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Medicated hair oil formulation and positive effect on dandruff control with hair growth

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Hair disorder is an emotional subject fashioned with so many feelings and reducing self-esteem and self-confidence. It influences the overall appearance of the person. Nowadays, such affected persons are addressing the issues with herbal therapies than chemical treatments. The market is full of hair oils claimed to have positive efficacy, some containing herbal parts and some other containing nutritional agents. Three different plants i.e., *Javākusum* (*Hibiscus rosa-sinensis*), *Jāti* (*Jasminum officinale*) and *Bargād/ Vaṭa* (*Ficus benghalensis*) identified from the descriptions of *Mādhava Cikitsā*, a classical ayurvedic text described in the formulations for hair disorder treatment. The GC-MS study of the flower extracts of *Javākusum* and *Jāti* (Chameli) and aerial root extract of *Bargād* revealed several phytocompounds which are considered as potential bioactive ingredients from the way 2 drug PASS analysis (cheminformatics' study) for therapeutic uses like antifungal, antiseborrheic agents and hair growth stimulants, etc. The medicated oil formulation/ preparation from the combination of these three selected plants also tested positive in effect for controlling dandruff and promoting hair growth in the affected individuals when experimentally studied. Hence, this research endeavour will certainly provide a future possibility of addressing hair disorder issues, especially with young generation and Pharma companies could bring new medicated oil products to the benefit of affected population in future.

Keywords: Dandruff, *Ficus*, Hair disorder, *Hibiscus*, *Jasminum*, Medicated oil

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Hair is one of the vital parts of our body which is derived from the ectoderm of the skin. Human scalp hair disorders cause a radical change in self-image and influence the overall appearance of the person[1,2]. Dandruff is the major cause for hair disorders which is treated with Fluconazole type antifungal chemicals to control scalp infection by a group of fungi like *Malassezia* and *Aspergillus* species. The most commonly used synthetic drugs cause different and unpredictable response (side effects) and affect immunity[3,4]. World Health Organization strategically encourages, recommends and promotes traditional herbal medicines in national health care programs (WHO)[5]. The use of herbal or medicated oil is a holistic therapy for hair disorders management. Plants contain many bioactive ingredients that improve the biological functions naturally. The medicinal plant extracts are proved inhibitory to many microbial growths too[6]. Quick transformation and development with alternative healthcare approaches have endangered the plant resources. The strength of these traditional practices rather has boosted the percentage of adultration[7]. It is essential to select the appropriate medicinal plants as mentioned in classical Sanskrit medical texts (*Mādhava Cikitsā*, *Aṣṭāṅgahṛdayam, Caraka Saṃhitā & Suśrut Saṃhitā*) for effective control of dandruff and hair disorders[8-11]. The surveys carried out of marketed products, doctors' opinion and literature on herbal and crude drugs-based hair oils indicate a selection of crude drugs for hair oil formulation is essential[12]. There are various methods for the formulation and making of medicated hair oils like direct boiling, paste extraction and cloth squeezing given by Ayurvedic Formulary of India (AFI)[13]. The chemoinformatics study of bioactive compounds have now opened possibilities of newer drug designing and added our competence to describe biological systems[14].

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In order to use the experiential wisdoms of ancient Sheers to address the present hair disorders, a coordinated study of Sanskrit medical texts, correct selection and identification of medicinal plants followed by doctors' opinion, market survey, GC-MS analysis, Lipase inhibition assay and antimicrobial activity of plant extracts, etc. are needed. The present work was thus aimed at formulating and evaluating medicated hair oil containing plant parts like *Hibiscus* flowers, *Ficus* (Bargad) aerial roots and *Jasminum* flowers in base oil of mustard and coconut to control dandruff and improve hair quality. All these medicinal plants are well known traditional potential drugs in the treatment of hair disorders but are not commonly mentioned in *Bṛhattrayī*. Only '*Mādhava Cikitsā'* Sanskrit medical text has selectively mentioned these names under *Kṣhudraroga* chapter describing verses for *Khalita* (hair fall), *Palita* (premature graying) and *Iṅdrabidda/Iṅdralupta* (patchy hair fall) *cikitsā*.

