Published online in http://ijam.co.in

ISSN: 0976-5921

International Journal of Ayurvedic Medicine, 2015, 6(4), 321-328

Swedana Samsakara of *Haritaki* (*Terminalia chebula* Retz) with *Jala* and *Gomutra*: A comparative Phyto-Pharmacognostical study

Research Article

Shivam Joshi[1*], Mandip Goyal[2], Harisha CR[3], Sukla VJ[4]

1. Ph.D. Scholar, 2. Assistant Professor, Department of Kayachikitsa,
3. Head, Pharmacognosy Laboratory, 4. Head, Pharmaceutical Chemistry
IPGT&RA, Jamnagar

Abstract

Samsakara (transformation) and *Samyoga* (combination) play major role in pharmaceutics. *Samsakara* is defined as *Gunantaradhanam* (transformation). *Swedana* is *Agni Sannikarsha Samsakara.* The changes in finished product because of *Swedana Samsakara* with two different media *Jala* and *Gomutra* can be perceived at pharmacognostical and phytochemical levels. Aims: To compare role of *Swedana Samsakara* with two different media *Jala* and *Gomutra* on basis of phyto-pharmacognostical, HPTLC and UV-VIS-NIR Reflectance (180-2500nm) study. Materials and Methods: In the present study, 3 samples were prepared viz. *Haritaki Churna* (Powder) (GH-1), *Gomutra Swedita Haritaki*(GH-3) and *Jala Swedita Haritaki* (GH-5), to compare role of *Swedana Samsakara* on basis of Pharmacognostical (powder microscopy), Pharmaceutical, HPTLC densitogram and UV-VIS-NIR reflectance (180-2500nm) study. Results: The samples prepared with different media showed difference in pharmacognostical, pharmaceutical, HPTLC and UV-VIS-NIR findings. *Gomutra Swedita Haritaki*(GH-3) had highest variation in all Phyto-Pharmacognostical, HPTLC and UV-VIS-NIR. Powder microscopy of GH-3 showed clumped epicarp cells, squashed mesocarp cells (not clear), parenchyma cells with brown content, cellular content was darker (brown) and crystalline material etc. Phytochemical parameters showed pH (7.0), loss on drying (9.303%w/w), ash value (15.84%w/w), water soluble extract (57.2%w/w), and alcohol soluble extract (43.5% w/w). HPTLC showed eight peaks at 256nm and 366nm. In UV-VIS-NIR, GH-3 has higher variation while other sample has higher leverage. GH -3 has apparent different profile from GH-1, GH-5. Conclusions: *Swedana Samsakara* effect was seen in both *Jala* and *Gomutra* but media (*Samyoga*) plays leading role to establish desired *Gunas* (qualities) and *Karma* (therapeutic action) in the final product.

Key words: *Gomutra*, *Haritaki*, HPTLC, *Jala*, Pharmacognosy, Phytochemical, *Swedana Samsakara*, UV-VIS-NIR

Introduction:

Samskara is defined as transformation (*Gunantaradhanam*) of the inherent attributes (*Swabhavika Guna*) of a substance which leads to the addition of new properties. Various methods of *Samskaras*(1) are mentioned in Ayurveda pharmaceutics such as *Toyasannikarsa*(Dilution), *Agnisannikarsa* or *Swedana Samsakara*(heat application), *Saucha*(cleaning), *Manthana*(churning), *Desha*(storing in a specific place), *Kala*(maturing), *Vasana*(container or preservation) and *Bhavana* (impregnation).

Swedana Samsakara is *Agnisannikarsha Samsakara*. Similar *Gunas* are found in *Agneya Dravya* (2), *Swedana Dravya*(3), *Pitta* and *Katuka Rasa*(4) which are *Ushna*, *Tikshna*, *Sukshma*, *Laghu*, *Vishada*, *Sthira* or *Sara* and *Snighdh* or *Ruksha Guna*. All above mentioned phenomena are having similar *Paka Karma* like *Swedana Samsakara. Gomutra* is *Agneya Dravya* with *Katu Rasa* (mainly), *Ushna*, *Tikshna*, *Sukshma*, *Pittala Guna* and *Pachana Karma*.(5) *Paka* or *Pachana* is having *Vayu* and *Agni Guna Bhuyistama* (*Pradhanyata*).(6) *Swedana* or *Paka Samsakara* is essential in preparation of *Ahariya Dravya*(food-diet)as well as *Aushadha Dravya*(Medicine formulation). It is also much important in *Shodhana* of *Visha Aushadhi* or *Rasa* (metals).

