

Development and Evaluation of VCO Based Herbal Hair Tonic

Sapana S. Patil, Dr. Abhijeet S. Kulkarni, Abhinav N. Shinde, Amruta G. Tayade, Sumit S. Patil

Ashokrao Mane Institute of Pharmaceutical Sciences and Research, Save, Kolhapur, Maharashtra, India

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ABSTRACT

Nowadays, people are interested in hair preparations and conditioner materials, such as shampoos, hair tonic and conditioner formulations containing herbal extracts. Hair tonic is a product which is used to style hair. The objective of present study involves preparation of herbal hair tonic by using jojoba, tulsi, and coconut oil and its evaluation for antifungal and antibacterial activity. The final preparation of this ingredients is formulated in batches with change in concentration. Each formulation is tested for antibacterial and antifungal activity. The formulation of different concentrations were characterized for proximate analysis including moisture content, total ash, acid insoluble ash, water soluble ash, water insoluble ash, sulphated ash. The formulation gives good results for antifungal and antibacterial activity also the formulation having good consistency good spreadability, homogeneity, appearance and pH.

Loss of hair or alopecia is a universal problem that has been estimated to affect between 0.2 and 2% of the world's population. Various synthetic formulations available for treatment of alopecia exhibit severe side effects and also do not cure the condition permanently while natural products are getting more popular mainly due to their fewer side effects. It is therefore necessary to discover natural remedies of plant origin having hair growth promoting potential to replace the synthetic one for the treatment of alopecia.

The aim of present study involves development of herbal hair oil from virgin coconut oil extracts of a mix of nine herbs which is beneficial as a hair tonic. The various herbs used in the formulation are amla, hibiscus, curry leaf, Aloe vera, henna, bhringraj, tulsi, small onion and neela amari in varying concentration. Parameters such as moisture content, pH, specific gravity, viscosity, acid value, saponification value etc., were evaluated and irritation test and sensitivity test were conducted and recorded. It was observed that all the parameters were within the permissible limits.

Keywords : Herbal formulations, antifungal activity, antibacterial activity, hair tonic, Cosmetics, Herbs, Evaluation , Amla ,Neem, Virgin coconut oil, hibiscus, bhringraj, Aloe vera.

I. INTRODUCTION

The term “hair tonic” has been used for some hair preparation because the term is used in therapeutics. Hair tonic is one kind of hair repairing tonic and re-texturing the hair.

Hair tonics, whether their therapeutic action is real or not, occupy a large market today. They claim action against a variety of disorders such as dandruff, alopecia or baldness, seborrhoea and the like. Dandruff can be controlled by using a 0.25 % solution of a cationic surfactant or selenium sulphide or other selected substances dissolved in water. Seborrhoea can be lessened by removing oily secretions by rubbing hair daily with an alcoholic lotion. Baldness, according to science, can not be cured by any external application on the head. But massaging on the scalp can enhance the blood supply to the scalp and the hair growth. But several tonics claim to grow hair on bald heads. People have suspicion about these products but still demands are there.

Hair is one of the vital parts of the body derived from ectoderm of the skin, is protective appendages on the body and considered accessory structure of the integument along with sebaceous glands, sweat glands and nails.

People in the tropical countries have effectively used coconut oil to promote hair growth and development as a traditional hair grooming practice for centuries. Unlike mineral oil, fatty acids present in the coconut (particularly lauric acid) have been found to have antiseptic properties and is more efficient and safer. Virgin coconut oil is the purest form of coconut oil with natural distinctive coconut taste and smell. Nutritionally, VCO has more beneficial effect than copra oil because it retains most of its functional components. VCO is unique among all the other vegetable oils because of its high lauric acid content.

VCO contains 92 percent medium chain fatty acids consisting of 48 to 53 percent lauric acid.

