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Formulation And Evaluation Of Polyherbal Shampoo Using Neem, Shikakai, Reetha, Fenugreek Seeds And Amla: A Review

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Abstract:

The rising use of herbal products for hair care highlights their safety and effectiveness. This review paper emphasizes the formulation and evaluation of a polyherbal shampoo containing Neem (Azadirachta indica), Shikakai (Acacia concinna), Reetha (Sapindus mukorossi), Fenugreek seeds (Trigonella foenum-graecum), and Amla (Emblica officinalis) .These herbs are well known on their own for having a range of hair-enhancing properties such as antimicrobial and anti-inflammation activity, conditioning, and hair growth promotion. In this review, the description begins with the phytochemical profile, ethnobotanical literature, and pharmacological rationales of these herbs and is followed by the formulation approach including the different extraction processes, chosen surfactants, preservatives, and other ingredients. Finally, it brings together the many assessment criteria used to determine the safety and effectiveness of the polyherbal shampoo, which includes the physicochemical properties, ability to foam, cleansing effect, and irritant potential.

1. Introduction:

Hair serves as a major marker of individuality, interpersonal relations, and social interactions. It is exposed to a variety of environmental aggressors, chemical treatments, and intrinsic factors such as aging and hormonal changes. These impact a person's hair cosmetic features like hair loss, dandruff, and dryness. Due to increased awareness on possible harmful reactions of synthetic chemicals of traditional hair care products, there has been a shift towards the use of herbal and natural products as alternatives. With the increased perception of their safety, decreased side effects, and therapeutic properties, herbal formulations, especially herbal shampoos, are gaining popularity. The utilization of herbal or medicinal plants for the care of a person’s hair is not new to other systems of medicines. It is well known that Ayurveda has been using herbs to enhance hair growth, avoid hair fall, and look after the scalp. The primary objective of this review is to elaborate the developed herbal shampoo which contains five important herbs, Neem (Azadirachta indica), Shikakai (Acacia concinna), Reetha (Sapindus mukorossi), Fenugreek seeds (Trigonella foenum-graecum), and Amla (Emblica officinalis). These herbs were

carefully chosen due to their established traditional claims as well as scientifically proven claims to promote hair health.

2. Botanicals and Their Phytochemical Composition:

As mentioned in the background, the therapeutic effects of herbal formulations is based on the assorted cocktail of bioactive constituents that the plant extracts contains. The five botanicals featured in this review are systematically selected because each of them have distinctive phytochemical characteristics that account for each of their beneficial properties towards hair.

2.1 Neem (Azadirachta indica):

Neem (Azadirachta indica) known as evergreen tree, is indigenous to the subcontinent of India and has been used for its medicinal properties in traditional medicine for centuries. Leaves, seeds, bark, and even oil from the neem tree are rich in compound of diverse bioactive constituents.

● Azadirachtin: One of the most studied constituents of neem is Azadirachtin, a potent and remarkable tetranortriterpenoid that has great insecticidal activity. Neem's ability to treat scalp infections and dandruff is attributed to arachidonic acid's antifungal, antibiotic, and antiviral properties.

● Nimbin and Nimbidin: Besides Azadirachtin, other noteworthy triterpenoids include Nimbin and Nimbidin. These constituent are known for their inflammation and Fungus inhibiting and bacterial properties. Hence they help in soothing scalp irritation, controlling inflammation, and help in fighting against fungus which causes dandruff.

● Quercetin: This is a flavonoid with great antioxidant activity. It helps protect hair from for Traditional Applications of Neem in Hair Care:

Neem has been employed in traditional medicine for various scalp and hair ailments, including:

● Dandruff: The antifungal activity of neem proves useful in managing dandruff and alleviating related itching and flaking.

● Scalp Infections: The antibacterial and antifungal actions of neem treat several infections of the scalp, including folliculitis and seborrheic dermatitis.