Haritaki(*Terminalia chebula* Retz.), one among most commonly used medicines, is extensively used in preparation of Ayurveda medicine either for preventive or curative aspect. *Haritaki* is used as prime ingredient in many formulations with different medications. *Gomutra Haritaki* is one of them. In the present study, total three samples were prepared, viz. *Haritaki Churna, Jala Swedita Haritaki* and *Gomutra Swedita Haritaki* to compare role of *Swedana Samsakara* with two different media *Jala* and *Gomutra.* Total three samples were *Haritaki Churna* [GH-1], *Haritaki* boiled with *Jala* (*Swedita*-boiled for 6 hrs) [GH-5] and *Haritaki* boiledwith *Gomutra* (*Swedita*-boiled for 6 hrs) [GH-3].

Materials and methods:

Collection and Authentication of Raw Drugs

Haritaki(*Terminalia chebula* Retz.) was collected from raw drug market, Jamnagar(Gujarat). Pharmacognostical authentication of drug was done in

*Corresponding Author:
Shivam Joshi
Ph.D. Scholar, Department of Kayachikitsa,
IPGT&RA, Gujarat Ayurveda University, Jamnagar
Phone Number: 9427230432
E-mail: ayuholistichealth@gmail.com

pharmacognosy laboratory attached with institute while *Gomutra*(cow urine) was collected from *Gaushala* located in Dared village(Di. Jamnagar). Mineral water was used in preparation of *Jala Swedita Haritaki*. The API standards were used for authentication.(7)

Method of Preparation of Samples

Total 6 samples of *Haritaki* were prepared with different media i.e., [*Jala*(water), *Gomutra*(cow urine) and *Eranda Taila*(castor oil)] by different method of preparation i.e., (*Samsakara-Klinna*, *Swedana*, *Bhavana*). The details of method of preparation of these six samples are;

GH-1: The fruits of *Haritaki* was powdered,

GH-2: *Haritaki*(whole fruit) was soaked in *Gomutra* for 24 hrs and then seeds were removed from soaked *Haritaki* and powdered.

GH-3: *Haritaki* (whole fruit-1 part) was boiled with cow urine until cow urine (2.5 part) was evaporated. Seed was removed, pulp was dried and powdered.

GH-4: *Haritaki Churna* was given *Bhavana* of *Gomutra* for 6 hrs and *Bhavita Gomutra Haritaki* was dried and powdered.

GH-5: *Haritaki* (whole fruit-1 part) was boiled with mineral water until water (2.5 part) was evaporated. Seeds were removed, pulp was dried and powdered.

GH-6: *Haritaki* was roasted in *Eranda Taila* and thereafter powder was prepared.

All the samples were sieved through 80 mesh and preserved in an air-tight glass vessel.

All the six samples were analysed but for present paper, the results of only three samples viz. GH-1 (*Haritaki* powder), GH-3(*Swedana Samsakarita Gomutra Haritaki*) and GH-5(*Jala Samsakarita Haritaki*) are discussed. Samples were subjected to pharmacognostical, pharmaceutical, HPTLC and UV-VIS-NIR Reflectance analysis to compare effect of *Swedana Samsakara* with two different media water (*Jala*) and cow urine (*Gomutra*) in present study.

Pharmacognostical Analysis

Pharmacognostical analysis of GH-1, GH-3 and GH-5 based on organoleptic characters, i.e., colour, odour, taste and texture were recorded. Microscopic studies were carried out dissolving drug (Powder) in small quantity of distilled water, filtering through filter paper and then precipitate was studied with and without stain to find out the lignified materials along with other cellular constituents. The micro photographs were taken under Carl Zeiss Trinocular microscope attached with camera.(8)

Pharmaceutical Analysis

All the three samples were analysed with appropriate protocols for standard physicochemical parameters such as aqueous extract, alcohol extract, pH, total ash, loss on drying at the Pharmaceutical Chemistry Lab, I.P.G.T.&RA., Jamnagar.

In the HPTLC study, Methanol extract of drugs were spotted on pre-coated silica gel GF 60_{254} aluminium plates by means of Camang Linomate V sample applicator fitted with a 100 µL Hamilton syringe. The mobile phase consisted of Chloroform:Methanolin a ratio of 9:1 v/v. After development, densitometric scan was performed with a Camag T. L. C. scanner III in reflectance absorbance mode at 254 and 366 nm under control of Win CATS Software (V 1.2.1. Camag). Then, the plate was sprayed with Vanillin sulphuric acid followed by heating and then visualised in daylight.(9)

UV-VIS-NIR

UV-VIS-NIR (180-2500nm) reflectance was carried out at SICART, Vallabh Vidhyanagar, Gujarat. Study was conducted with instrument model Lambda 19 UV/VIS/NIR, data interval 1.0000 nm, slit width 5.0000nm, scan speed 240nm/min and smooth bandwidth 8 nm. PCA performed on the unscramble software 9.7.