Hair is a protein filament that grows from follicles found in the dermis. Due to low molecular weight and straight linear chain, lauric acid has high affinity for hair proteins and is able to penetrate into hair shaft and promote hair growth. Lauric acid is the most active antimicrobial fatty acid. VCO exhibits antibacterial, antiviral and antifungal activity. A natural product with antiseptic effects has higher consumer appeal in the market. So VCO can be viewed as an ingenious and safe replacement for mineral and petroleum-based oils because of its appreciable contents of hair grooming principles. VCO has multiple benefits that include moisture retention and hydration, softening, smoothening and protecting the hair. The presence of fatty acids, vitamins and minerals in VCO nourish and restore the hair naturally and prevent premature greying. The studies show that the VCO can be used as protective medium against hair damage by blocking about 20% of the sun's ultraviolet rays.

The various hair growth promoting and curative properties of VCO thus makes it an incredible base for the development of a hair tonic. Hair tonics are the hair care formulations effective in the treatment of hair disorders such as baldness, greying of hairs, hair falling, and dryness of hairs. To qualify with the status of a hair tonic, the formulation requires fortification with herbal extracts in Virgin coconut oil as base. Since ages, herbs and natural products are being used to treat hair loss or other hair related problems worldwide. India is a good repository of medicinal herbs and a number of plants and herbal formulations are reported for hair growth promotion as well as improvement of quality of hair.

Hair tonics enriched with herbs are used regularly by Indian women from time immemorial as a hair care practice. Natural products involving herbal

formulations available in the market are used as hair growth promoter, hair conditioner, hair-cleansing agent, antidandruff agents, as well as for the treatment of alopecia, dandruff and lice infection. A number of herbal products have been acclaimed with hair growth promoting activity and the use of some of the herbal oils is also reported to reduce the hair fall.

Virgin coconut oil (vco) :

Synonym :

Copra oil

Biological source :

It is a fixed oil obtained by expression from thoroughly dried kernels of *cocos nucifera* belonging to family *palmae*.

A cracked coconut and a bottle of coconut oil



High-quality organic virgin coconut oils are cold-pressed and 100% naturally made with a single ingredient, fresh, white coconut kernels. You can differentiate the virgin coconut oils from other grades by the fresh aroma of coconuts and clean-taste it has on the palate with no acidity. Rich in medium-chain fatty acid, it is considered a functional superfood because it has healing benefits beyond its nutritional contents. A coconut has more nutrients. This is simply the reason why coconut oils have many advantages over other oil sources. It comes from a source that's naturally higher in minerals and phytonutrients.

It moisturises and conditions hair Coconut oil is rich in lauric acid that helps in better penetration into the hair strands. Regular usage helps in keeping hair moisturised, nourished and conditioned.

It makes hair soft and adds shine

Continuous use of coconut oil adds shine and makes hair soft. It locks the moisture and adds a natural shine to hair strands. Make sure that you are not overusing the oil as it can make hair greasy.

It repairs dry and damaged hair

Massaging coconut oil into the scalp nourishes hair from roots. It helps to reduce dryness and frizz, making hair softer and smoother. With continuous usage it repairs dry and damaged hair, making it healthier.

It prevents hair breakage

Coconut oil prevents hair from breakage, makes hair stronger from roots and stimulates better hair growth. It penetrates into the hair follicles and nourishes them for healthier new hair growth.

Amla :

Synonym :

Emblica ,India gooseberry.

Biological source :

This consists of the dried as well as fresh fruits of plant *Emblica officinalis* Gaerth *phyllanthus* *Emblica* Linn. belonging to family *Euphorbiaceae*.

Linn. is one of the richest sources of vitamin-C, amino acids and minerals. Amla fruit is widely used in the Indian system of medicine alone or in combination with other herbs as a tonic. It is considered as a *rasayana* (rejuvenator) useful against degenerative and senescence related processes. Amla is reported to have antioxidant, anti-inflammatory, analgesic, antipyretic, refrigerant, diuretic, laxative and restorative properties. It contains several chemical constituents

like tannins, alkaloids, phenols, amino acids and minerals such as phosphorus, iron and calcium which provides nutrition to hair and also improves darkening of hair. Amla powder and the fixed oil from amla are used traditionally in Ayurvedic applications for the treatment of scalp.

