

Pharmaceutical development of polyherbal *Kushthaghna Mahakashaya* lotion with FTIR and HPTLC characterization

Research Article

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Abstract

Introduction: *Kushthaghna Mahakashaya* is a traditional herbal group of ten medicaments (*dashemani*) explained in classical texts and administered in the form of *kashaya* (decoction) indicated for the management of *Kushtha* (skin ailments). In the present scenario, based on disadvantages of the *kashaya* like lesser shelf-life, cumbersome, difficult to prepare and administer on a daily basis. Furthermore, if it is administered by an external route then, it may avoid first-pass metabolism and thereby enhancing the drug's bioavailability and causing its rapid action. So, the present study is an attempt to prepare and analyze the modified dosage form of *Kushthaghna Mahakashaya Kwatha* in the form of *Kushthaghna Mahakashaya* Lotion. **Materials and methods:** *Kushthaghna Mahakashaya Churna*, *Ghana*, and Lotion were all prepared. Lotion was made by mixing the aqueous and oil phases together at the same temperature. It was stabilized with Carbopol and neutralized with Triethanolamine to improve the sample's stability. Different trials were conducted to check the excipient ratio in the formulation, and samples were evaluated according to standards. Organoleptic parameters, physico-chemical analysis, FTIR, HPTLC, and microbiological specification tests were all performed on the *Ghana* and Lotion. **Results:** All the tests and observations were carried out on *Kushthaghna Mahakashaya Ghana* and Lotion samples, and the results were recorded. **Conclusion:** *Kushthaghna Mahakashaya* Lotion can be prepared from *Kushthaghna Mahakashaya Kwatha*. The prepared lotion will be light brown in colour, characteristic smell and semi-liquid in consistency with good spreadability.

Key Words: *Ayurveda*, *Kushthaghna Mahakashaya*, *Ghana*, Lotion, FTIR, HPTLC.

Introduction

Skin is the vital boundary that connects the environment to the human organs, and it serves certain roles that help humans survive by protecting them from diseases.(1) In 2019, WHO has reported a high frequency (21-87%) of skin diseases in general population of developing nations of the world, after assessing 18 prevalence studies.(2) Skin ailments are the 4th leading cause of non life-threatening disorders worldwide.(3) In *Ayurveda*, the skin ailments are broadly classified as *Kushtha*, which are of 18 types.(4) Thus, includes a wide variety of skin ailments which can be compared with the present day.

In modern treatment, topical steroids are included in the main treatment plan of many skin disorders, which causes the side effects like striae, telangiectasia.

(5) In some cases, topical steroids can even worsen the condition.(6)

Kwatha (decoction) is one of the liquid dosage forms and it is third amongst the *Panchavidha Kashaya Kalpanas*.(7) It is widely used therapeutically as well as pharmaceutically in *Ayurveda*. *Kwatha* are more effective in diseases of vitiated *Kapha* and *Vata* because it is *Agni siddha Kalpana*, as it is prepared by heating under controlled conditions. This makes it more efficient in treating various *Kushtha* conditions.

Kushthaghna Mahakashaya is a group of ten drugs (*dashemani*), used in the form of *kashaya* indicated for the management of *Kushtha*, administered internally through oral route.(8) This mode of administration is somehow inconvenient to the patients as *Kwatha* is to be freshly prepared each time with the specific amount of ratio and need to be consumed in the warm condition as due to lesser shelf life, it cannot be stored and consumed later. External administration will be more helpful as it will give the local effect to the affected tissues.

Lotion is a type of emulsion used for topical application and is compared better to other semi-solid dosage forms. It spreads evenly as a thin uniform layer and gets applied without friction even on the regions of hair growth due to its low viscosity. The particles in a colloidal preparation (esp., oil in water emulsion) turns

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out to be more soothing and gives a cooling effect on the inflamed area, as it is much efficient due to more water content.(9)(10) So, it was preferred as the mode of drug administration over others. The present study is an attempt to develop a *Kushthaghna Mahakashaya* Lotion from *Kushthaghna Mahakashaya Kwatha* referenced in traditional scriptures.

