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# Standardization And Efficacy Testing Of Alternanthera Sessilis –Based Hair Serum

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➢ **Abstract :**

In mammals, the hair follicle is a crucial organ that influences appearance, gender differentiation, provides significant protection against temperature changes, and plays a role in defense mechanisms. Recently, younger individuals have begun experiencing severe hair loss due to various factors, with the condition often leading to permanent hair loss, such as alopecia. Many people affected by hair loss seek a variety of treatments due to the anxiety and stress it causes. To promote hair growth and prevent further hair loss, it is essential to activate the hair roots. Citrus sinensis is commonly used in hair care for its anti-dandruff properties and its antibacterial and anti-inflammatory effects. Nigella sativa is known for enhancing the shine, strength, volume, and texture of hair. Flaxseed, rich in fatty acids and antioxidants, helps cleanse the scalp by removing pollutants and dead skin cells. Coconut oil serves as an effective moisturizer, helping to seal moisture into the hair and prevent dryness, flakiness, and dandruff. This review article examines the ingredients necessary for formulating hair serums and the various tests used to evaluate their effectiveness.

**Keyworlds :** In vitro study , efficacy of cosmetic product , keratin , plant based ingradient , hair sterngth

➢ **Introduction :**

Hair is a complex structure with distinct chemical and physical properties. It is a slender, flexible strand of keratin that possesses remarkable strength and elasticity. Hair care products are designed to enhance its appearance, and hair itself undergoes a natural cycle involving the merging, growth, and shedding of the hair shaft. Hair grows from follicles that pass through the anagen, catagen, and telogen phases, and it consists of a root, shaft, and tip. As people age and hair begins to lose pigment, turning white, various cosmetic products are developed to promote growth and prevent hair loss. Cosmetic science is a recognized and multidisciplinary field that draws from many scientific areas due to its broad and informative nature. It involves the research, design, and manufacturing of cosmetics and personal care products.

Cosmeceuticals represent a rapidly growing niche within dermatology and the skincare industry. "Natural" or "herbal cosmetics" refer to products formulated with approved cosmetic ingredients combined with one or more herbal components, intended specifically to provide cosmetic benefits. These herbal cosmetics are preparations that incorporate plant-based phytochemicals from a variety of botanical sources. The aim of the study was to evaluate the risk factors associated with synthetic product usage, especially in contrast with local herbal products, and to measure user satisfaction with hair serums made from local herbal ingredients.[25]

- **Advantages**

Hair serum enhances natural shine and helps protect hair from environmental stress and heat damage due to its deep moisturizing effects. Serusms help retain moisture, leading to healthier, less brittle hair while also improving smoothness and appearance. Additionally, their anti-frizz properties contribute to a smoother hair texture.

- **Disadvantages**

However, frequent or excessive application can potentially lead to hair damage.[25]

➢ **Experimental :**

**Materials and method**

**1.Alternanthera sessilis:** A perennial herb from the Amaranthaceae family, has been utilized as food since ancient times.[1] The genus *Alternanthera* includes between 80 and 200 species. While its exact native range is unclear, some studies suggest that it was initially cultivated in North America, as well as in the tropical and subtropical regions and open forests of South America. [2]

It contains many of the Phytochemical compounds especially stigmasterol, campesterol, ß-sitosterol, α -, ß-spinasterol, palmitates of sterol, etc.Taxonomic Hierarchy

