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Research Article

A Phytochemical and Comparative Study to Assess the Efficacy of *Kaidarya* (*Murraya koenigii* (L.) Sprengel) *Siddha* Taila Plus *Kaidarya Vati* and *Kaidarya Vati* in *Akala Palitya*

Aditi Batra, Jayashree Changade*

Department of Dravyaguna Vigyana, Dr. D. Y. Patil College of Ayurved & Research Center, D.Y. Patil Vidyapeeth (Deemed to be university), Pune, Maharashtra, India.

ARTICLE INFO

ABSTRACT

Regardless of gender, premature hair greying naturally happens in the fourth decade. But these days, it may strike in the early twenties as well. According to Ayurveda faulty eating habits, physical strain, psychological issues, environmental variables, and changes in lifestyle are major reasons which lead to impaired digestion and *Pitta dosha* vitiation (associated with fire and water element). This mostly leads to loss of hair color. Present study was a phytochemical and interventional study done to assess the efficacy of *Kaidarya* [*Murraya koenigii* (L.) Sprengel] *siddha taila* plus *Kaidarya vati* and *Kaidarya vati* alone in *Akala palitya*. The selection of plant was done on bases of classical lexicons. The group A patients were allotted to *Kaidarya siddha taila* plus *kaidarya vati* treatment. The group B patients were only assigned with *kaidarya vati*. Total enrolled subjects were 95 with respect to the dropout rate. The paired t-test was used to analyse the data from group A and group B before and after treatment. A noteworthy distinction was noted between the mean values obtained prior to and following the therapy. An independent t-test was used to compare the results between groups A and B. A significant difference in *Akala palitya* was found between groups. Group A's mean difference score is higher than group B's. Therefore, the effect of *Kaidarya siddha taila* plus *kaidarya vati* is more than *Kaidarya vati* in the management of *Akala palitya*. Furthermore, it requires thorough study, restricted diet and alteration in regimen for more effective results.

INTRODUCTION

The human skin and hair system plays a major role in communication. The thick, long, and highly pigmented hair on the scalp set humans apart from other primates. It is probable that during the course of evolution, this offered humans one or more advantages for survival.

Keratinized gross fibre produced by the hair follicle is hair. The morphologic traits vary depending on the mammal species.[1] Although human hair is a unique and treasured characteristic, its primary purposes are to protect the skin from mechanical trauma and to promote homeothermy. Additionally, it produces pheromones, produces sebum, enhances the apocrine sweat, increases the sense of touch and plays a vital role in social and sexual communication.[2] The hair follicle is one of the few immune-privileged locations in the human body and acts as a reservoir for melanocyte and epithelial stem cells.[3] Among the first and most visible indications of aging in humans is the incidence of grey hair. Across cultures, regions, and ethnic groups, greying is socially significant, and there is a general fascination with its reversal. It can be pathological or physiological, with the latter usually occurring earlier. The rate at which physiological aging occurs varies significantly among races. According to the conventional 50/50/50 rule of hair greying, 50% of people will have 50% black hair by the time they are 50 years old. [4,5]

*Corresponding Author: Dr. Jayashree Changade

Address: Department of Dravyaguna Vigyana, Dr. D. Y. Patil College of Ayurved & Research Center, D.Y. Patil Vidyapeeth (Deemed to be university), Pune, Maharashtra, India.

Email ✉: jayshreeulemale28@gmail.com

Tel.: +91-7768048008

Premature hair greying, a dermatological condition that has long been recognized and affects both sexes equally, is the foremost curse of humanity. The term premature hair greying (PHG) also known as canities or achromotrichia, is generally used in several literature studies to describe greying that occurs before the ages of 20 to 25 in caucasians, 25 to 30 in Asians, including Indians, and late 30s in black people.[4] It is determined by the several variables that contribute to the etiology of premature hair greying, such as abnormal lifestyles along with indifferent dietary habits, stressful lifestyles, environmental influences, physical and psychological factors, genetic components, endocrine problems, nutritional condition and irregular daily routines.[4,5]