Materials and methods

Collection of raw materials

Kushthaghna Mahakashaya contains ten herbal drugs (Table no. 1) which were collected from GMP certified KLE Ayurveda Pharmacy, Khasbag, Belagavi. The authentication, analytical test and the quality assessment were carried out in Drug Testing Laboratory (DTL) approved by GoI for ASU drugs, KAHER's Shri B. M. Kankanawadi Ayurveda Mahavidyalaya, Belagavi were then subjected for further procedures. Other required excipients were procured from KLE college of Pharmacy, Belagavi.

Table no. 1: Name, Botanical name, Part used and Ratio of *Kushthaghna Mahakashaya Kwatha Churna*

Name	Botanical name	Part used	Ratio
<i>Khadira</i>	<i>Acacia catechu</i> Willd.	Heartwood	1
<i>Abhaya</i>	<i>Terminalia chebula</i> Retz.	Fruit	1
<i>Amalaki</i>	<i>Emblia officinalis</i> Gaetrn.	Dried Fruit	1
<i>Haridra</i>	<i>Curcuma longa</i> Linn.	Rhizome	1
<i>Bhallataka</i>	<i>Semecarpus anacardium</i> Linn.	Ripened seed	1
<i>Saptaparna</i>	<i>Alstonia scholaris</i> R.Br.	Bark	1
<i>Aragwadha</i>	<i>Cassia fistula</i> Linn.	Bark	1
<i>Karvira</i>	<i>Nerium indicum</i> Mill.	Root	1
<i>Vidanga</i>	<i>Embelia ribes</i> Burm.f.	Fruit	1
<i>Jati</i>	<i>Jasminum officinale</i> Linn.	Fresh leaf	2

Procedures

Preparation of *Kushthaghna Mahakashaya Kwatha Churna*

The physical impurities of the raw drugs were removed and the coarse powder were made separately (except *Jati*) by pulveriser then sieved through sieve no. 40#.(11)

Preparation of *Kushthaghna Mahakashaya Kwatha*

Selection (12) and *Shodhana* of *Ashodhita Bhallataka* seeds(13) were done by *Narikela jala* and *Shodhana* of *Karvira* roots(14) using *Godugdha*. One part each of all the nine drugs coarse powder (except *Jati*) with two parts(15) of fresh and cleaned *Jati* leaves were taken, *Kwatha* was prepared(16) and tested using organoleptic, physico-chemical parameters mentioned in API(17) (Table no. 2 and 3).

Preparation of *Kushthaghna Mahakashaya Ghana*(18)

Prepared *Kashaya* was heated again in a thick bottom stainless steel vessel; the *Ghana* obtained was stored in an airtight glass container taking care of the aseptic precautions and tested using organoleptic, physicochemical parameters mentioned in API(17) (Table no. 2 and 3).

Preparation of *Kushthaghna Mahakashaya Lotion*(19)

Kushthaghna Mahakashaya Ghana and water soluble components (Glycerine, Tween-80) were dissolved in Aqueous Phase (Part A) and heated upto 80 °C. Span-20 with Coconut oil in a beaker were dissolved as Oil phase (Part B) and heated upto 80 °C. After heating, oil phase was added in small portions to the aqueous phase by constant stirring with blender to prepare primary emulsion. Soaked Carbopol was added gradually to the primary emulsion (45 °C) and was again blended uniformly. Triethanolamine (TEA) was added drop by drop until it turns into a neutral pH to attain stability of the samples and Methyl Paraben, Propyl Paraben and Perfume were added at the end (Table no. 4). After cooling the prepared lotion was transferred into sterile bottles and was kept at room temperature in a cool place. The lotion samples were kept at room temperature, preliminary, physico-chemical studies were performed and were observed at a regular time intervals (Table no. 5).

Preliminary phytochemical analysis (Organic compounds):

These qualitative tests were carried out for both 5 % alcohol and 5 % aqueous extracts of raw materials. (20)

Preliminary phytochemical analysis (Inorganic compounds):

These qualitative tests were performed by using the ash filtrate of raw materials as per the standard procedures.(20)

Fourier Transform Infrared Spectroscopy:

Here, *Kushthaghna Mahakashaya Ghana* sample was tested using Shimadzu IR Affinity-1 (Diffuse reflectance spectroscopy) DRS 8000 spectrometer by doing sample preparation using 99 parts of Potassium bromide (KBr) with 1 part of *KM Ghana* which were triturated in this fixed ratio, aliquot of this was used as sample scan and its background scan was obtained prior to sample scan.