- Kingdom: Plantae
- Subkingdom: Tracheobionta
- Super division: Spermatophyta
- Division: Magnoliophyta
- Class: Magnoliopsida
- Sub Class: Caryophyllidae
- Order: Caryophyllales
- Family: Amaranthaceae
- Genus: Alternanthera
- Species: Alternantherasessilis (L.) R Br
- Synonym; Alternantheradenticulata R. BrownAlternantheranodiflora R. Brown Gomphrenasessilis L AlternantheraglabraMoq.
- Vernacular Names:
- Tamil: Ponnankanni ,Citai, Koduppai
- Malayalam: Meenamgani,Ponnankannikkira
- Sanskrit: Matsyaki, lonica
- Hindi: Gudrisag, Garundi
- Kannada: Honagonesoppu
- Telugu: Ponnagantikura
- Bengali: Chanchi, Haicha, Sachishak
- Marathi: Kanchari
- Manipuri: Phakchet
- Other Geographical names:
- French: Brede Chevrette, Magloire.
- Portuguese: Bredo-D,Periquito-Sessil,Perpétua.
- Indonesian :DaunTolod
- Malaysia: Keremak.
- Sinhalese: Mukunu-Wenna
- Chinese: LianZi Cao, Bai Hua Zi
- Geographical distribution: This is a pioneer species,
- typically growing on disturbed parts of a variety of wetland
- habitats, often in species-rich associations with a range of

other aquatic and wetland plants[24]

The uncertainty surrounding the exact number of species in the *Alternanthera* genus is primarily due to the considerable variability among its species. This variability stems from differences in growth habit, flower color, chemical composition of the leaves and stems, and overall morphology. Cross-pollination occurs easily in *Alternanthera sessilis*, leading to significant diversity and variety, which has prompted some researchers to reclassify certain sections of the genus. *Alternanthera sessilis* is a small, herbaceous plant that typically grows up to 1 meter in height. Its leaves can be opposite, simple, with petioles, and vary in shape from linear to obovate. The flowers are bisexual and range in color from white to pink. The most common varieties of *Alternanthera sessilis* are generally considered perennials, though some can be annuals. Over the past few decades, the demand for this noxious weed has increased due to its widespread use in both food and medicine, thereby enhancing its economic value.

This plant is known by various names in different languages. In Hindi, it is called "Gudrisag"; in Telugu, "Ponnagantikura"; in Malayalam, "Minannani," "ponnannani," or "ponnankannikkira"; in Kannada, "Honugonesoppu"; and in Tamil, "Ponnannkannikkirai." In Malaysia, it is commonly referred to as "keremak," "pudohrumputaoh," and "serapat," depending on the local region. Other common names for *Alternanthera sessilis* include "water amaranth," "Dwarf Copperleaf," "Sessile Joy weed," and "Carpet

Weed."Among the most widely recognized varieties of this plant is "Abisrana," also known as *Alternanthera sessilis*, which has several cultivars that vary in flavor, scent, and use. Over 120 named cultivars exist, with popular examples including *Alternanthera sessilis* "narrow leaf cultivars," *Alternanthera sessilis* "Abisrana," and *Alternanthera sessilis* "water amaranth." Depending on the growing conditions, the leaf size and shape of *Alternanthera sessilis* can vary from lanceolate to more ovate, and its growth habit can range from creeping to upright.[3]

**Fig.1 Alternanthera sesillis**

**Pharmacological activity:**

Alternanthera sessilis, a plant with a rich history of medicinal use, is employed in the treatment of a diverse array of health conditions, including fever, skin wounds, and digestive disorders. Additionally, it is valued for its galactagogue, febrifuge, abortifacient, and cholagogue properties. In traditional medicine systems, such as Ayurveda and Siddha, this plant is revered for its cooling, digestive, and hepatoprotective properties.[4]

**2. Maca : Maca (Lepidiummeyenii Walp.)**, commonly known as Peruvian ginseng, is a biennial plant native to the high Andes of Peru, particularly around the Junín Plateau at elevations above 3,500 meters. It belongs to the **Brassicaceae** family and has been cultivated for over 2,000 years for its **nutritional and medicinal** value.

Traditionally consumed as a food and herbal remedy by indigenous populations, maca is valued for its **adaptogenic properties**, meaning it may help the body resist physical and mental stress. The most commonly used part of the plant is the **hypocotyl (root)**, which is dried and ground into powder or used in extracts.