Amla oil is usually extracted by boiling dried and powdered amla fruits in coconut oil. This is a very effective conditioner which prevents balding. Massaging the head with amla oil induces sound sleep, prevents premature greying of hair, and is useful in curing dandruff, alopecia and insomnia. Amla has antibacterial and antioxidant properties that can help promote the growth of healthy and lustrous hair. The fruit extract is useful for hair growth and reduce hair loss. Amla maintains the hair colour and prevents premature greying and strengthens the hair follicles. *Phyllanthus emblica* L. is a potent inhibitor of 5 α -reductase, which promotes the growth of the hair. Thus, amla is an ideal component that can be selected in traditional recipes for herbal hair oil.

Hibiscus :

Synonym:

Hibiscus rosa sinensis

Biological source: hibiscus, (genus *Hibiscus*), genus of numerous species of herbs, shrubs, and trees in the mallow family (Malvaceae)

Hibiscus rosa sinensis has been used for ages in Ayurveda to cure many ailments. The flowers of *Hibiscus rosa-sinensis* have been reported to possess wound healing, antibacterial and immunomodulatory properties. Several studies have proved the presence of anti-oxidant, anti-fungal, and antimicrobial properties in flowers of *Hibiscus rosa-sinensis*.

Hibiscus is used for rejuvenating the hair growth and for controlling dandruff. The hair growth potential of *Hibiscus rosa sinensis* aqueous flower extract was evaluated by Agarwal and Singh (2017). The results

indicated an increase in hair length and hair follicle length after 30 days. Similar results were reported by Pathak and Gala, (2018) in which *Hibiscus rosa-sinensis* flower and leaf extracts recorded significant hair growth promoting characteristics after 30 days without adverse effects compared to minoxidil. Hibiscus also helps to improve the overall texture and health of hair. Considering these clinical evidences, the leaf and flower extract of *Hibiscus rosa sinensis* could be selected as a constituent in the herbal hair oil formulation.

Aloe :

Synonym:

Aloe ,kumari

Biological source:

Aloes is the dried juice of the leaves of *Aloe barbadensis* miller, known as curacao aloes ;or of *Aloe perryi* Baker ,known as socotrine aloes ;belonging to family Liliaceae.

Aloe is used as purgative. It is also used in the treatment of pain and itching and also to slow down ulceration and keratosis, Aloe is used in skin cosmetics as a protective due to its anti wrinkle properties. Aloe is used externally for painful inflammation.

Aloe vera, is widely known for its therapeutic effects and has been used as a natural remedy for centuries. It is rich in anti-oxidants and is a broad source of essential micronutrients (Na, Ca, Mg, K), Vitamin C, E and total phenolic compounds which are anti- ageing. Topical application of Aloe vera, is reported to be highly effective in accelerating the healing process of wounds and burns including sunburns and reducing the scar. Aloe vera clears acne and skin allergies, dark spots and skin blemishes, and makes the skin clearer. Aloe vera is also effective in treating skin disorders like dermatitis, and even psoriasis and eczema of the skin, relieve itching and facilitate skin healing in exanthematic diseases such as measles, rubella, and varicella.

Basically Aloe Vera is a cellular regenerator by boosting the circulatory system. As a result, Aloe vera wards off wrinkles and age related changes. It nourishes the hair and is used for the treatment of scalp and hair loss. Aloe vera lotion is used for treating seborrheic dermatitis (Dandruff). Aloe vera hair conditioners and shampoos are used widely for the purpose. It can also be used as a hair styling gel and works especially well for conditioning the damage hair.

Curry leaf :

Synonym :

Murraya koenigii

Biological source: The curry tree, *Murraya koenigii* or *Bergera koenigii*, is a tropical and sub-tropical tree in the family Rutaceae.

Curry leaves hair oil also called Kadi Patta oil in Hindi and Karuveppilai oil in Tamil has amazing hair benefits and we make it by mixing curry leaves with coconut oil. We use it to treat premature greying of the hair and to arrest hair fall. Our neighbor in our village used to collect curry leaves from our farm regularly. One day when I was talking to her, she mentioned about this curry leaf hair oil.

She said that she has been using this oil regularly and it has helped treat her premature greying along with promoting hair growth significantly. She taught me the way she makes the oil and it is so very easy to make the curry leaf hair oil using her method. Just two ingredients and you have a very nice hair oil in your hands. But the quality of the ingredients are very important.