Kushthaghna Mahakashaya Lotion sample was tested using Perkin elmer spectrum two FT-IR Spectrometer instrument. Attenuated Total Reflection (ATR) contact sampling method was adopted using ATR crystal as diamond with resolution 8 cm⁻¹ and 28 number of scans were performed.

High Performance Thin Layer Chromatography:

Methanolic extract of *Kushthaghna Mahakashaya Ghana* and Lotion samples were spotted as two number

of tracks with 8 mm band length separated with 20 mm using 3µl as application volume on Precoated Silica Gel 60 F 254 aluminium plate (5 cm x 10 cm) using CAMAG Automatic TLC Sampler 4 (ATS4) applicator fitted with 25µl syringe and unheated N₂ as spray gas. Toluene: Ethyl acetate: Methanol: Formic acid (6:4:1:0.5) v/v was used as the mobile phase in Twin Trough Chamber (20 x 10 cm) which was later dried using oven at 60°C temperature for 5 minutes. HPTLC was performed to develop a chromatographic pattern of the samples by following the standard procedure with a CAMAG TLC Scanner 3 in 254 nm, 366 nm and 550 nm reflectance absorbance mode well equipped with CAMAG Visualizer: 170205, DXA252:441480210 Digital camera type: snr & Lens, Savitsky-Golay 7, D2 & W lamp and winCATS software.

Observation and Results

The present study revealed the presence of Organic Phytochemicals like Carbohydrates, Reducing sugar, Monosaccharides, Pentose sugar, Steroids, Cardiac Glycosides, Anthroquinones, Flavanoids, Alkaloids, and Tannins in majority of both the alcoholic and aqueous extracts of raw drugs. While, Saponins were present in all the aqueous extracts except *Haridra*. The Inorganic elements like Sodium, Iron, Chlorides, Nitrates were mostly present in all the raw drug samples while, Sulphates, Phosphates, Carbonates were present in some of them. The observations drawn during the Kwatha and Ghana preparation were noted down (Table no. 2).

Table no. 2: Total yield of Kushthaghna Mahakashaya Kwatha and Ghana

Quantity of <i>Kwatha Churna</i> taken	1200 gm
Quantity of Potable water taken	19.2 litre
Quantity of <i>Kwatha</i> obtained	2870 ml
Quantity of <i>Kwatha Churna</i> after filtration (wet <i>churna</i>)	2460 gm
Quantity of <i>Ghana</i> obtained before drying	248.8 gm
Quantity of <i>Ghana</i> obtained after drying	150.8 gm
% yield of <i>Ghana</i> obtained from <i>Kwatha Churna</i>	12.56%

The Organoleptic characters of *Kwatha*, *Ghana* and Physico-chemical investigations are clearly mentioned in Table no. 3.

Table no. 3: Organoleptic characters and Physico-chemical investigations of *Kushthaghna Mahakashaya Kwatha and Ghana*

Sample	Parameters	Observations	
KM <i>Kwatha</i> Soaked water	pH	4.1	
	KM <i>Kashaya</i>	Colour	Greenish brown
		Odour	Characteristic
		Taste	<i>Amla, Kashaya</i>
		Consistency	Thicker and even; Liquid consistency
	pH	3.676	
	Specific gravity	1.046	
KM <i>Ghana</i>	Clarity test	Opaque/Turbid i.e., light did not pass through it	
	KM <i>Ghana</i>	Colour	Blackish brown
		Odour	Characteristic
		Taste	<i>Amla, Kashaya</i>
	Form	Sticky	
	pH (1% Solution)	3.82	
	LOD	11.764%	
	Ash value	8.939%	
	Acid Insoluble ash	6.686%	
Water Soluble ash	5.978%		

The different lotion trials were performed to get a stable formula (Table no. 4), which were then evaluated using the same set of lotion evaluation parameters (Table no. 5). The final and accepted lotion formula Trial 4 showed spreadability as 3.8 cm.