In recent decades, maca has gained international attention due to its potential **pharmacological activities**, including **enhancing fertility and libido**, **alleviating menopausal symptoms**, **boosting energy and endurance**, and **supporting cognitive function**. Unlike many hormone-related supplements, maca does not contain phytoestrogens or steroids, but it appears to influence hormonal balance through bioactive compounds such as **macamides, macaenes**, and **glucosinolates**. Ongoing research continues to explore its wide range of **biological effects**, positioning maca as a promising **functional food** and **natural therapeutic agent** in modern phytotherapy and integrative medicine.[29]

**Fig.2 Maca**

**3.Flexseed oil :** Flaxseed, also known as linseed, is increasingly recognized as an important functional food due to its rich content of alpha-linolenic acid (ALA), a type of omega-3 fatty acid, along with lignans and dietary fiber. These components may contribute to lowering the risk of various health conditions, including cardiovascular disease, atherosclerosis, diabetes, cancer, arthritis, osteoporosis, as well as autoimmune and neurological disorders. Additionally, flaxseed is packed with antioxidants and healthy fats that help detoxify the scalp by removing dead skin cells and impurities. Using flaxseed gel on the scalp and hair can act as a

natural moisturizer, encouraging hair growth and strengthening existing strands. Flaxseed extract also helps keep the skin hydrated and elastic, making it suitable for all skin types—whether normal, dry, or oily. Furthermore, flaxseed oil nourishes damaged hair, calms irritated scalps, and adds body to dull, lifeless hair.[25]

**Fig.3 Flexseed oil**

**4. Rose water :** Rose water is a fragrant liquid made by steeping rose petals in water or distilling rose petals with steam. It has been used for centuries across many cultures for its numerous benefits and pleasant aroma. Originating from ancient Persia, rose water has traditionally been a part of skincare, culinary arts, religious rituals, and medicine.In modern times, rose water remains popular due to its **soothing**, **anti-inflammatory**, and **hydrating** properties. It is widely used in **cosmetics**, **perfumes**, **culinary dishes**, and **aromatherapy**. Its versatility and natural origin make it a gentle and effective ingredient for both health and beauty routines.[30]

**Fig.4 Rose water**

**5. Vitamin E:** An oil rich in vitamin E can help bring back shine by repairing the hair's protective barrier. Generally, oil acts as a sealant to lock in moisture, reduce breakage, and shield hair from damage. Vitamin E, in particular, may promote a healthy scalp and hair growth thanks to its natural antioxidant properties. These vitamins and antioxidants help lower oxidative stress and neutralize free radicals, which can otherwise damage the cells of the hair follicles on the scalp.[30]

**Fig.5 Vitamin E capsule**

**6.Caster oil:** Castor oil is a vegetable oil obtained by pressing the seeds of the *Ricinuscommunis* plant, commonly known as the castor bean plant. It has been used for centuries for its wide range of medicinal, industrial, and cosmetic properties.

Rich in **ricinoleic acid**, a unique fatty acid, castor oil is known for its **anti-inflammatory, antimicrobial, and moisturizing** effects. It is a thick, pale yellow liquid with a distinct taste and odor.Traditionally, castor oil has been used as a **natural laxative**, and it's also a popular ingredient in **hair and skin care products**,

thanks to its ability to deeply hydrate and promote growth. Beyond personal care, castor oil serves as a valuable component in **lubricants, paints, dyes, coatings**, and even **biofuels**.[25]

**Fig.6 Caster oil**

**7. Glycerin : Glycerin**, also known as **glycerol**, is a **colorless, odorless, and sweet-tasting liquid** that is widely used in pharmaceuticals, cosmetics, food, and industrial applications. It is a **trihydroxy alcohol** with the chemical formula **C3H8O3** and consists of three hydroxyl (-OH) groups.Glycerin is a **natural compound** typically obtained from **animal fats or plant oils** during the process of saponification (soap making) or through the hydrolysis of fats. It is also produced synthetically.Because of its **non-toxic, moisturizing, and hygroscopic** (water-attracting) properties, glycerin is commonly found in skincare products, cough syrups, toothpaste, and processed foods. It is also used as a solvent, preservative, and in antifreeze mixtures due to its ability to lower the freezing point of water.