● Hair Fall: Neem is said to make hair follicles stronger and encourage hair growth, thereby inhibiting hair fall.

● Lice Infestation: Neem oil contains insecticidal chemicals that are helpful in the treatment of head lice infestation.

Scientific Validation of Neem's Efficacy:

There have been several scientific experiments that have authenticated neem's age-old uses in hair care.

● It has been proved through studies that neem works against Malassezia furfur, the causative fungus for dandruff.

● Studies have indicated that neem extracts inhibit the growth of bacteria and fungi responsible for scalp infections.

● Neem oil has been said to induce hair growth by enhancing blood flow to the scalp and making hair follicles stronger.

2.2 Shikakai (Acacia concinna):

Shikakai, a climbing shrub native to tropical regions of Asia, has been used for centuries in traditional hair care practices. The pods, bark, and leaves of the shikakai plant contain valuable bioactive compounds.

● Saponins: They are natural surfactants present in large quantities in shikakai pods. Saponins yield foam and cleansing action, rendering shikakai a good natural shampoo for hair and scalp. They remove dirt, oil, and impurities while being gentle on the hair, without damaging the hair by stripping off its natural oils.

● Alkaloids: Alkaloids such as acacic acid and lupeol present in shikakai have anti-inflammatory and antimicrobial activities. These substances are capable of soothing irritation of the scalp as well as inhibiting infections.

● Tannins: Polyphenolic chemicals that are responsible for hair strengthening and conditioning. Tannins are able to cross-link with hair proteins, strengthening the hair, reducing the likelihood of hair breakage, and increasing manageability.

● Vitamins: Vitamins A, C, D, E, and K are present in shikakai and are responsible for healthy hair and scalp. These vitamins nourish hair, cause growth of hair, and maintain healthy hair.

Traditional Applications of Shikakai in Hair Care:

Shikakai has been traditionally applied for the following hair care applications:

● Natural Cleanser: The saponin content in Shikakai makes it a good natural cleanser that effectively removes dirt and oil from the scalp and hair.

● Conditioner: Shikakai conditions the hair, making it soft, smooth, and easy to manage.

● Promotion of Hair Growth: Shikakai is said to promote hair growth by nourishing the scalp and making hair roots strong.

● Dandruff Control: Shikakai's mild cleaning and antimicrobial action can control dandruff.

Scientific Validation of Shikakai's Efficacy:

Scientific research has validated the ancient applications of shikakai in hair care.

● Experiments have proven shikakai's function as a mild surfactant, efficiently cleaning the hair without leading to excessive dryness.

● Research has established that shikakai extracts can enhance hair texture, enhance hair shine, and minimize hair breakage.

● Certain research indicates that shikakai can possess anti-inflammatory and antimicrobial properties that can be useful for scalp health..

2.3 Reetha (Sapindus mukorossi):

Reetha, or soapnut, is a deciduous tree whose fruits contain high levels of saponins. These saponins render reetha a natural surfactant and cleansing agent.

● Saponins (Sapindosides): Fruits of reetha are rich in saponins, specifically sapindosides. Saponins present in reetha are accountable for the excellent foaming and cleansing ability of reetha. Saponins form a lather upon mixing with water and efficiently cleanse the hair and scalp of dirt, oil, and impurities.

● Sesquiterpenoids: Reetha is also rich in sesquiterpenoids, which are responsible for its anti-inflammatory and antimicrobial action. These sesquiterpenoids can help ease irritation of the scalp and avert infections.

● Sugars: The presence of sugars such as glucose and fructose in reetha has moisturizing advantages. The sugars hydrate the scalp and hair, thus keeping them from getting dry and also enhancing hair texture.

Traditional Uses of Reetha in Hair Care:

Reetha has been traditionally used for various hair care purposes:

● Natural Cleanser: Reetha is primarily used as a natural cleanser for hair and scalp. Its saponin content makes it an effective alternative to synthetic surfactants.