Table no. 4: Formulation Trials (1-5) for Lotion using various ingredients

Ingredients/ Chemicals	Active Role	Trial 1	Trial 2	Trial 3	Trial 4*	Trial 5
<i>Ghana</i>	Main ingredients	1 gm	1 gm	1 gm	1 gm	1 gm
Distilled water	Diluent	57 ml	56 ml	52 ml	50 ml	40 ml
Glycerin	Humectant	5 ml	5 ml	5 ml	5 ml	5 ml
Tween-80	Emulsifier	4.8 ml	4.8 ml	4.8 ml	4.8 ml	4.8 ml
Carbopol	Auxiliary emulsifying agent/ Thickening agent	0.25 gm	0.5 gm	0.75 gm	1 gm	1.5 gm
Coconut Oil	Emollient	24 ml	24 ml	24 ml	24 ml	24 ml
Span-20	Emulsifier	1.2 ml	1.2 ml	1.2 ml	1.2 ml	1.2 ml
TEA	Neutralizing agent	12 drops	14 drops	22 drops	25 drops	42 drops
Methyl paraben	Preservative	0.1 gm	0.1 gm	0.1 gm	0.1 gm	0.1 gm
Propyl paraben	Preservative	0.05 gm	0.05 gm	0.05 gm	0.05 gm	0.05 gm
Fragrance		-	-	-	-	Q.S.

Table no. 5: Evaluation Parameters of Polyherbal Lotion Trials (1-5)

Parameters	Trial 1	Trial 2	Trial 3	Trial 4*	Trial 5
Physical evaluation					
Colour	Light brown	Light brown	Light brown	Light brown	Light brown
Odour	Characteristic	Characteristic	Characteristic	Characteristic	Characteristic
Appearance	Liquid	Semi-liquid	Semi-liquid	Semi-liquid	Semi-liquid
Homogeneity	Good	Good	Good	Good	Good
Ph	7.02	7.02	6.9	6.96	6.9
Specific gravity	1.001g/mL	1.001g/mL	1.001g/mL	1.002g/mL	1.001g/mL
Sedimentation	Seen within 24 hr	Seen within 24 hr	Not seen upto 24 hr and later	Not seen upto 24 hr and later	Not seen upto 24 hr and later
Redispersibility	10 cycles	2 cycles	Not seen	Not seen	Not seen
Cracking	Not seen	Not seen	Not seen	Not seen	Not seen
Phase inversion	Not seen	Not seen	Not seen	Not seen	Not seen
Viscosity	45 cps (50 rpm) 113 cps (20 rpm)	203 cps (50 rpm) 300 cps (20 rpm)	529 cps (50 rpm) 816 cps (20 rpm)	566 cps (50 rpm) 872 cps (20 rpm)	2257 cps (50 rpm) 3769 cps (20 rpm)

*Trial 4 has passed the lotion evaluation parameters and thus, it was selected.

KM Ghana and KM lotion (Trial 4) were further undergone through qualitative and quantitative analytical technique like FT-IR and HPTLC to substantiate that blend of excipients along with Ghana doesn't infringes the principles mentioned in classical texts. FTIR of Ghana sample had shown 26 peaks (Graph-1 and Table no. 6) while, FTIR of lotion sample had shown 10 major peaks (Graph-2 and Table no. 7).

Graph-1: FT-IR absorption bands and vibration assignments for *Kushthaghna Mahakashaya Ghana* obtained in present study.