Tulsi:

Synonym :

Holy basil or *Ocimum sanctum*.

Biological source:

Tulsi is an aromatic shrub in the basil family Lamiaceae that is thought to have originated in north central India and now grows native throughout the eastern world tropics.

It is a tropical aromatic herb having a vast array of health benefits which offers solutions to many modern-day health problems. It is a powerful antimicrobial with antibacterial, antiviral, antifungal, antiprotozoal, antimalarial, and anthelmintic properties. It is also an antioxidant, anti-inflammatory, radioprotective, hepatoprotective, neuroprotective, cardioprotective, anti-diabetic, anti-hypertensive, anti-carcinogenic, anti-pyretic, anti-allergenic, and analgesic properties.

A number of scientific studies have been conducted on Tulsi's various potential uses for hair-related disorders. Essential oil of Tulsi was capable of enhancing normal hair growth and promoting follicular proliferation in controlling chemotherapy induced hair loss. Tulsi also have been reported to have potential to address alopecia. It is a plant that is easily available locally in every household and thus can be selected as one of the ingredients.

Henna :

Synonym :

Lawsonia inermis (Lythraceae) or Mailanchi

Biological source:

henna tree, (*Lawsonia inermis*), also called Egyptian privet, tropical shrub or small tree of the loosestrife family (Lythraceae), native to northern Africa, Asia, and Australia.

It is a hair care plant reported to possess immunomodulatory, antiviral, antibacterial, antifungal, anti-inflammatory, and antioxidant properties. Henna is an important source of natural hair colouring agent due to presence of lawsone, a red orange dye present in dried leaves of the plant. Carbohydrate present in it give the henna paste a suitable consistency for sticking to the hair. Henna has also antifungal activity

against *Malassezia* species which is the causative organism of dandruff. Henna prevents premature hair fall by balancing the pH of the scalp and greying of hair. Henna has a natural affinity with the proteins in our hair, making it able to stain the colour onto the hair shaft. Hence, these properties qualify henna for selecting it as one of the component of the herbal hair oil, which will complement the overall quality of the product.

Bhringraj : Synonym : *Eclipta alba*

Biological source:

bhringraj, is a species of plant in the family Asteraceae.

Bhringraj or *Eclipta alba* Hassk is traditionally known to stimulate hair growth as well as to check hair loss and greying of hair. The oil based extract of leaves has been used traditionally for improving hair growth and for imparting natural hair colour. Bhringraj is a major component of Neelibhringaadi Thailam, a popular hair tonic based on classic ayurvedic text. Numerous pharmacological properties including hair growth-promoting activity, anti-inflammatory, antioxidant, antimicrobial activities have been demonstrated. The extracted juice of bhringraj applied to the scalp blackens the hair. Treatment with 5% of petroleum ether extract of bhringraj initiates greater number of hair follicles (Khare, 2004) [34]. Topical application of Ethanol extract of *Eclipta alba* Hassk reduced hair growth initiation time and the time required to complete hair growth significantly and exhibited greater number of hair follicles compared to minoxidil. 2% treatment also reported that the whole plant extract of bhringraj exhibited strong hair growth promoting activity compared to other ingredients tried.

Neelayamari :

Synonym:

Common indigo

Biological source : *Indigofera tinctoria*, also called true indigo, is a species of plant from the bean family that was one of the original sources of indigo dye.

Common Indigo, 'neelayamari' or *Indigofera tinctoria* Linn is a leguminous medicinal plant valued for the blue dye (indigo) content in its leaves. It is a well-known Ayurvedic herb for hair treatment, and the leaf extract of the plant is used to prevent juvenile greying of hair and to promote hair growth. It is a traditional practice of Indian women to soak the dried or fresh leaves of indigo in water and usually apply it mixed with henna as a paste to intensify the black colour of hair.

small onions:

Synonym:

Shallots, *Allium cepa* var. *aggregatum* or small onions

Biological source: onion, (*Allium cepa*), herbaceous biennial plant in the amaryllis family (*Amaryllidaceae*) grown for its edible bulb. The onion is likely native to southwestern Asia but is now grown throughout the world, chiefly in the temperate zones.