● Gentle Cleansing: Reetha is known for its mild cleansing action, which cleanses the hair without stripping it of its natural oils.

● Shine Enhancer: Reetha is believed to impart shine to the hair, making it look healthy and lustrous.

● Dandruff Control: Reetha's antimicrobial properties may help in controlling dandruff.

Scientific Validation of Reetha's Efficacy:

Scientific studies have validated the traditional uses of reetha in hair care.

● Research has confirmed reetha's surfactant properties and its ability to produce a stable foam.

● Studies have shown that reetha is a safe and effective cleansing agent for hair, with minimal irritation potential.

● Some studies suggest that reetha extracts may have antimicrobial activity against certain scalp pathogens.

2.4 Fenugreek Seeds (Trigonella foenum-graecum):

Fenugreek, an annual herb, has been used in traditional medicine for various purposes, including hair care. Fenugreek seeds are a rich source of nutrients and bioactive compounds.

● Saponins: Fenugreek seeds contain saponins, including diosgenin and yamogenin, which have been shown to possess anti-inflammatory and hair growth-promoting properties. These saponins may help stimulate hair follicles and promote hair growth.

● Mucilage: Fenugreek seeds are rich in mucilage, a gel-forming fiber that provides conditioning and moisturizing effects. Mucilage helps to hydrate the hair, improve its texture, and make it more manageable.

● Proteins and Amino Acids: Fenugreek seeds are a good source of proteins and amino acids, which are essential for hair growth and repair. These nutrients provide the building blocks for keratin, the protein that makes up hair.

● Nicotinic Acid: Also known as vitamin B3, nicotinic acid improves blood circulation to the scalp. Increased blood flow to the scalp can nourish hair follicles, promote hair growth, and prevent hair loss.

Traditional Uses of Fenugreek Seeds in Hair Care:

Fenugreek seeds have been traditionally used for various hair care purposes:

● Hair Fall Treatment: Fenugreek is a popular remedy for hair fall. It is believed to strengthen hair roots, reduce hair breakage, and promote hair growth.

● Dandruff Treatment: Fenugreek's anti-inflammatory and antimicrobial properties may help in controlling dandruff and relieving scalp itching.

● Dry Scalp Treatment: Fenugreek's mucilage content provides moisturizing benefits, making it effective in treating dry scalp and improving hair hydration.

● Hair Conditioning: Fenugreek helps to condition the hair, making it soft, smooth, and shiny.

Scientific Validation of Fenugreek Seeds' Efficacy:

Scientific evidence has validated traditional fenugreek seed uses for hair care.

● Scientific research has established that fenugreek extracts can provoke hair follicle growth and stimulation.

● Science has proven that fenugreek seed extracts are anti-inflammatory and antioxidant in action and can ensure healthy scalp states.

● It has been evidenced by some research that fenugreek can also decrease dandruff and strengthen hair texture.

2.5 Amla (Emblica officinalis):

Amla, or Indian gooseberry, is a good source of vitamin C and other antioxidants. It has been used in Ayurveda for centuries to support overall health, including hair health.

● Vitamin C (Ascorbic Acid): Amla is a very rich natural source of vitamin C, a powerful antioxidant that helps safeguard hair against oxidative damage from free radicals. Vitamin C plays a crucial role in collagen formation, which helps ensure hair strength and breakage prevention.

● Tannins: Amla is a rich source of tannins like ellagic acid and gallic acid that have been observed to make the hair follicles stronger and hinder hair loss. Tannins are capable of binding with proteins in hair and making the hair stronger and resilient to damage.

● Flavonoids: Amla is a source of flavonoids like kaempferol and quercetin, which are anti-inflammatory and antioxidant agents. These elements are capable of shielding the scalp from oxidative damage and inflammation.

● Minerals: Amla has vital minerals such as iron, calcium, and phosphorus, which are essential for feeding the scalp and encouraging healthy hair growth.