Result of Pharmacognostical study:

Organoleptic Characters

The sample GH-1 was a golden yellow powder with predominant *Kashaya* (Astringent) taste and characteristic smell. The sample GH-3 was brownish with pungent, piercing taste and smelled like cow urine (*Gomutra Gandhi*). The sample GH-5 was brownish with predominant *Kashaya* (Astringent) taste and characteristic smell. [Table-1]

Microscopic Characters

Powder microscopy of GH-1 showed group of epicarp cell, fragment of mesocarp cells, mesocarp cells with tannin content, mesocarp cell with cluster crystals, group of scleroids with wide lumen, lignified scleroids in group, fiber with wide lumen, simple starch grains and small group of stone cell. Powder microscopy of GH-3 showed epicarp cells some of clumped, mesocarp cells are more squashed (not clear), fibers with lumen, pitted scleroids with wide lumen, simple starch grains with hilum, parenchyma cells with brown content, fragment of pitted vessels, pitted stone cells, cellular content were darker (brown) and had crystalline material Powder microscopy of GH-5 showed little bit squeezed inner wall of epicarp cell, mesocarp cell with clumped cluster crystals, fibers were fragmented, simple starch grains with hilum, scleroids with wide lumen (clear), group of scleroids, fragment of pitted vessels, pitted stone cells, stone cell and unevenly distributed brown content (tannin) all over the powder. [Plate-1to9]

Pharmaceutical findings

All the three samples were analysed using various standard pharmaceutical parameters such as aqueous extract, alcohol extract, pH, total ash and loss on drying which were found within the permissible limits. [Table 2]

HPTLC

On performing HPTLC, the chromatogram of samples GH-1, GH-3 and GH-5 showed peaks with R_f values at 254nm and 366 nm. [Table 3, plate 10]

UV-VIS-NIR

All samples were used for UV-VIS-NIR Reflectance study with different media and different

preparation methods. Result of 3 samples GH-1, GH-3 and GH-5 are described in present study. In PCA, PC-I-92.6%, PC-II – 98.25%, PC-III – 99.84% data were found. GH-1 shows difference in visible range of spectrum i.e., 400-800 nm from GH-3 and GH-5. GH-3 show difference in totality and also shows weak peaks on spectrum. GH-3 had higher variation and its chemical profile was changed. GH-1 and GH-5 are partially similar frequency as PC-I make them apart due to effective variable in NIR Region. GH-5 was discriminated through unsaturated due to UV Visual region. In NIR region, GH-5 is in lower gradient. [Plate 11]

Discussion:

Organoleptic characters

Rupa(Colour) is *Guna* of *Agni Mahabhuta*(fire element). Colour of *Haritaki* was golden yellow which was changed to brown after *Swedana* process of *Gomutra* (GH-3) as well as *Jala*(GH-5). It indicates that *Agni Mahabhuta* was increased in samples (GH-3,5). *Gandha*(Odour) is *Guna* of *Prithvi Mahabhuta*(earth element). Odour of *Haritaki* was specific of drug which was changed as *Gomutra Gandhi* in GH-3 while GH-5 had similar smell as GH-1. Due to *Ushna*, *Tikshana*, *Drava Guna* of *Gomutra*, it decreased qualities of *Parthiva Ghataka* (earth component) of *Haritaki* and increased *Mruduta* (*Dravata*) and *Sukshmata* in *Swedita Gomutra Haritaki* (GH-3).

Rasa(Taste) is *Guna* of *Jala Mahabhuta*(water element). Taste of *Haritaki* was *Kashaya*(astringent) which was changed as pungent with piercing taste in GH-3 sample. It is due to *Ushna* and *Tikshna* (penetrating) *Guna* and *Bhedana Karma* of *Gomutra* which will responsible to increase potency of drug. GH-5 had similar taste as GH-1 *Sparsha*(Touch) is *Guna* of *Vayu Mahabhuta*.(air element) Touch of GH-1, GH-3 and GH-5 were fine coarse but fineness was increased in GH-3 which may be due to boiling effect of *Gomutra* with *Haritaki*.