Even with substantial research being done on molecules to comprehend the pathophysiology of canities, available choices for treatment are still distant from ideal. Few oral therapies, such as nutritional augments comprising different combinations of vitamins and minerals like copper, zinc, calcium pantothenate, selenium and biotin, are prescribed arbitrarily. Numerous investigations have shown the beneficial effects of para-aminobenzoic acid, calcium pantothenate, alternative medicines such as phytoestrogens, polyphenols, and topical application of PUVA-SOL, prostaglandins-latanoprost, melitane, SkQs plastoquinone and palmitoyl tetrapeptide-20 on endorsing hair pigmentation and reversing hair greying. However, there are also contradictory studies in the literature that mention no benefits when using calcium pantothenate and PABA.[4]

Many more herbal remedies for premature hair greying have been documented in numerous research articles, especially with regard to the traditional Indian system of medicine. Multiple research papers of authors have been supported by solid scientific evidence supporting their entire information and data presented in studies. However, the current study taken on reversing of premature hair greying from *Kaidarya* (*Murraya koenigii* (Linn.) Sprengel) *siddha taila* (oil) and *kaidarya vati* (tablet), the primary focus of the study was the mindset and its potential in scientific research.

Kaidarya is an aromatic plant, referred as *Kadi patta*, a member of the family Rutaceae is a deciduous shrub, grown year-round, frequently found in the tropical forests of India and utilized extensively in culinary, medicines and pharmaceutics.[6] Iron, phosphorus, calcium, proteins, carbohydrates, fibres, copper, zinc and vitamins B, C, A, E, and nicotinic acid as well as antioxidants, flavonoids and glycosides, are all abundant in curry leaves. Thus far, isolated phytoconstituents from leaves include alkaloids viz., carbazole alkaloid, koenine, koenimbine, mahanine, girinimbiol, murrayanine, girinimibine and O-methyl murrayamine A.[7]

In previous studies, *M. koenigii* leaves were found to have tannins, saponins and flavonoids, which show antioxidant and inflammatory activity on the skin. *M. koenigii* leaf extract in ethyl acetate has the potential against the *Vibrio alginolyticus*, *V. parahaemolyticus* and *Escherichia coli* bacteria to show antibacterial activity.[8] The ethyl alcohol-water extract of *M. koenigii* leaf has the potential against ghost lipid peroxidation to exhibit maximum antioxidant and free radical scavenging activities.[9]

M. koenigii significantly influences the physiology of hair melanogenesis and may cause premature canities.[10] Besides that, *Kaidarya Siddha taila* and *vati* are not only crucial for hair healthiness but also have pharmaceutical advantages as well as used further for preserving immunocompetence,[11] preventing hair loss,[12] treating skin conditions like pemphigus vulgaris, atopic dermatitis, seborrheic dermatitis[13] and used as supportive treatment in neurodegenerative disorders like Alzheimer's disease.[14] The *M. koenigii* herbal plant have been discarded because of a lack of studies focusing on its commercial application.

It is not the total depletion of follicular melanocytes that causes the loss of pigmentation in canities. In fact, the outer root sheath (ORS) of senile white hair follicles retains melanocytes. They may be used for dermis repopulation or repigmentation even though their purpose is unknown. The lack of hair pigmentation may be a sign of a deficit in the inductive microenvironment required for the production of bulbar pigment. [15]

The current study's objectives are to assess *M. koenigii's* potential in premature grey hair, as well as to ensure its authentication, standardization and safety. It also aims to create appropriate formulations that can treat the condition in an herbal way. Based on their stated roles in hair melanogenesis, flavonoids, saponins, tannins, iron, zinc, and copper are the reasons this herbal plant was chosen for the purpose.[16,17] So main aim is to evaluate the efficacy of *Kaidarya siddha taila* and *Kaidarya vati* in *Akala Palitya* for a synergistic effect.

MATERIAL AND METHODS

The goals of the Declaration of Helsinki and/or good clinical practice guidelines were followed in the conduct of this study. After receiving approval from the Institutional Ethics Committee, the study was started with Reference No: DYPCARC/IEC/548/2022, dated 05/08/2022. The research procedure was registered with the Central Trial Registry of India under the CTRI/2023/02/049833 registration number. Using the NAMASTE portal, which was created by CCRAS, the Ayurvedic scientific terms were converted into terms used in conventional science.