**Fig.7 Glycerin**

**8.Peppermint oil:**

Peppermint oil is an essential oil derived from the leaves of the peppermint plant (*Mentha* × *piperita*), a hybrid species of spearmint and watermint. Known for its distinct cooling effect and invigorating scent, peppermint oil has a wide range of uses, both in traditional medicine and modern applications. The oil is extracted through steam distillation from the fresh leaves and flowering tops of the peppermint plant. It contains menthol, which gives peppermint its characteristic cooling sensation and contributes to its medicinal properties. Peppermint oil is used in various products, including lotions, shampoos, toothpaste, candles, and even food flavorings. When using it for therapeutic purposes, it's important to dilute peppermint oil properly to avoid skin irritation or adverse reactions. Its versatility and natural origins make peppermint oil a popular choice for those seeking alternative remedies or ways to enhance their well-being.[31]

**Fig.8 Peppermint oil**

➢ **Method of Extraction:**

**Meciration-**

Preparation of extracts:

The plant leaves were collected and washed thoroughly 3-4 times with running tap water and shade dried for 3 -5 days. periodically the moisture level of the leaves was observed. once it is completely dried using electric grinder, the plant leaves were powdered . 20 grams of the dried powder of Alternanthera sessilis (Linn) leaves placed in four separate round bottom flask for sample extraction using two solvents namely aqueous, ethanol. The extraction was conducted with 280 ml Ethanol and 120 ml of water for period of 96hrs [4 days]. At the end , extraction was filtered and solvent were evaporate by heating mental and the crude extracts were stored in air tight containers at 4-5° C aseptically in refrigerator for the further use.[28]

**Fig.9 Meciration**


**Fig.10 Evaporation of ethanol**

➢ **Phytochemical analysis-**

Phytochemical analysis involves identifying the primary classes of chemical compounds present in a plant extract. Preliminary screening was conducted to assess the qualitative presence of various compounds in the tested weed plant, such as alkaloids, carbohydrates, cardiac glycosides, flavonoids, phenols, amino acids/proteins, saponins, tannins, terpenoids, quinones, and coumarins. These compounds, known as secondary metabolites, are crucial in determining the medicinal potential of a plant species. According to the available literature, different chemical tests were performed to detect the presence or absence of these secondary metabolites. [26][28]

➢ **Test for Alkaloids (Wagner's test)** [27]

1 ml of plant extract was taken and added 3 –5 drops of Wagner's reagent [1.27g of Iodine and 2g of potassium iodide in 100 ml of water] and observed for the formation of Reddish-brown precipitate or coloration indicated the presence of alkaloids.

➢ **Test for carbohydrates (Molisch's test)**

1 ml of plant extract was taken and added 3 - 5 drops of Molisch's reagent, along with this Added 1 ml of conc. Sulphuric acid ($H_2SO_4$) down the side of the test tube. Then allowed the mixture to stand for 2 - 3 min. It was observed red or dull violet color at the interface of the Two layers which indicates the presence of carbohydrates

➢ **Test for Cardiac glycosides (Keller Killiani Test)**

1 ml extracts was taken and treated it with 1 ml of glacial acetic acid and 2 – 3 drops of 5 % ferric chloride solution. This was under layered with 1 ml. of conc. sulphuric acid. Observed a brown ring at the interface shows the presence of deoxy sugar characterstics of Cardenolides. A violet ring was appeared below the ring while in the acetic acid layer, resulted information of greenish ring

- **Test for Flavonoids (Alkaline reagent test)**

1 ml of extract was taken and treated it with 3 – 5 drops of 20 % NaOH solution. It was Observed for the formation of intense yellow color which becomes colorless on addition of 0.5 ml Dil. HCL indicated the presence of flavonoids

- **Test for phenols (ferric chloride test)**

2 ml of distilled water followed by few drops of 10%ferric chloride was added to 1ml Of the extract. Formation of blue or green color indicated the presence of phenols.