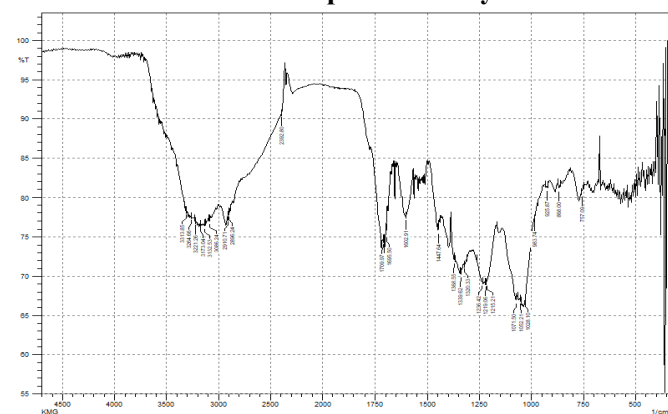


Table no. 6: FT-IR, frequency, bonds and functional group for *Kushthaghna Mahakashaya Ghana* obtained in present study.

Frequency (cm ⁻¹)	Functional groups
2910.71	C-H
3086.24	OH of COOH
1709.97	C=O
1695.50	C=C
3173.04	NH

Graph-2: FT-IR absorption bands and vibration assignments for *Kushthaghna Mahakashaya Lotion* obtained in present study.

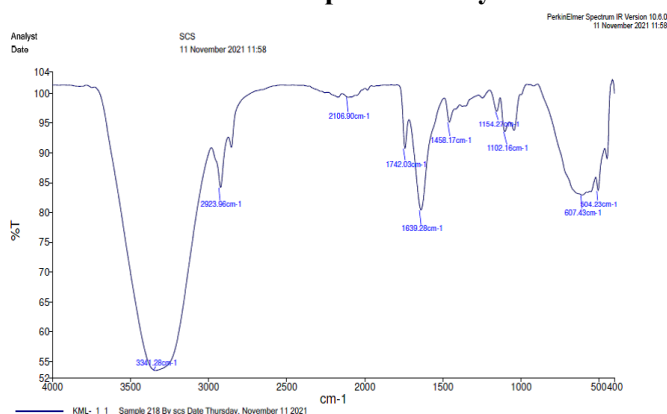


Table no. 7: FT-IR peak number, frequency, bonds and functional group for *Kushthaghna Mahakashaya Lotion* obtained in present study

Frequencies (cm ⁻¹)	Functional group
3341.28	OH stretch
2923.96	Ar-CH stretch
1639.28	C=O stretch
607.43	-NO ₂
1458.17	-OH Bending

HPTLC of Ghana sample had shown 10 peaks at Short wavelength UV 254 nm, 10 peaks at Long wavelength UV 366 nm and 10 peaks at Visible light 550 nm while, Lotion sample had shown 8 peaks at Short wavelength UV 254 nm, 4 peaks at Long wavelength UV 366 nm and 8 peaks at Visible light 550 nm shown in Graph 3, 4 and 5 (Figure-1).