Raw Drug, Authentication, Standardization and Ayurveda Medicine Procurement

The raw drug was collected in the month of April from Mahesh Nagar area of Pimpri situated in Pune, Maharashtra, India. The authentication of drug was

done by botanist Mrs. Anita Navare with authentication no.- A.M.-80/01-23 followed by standardized and drug analysis performed at Sheetal analytical laboratory, Pune, Maharashtra. The finished products *Kaidarya siddha taila* (oil) and *kaidarya vati* (tablet) were manufactured and standardized in the pharmacy, which is GMP certified in-house pharmacy of the institution. The clinical trial was caried out from May 2023 to July 2023 for a period of three months in the hospital of the institution.

Drug Preparation

The *Kaidarya siddha taila*[18] and *Kaidarya vati*[19] were prepared by the basic concept of *taila* and *vati* preparation as stated in the chapter *Sneha Kalpana* and *Gutika Kalpana* of *Shargandar Samhita,* respectively. After carefully washing the collected samples with tap water, they were let to dry for five days in the shade. The fresh *Kaidarya* leaves were then precisely weighed. *Till taila* (sesame oil) was taken as base.

Oil Preparation

The oil was made by combining 16 litres of fresh curry leaf decoction, 2 kg of fresh curry leaf paste and five litres of sesame oil. The decoction was prepared by adding 5 kg of fresh *Kaidarya* leaves to 64 litres of water and reduced to a quarter that is 16 L. Followed by adding 2 kg of fresh curry leaf paste in the quarter decoction. It was heated to a boil over low flame. About 5 L of sesame oil were added to the decoction and heated over a low flame until the water content evaporated completely and the volume dropped to five liters. At last, *Varti pariksha* was done to check the water content in oil.

Tablet Preparation

The fine power of the *Kaidarya* (curry leaf) was used to prepare *Kaidarya vati*. At room temperature, the fresh leaves were dried and then grinded to make a powder. The 5 kg powder was put through an #8 no. mesh sieve. Thereafter 460 grams of acacia gum (binding agent) and water accordingly were added for wet granulation and sieved. This powder was dried in the drying oven. The powder was again sieved through #8 no. mesh, and tablets were prepared by compressing through a tablet machine. Ayurvedic Pharmacopoeia of India (part 1, volume 6), recommended total dose for adult is 3 to 6 grams. We prefer minimum total dose of 1 gram daily, calculated by the dose conversion table between animals and humans.[20]

Study Design, Sample Size and Recruiting Patients

The current research was a phytochemical and comparative interventional clinical study. The calculated each group's sample was 42 giving a total of 84 subjects. Considering the dropout rate total 95 subjects were enrolled in this study. *Kaidarya siddha taila* along with *kaidarya vati* was given to group A patients whereas *kaidarya vati* was given to group B patients. The patients present with *Akala palitya* (premature greying of hair) were recruited from the OPD of *Kayachikitsa* and *Swasthavritta & Yoga* department for the study. The *Akala palitya* (premature grey hair) was assessed through physical examination and medical instrument trichoscope/dermascope. The grey hair projected on screen through a trichoscope/ dermascope [area taken- 4 cm^2] and the data was maintained in the form of photographic record for subsequent evaluation.

Inclusion Criteria

Age range of 18 to 35 years; gender: transgender, female and male; clinically established *Akala palitya* (premature grey hair) through physical examination and trichoscope/ dermascope; subjects not using hair color or hair dye.

Exclusion Criteria

Age range: under 18 to over 35; patients having scalp psoriasis, fungal and bacterial infection; all types of alopecia, dermatitis, dandruff, surgical correction of hair loss, malignancy, neurological diseases, autoimmune diseases, endocrine disease, pregnant and lactating women and patients on hormone replacement therapy; patients having history of smoking, drug and alcohol intake; patient having sensitivity or allergy to any ingredient or product.