Traditional Applications of Amla in Hair Care:

Amla has been traditionally applied for different hair care uses:

● Promotion of Hair Growth: Amla is said to encourage the growth of hair, fortify hair follicles, and retard hair loss.

● Prevention of Premature Grayness: Amla is said to prevent premature grayness of the hair. Its antioxidant functions shield hair pigment cells from destruction.

● Hair Strengthening: Amla strengthens the hair shaft, lowering hair breakage and enhancing overall hair health.

● Dandruff Control: The antimicrobial and anti-inflammatory properties of amla can assist in controlling dandruff and soothing scalp itch.

Scientific Validation of Amla's Efficacy:

The traditional applications of amla in hair care have been supported by scientific research.

● Amla's strong antioxidant activity and hair protection against oxidative damage have been proven by research.

● Research has indicated that amla extracts have the ability to enhance hair growth and improve hair follicles.

● Certain research indicates that amla can prevent early graying of hair.

3. Formulation Strategies:

Formulating an extraction and stable polyherbal shampoo entails meticulous attention to many factors such as the determination of proper methods of extraction, surfactants, preservatives, and additives. The objective is to formulate a product that is not only cleansing to the hair and scalp but also retains the therapeutic effects of the chosen herbs along with its stability and beauty.

3.1 Extraction Methods:

Extraction of bioactive principles from the herbs is a vital process in the formulation stage. The selection of extraction method has a considerable impact on the yield and nature of the extract, and thus on the activity of the end product. There are various extraction techniques available, each with merits and demerits.

● Soxhlet Extraction: This is an old technique that entails the continuous reflux of a solvent over the herb material. It is effective in the extraction of non-polar constituents but might not be ideal for heat-sensitive constituents.

● Maceration: This process is done by immersing the herb material in a solvent at room temperature for a long time. It is an easy and inexpensive process but can have a lower yield of extraction than other processes.

● Infusion: This process is done by immersing the herb material in hot water. It is used to extract water-soluble compounds and is ideal for herbs such as Reetha and Shikakai, which have saponins.

● Decoction: In this process, the herb material is boiled in water for a limited time. Decoction is also applied to extract water-soluble constituents and is mostly employed in extracting hard plant materials such as bark and roots.

● Supercritical Fluid Extraction (SFE): This process utilizes supercritical fluids as the solvent, such as carbon dioxide. SFE has some advantages like high efficiency in extraction, selectivity, and utilization of non-toxic solvents.

● Ultrasound-Assisted Extraction (UAE): It employs the use of ultrasound waves to intensify the process of extraction. UAE can enhance extraction yield and lower extraction time.

Considerations for Extraction of the Selected Herbs:

● Neem: Various solvents, like ethanol, methanol, and hexane, may be employed to extract different bioactive compounds present in neem. For instance, organic solvents are frequently employed for the extraction of azadirachtin.

● Shikakai and Reetha: Water-based processes like decoction and infusion can be utilized to extract the saponins present in Shikakai and Reetha.

● Fenugreek Seeds: Organic solvents and water can be employed to extract bioactive compounds from fenugreek seeds.

● Amla: Water is a widely used solvent for the extraction of water-soluble compounds such as vitamin C from Amla.

3.2 Surfactants:

Surfactants are a necessary ingredient in shampoos as they give cleansing and foam action. Surfactants function by lowering the surface tension of water so that it spreads more and can remove dirt and oil from the scalp and hair. Choice of surfactants is important in formulating a polyherbal shampoo because it can have an influence on its efficacy, safety, and feel.

● Synthetic Surfactants: They are used widely in commercial shampoos because they are excellent at cleaning and creating foam. Nevertheless, a few synthetic surfactants like sodium lauryl sulfate (SLS) can be very harsh and irritate the scalp, particularly among those with sensitive scalps.