Materials and Methods

Ancient Sanskrit medical texts

Bṛhattrayī: *Caraka Saṃhitā* (CS), *Suśrut Saṃhitā* (SS), *Aṣṭāṅgahṛdayam* (AH) and *Mādhava Cikitsā* (MC) were studied to enlist and identify correct medicinal plants from the chapters under *Kṣhudraroga* and from the verses describing *Khalita, Palita and Iṅdrabidda/Iṅdralupta cikitsā*.

Plants selected for experimentation were – *Javākusum* (*Hibiscus rosa-sinensis* L.), *Jāti* (*Jasminum officinale* L.) and *Bargād* (*Ficus benghalensis* L.)

Extraction of plant parts

The active principle containing part of each selected plant was separately extracted in Soxhlet apparatus using water as solvent[15].

Collection, identification and culture of dandruff contents from rare to heavily infected individuals. Standard laboratory procedures followed and cultures maintained in optimized mDixon agar plates[16].

Lipase inhibitory assay

The inhibitory effect study on the activity of lipase produced from *Malassezia furfur* CRS-39 using extracts of *Hibiscus rosa-sinensis, Ficus benghalensis* and *Jasminum officinale* was done by enzyme assay method[17]

Microbial inhibitory tests

Selected plant extracts (concentrated) were tested for antimicrobial /antifungal activities by disc diffusion method in GPA plates for finding zones of inhibitory effects against fungal species of dandruff contents and compared with known antibiotics[18].

Chemoinformatics study

The *in-silico* software for activity spectrum PASS was used to find the therapeutic actions of select phytocompounds [based on probability to be active (pa) and probability to be inactive (pi) value for hair disorder parameters][19].

Preparation/ formulation of medicated oil

In the base oil of mustard + coconut, crushed pastes of active principle containing parts (flower and aerial roots) were added together in a proportion of 1000 mL: 100 g: 100 g: 100 g and heated over flame till the volume reduced to one third. The oil then was filtered through several times folded muslin cloth and used under the guidance of Ayurvedic doctors.

Organoleptic property of oil

Colour and odour of the prepared oil observed and primary skin irritation property was determined manually by applying formulated medicated oil on hand and exposed to sunlight for 5 min[20].

Ethical approval

Animal study was approved by the Ethics Committee of Channabasweshwar Pharmacy College, Latur (Approval letter CPCSEA/CBPL/AH-33/2017-18, dated 16-12-2017). Trials of the same medicated oil conducted under the supervision of medical practitioners over select hair disordered participants, who were intimated about the study objectives and have signed informed consent forms.

Inclusion and exclusion criteria

Inclusion criteria	Exclusion criteria
1. Participants' age between 18-35 years	1. Participants who used different chemical-based therapies
2. Physical observation of scalp and categorisation	2. Those are not considering dandruff and hair disorder as a health problem
3. Microscopic observation of scalp hairs for the papilla and medulla	3. Persons having other skin disease and under medication
4. Participants signed informed consent forms	4. Allergic to oil application on scalp
5. Ready to follow trial guidelines	

Observation of scalp hair

Simple microscopic observation of hair papilla and medulla was done and compared to a range scale.

Statistical analysis

Sample data collected / observed during the study were analysed using SPSS as and where required.

Results

The GC-MS analysis data of the plant part extracts of the three selected medicinal plants revealed presence of altogether 65 numbers of bioactive phytocompounds. The *in silico* software checking data for the activity spectrum PASS of select phytocompounds' therapeutic actions (based on high pa and low pi value for hair disorder parameters) from the 65 are endorsed in the Table 1. Further, the antimicrobial activity or inhibitory effects observed from the zones of inhibitions of the selected medicinal plant extracts and known antifungal agent against identified dandruff fungal species like *Malassezia furfur* (Robin) Baillon and *Aspergillus niger* (Van Tieghem.) are recorded in Table 2.

The scalp hair health condition (papilla and medulla) of the select participants has been limited to a range between 0-10 and shown in Table 3 and photographs in Fig. 1-3. Also, the prepared medicated hair oil was evaluated for its various characteristic parameters are noted in Table 4. The post effect results of application of medicated oil prepared from the medicinal plants on the scalps of affected persons are noted in Table 5. The reduced dandruff infection is visible from the photographs in Fig. 4. Further, the percent (%) reduction in dandruff as per Visual Analogue Scale (VAS) between rare (Mean range - 7.16 and 70% improved), mild (Mean range - 6.66 and 66% improved), moderate (Mean range - 6.33 and 63% improved) and severe (Mean range - 5.33 and 55% improved) cases after 24 weeks of post oil application showed remarkable result (Fig. 5). Overall mean range is 6.37 and improved to 66% as compared to infected hair papilla and medulla. The post oil treatment could make 63.33% healthy hair within 24 weeks of oil treatment.