Withdrawal Criteria

Drug intolerance, occurrence of any other sickness, adverse events occurring during a clinical trial, patient willing to discontinue the treatment during the study and patient not reported during the follow-up will lead to withdrawal of patients. The proforma for withdrawal and adverse drug reaction was made with the intention of documenting and reporting any major side effects. Before conducting the trial, each patient was given a written informed consent form that had been predesigned, after a local language explanation regarding the study (Marathi). For those who were not familiar to Marathi, the study was narrated in Hindi and English language.

Intervention

Group A with *Akala palitya* (premature grey hair) received *kaidarya siddha taila* for topical application of 2 mL on scalp daily followed by light massage and *kaidarya vati* with dosage of 500 mg twice daily after meal with lukewarm water for duration of 51 days with a follow-up period of 15th, 30th and 51st day. Similarly, group B with *Akala palitya* (premature grey hair) received *kaidarya vati* with a dosage of 500 mg twice daily following a meal with lukewarm water for 51 days with a follow-up period of 15th, 30th and 51st day. The outcome was measured by physical investigation and trichoscope/dermascope by counting the hair projected on a laptop screen. The secondary outcome measures analysis of mean age group, male and female, which age and gender are more affected is studied.

Outcome

The data was obtained by taking patient's history in case sheets. The physical examination of hair and scalp was done and the photographs were clicked using a trichoscope/dermascope after taking written informed consent. There were three further grades for the greying severity score: Mild, moderate, and severe. The score ranged from 0 to 22. A total 95 patients were enrolled in which one patient dropped out from group A and two patients dropped out from group B. The maximum score was 22 and the lowermost was 3. Out of 92 patients, 68 has mild, 20 moderate and only 4 has severe greying severity score.[21] During each follow-up period, improvements such as the numbers of hair attaining their nature color, reduction in fizziness, dryness and scalp itching, smoothness of hair, improved digestion and increase in appetite were recorded and documented on case sheets. No allergic reaction of drug was reported during and after the trial.

Statistical Analysis

The version SPSS was used for the analysis of the obtained data. A bar graph and percentage were used to display the demographic information. The outcomes within the both groups of *Kaidarya siddha taila* along with *Kaidarya vati* (Group A) and *Kaidarya vati* (Group B) before and after therapy were analysed using a paired t-test. The findings revealed, *p-value* [0.000] < 0.05 for *Kaidarya siddha taila* along with *kaidarya vati* and *p-value* [0.006] < 0.05 for *kaidarya vati.* Independent t-test was used to do statistical analysis for the comparison of group A and group B, with *p-value* 0.00 < 0.05 for *Kaidarya siddha taila* along with *kaidarya vati* and *kaidarya vati,* respectively. The result found was statistically significant.

Results And Discussion

The chemical constituent's analysis of raw *M. koenigii* leaf was performed according to the requirement of study. The physiochemical, phytochemical, nutrition deposits and thin layer chromatography were done to achieve the active compounds which are documented in Tables 1-4, respectively. The base oil (sesame oil) and finished products *Kaidarya siddha taila* and *Kaidarya vati* were analysed whose results are demonstrated in Tables 5-7, respectively.

Total 95 patients were enrolled in the study which satisfied the inclusion criteria. In total three patients dropped out. Before and after the treatment, each patient underwent an assessment. The variations were photographed and noted on the case sheet. Moreover, the greying of hair was seen mainly on parietal region of head. *Nadi pariksha* (pulse diagnosis)*,* lifestyle, physical activity and eating habits were quizzed and causes were ruled out such as *Pittavataj prakruti, Pitta prakruti,* screen time more than 7 hours, intake of more *Katu* (pungent), *Amal* (sour), *Lavana* (salt)

Table 1: Physio-chemical analysis of *Murraya koenigii* leaf

S. No.	Parameter	Results
1.	Color	Yellowish brown
2.	Odor	Aromatic
3.	Taste	Bitter-astringent
4.	pH 5%	6.85
5.	Loss on drying @ 110° C	6.91
6.	Total ash content	11.49%
7.	Acid insoluble ash	0.055%
8.	Water soluble extract	23.88%
9.	Water soluble ash	3.26%