● Natural Surfactants: They are obtained from natural sources, e.g., plants. They are typically milder and less irritating compared to synthetic surfactants. Saponins from Reetha and Shikakai and glucoside surfactants like coco glucoside and decyl glucoside are examples.

Surfactant Selection for the Polyherbal Shampoo:

For a polyherbal shampoo formula, a blend of natural and mild synthetic surfactants may be employed in order to deliver maximum performance with minimal irritation.

● Reetha and Shikakai Saponins: These surfactants are gentle cleansers and foaming agents. They are mild and will not strip the hair of its natural oils.

● Mild Synthetic Surfactants: Surfactants such as coco glucoside and decyl glucoside may be added to add foaming and cleansing action to the shampoo without leading to over-drying or irritation.

3.3 Preservatives:

Preservatives are required to inhibit microbial contamination and improve the shelf life of the shampoo. Herbal product formulations are very prone to microbial growth because they contain water and nutrients from the plant extracts. The preservative selection must take into account their effectiveness against a wide range of microorganisms, their safety profile, and their compatibility with the other formulation ingredients.

● Synthetic Preservatives: These are being widely utilized across cosmetics and personal care products. Parabens, phenoxyethanol, and sodium benzoate are some such examples. Some synthetic preservatives, although working well, raised concerns regarding possible toxicity and impacts on the environment.

● Natural Preservatives: These are plant and essential oil-based. They are usually regarded as safer and more eco-friendly compared to synthetic preservatives. Some examples include essential oils of tea tree oil, neem oil, and rosemary extract, and plant-derived chemicals such as potassium sorbate.

Preservative Choice for the Polyherbal Shampoo:

For a polyherbal shampoo, it is possible to use a mixture of mild synthetic and natural preservatives to promote product stability and safety.

● Natural Preservatives: Tea tree oil and neem oil contain antimicrobial compounds and can be added to the formula.

● Mild Synthetic Preservatives: Potassium sorbate and sodium benzoate are preservatives that can be added in minimal quantities to give an extra measure of protection from microbial growth.

3.4 Additives:

Besides the vital ingredients such as surfactants and preservatives, other additives may be added in the polyherbal shampoo formulation to improve its functioning, appearance, and sensory characteristics.

● Conditioning Agents: These actives enhance the texture, manageability, and luster of the hair. Hydrolyzed proteins, silicones, and polyquaternium compounds are examples.

● Thickeners: These actives thicken the shampoo, enhancing its consistency and application. Xanthan gum, guar gum, and cellulose derivatives are examples.

● pH Adjusters: They assist in ensuring the pH level of the shampoo remains within the ideal range for scalp and hair health (ideally 5.5-6.5). Citric acid and sodium hydroxide are examples.

● Fragrances and Colorants: Fragrances and colorants can be used to make the product more pleasing to the senses. Examples of natural fragrances and colorants include essential oils and plant dyes.

Additives for the Polyherbal Shampoo:

● Conditioning Agents: Hydrolyzed proteins can be incorporated to strengthen hair and lower breakage.

● Thickeners: Xanthan gum or guar gum can be applied to thicken the shampoo.

● pH Adjusters: Citric acid can be employed to adjust the pH of the shampoo to the range of choice.

● Fragrances and Colorants: A natural fragrance can be imparted through the use of essential oils, and colorants derived from plants can be used to beautify the product.

4. Evaluation Parameters

Testing the safety and efficacy of a polyherbal shampoo is important to determine whether it is of the desired quality and offers the desired benefits. A series of in vitro and in vivo tests can be performed to determine different aspects of the performance of the shampoo.

4.1 Physicochemical Characteristics:

These tests determine the physical and chemical characteristics of the shampoo, which may influence its stability, performance, and acceptability by the user.

● pH: The pH value of the shampoo must fall in the range 5.5 to 6.5, which is the ideal range to preserve the natural pH level of the scalp and hair. A pH meter may be used to measure the pH.