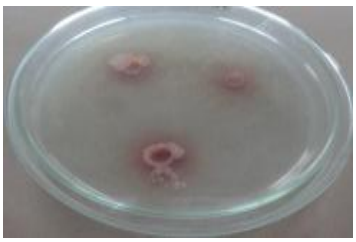
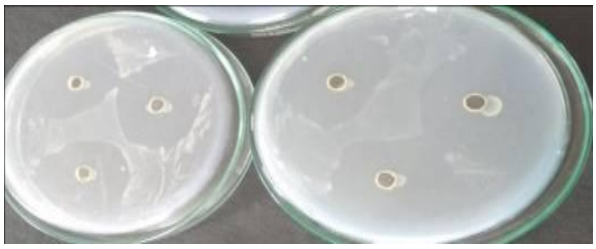
Discussion

Mohamed *et al.*[21] prepared and evaluated an antidandruff herbal shampoo by using natural ingredients with *Ocimum sanctum* (Tulsi) and *Azadiracta indica* (Neem) in powdered form. Use of these plants for herbal shampoo formulation was found to be more effective, harmless and cost-effective. This shampoo was tested against Gram-positive, Gram-negative bacteria and fungal organism *Candida albicans*. Dubey *et al.*[22] evaluated organoleptic powder and observed physical and biological characteristics of hair care products. Antidandruff activity of *Wrightia tinctoria* L., *Ziziphus jujube* L. and *Lippia nodiflora* L., was reported against *Malassezia furfur*, *Trichophyton mentagrophytes* and *Microsporeum gypseum*[23]. Thorat *et al.*[24] and Roy *et al.*[25] formulated polyherbal hair oil that showed significant control of hair fall when compared with coconut oil. In the present study, coconut and mustard oil are used as base oil and mixture of herbal extract was reported for antioxidant property and proven best to control dandruff. Hair papilla and medulla from all the groups were evaluated microscopically in present study and compared between healthy, infected and post oil applied (Fig. 1-3). Oil application has proved this formulated medicated hair oil to improve not only the strength and texture of the hair but also reduced the dandruff infection impressively, which are visible from the photographs (Fig. 4) before and after treatments. The overall mean range of VAS is 6.37 and improved to 66% as compared to infected hair

Table 1 — Result details of select phytocompounds and the therapeutic characteristics based on *in silico* study

Sr. No.	Name of phytocompound	Smiles	Molecular Formula	Activity spectrum (PASS) specific to hair disorders
1.	t-Butyl-(2-(3-(2,2-dimethyl-6-methylene-cyclohexyl)-propyl-(1,3) dithian-2yl)-dimethyl-silane	CC1(CCCC(=C)C1CCCC2(SCCCS2)[Si](C)(C)C(C)(C)C)C	$C_{22}H_{42}S_2Si$	Antifungal, Antiseborrheic, Antipsoriatic, Antiandrogenic, Hair growth stimulant
2.	2-Butenal, 2-ethyl	CCC(=CC)C=O	$C_6H_{10}O$	Antifungal, Antiseborrheic, Alopecia treatment, Lipoprotein lipase inhibitor, Hair growth stimulant
3.	4H-Pyran-4-one,2,3-dihydro-3,5-dihydroxy-6-methyl	CC1=C(C(=O)C(CO1)O)O	$C_6H_8O_4$	Antifungal, Antiseborrheic, Alopecia treatment, Lipoprotein lipase inhibitor

Table 2 — Antimicrobial activity (measured for zone of inhibition) of plant extracts and antibiotics against dominant dandruff fungal species

Plant name	Zone of Inhibition (mm)	
	Aspergillus niger	*Malassezia furfur*
Hibiscus rosa-sinensis	6.67 ± 1.15	10.66 ± 1.15
		