Table 2: Results of phytochemical composition of *Murraya koenigii* leaf

S. No.	Phytochemicals	Results (ppm)
1.	Tannin	Present+++
2.	Saponins	Present+++
3.	Phytosterols	Present+
4.	Carbohydrates	Present++
5.	Protein	Present++
6.	Flavonoids	Present++
7.	Glycosides	Present+

Table 3: Natural deposits tested in *Murraya koenigii* leaf

S. No.	Trace elements	Values
1.	Iron	344.8 ppm
2.	Zinc	66.2 ppm
3.	Copper	5.59 ppm

rasa (taste) in diet, extra salt in diet, processed food, fried-deep fried food, more intake of junk food and soft drinks, poor digestion, irregular sleep, disturbed sleep cycle, anger, stress and lack of exercise. These causes increase the *ushna guna* (heat) in body and vitiates *Pitta dosha* along with *Vata dosha* (associated with space and air)*. Kaidarya siddha taila* plus *kaidarya vati* (Group A) and *kaidarya vati* (Group B) were given and comparison of results between the groups was done in which *Kaidarya siddha taila* plus *kaidarya vati* (Group A) have showed more effective results than *kaidarya vati* (Group B).

In additional outcomes, out of 92 patients, 90 patients have improved digestion, 89 patients have increased appetite, 7 patients have improved fizziness, 13 patients have improved dryness, 36 patients have smoothness of hair, 17 patients have reduced itching and six patients have improved hair texture. The statistical analysis of results was done according to gender (Fig. 1), age (Fig. 2), followed by analysis within the group (Tables 8A and B) (Tables 9A and B) and between the group (Tables 10A and B).

In Fig. 1, among 92 participants, the maximum no. of the participant were female 78.26 and 21.74% were male.

Table 4: Thin layer chromatography of *Kaidarya* (*Murraya koenigii* (L.) Sprengel) leaves

Stationary phase- Toluene; Ethyle acetate; Formic acid (6:3:1)	Mobile phase- Ethanolic extract	
Eye observed		
SN	Rf value	Color
1.	0.89	Yellow
2.	0.85	Yellow
3.	0.75	Yellow
4.	0.72	Yellow
254 nm observed		
SN	Rf value	Color
1.	0.89	Yellow
2.	0.85	Yellow
3.	0.75	Yellow
4.	0.72	Yellow
365 nm observed		
SN	Rf value	Color
1.	0.89	Florescent yellow
2.	0.85	Florescent yellow
3.	0.75	Florescent yellow
4.	0.72	Florescent yellow
Iodine chamber		
SN	Rf value	Color
1.	0.89	Brown
2.	0.85	Brown
3.	0.75	Brown
4.	0.72	Brown

Table 5: Analysis of *Till taila* (sesame oil)

S. No.	Parameters	Test observation
1.	Description	Color- Light golden Odor- Pleasant Solubility- Soluble in alcohol
2.	Identification test	Pink Color changes to red
3.	Specific gravity	0.917 gm/mL
4.	Refractive index	1.4655
5.	Weight per mL	0.917 gm/mL
6.	Viscosity (at 60 RMP)	7.92 mPa.s
7.	Rancidity	No pink Coloration
8.	Acid value	1.4
9.	Saponification value	187

Table 6: Analysis of *Kaidarya Siddha Taila*

S. No.	Parameters	Test observation
1.	Description	Color- Blackish green Odor- Characteristic
2.	Specific gravity	1.07 gm/mL
3.	Refractive index	1.4236
4.	Weight per mL	0.97 gm/mL
5.	Rancidity	No pink Coloration
6.	Acid value	3.5
7.	Saponification value	120
8.	pH	6.47
9.	Viscosity (at 60 rpm)	20.8 mPa.s