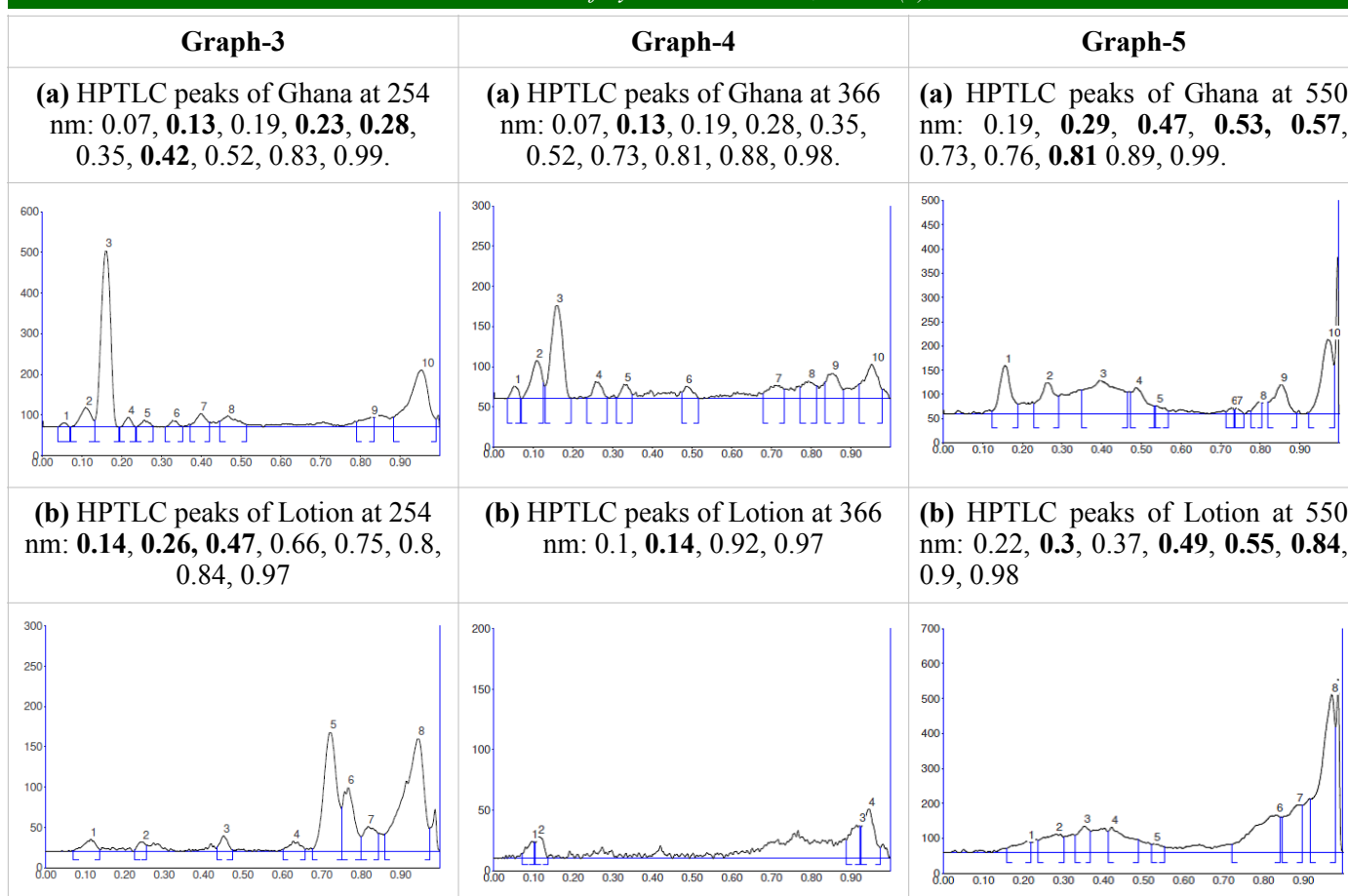
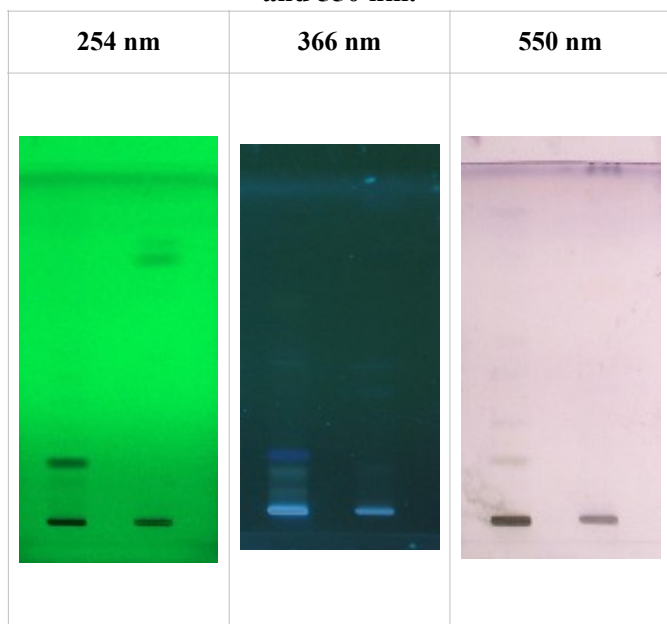


Figure-1: HPTLC fingerprinting profile for various secondary metabolites present in *Kushthaghna Mahakashaya Ghana* and Lotion at 254 nm, 366 nm and 550 nm.