Pharmacognostical

Epicarp cell was little bit squeezed in GH-5[Plate -1(c)] while *Gomutra Swedita Haritaki*(GH-3) was changed as clumped epicarp cell.[Plate-1(b)] GH-1 and GH-5 were having same characteristic of mesocarp cell with cluster crystal. [Plate-2(a),(c)] In GH-3, mesocarp cell was changed as squashed mesocarp cell. [Plate-2 (b)] Fiber with narrow lumen was found in GH-3 [Plate-3(b)] while GH-5 was found fragment fibers. [Plate-3 (c)] In GH-3, due to *Swedana* with *Gomutra* (*Ushna-Tishna Guna* and *Bhedana Karma* of *Gomutra*) epicarp cell were clumped, mesocarp cell were squashed and fiber was found with narrow lumen. Scleroids was found with wide lumen in GH-5.[Plate-4(c)] Pitted vessels were fragment in both GH-3 and GH-5.[Plate-5 (b),(c)] Simple starch grains were found in GH-1[Plate-6(a)] while simple starch grains with hilum were found in GH-3 and GH-5. [Plate-6(b),(c)] GH-1 and GH-5 were having stone cell[Plate-7(a),(c)] while GH-3 was having pitted stone cell.[Plate-7(b)]Change in scleroids, pitted vessels and stone cells were same after *Swedana Samsakara* in both media(*Jala* and *Gomutra*). GH-5 was changed containing unevenly distributed brown content all over body [Plate-8(c)] while GH-3 was changed having parenchyma cell with brown content. [Plate-8(b)] Probably, it may due to *Pittala Guna*(*Pitta Guna* dominance) and *Dipana*, *Pachana* and *Bhedana Karma* of *Gomutra*. GH-3 was found to have crystalline material [Plate-9(a), (b)], it may be from *Gomutra.* Crystalline material may be due to *Saksharatvata* (alkaline)(5) of *Gomutra.* Changes in the intra cellular structures were also found this may be due to increase bio-availability of intra cell nutrients due to *Swedana Samsakara* of *Gomutra*. Previous findings also indicates that it is bio enhancer.(10)

Pharmaceutical

Loss of drying of GH-3 sample was 9.303% w/w which indicates moisture content due to *Gomutra.* Total Ash value of GH-3 was 15.84% w/w while in GH-1, it was 2.5% w/w and in GH-5, it was 1.95% w/w which was less in comparison to GH-3. Ash value in GH-3 indicates inorganic component of drug. It can be stated that *Haritaki* absorbs *Gomutra* materials highest in comparison to GH-5. pH of GH-1 and GH-5 was 3.0. pH of *Gomutra Swedita Haritaki* (GH-3) was 7.0. Average pH value of *Gomutra* is near by 7.6 to 8.2. *Haritaki* is *Kashaya Rasa pradhana Dravya* (*Prithvi* and *Vayu Mahabhuta Pradhanya*) and *Gomutra* is *Katu Rasa Pradhana Dravya* (*Vayu* and *Agni Mahabhuta Pradhanya*). *Haritaki* is *Amla pradhanya Drava* while *Gomutra* is *Kshara Pradhanya Dravya*. *Amla* and *Kshara Samyoga* create *Madhuryam*. Variation found in pH value of all the three samples indicate *Madhurikarana* process in *Gomutra Swedita Haritaki*. (11) Water soluble extract value of GH-1(49.2%w/w) and GH-5(50.1%w/w) were similar. But it was increased in *Gomutra Swedita Haritaki* GH-3(57.2%w/w). The water soluble contents dissolve and separate from the raw drug *Haritaki* during *Swedana Samsakara* with *Gomutra*, this phenomenon may occur due to molecular diffusion mechanism(12), and follows the principles of mass transfer. Mass transfer increases as the viscosity of the liquid decrease. GH- 1 and GH-5 were having almost similar value. It means that increase value of (GH-3) may be due to mass transfer process and *Gomutra* effect. Alcohol soluble extract value of GH-1(62.5%w/w) and GH-5(59.1%w/w) were similar. The alcohol soluble extractive was less in *Gomutra Swedita Haritaki* GH-3(43.5%w/w) in comparison to GH-1 and GH-5, which indicate removal of the content during the procedure of *Gomutra Swedana Samsakara.*

HPTLC

HPTLC study of the GH-1 has yielded a standard fingerprint of the formulation consisting of six and six peaks on short and long UV, respectively with common Rf value of 0.17 and 0.34. HPTLC study of the GH-3 has yielded a standard fingerprint of the formulation consisting of eight and eight peaks on short and long UV, respectively with common Rf value of 0.36 and 0.42. HPTLC study of the GH-5 has yielded a standard fingerprint of the formulation consisting of five and four peaks on short and long UV, respectively with common Rf value of 0.17 and 0.89.