Ficus benghalensis	5.67 ± 1.15	10.33 ± 0.57
		
Jasminum officinale	Nil	Nil
		
Hibiscus + *Ficus* + *Jasminum* (Formulated oil)	5.67 ± 1.15	8.66 ± 0.15
 		
Antibiotics (Fluconazole) DMSO + Tablet	12.00 ± 00	15.33 ± 0.57
		

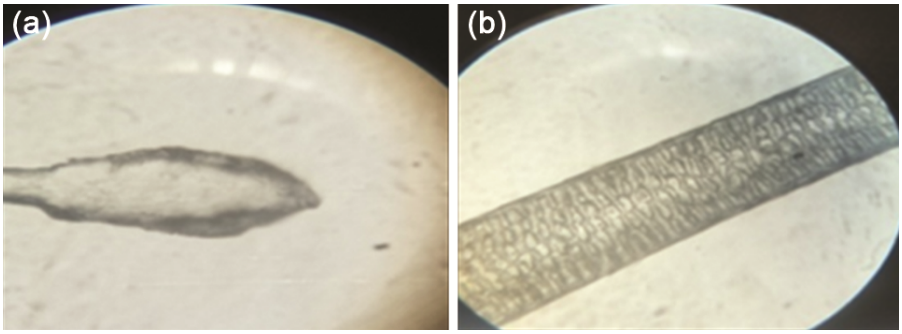


Fig. 1 — Healthy a) Hair papilla; b) Medulla

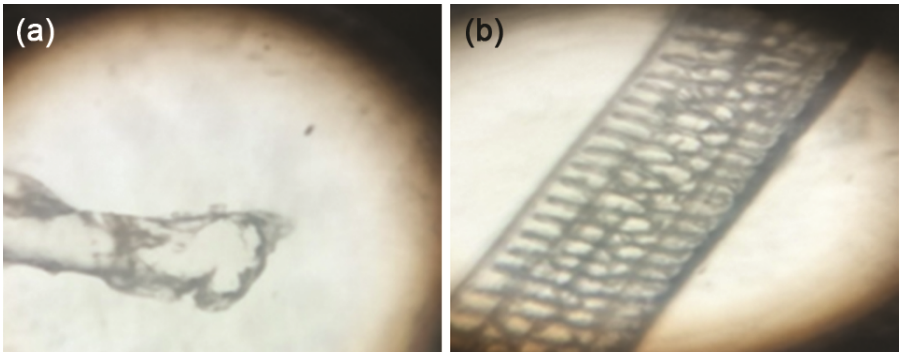


Fig. 2 — Infected a) Hair papilla; b) Medulla

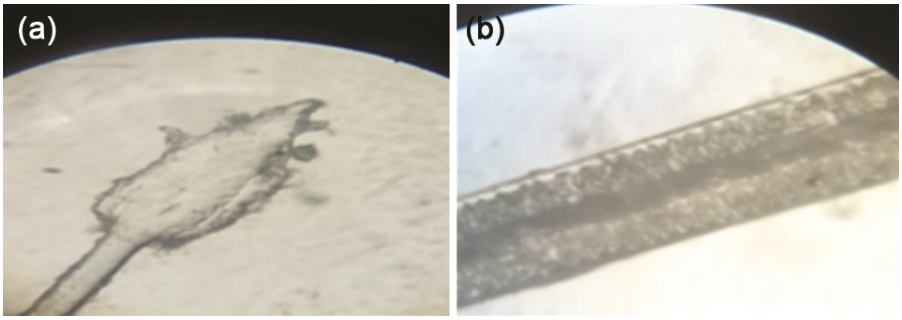


Fig. 3 — Post oil applied a) Hair papilla; b) Medulla

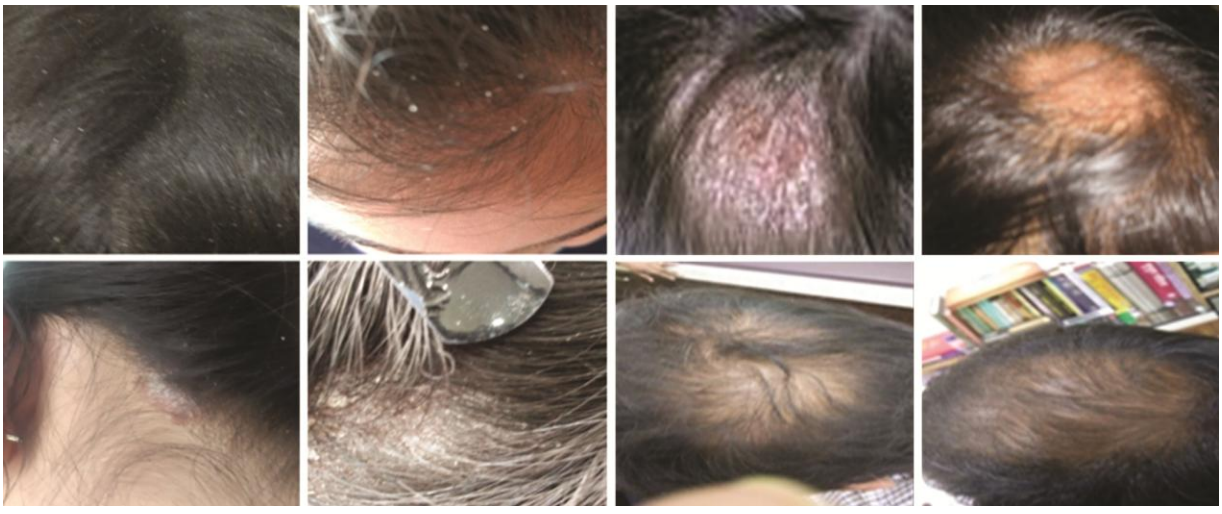


Fig. 4 — Photographs showing hair disorder scalps before and after treatments

Table 3 — Range of hair health condition

Hair health	Range
Weak	0-3
Moderate	4-7
Better / Healthy hair	8-10

Table 4 — Evaluation of medicated hair oil

Sr. No.	Parameter	Inference
1.	pH	5.5
2.	Specific gravity	53.84
3.	Acid value	5.2
4.	Saponification value	177.64
5.	Sensitivity test	No irritation

Table 5 — Details of effects of application of medicated oil on hair disorder scalps

Type of dandruff	Initial condition of hair		Oil application	Post oil application result		Observation/ Remarks after six months
	No. of participants	Mean range	No. of times oil applied/ week	Mean range	% Improvement	
Rare	06	5	04	7.16	70% reduction of dandruff	Hair growth and appearance became normal
Mild	09	4	04	6.66	66% reduction of dandruff and healing of infected patches	Growth of new hairs at the infected hair loss patches
Moderate	06	4.66	04	6.33	63% reduction of dandruff and new growth of hairs at the loss patches	Infection disappeared and new hair growth initiated
Severe	06	3	04	5.33	55% reduction of dandruff and new growth of hairs at the loss patches	Infection disappeared and new hair growth initiated

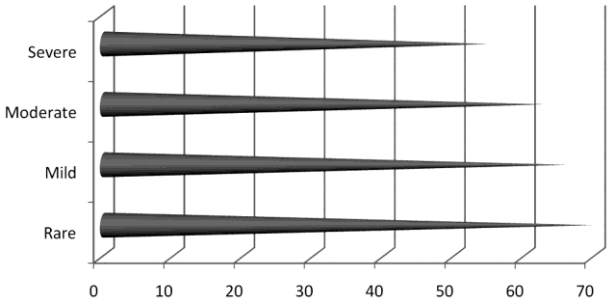