Table 7: Analysis of *Kaidarya Vati*

| S. No.	Parameters	Test observation
1.	Description	Color-Greenish brown Odor- Characteristic Taste- Slightly bitter
2.	Thickness (in mm)	0.3 mm
3.	Diameter (in mm)	0.5 mm
4.	Average weight test	500 mg 7.5%
5.	pH (10% solution)	6.59
6.	Color of aqueous solution	Brownish green
7.	Hardness test	1.9 kg/cm^2
8.	Disintegration test	6 minutes:50seconds
9.	Friability test (%)	0.52
10.	Loss on drying (%)	1.67
11.	Total ash (%)	0.79
12.	Acid insoluble ash (%)	0.28
13.	Water soluble extractive (%)	42.32
14.	Alcohol soluble extractive (%)	23.66
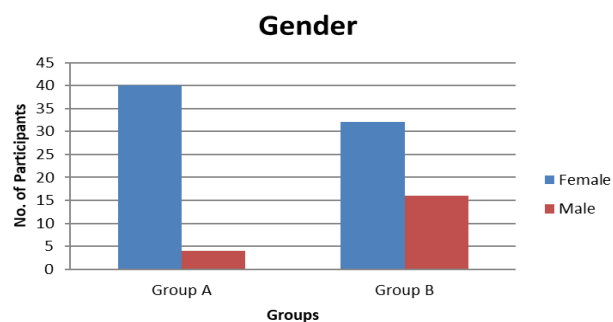
Fig. 1: Graphical representation of gender distribution of *Kaidarya siddha taila* plus *Kaidarya vati* and *Kaidarya vati.*

Fig. 2 reveals that the majority of the patients, 55.4 % were in the age group of above 21 to 25 years followed by 30.4% in age range of 26 to 30 years. 7.6% were reported in age group 16 to 20 years, whereas 6.5% were in age range of 31 to 35 years.

Table 8 states analysis within group A, *p-value* (0.000) < 0.05, provides compelling evidence to refute the null hypothesis. The result was found to be significant. The mean value suggested that the grades were decreasing significantly.
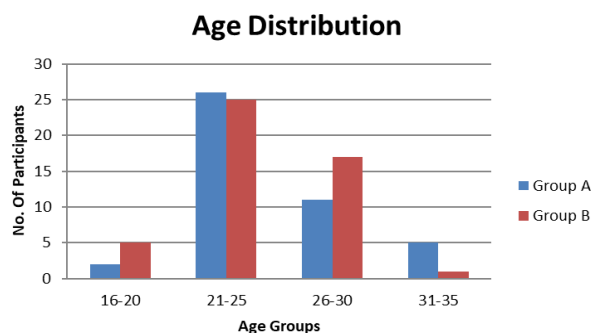
Age Distribution

Fig. 2: Graphical representation of age distribution of *Kaidarya siddha taila* plus *Kaidarya vati* and *Kaidarya vati*

Table 8A: Statistical analysis (Paired samples statistics) of *Kaidarya siddha taila* plus *Kaidarya vati*

		Mean	N	Std. Deviation	Std. Error mean
	Paired samples statistics				
Pair 1	Before	4.7500	48	2.24556	0.32412
	After	4.4375	48	2.41367	0.34838

Table 9 states analysis within group B, *p-value* (0.006) < 0.05, suggests substantial evidence against the null hypothesis. The result was found to be significant. The mean value suggested that the grades are decreasing significantly.

Table 10 states the analysis between the group A and B. The result is shown in percentage effect. Group A is 46.67% more effective than group B which was only 6.58%. Group A's (*Kaidarya siddha taila* plus *Kaidarya vati*) mean difference score is higher than group B's (*Kaidraya vati*). Hair are protein filaments and act as crown for each sexuality. Maintaining the hair health and its natural color is prime concern of every individual. Impaired melanin production and hereditary factor are among the causes but in Ayurveda, *Acharya Charaka, Sushruta and Vagbhata* specified *Aharaja nidana* such as predominant usage of *Katu* (pungent), *Amal* (sour), *Lavana* (salt), *Kshara* (alkali), *Ushna* (hot in potency) and *Ruksha* (dry) *ahara* (food), *Ati guru ahara* (heavy to digest food), *Sheeta ahara* (cold and frozen food), *Dusta bhojana* (stale food), *Ati madyapana* (alcohol addiction); *Viharaja nidana* such as *Ratrijagarana* (night vigil), *Atapasevana* (excessive exposure to sunlight), *Dhumasevana* (smoking), *Shrama* (physical strain) and *Mansika nidana* such as *Krodha* (anger), *Chinta* (Stress)