Shallots / small onions

Shallots are a member of the allium family, but their flavour is richer, sweeter and more potent than onions. Shallots are rich in antioxidants, and have anti-inflammatory, antimicrobial, and anti-allergic properties.

Shallots have a rich content of Sulphur and phenolic compounds which is considered to be healthy for hair as it facilitates the production of collagen tissues that stimulate hair growth. Shallots can also help treat hair loss and might even cure baldness to some extent. Shallot juice can also help treat scalp infections and dandruff.

Nourishment of hair and cure for hair related problems as validated through literature. Raw materials of the above 9 plants were collected and then formulation was prepared by extracting them in a definite proportion using virgin coconut oil as a base and adding an essential oil for fragrance. Different

ingredients used in the formulation of herbal oil are presented in Table 1.

II. MATERIAL AND METHODS



The present work was aimed to develop and evaluate a polyherbal hair oil contain leaf), henna (leaf), bhringraj (leaf), tulsi (leaf), small onion (whole ning herbs, such as amla (fruits), hibiscus (leaf & flower), curry leaf, Aloe vera (fresh fruit) and neela Amari (leaf), using Virgin coconut oil as base (Fig 1). All these herbs have well-known potential in the nourishment of hair and cure for hair related problems as validated through literature. Raw materials of the above 9 plants were collected and then formulation was prepared by extracting them in a definite proportion using virgin coconut oil as a base and adding an essential oil for fragrance. Different ingredients used in the formulation of herbal oil are presented in Table 1.

Collection of Raw materials:

The raw materials selected for the preparation of herbal hair oil were Virgin Coconut Oil, amla, hibiscus, curry leaf, Aloe vera, henna, bhringraj, tulsi, small onion, neela amari and lavender oil for fragrance of which all of them except small onion and lavender oil are collected from Regional Agricultural Research Station, Pilicode, Kerala, India. Small onions were procured from the nearby supermarket.

Preparation of herbal extract:

1. All the fresh herbs are weighed accurately according to the ratio presented in Table 1.
2. Virgin coconut oil is added to a vessel on the proportion fixed and heated on a medium low flame.
3. When oil is hot, grated amla fruit and small onion is added to it first, because of their higher water content.
4. mix it well for some time and then add the remaining ingredients like hibiscus, curry leaf, Aloe vera, henna, bhringraj, tulsi, neela amari and heated further in virgin coconut oil with constant stirring for about 20-30 min.
5. The mixture has to be stirred continuously and carefully to avoid sticking to the bottom of the vessel when the moisture present in the herbs gets evaporated.
6. A piece of cotton cloth is dipped into the mixture and taken out to conduct flame test to know whether moisture has completely got evaporated from it.
7. The correct stage of finishing the extraction of herbs in virgin coconut oil is until the entire drugs are extracted and when the entire moisture is removed.
8. At this stage, there won't be any cracking sound while boiling and the heat source is closed and left it for cooling.
9. The mixture containing Virgin coconut oil and the herbs is filtered by straining through a muslin cloth or stainless steel mesh
10. Finally, the mixture is filtered again using filter paper to get the pure oil in homogenous condition.
11. Lavender oil was added to the extracted oil for fragrance in the ratio proposed after which it was filled in glass bottle.

Table 1 : Ingredients and formulation of herbal hair tonic

SI .No	Ingredients	Part used	Form ulation
1	Virgin coconut oil	Kernel / milk	70.0
2	Amla	Fruit pulp	5.0

3	Hibiscus	Leaf (2.5) & flower (2.5)	5.0
4	Curry leaf	Leaves	4.5
5	Aloe vera	Leaf pulp	4.0
6	Heena	Leaves	3.0
7	Bhringraj	Leaves	2.5
8	Tulsi	Leaves	2.5
9	Small onion (shallots)	Whole fruit	1.5
10	Neela amari	Leaves	1.5
11	Lavender	Oil	0.5

Evaluation of herbal hair tonic :

As in any other cosmetic product ,this products should also be evaluated for the contents estimation and their identification. Also some other test are required to be done according to purpose.