Discussion

The Preliminary phytochemical tests of raw materials divulge the presence of primary metabolites like Carbohydrates, Reducing sugar, Monosaccharides, Pentose sugar which are having direct involvement in the growth, development and reproduction of plant. Thus, could be helpful in the cell and tissue building in

the human body. While, the secondary metabolite like Steroids, Cardiac Glycosides, Anthroquinones, Tannins, (21) Alkaloids(22) and Flavanoids,(23) acts as weapons against various bacteria, fungus, insects or animals which try to invade the plants; metal transporting agents; symbiosis agents and plant hormones. Thus, acts as anti-microbial, anti-oxidant, free radical scavenging, anti-inflammatory agents, natural steroids mimicking human hormones. While, Saponins were present in all the aqueous extracts except *Haridra* which exhibit antimicrobial property, help in improving production of T cells, anti-oxidants, free radical scavenging and antiseptic activity against acne, protects the skin against UV damage.(24,25) The Inorganic elements like Sodium, Iron, Chlorides, Nitrates were mostly present in all the raw drug samples while, Sulphates, Phosphates, Carbonates were present in very few. Sodium ions help in managing healing of wounds, ulcerations and skin allergies.(26) Chloride ions maintain the flow of water and dissolved substances in various layers of skin; coolness of skin surface with the help of perspiration and excretion of various metabolites.(26) Iron takes part as an important role in photo-induced skin cell damage and oxidative stress. (27) Nitrates can't absorb directly through the skin, they can only be ingested. Thus, its effect through the external route is tentative.(28) As *Ghana* is the concentrated form of *Kwatha* (decoction) thus, its % yield from *Kwatha Churna* was 12.65% (Table no. 2).

Carbopol along with TEA acts as a thickening agent and increases the stability of lotion which was poor in trial 1, 2 and 3 because of more sedimentation

volume. Sedimentation volume, Redispersibility of the emulsion imparts its important role in the physical stability. Lotions are biphasic dosage form where solid drug is dispersed in liquid. So, lesser the time for dispersion, stable will be the lotion. Cracking, Phase inversion, Redispersibility, etc all the lotion evaluation parameters were passed in the Trial-4 and had good viscosity as well as spreadibility. Microbial test were under normal permissible limit so, the developed samples are safe in use. As the maximum drug (esp., *Khadira*) are having good amount of anti-oxidants i.e., natural anti-oxidants. So, there was no need of adding BHT, BHA or any other anti-oxidants. The pH was 6.96 (ideal pH 5.5-7) which is not harmful for the skin and can be used on wounds.

FTIR is a qualitative and quantitative analytical technique which helps in the identification of an unknown sample, with quality of a sample along with determining the numbers and types of functional group in that mixture. Thus, it works as a fingerprint of a particular sample. FTIR of *Ghana* and lotion samples had shown two similar peaks containing C-H and C=O functional group which could be due to presence of Gallic acid, Ellagic acid, Chebulagic acid in *Haritaki*; Gallic acid, Ellagic acid, Chebulanic acid in *Amalaki*; Curcumin (phenol, ether, ketone, phenol) in *Haridra*; Bioflavonoids, Anacardiac acid in *Bhallataka*; Embelin in *Vidanga*; Salicylic acid in *Jati*. HPTLC of *Ghana* and Lotion had shown much similarity in peaks under UV 366 nm and visible light rather than UV 254 nm. This could be due to due to adsorption of those water soluble phytochemicals which are visible under these spectra. Thus, it can be concluded here that FTIR and HPTLC peaks of both the samples confirms the presence of various phytochemicals in the sample and it depicts that there were no interactions between the *Ghana*, polymers and other excipients used, proving that they are compatible to develop a stable product.

Conclusion

The present study can conclude that *Kushthaghna Mahakashaya* Lotion is a modified dosage form of *Kushthaghna Mahakashaya Kwatha*. *Kwatha* as well as *Lotion* samples had shown the presence of similar bioactive components in the Phytochemical, Chromatographic and absorbance analytical techniques. The analytical findings can be used as a reference for *Kushthaghna Mahakashaya Ghana* and *Lotion*. *Kushthaghna Mahakashaya Ghana* as well as *Lotion* can be used for treatment of various types of *Kushtha* and thus, different clinical studies can be performed using the developed lotion.

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