of active ingredients in the liposomes. Methods for separating encapsulated and free drug by centrifugation process. EE% is calculated by dividing the total amount of serum added minus the amount of free non-encapsulated serum by the total amount of a serum added.

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$$EE\% = \frac{(\text{Total amount of serum} - \text{Supernatant liquid})}{\text{Total amount of serum added}} \times 100$$

III. RESULT AND DISCUSSION

➢ *Herbal hair serum was formulated using alkanet root extract.*

➢ *Physical Appearance:*

The hair serum was found to be red in colour with a translucent appearance, and the application was discovered to be smooth.

Table 4 Physical Appearance

S.No	Parameter	Result
1	Colour	Red
2	Odour	Pleasant
3	Texture	Smooth
4	Transparency	Transparent

➢ *Homogeneity, Viscosity, PH, Spreadability:*

The pH scale is used to specify the acidity or basicity of a product in order to ensure that it is safe to use. Brookfield viscometer is used to determine the viscosity of the formulation. The value obtained is recorded in table 5.

Table 5: PH, Viscosity, Homogeneity and Spreadability test of Herbal Hair Serum

S. No	Parameter	Result
1	Homogeneity	Very good
2	Viscosity	221
3	pH	5.2
4	Spreadability	Easily spreadable

➢ *Skin Irritation:*

It is carried out by applying the serum on skin and tested for any redness or itching after 2 hours. After 2 hrs. It is observed that there was no redness or itching on the part of skin where serum was applied. It is suggested that the hair serum was safe for the use.

➢ *Optical Microscope:*

The formation of liposomes was observed under 40X lens using Optical microscope.

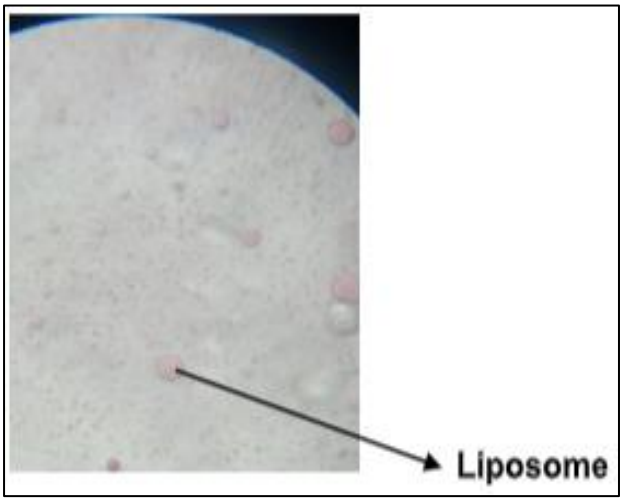

Fig 11 Optical Microscopy Image of Liposome

- *Encapsulation Efficiency:*

The encapsulation efficiency was calculated using the formula. The EE% of formulated liposome is 9%. The liposomes made by conventional methods must have EE% ranging from 5 – 20%. Thus, the EE% of formulated liposomes lie within the range.

- *Antimycotic Activity:*

After incubation, the diameter of the inhibition zone was measured accurately using a calibrated ruler or digital caliper.

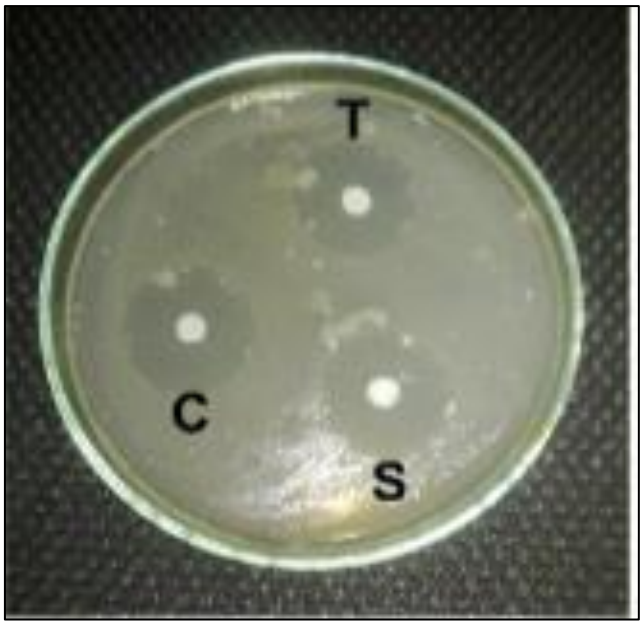

Fig 12 Zone of Inhibition of Formulated Hair Serum against Malassezia Globosa

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Table 6 Antimycotic Activity

S.No.	Name of the Compound	Zone of Inhibition (Mm)
1	Ketakonazole	22 mm
2	Hair serum	17 mm

IV. CONCLUSION

The formulated liposomal herbal hair serum is optimal and proved to produce effects against hair problems. Evaluation of the herbal hair serum is conducted through physical appearance, viscosity, skin irritation tests, and antimicrobial efficacy against Malassezia globosa, demonstrated promising results, indicating that the formulated serum is safe and effective for everyday use. The results indicate that this herbal hair serum offers a nourishing approach to hair care, which could significantly benefit individuals facing hair-related challenges.

This formulation represents a significant advancement in natural hair care, presenting a non-toxic alternative to conventional chemical products.

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