(1) Antiseptic property : This can be done by invitro anti microbiological test are required to be done according to purpose.

(2) Stability test : stability of the products of the ingredients must be studied particularly effects of heat ,light etc. It is well known that most of the phenolic materials will discolour on exposure to light and thus may make fair hair dark ,particularly in the presence of traces of alkali or hair care.

(3) Sensitivity test : some of the ingredients, like antiseptic, may cause irritation, sensensitization or photosensitization of the skin. So,these should be tested and can be done by patch test either open or occlusive.

(4) Moisture content: Moisture content was analysed based on the American Oil Chemists Society method.About 5.0 g of the herbal hair oil sample was placed into a pre - heated and pre - weighed crucible with lid and then heated at 105° C for at least 24 hr. The sample was then placed in a desiccator and allowed to cool down to room temperature. The crucible containing the herbal oil

was then re - weighed. The moisture and volatile content was calculated using the following formula:

Moisture content (%) = (Initial weight - Final weight)/ Initial weight × 100

(5) Acid value: Preparation of 0.1 molar solutions: Weighed

0.56 g KOH pellets and dissolved in 100 mL of distilled water and stirred continuously. The prepared 0.1 molar KOH solution was filled in the burette. Preparation of sample: Measured 10 ml oil and dissolved in 25 mL of ethanol and 25 mL of ether mixture and shacked. Added 1 mL of phenolphthalein solution and titrated with 0.1 molar KOH solution.

Acid value = $5.61V N / W$

Where, V = Volume of standard sodium hydroxide used (ml). N = Normality of the sodium hydroxide solution.

W = Weight of the sample (g).

(6) Saponification value: 1 ml of herbal hair oil is accurately weighed in a 250 ml conical flask. A mixture of ethanol: ether is prepared in 2: 1 proportion and 10 ml of this mixture was added to the oil. To this, 25 ml of 0.5 N alcoholic KOH was added and was kept undisturbed for 30 minutes. When the flask is cool, this solution is titrated against 0.5 N HCl using phenolphthalein indicator. Similarly, the blank titration was performed with HCl excluding oil sample. Amount of KOH used (in mg) was calculated using formula

Saponification value = $56.1(B-S) N/W$

Where, B= Volume of standard HCl (ml) required for the blank, S= Volume of standard HCl (ml) required for the sample, N= Normality of standard HCl, W= Weight of the oil (g) used for the test.

(7) pH:The pH of herbal hair oil was determined using digital pH meter. 20ml of herbal hair oil was transferred in a beaker and the bulb of pH meter was dipped in hair tonic. The pH value displayed is recorded.

(8) Viscosity: It is an index of resistance of a liquid to flow. The higher the viscosity of the liquid, the greater is the resistance to flow. The viscosity was

determined using Ostwald's viscometer and the readings recorded.

(9) Skin irritation test: This test was performed to evaluate the irritation of the formulated oil on the skin of selected volunteers for organoleptic test. The prepared herbal hair oil was applied on 1 cm² skin of hand after cleaning with absolute alcohol and exposed to sunlight for 4-5 minutes and observed and their response recorded

III. RESULT

This study reports the formulation, development and evaluation of a VCO based herbal hair tonic for organoleptic properties, quality characteristics and overall acceptability. After developing the formulation, the samples were tested for organoleptic properties, Physicochemical properties like moisture content, acid value, saponification value, specific gravity, pH, viscosity and biological parameters like skin irritation test and the experimental results obtained from the present study have been discussed here under.

consisting of twelve semi-trained members and the average organoleptic scores were presented in Table 2.

Table 2. Organoleptic score card for herbal hair tonic

Characteristic	Average scores
Colour	8.0
Odour	7.8
Appearance	8.4
Texture	8.2
Stickness	7.9
Overall acceptability	8.8

Organoleptic evaluation revealed that the herbal hair oil is dark green in colour, having pleasant aromatic odour, less viscous, smooth in texture, non-greasy and good overall acceptability (Table 3). Colour and odour

of the oil sample was typical of their constituents and the fragrance added. Organoleptic evaluation indicates the acceptability of the product.