- **Test for Amino acid and Proteins (1% ninhydrin solution in Acetone)**

Take 1ml of extract and add 2-5 drops of aqueous ninhydrine solution and keep it in a boiling water bath for 1-2 min and observe for the formation of purple color.

- **Test for Saponins (foam test)**

1 ml of extract was taken and added to water and shaken well Vigorously. Observed For the formation of honey comb like foam for 10 – 15 min. indicated the presence of Saponins.

- **Test for Tannins (Braymer's test)**

1 ml of extract was taken and treated it with 1 ml of 10% alcoholic ferric chloride solution and observed for the formation of blue or greenish color indicated the presence of Tannins

- **Test for Terpenoids (Salkowski test)**

1 ml of extract was treated it with and 0.5 ml of conc. HCL and observed for the formation of yellow precipitate or coloration. Indicated the presence of terpenoids

- **Test for Quinones**

1 ml of extract was taken and added 5ml distilled water and observed the Turbidity indicated the presence of quinones.

- **Test for Coumarins**

1ml of extract was taken and added 1.5 ml of 10% NaOH. It was observed the formation of yellow color indicated the presence of coumarins.


**Fig no.11**


**Fig.no.12**

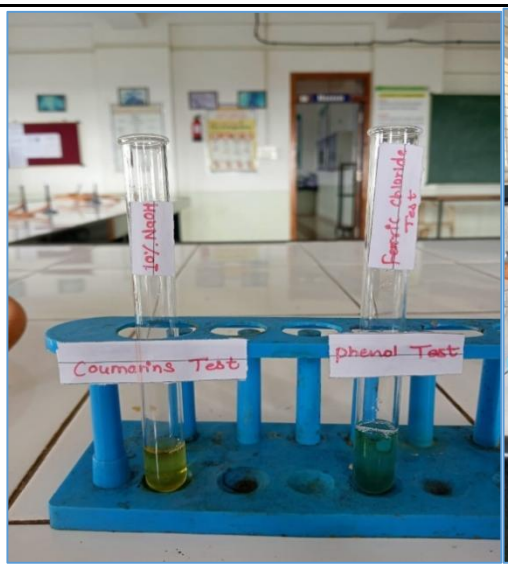



Fig.no.13

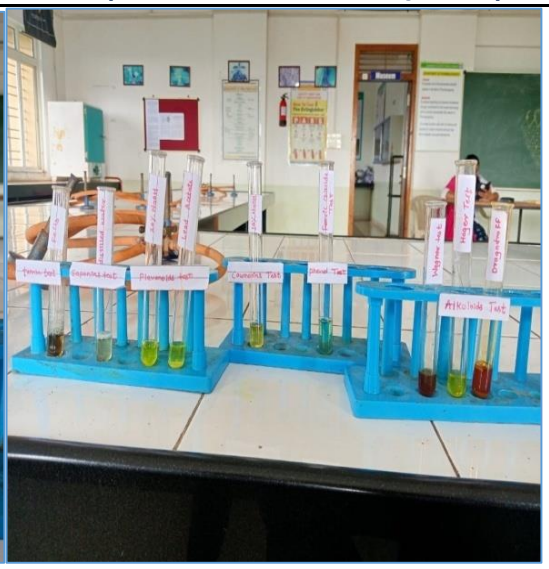


Fig.no.14

- **Result of chemical test:**

| Sr. no | Chemical constituent | Test | Result |
|---|---|---|---|
| 1 | Test for Alkaloids | 1.Wagner's test<br>2.Hagar's test<br>3.dragandroff test | +ve |
| 2 | Test for carbohydrates | Molisch's test | +ve |
| 3 | Test for Cardiac glycosides | Keller Killiani Test | +ve |
| 4 | Test for Flavonoids | Alkaline reagent test | +ve |
| 5 | Test for phenols | ferric chloride test | +ve |
| 6 | Test for Amino acid and Proteins | 1% ninhydrin solution in Acetone | +ve |
| 7 | Test for Saponins | foam test | +ve |
| 8 | Test for Terpenoids | Salkowski test | +ve |
| 9 | Test for Tannins | Braymer's test | +ve |