Table 9: Statistical analysis (Paired samples statistics) of *Kaidarya vati*

		Mean	N	Std. Deviation	Std. Error mean
	Paired samples statistics				
Pair 1	Before	5.4545	44	3.71330	0.55980
	After	2.9091	44	3.15357	0.47542

and *Shoka* (grief) as chief causative rudiments which collectively causes vitiation of *Pitta dosha* and impaired digestion.[22,23,24] *Pitta dosha* is responsible for digestion, cellular metabolism and normal function of *Rasa dhatu* (circulatory fluid) which mainly reflects on skin and hair.[25] Increased *Ushana* (hot) and *Tikshna* (sharp) *guna* (quality) in *Akala palitya* causes *Bhrajaka Pitta* (biological pigment) to produce in smaller amounts, which mostly results in loss of hair color.[25]

In Ayurveda *Nighantus* (lexicons) *Kaidarya* is regarded as pungent, bitter, sweet in taste, appetizer, digestant, improves digestion, cool potency, reduces body heat, pacifies burning sensation and anti-inflammatory.[6,26-28] The phytochemicals present in leaves such as O-methyl murrayamine, koenigine, mukonicine, mahanimbinine, murrayacinine, mahanimboline, mukoeic acid and murrayanine which act as antioxidant as well as active free radical scavenger.[29] Moreover, *Kaidarya* works as nutraceutical consisting of various nutritional compounds like vitamins such as β-carotene 6.04 ± 0.02 mg/100 g, ascorbic acid 0.04 ± 0.002 mg/100 g, vitamin E 0.03 ± 001 mg/100 g, niacin 2.73 ± 0.02 mg/100 g and minerals such as calcium 19.73 ± 0.02 mg/g, magnesium 49.06 ± 0.02 mg/100 g, sodium 16.50 ± 0.21 mg/100 g, potassium 0.04 ± 0.001 mg/100 g, the values are represented in mean ± STD.[30] These ingredients support hair growth as well as the maintenance and attainment of color by nourishing the scalp and hair both internally and externally. The rapid reproduction and multiplication of hair follicle cells is dependent on the synthesis of DNA, which is in turn dependent on the consumption of macro- and micronutrients,[31] all of which are abundant in *Kaidarya*. Vitamin A and calcium works in osteoporosis, calcium deficiency and strengthens bone. Furthermore, the plant contains terpenoids like β-sitosterol, [-] α-pinene, [-] β-pinene and [+] β-pinene, [-]-epiloliolide, icariside B$_1$, blumenol A; flavonoids such as quercetin, apigenin, rutin, kaempferol, quercetin, apigenin, catechin and

Table 8B: Statistical analysis (Paired samples test) of *Kaidarya siddha taila* plus *Kaidarya vati*

			Std. deviation	Std. error mean	95% Confidence interval of the difference		t	df	Sig. (2-tailed)
Mean		*Paired samples test*							
		Paired differences							
					Lower	Upper			
Pair 1	Before - After	0.31250	0.74822	0.10800	0.09524	0.52976	2.894	47	0.006

Table 9: Statistical analysis (Paired samples test) of *Kaidarya vati*

		Paired samples test								
				Paired differences						
Mean		*Std. deviation*	*Std. error mean*	*95% Confidence interval of the difference*			*t*	*df*	*Sig. (2-tailed)*	
				Lower	*Upper*					
Pair 1	Before - After	2.54545	1.15042	0.17343	2.19569		2.89521	14.677	43	0.000