Fig. 5 — The bar graphs showing the percent (%) reduction in dandruff as per Visual Analogue Scale (VAS) between rare, mild, moderate and severe cases after 24 weeks with remarkable improvement.

papilla and medulla. The post oil treatment could make 63.33% healthy hair within 24 weeks of oil treatments. The positive effect of the medicated hair oil was logically linked to the presence of three specific phytocompounds in the active parts of the select plants that are having appropriate therapeutic characteristics in addressing hair disorders as per PASS analysis data.

Conclusion

The present scientific endeavor provided a new thrust to the understanding of the traditional knowledge of India coded in Sanskrit language of Ayurveda for selection of appropriate medicinal plants. Unfolding of the specific phytocompounds of these plants with therapeutic activities in light of preparation of medicated oil for treatment of hair disorders resulted positive effect in controlling dandruff, healing of infection and promoting hair growth in the affected individuals. The formulation was proven to be safe for human use. Pharma companies could bring new medicated oil products in future after appropriate scientific study of classical Sanskrit medical texts for hair disorders.

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Conflict of Interest

The authors declare that they have no conflict of interest.

Authors' Contributions

The contribution of authors in this study: KG contributed in designing and conducting the study; reviewing, analyzing results and preparing manuscript; DM guided in planning the study, reviewing the data and approval of manuscript; KN,

GG and SG were involved in collecting the patients' information and making clinical data, planning the treatment, discussion, review the data and analysis.

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