➢ **Molecular Docking :**

**Introduction:**

**MolSoft's ICM Software for Docking**

**MolecularDocking**

ICM is extensively used for protein-ligand docking, simulating how small molecules bind to target protein structures. It employs a flexible docking approach, enabling both the ligand and receptor to undergo conformational changes during the process. This flexibility often leads to more accurate predictions compared to rigid docking methods.

**High-PrecisionScoringFunctions**

ICM incorporates advanced scoring functions to predict binding affinities and rank ligand docking poses. The scoring system evaluates a range of physical and chemical interactions, including van der Waals forces, hydrogen bonds, and electrostatic interactions

**FlexibilityinDocking**

The software supports flexible docking, accommodating the dynamic nature of both ligands and receptors. This feature is crucial for macromolecules, such as proteins, that frequently undergo substantial conformational changes upon binding.

**VirtualScreening**

ICM includes high-throughput virtual screening tools, enabling researchers to scan large compound libraries against a target protein. This helps identify potential ligands with strong binding affinities.

**Ligand-BasedandStructure-BasedApproaches**

ICM supports both structure-based docking (using an existing protein structure) and ligand-based docking (deriving the binding site from a known ligand).

**Analysis**

The docked poses can be analyzed for interactions like hydrogen bonding, hydrophobic contacts, and electrostatic forces, providing insights into the binding mechanism.

➢ **Androgen Receptor Crystal Structure (PDB code 4K7A):**

The crystal structure of the androgen receptor (AR) with PDB code 4K7A is available on the **RCSB Protein Data Bank** (www.rcsb.org).

This structure is important for understanding how ligands interact with the androgen receptor, which plays a crucial role in androgen signaling in various tissues[33]

➢ **Procedure of Docking:**

**Preparation of protein receptor**

The crystal structure of the androgen receptor (PDB code 4K7A) was obtained from **https://doi.org/10.2210/pdb4k7a/pdb** with a resolution of 2.44 Å. Furthermore, the Auto Dock Tools program were used to use to provide a grid box to determine spatial shape and spatial coordinates as docking materials. [35]

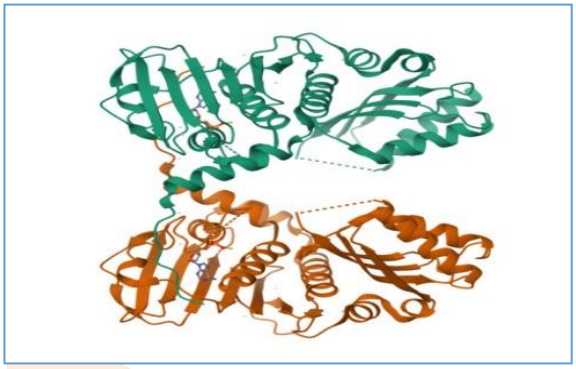


**Fig.15 Protein 4K7A**

Two-dimensional structures of CHEMICAL CONSTITUENT and test ligands derived from the leaves of *ALTERNANTHERA SESSILS AND ECLIPTA PROSTATA from [https://pubchem.ncbi.nlm.nih.gov/]*

➢ **Steps Involve in Molecular Docking**

**Step 1: Prepare the Receptor (Protein)**

- Obtain the 3D structure of the target protein (e.g., from the PDB).
- Clean the structure by removing water molecules, ligands, and other non-essential components.
- Assign partial charges and prepare the binding site for docking.

**Step 2: Prepare the Ligand (Small Molecule)**

- Obtain or design the ligand molecule.
- Optimize the ligand's structure by minimizing its energy.
- Perform a conformational search to model the ligand's flexibility.