Table 10A: Statistical analysis (Group statistics) between the group A and B

		Group statistics			
	Groups	*N*	*Mean*	*Std. deviation*	*Std. error mean*
VAR00002	Group A	44	2.5455	1.15042	0.17343
	Group B	48	0.3125	0.74822	0.10800

myricetin; polyphenols like selin-11-en-4α-ol[14] and tannins [tannic acid-antioxidant] which are natural colorants and promotes the hair health. Furthermore, recent research have demonstrated that flavonoids, which are anti-inflammatory and antioxidant substances that absorb free radicals and activate the wingless-type integration site (WNT) signaling pathway to promote melanogenesis, can regenerate pigmented hair in a mouse model.[31] Hair regimentation may be achieved by both promoting melanogenesis and inhibiting inflammation, as demonstrated by many of these experimental treatments.[31] Also, it is well known that antioxidants like flavonoids promote hair growth by relaxing the muscles in the blood vessels that surround hair follicles, which makes it easier for the cells in the hair follicles to receive a steady flow of blood that is rich in nutrients.[32]

Tannins are astringent in nature and beneficial for the external management of wound healing and inflammatory skin, according to epidemiological data.[33] Tannins may exert their biological effect as absorbable, given that they are typically low molecular weight compounds that have systemic effects and are readily absorbed.[33] There are several *in-vitro* bioactivities associated with tannins and glycosides, but the most well-researched were their antioxidant qualities.[32,34] While, through packing and stabilizing the membrane, phytosterols physically and chemically function as a mild radical scavenger and antioxidant in solution.[35]

Since saponins are antioxidants, they help protect the body from free radicals and oxidative stress. Free radicals are unstable molecules that speed up aging and several diseases in addition to causing damage to cells.[35] By rummaging these free radicals, saponins contribute to overall health improvement and the prevention of cell damage. Numerous *in-vivo* investigations determined its anti-inflammatory properties.[36]

Besides all, when massaged, *Kaidarya siddha taila* [which has a lipophilic character] may penetrate along the intersection of the root sheath, both internal and external. The protective stratum corneum of surface skin, which shields epithelial surfaces, is absent from these apertures. Thus, research suggests that sebaceous glands and hair follicles create a lipoidal channel for lipophilic substances within the follicles, which may play a major role in transdermal dry delivery.[37] Although the pharmacokinetics of the tablet *Kaidarya vati* are unknown, it is possible that they function by passive diffusion, the most prevalent drug absorption mechanism. Passive diffusion is the process by which a drug molecule travels from a higher drug concentration to a lower concentration along a concentration gradient until equilibrium is reached. This process can take place in an aqueous or lipid environment. Absorption can also occur through carrier-mediated membrane transporters.

The body uses a variety of specialized membrane transport mechanisms mediated by carriers, especially in the intestine, to move nutrients and ions. Diffusion in these systems can be both assisted and active. A

Table 10B: Statistical analysis (Independent samples test) between the group A and B

		Independent samples test								
		Levene's test for equality of variances		*t-test for equality of means*						
F										
		Sig.	*t*	*df*	*Sig. (2-tailed)*	*Mean difference*	*Std. error difference*	*95% Confidence interval of the difference*		
								Lower	*Upper*	
VAR00002	Equal variances assumed	11.076	0.001	11.126	90	0.000	2.23295	0.20070	1.83423	2.63168
	Equal variances not assumed			10.929	72.798	0.000	2.23295	0.20431	1.82575	2.64016

mechanism that requires energy for gastrointestinal absorption as well as the renal and biliary excretion of several medications is active diffusion. Certain lipid-insoluble medications are easier to absorb through this mechanism, which imitates natural physiological metabolites from thegastrointestinal tract. Drugs can travel from area with low drug concentrations to areas with high drug concentrations by active diffusion. Some physicochemical factors that impact systemic drug absorption include surface area, particle size, dosage form, composition, dissolution rate, amorphism, and polymorphism features. [38]

Safety Aspects

On view of safety aspects, no adverse reaction reported during and after treatment. It is traditionally considered to be safe, as the safety aspect of plant *Kaidarya* (*M. koenigii* (Linn.) Sprengel) is stated in the book of Quality Standards of Indian Medicinal Plants.[6]

CONCLUSION

Hence, the existing study concludes that *Kaidarya siddha taila* plus *Kaidarya vati* is more effective in *Akala palitya* as compare to *Kaidarya vati.* The synergetic outcome of *Kaidarya siddha taila* plus *Kaidarya vati* gave good results during the entire study. Individuals having premature greying of hair must avoid all the causative factors which increase the *Pitta* properties.

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