● Viscosity: Viscosity is the thickness or consistency of the shampoo. Viscosity impacts the ease of application and sensory feel of the product. Viscosity is quantifiable by a viscometer.

● Surface Tension: Surface tension is a quantitative measure of the surfactant activity of the shampoo. A lower surface tension means better wetting and cleansing ability. Surface tension is measurable by a tensiometer.

● Foaming Ability: This is a test of the volume and quality of foam generated by the shampoo. Foaming ability is crucial in terms of consumer acceptability because it is related to cleansing effectiveness. Foaming ability is quantified by shaking an aqueous solution of the shampoo and determining the volume of foam that forms.

● Cleansing Action: It is a test that measures how well the shampoo can clean hair of dirt, oil, and other impurities. Cleansing action may be measured by comparing the amount of sebum and artificial soil from hair samples after shampooing.

● Stability Studies: Stability studies analyze the physical and chemical stability of the shampoo under various storage conditions like temperatures and humidity. Stability studies are used to find the shelf life of the product and ensure that it is stable and effective over a period of time.

4.2 Safety Assessment:

These tests determine the ability of the shampoo to irritate or cause other adverse reactions.

● Irritation Tests: These tests determine the ability of the shampoo to irritate the skin or eyes. In vitro tests, including the Draize test and the neutral red uptake assay, can be utilized to determine irritation potential. Human patch tests can also be used to determine skin irritation in vivo.

● Sensitization Tests: These tests determine the ability of the shampoo to produce an allergic response. Human repeated insult patch test (HRIPT) is one of the standard methods applied to measure sensitization potential.

4.3 Efficacy Evaluation:

These tests determine the capability of the shampoo to provide the desired benefits, including hair health improvement, dandruff reduction, or hair growth stimulation.

● Dandruff Control Tests: These tests assess the ability of the shampoo to control dandruff. Clinical trials can be performed to determine the decrease in severity of dandruff and related symptoms such as itching and flaking.

● Hair Growth Promotion Tests: These tests assess the capacity of the shampoo to promote hair growth. Hair growth can be measured by determining hair length, hair density, and hair growth rate in clinical trials.

● Hair Strengthening Tests: These tests measure the capacity of the shampoo to strengthen the hair and minimize breakage. Hair strength can be measured by testing tensile strength and hair breakage in laboratory and clinical studies.

● Consumer Studies: These studies entail assessing the performance and acceptability of the shampoo among consumers. Consumers may be required to provide ratings of different dimensions of the shampoo, i.e., cleansing, foaming, conditioning property, and satisfaction.

5. Conclusion:

Formulation and testing of polyherbal shampoos with Neem, Shikakai, Reetha, Fenugreek seeds, and Amla present a viable solution to natural hair care. These botanicals contain a rich profile of bioactive compounds known with well-documented traditional applications and scientifically proven attributes in supporting hair wellness. Through the strategic choice of extraction techniques, surfactants, preservatives, and other additives, it is feasible to formulate a stable and efficacious polyherbal shampoo that conveys the therapeutic benefits of such herbs without compromising the risk of irritation and other side effects.

The assessment of polyherbal shampoos entails a general evaluation of their physicochemical properties, safety, and potency. Both in vitro and in vivo testing could be used simultaneously to verify if the product maintains the required level of quality as well as guarantees the expected advantage. Clinical research is especially used to test the effectiveness of polyherbal shampoos at treating certain concerns about the hair, including dandruff, hair loss, and hair deterioration.

The increasing popularity of natural and herbal products in hair care underlines the need for more research on this subject. Future research needs to emphasize optimizing the formulation of polyherbal shampoos, undertaking serious clinical trials to assess their effectiveness, and the development of novel extraction methods and delivery systems to improve the bioavailability of the active constituents. By reconciling the conventional wisdom with contemporary scientific methods, it is feasible to create novel and efficient herbal hair care products which enable healthy hair and scalp.

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