**Step 3: Set Up Docking Parameters**

- Choose the docking mode (rigid or flexible docking).
- Define the docking grid or search space, typically based on the binding site.
- Select the docking algorithm (e.g., Monte Carlo, genetic algorithm).

**Step 4: Perform Molecular Docking**

- Dock the ligand into the receptor's binding site.
- Search for the most optimal ligand-receptor binding poses.
- Evaluate multiple ligand poses during the docking process.

**Step 5: Scoring and Ranking of Poses**

- Apply scoring functions to estimate binding affinity (e.g., energy-based scoring).
- Rank the ligand poses based on their predicted binding affinity.
- Filter the top-ranking poses for further analysis.

**Step 6: Analyze Docking Results**

- Visualize the docked ligand-receptor complex.
- Examine critical interactions, such as hydrogen bonds, hydrophobic interactions, and electrostatics.
- Refine and optimize the docking poses if necessary.

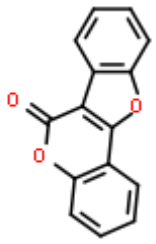
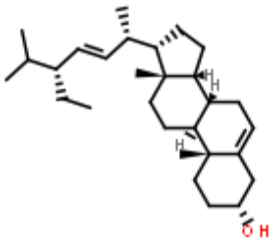
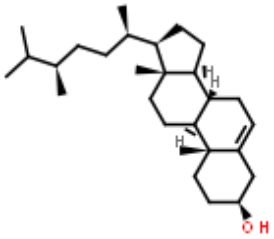
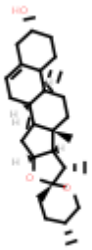
**Step 7: Post-Docking Analysis and Refinement**

- Further optimize the ligand-receptor interactions to improve binding.
- Perform free energy calculations to obtain more accurate binding affinity estimates.
- Explore potential ligand modifications and re-dock if required.

**Step 8: Reporting and Final Output**

- Generate final reports that include binding affinity scores and ligand poses.
- Export results for publication or further research.[34]

➢ **Result of docking :**

| Sr.no | Chemical constituent | Ligand molecule | Score |
|---|---|---|---|
| 1 | Quercetin |  | -21.09 |
| 2 | Stigmasterol |  | 26.21 |
| 3 | Campesterol |  | 38.34 |
| 4 | Diosgenin |  | 12.24 |

➢ **Conclusion of docking :**

Molecular docking revealed promising interactions between Alternanthera sessilis compounds and target proteins. This highlights the plant's potential for therapeutic drug discovery. According to score, Quercetin shows high binding affinity to protein.

➢ **Formulation table:**

| Sr. no | Ingredients | Batches | | | Role |
|---|---|---|---|---|---|
| | | B1 | B2 | B3 | |
| 1 | AlternantheraSesillis Extract | 3 g | 3 g | 3 g | Hair growth stimulant |
| 2 | Maca extract | 2 g | 2 g | 2g | Strengthens hairs |
| 3 | Flexseed oil | 3 ml | 2ml | 1 ml | Smoothning hairs. |
| 4 | Castor oil | 5 ml | 2 ml | 2 ml | Emollient,Moisturizing agent |
| 5 | Peppermint oil | 1 ml | 0.5 ml | 0.5 g | Promote hair follicle activity. |
| 6 | Glycerin | 5 ml | 2 ml | 2 ml | Humactant, hydrate hairs |
| 7 | Vitamin E | 1 ml | 0.5 ml | 0.8 ml | Antioxidant |
| 8 | Tween 80 | 1 ml | 0.5 ml | 0.5 ml | Emulsifier |
| 9 | Methyl paraben | 0.1 g | 0.05 g | 0.1 g | Preservative |
| 10 | Rose water | 10 ml | 5 ml | 5 ml | Perfume |
| 11 | Purified water | q.s. | q.s. | q.s. | Solvent |