Table 3: Organoleptic evaluation of herbal hair tonic

Sr.no	Parameters	Results
1.	Colour	Dark green
2.	Odour	Aromatic
3.	Appearance	Less viscous
4.	Texture	Smooth
5.	Greasiness	Non greasy
6.	Overall acceptability	Good

The various quality parameters like moisture content, acid value, saponification value, Specific gravity, pH, and viscosity of the herbal hair oil was evaluated and presented in Table 4.

Table 4 : Quality evaluation herbal hair tonic

SI.No.	Parameter	Inference
1	Moisture content	0.21
2	Acid value	1.60
3	Saponification value	256.08
4	Specific gravity	0.916
5	PH	6.6
6	Viscosity	0.966

Moisture content: These are important determinants of oil quality. It is desirable to keep the moisture content low as it will increase the shelf life by preventing oxidation and rancidity processes. The moisture content recorded in the herbal hair oil is 0.21% and the values are within the set standards and hence facilitate keeping quality. Due to low moisture content, there is only minimal possibility of the deterioration of the formulation.

Acid value: This is defined as the number of milligrams of potassium hydroxide required to neutralize the free fatty acids present in one gram of fat. It is a relative measure of rancidity as free fatty acids are normally formed during decomposition of oil glycerides. More acid value indicates the higher percentage of free fatty acid leading to more oxidation and less quality of oil.

Acid value calculated for the herbal hair oil sample was only 1.60. The low acid value recorded indicates that the oil contains relatively little or no water. Lower the acid value, higher the quality of oil.

Specific gravity: Specific gravity of the herbal oil was 0.916 which are within the range proposed by BIS. It is lighter than water and is thin. This result was in agreement for herbal hair oil.

pH: The pH of oil was found to be 6.6 indicating near neutral value, which was relevant with human skin.

Viscosity: Viscosity of the oil was found to be 0.966. This was in conformity with the studies conducted by which recorded a viscosity of 0.93 and 0.9936 respectively for herbal hair oil.

IV. Conclusion

Based on the results of this study, hair tonic formula showed the ability of hair growth. hair tonic containing 10.0 % water fraction was the best formula. The developed herbal formulation did not show any sedimentation stored at the room temperature up to three months and has good stability. Virgin coconut oil which constitutes a major proportion of the formulation itself acts as a preservative increasing the shelf-life of the herbal hair oil and prevents it from microbial degradation. The product developed thus has long shelf-life and is quite stable. Virgin coconut oil is an incredible base for herbal hair oils because of its appreciable contents of hair grooming and curative principles. The presence of medium chain fatty acids, essential nutrients,

vitamins, minerals and antioxidants in VCO nourish and restore the hair naturally through moisture retention and hydration, softening, smoothing and protecting the hair. The herbal constituents chosen for the present formulation also have been reported to possess extremely good content of principles vital to the nourishment of hair and providing protection from hair loss related problems. Virgin coconut oil with rich functional properties and diverse herbal ingredients when blended together elicit a synergistic effect in nourishment of hair, promoting hair growth. A product developed through such a combination will be effective in compensating protein loss through higher penetration deep into the hair follicles making it stronger, maintaining normal function of sebaceous glands, turning grey hairs to black, providing protection from dandruff, resulting in healthy lustrous hairs. It can be concluded that this hair care formulation based on VCO along with other herbal ingredients devoid of any preservatives could be an effective remedy for hair loss treatment. This process technology and formulation could be applied in industrial scale and is viable for mass production. The herbal hair tonic developed was dark green, pleasantly aromatic, non-greasy and appears as light, smooth, free flowing with uniform consistency. When applied to the hair it adheres as a film and gets absorbed into the scalp quickly with in a shorter period of time. It has a cooling effect and is helpful in relieving stress. The results for the evaluation of physical parameters like moisture content, acid value, saponification value, specific gravity, pH and viscosity are according to the standard values and are under the specified limits. It is constituted completely with natural ingredients and is safe, devoid of any side effects and is free from skin irritancy.

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