**Fig.no 16 formulation batches**

➢ **Procedure:**

1. Take beaker in that add given quantity of alternanthera sessilis extract, maca extract in water and apply heat .
2. In above solution add glycerin, continous heating at 70 º c
3. In another beaker add required quantity of castor oil , peppermint oil , flexseed oil , tween 80.Heat the solution at 70º c .
4. Mix. Aqueous phase into oil phase at 70ºc by continous stirring .
5. Cool the mixture and add vitamin E , preservative and rose water .
6. Homogenize mixture by using mechanical stirrer at 140 rpm for 30 min.
7. Store serum in well closed container. [30]


**Fig.no .17 mechanical stirrer**

➢ **Evalution test and Result :**

**1. Organoleptic Properties:** The organoleptic characteristics of the formulated cosmetic serum—such as texture, color, and odor—were evaluated through direct observation.

**2. pH Determination:** The pH of the formulation was measured using a calibrated digital pH meter.

| Sr. No | Batch | pH |
|---|---|---|
| 1 | B1 | 4.6 |
| 2 | B2 | 5.9 |
| 3 | B3 | 5.3 |


**Fig.18 pH meter**

3. **ViscosityDetermination:**

Viscosity was assessed using a Brookfield Viscometer set to 100 rpm, employing spindle number 62

| Sr.No | Batch | Viscosity |
|---|---|---|
| 1 | B1 | 880 |
| 2 | B2 | 1094 |
| 3 | B3 | 756 |


**Fig no.19 Brookfield viscometer**

**4.Spreadability Test:**

Spreadability was evaluated using a standard parallel plate method commonly applied to semi-solid formulations. One gram of the hair serum was placed between two horizontal glass plates measuring 20 × 20 cm, with a 125 g weight applied to the upper plate. The diameter of the spread was recorded after one minute.


**Fig no.20 Spredability test**

Spreadability (S) was calculated using the following formula:

S=M×L\T

S= 150×6.8\1

S= 1020

Where:

- **S** = Spreadability
- **M** = Weight applied on the upper slide (g)
- **L** = Distance traveled by the upper plate (cm)
- **T** = Time taken to fully separate the plates (sec)

**5.HomogeneityTest**

To evaluate homogeneity, a small amount of serum was evenly spread on a clean glass slide and covered with a cover slip. The sample was visually inspected under light for the presence of coarse particles, lumps, flocculates, or aggregates.

**6.StabilityTest**

The herbal hair serum was stored for a duration of three months under two different conditions: at 4 ± 2°C and at 30 ± 2°C with 65% relative humidity. After the storage period, the pH and viscosity were re-evaluated and compared to the initial values to assess stability. [25] [32]

## ➢ Conclusion :

In contrast to the wide availability of other beauty products, natural cosmetics are both safe and effective for use on all hair types. Studies show that herbal hair serums provide essential nutrients necessary for maintaining normal sebaceous gland function and promoting natural hair growth. Medicinal plants have been used for centuries to treat hair issues, owing to their lower risk of side effects and allergic reactions. In India's traditional medical system, many herbal remedies are recommended for stimulating hair growth. One of the key benefits of herbal extracts is their ability to nourish hair and supply microproteins, ensuring its safety. Because herbal cosmetics are free from parabens and sulfates, they are increasingly popular in the personal care industry and are highly sought after in daily use. Through trial and error, a successful herbal

hair serum formulation has been developed and tested. The results of the study show that the serum's natural ingredients support hair growth and maintenance. Flaxseed and fenugreek, known for their antioxidant properties, along with amino acids, help promote hair growth and prevent premature greying. The plant extract from Alternanthera sessilis is rich in nutrients, nourishing the scalp and protecting it from dandruff and irritation. Besides soothing scalp irritation, this plant also aids in hair growth, reducing both hair loss and promoting the growth of new hair. With their safety and minimal risk, these natural alternatives are an excellent choice compared to synthetic chemicals.

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