UV-VIS-NIR

Considering all UV(200-400 nm)-VIS(401-800 nm)-NIR(801-2500 nm), total 2302 data points were found, 99.84% data was described in 3 PC. GH-3 has higher variation while other samples have higher leverage. *Gomutra Swedita Haritaki* (GH-3) has apparent different profile then other samples. It proves that *Swedana* with *Gomutra* of *Haritaki* had different effect. It has higher potency and penetration quality. Apparent colour difference is observed in GH-1 i.e., that considered average deviated sample. GH-1 and GH -5 are somewhat similar frequency in NIR Region of PC I. GH-5 was spotted different frequency in unsaturated UV Visual region. It can be stated that *Jala Swedana* and Simple *Haritaki* have similar chemical profile.

Conclusion:

Swedana Samsakara effect was seen in both *Jala* and *Gomutra* prepared *Haritaki* but media (*Samyoga*) may be playing leading role to attribute desired *Gunas* (qualities) and *Karma* (therapeutic action). Alteration in pharmacognostical, pharmaceutical and UV-VIS-NIR reflectance (180-2500nm) findings of *Gomutra Swedita Haritaki* (GH-3) indicate that preparation of *Haritaki* in the *Gomutra* media had Changes the intra cellular structures which may increase bio-availability of intra cell nutrients. Present study supports the previous findings that it is bio enhancer.

References:

1. Agnivesha, edited by Vaidya Jadavaji Trikamaji Acharya. Charaka Samhita Vimana Sthana 1/21/2. Varanasi; Chaukhambha Surbharati Prakashana; 2009. 235p.
2. Agnivesha, edited by Vaidya Jadavaji Trikamaji Acharya. Charaka Samhita Sutra Sthana 26/11. Varanasi; Chaukhambha Surbharati Prakashana; 2009. 138p.
3. Agnivesha, edited by Vaidya Jadavaji Trikamaji Acharya. Charaka Samhita Sutra Sthana 22/16. Varanasi; Chaukhambha Surbharati Prakashana; 2009. 120p.
4. Sushruta, commentary by Dalhana, edited by Vaidya Jadavaji Trikamaji Acharya. Sushruta Samhita Sutra Sthana 42/7-2. Varanasi; Chaukhambha Surbharati Prakashana; 2012. 184p.
5. Sushruta, commentary by Dalhana, edited by Vaidya Jadavaji Trikamaji Acharya. Sushruta Samhita Sutra Sthana 45/220-221. Varanasi; Chaukhambha Surbharati Prakashana; 2012. 213p.
6. Agnivesha, edited by Vaidya Jadavaji Trikamaji Acharya. Charaka Samhita Sutra Sthana 22/9-17. Varanasi; Chaukhambha Surbharati Prakashana; 2009. 120p.
7. Anonymous. The Ayurvedic Pharmacopoeia of India, Part 1, Vol. 1-5. 1st ed. New Delhi; Department of AYUSH, Ministry of Health and Family welfare, Government of India; 2001.
8. Khandelwal KR. Practical Pharmacognosy techniques and experiments. 19th ed. Pune; Nirali Prakashan; 2008. 162p.
9. Stahl E. A Laboratory hand book. Berlin: Springer-Verlag; 1969.
10. http://www.ncbi.nlm.nih.gov/pmc/articles/ PMC3117312/ [last assessed on 2nd august]
11. Agnivesha, edited by Vaidya Jadavaji Trikamaji Acharya. Charaka Samhita Chikitsa Sthana 24/114. Varanasi; Chaukhambha Surbharati Prakashana; 2009. 588p.
12. Carter SJ. Cooper and Gunn's Tutorial Pharmacy. 6th ed. New Delhi; CBS Publishers and distributors; 2000.

Table 1: Organoleptic characters of the samples - GH-1, GH-3 and GH-5

Organoleptic characters	GH-1	GH-3	GH-5
Colour	Golden yellow	Brownish	Brownish
Odour	Characteristic	*Gomutra Gandhi*	Characteristic
Taste	Astringent	pungent with piercing	Astringent
Touch	Fine coarse	Fine coarse	Fine coarse

Table 2: Phytochemical parameters of the samples - GH-1, GH-3 and GH-5

Investigation	GH-1	GH-3	GH-5
pH	3.0	7.0	3.0
Loss on drying	6.237% w/w	9.303%	7.412% w/w
Ash value	2.5% w/w	15.84% w/w	1.95% w/w
Water soluble extract	49.2% w/w	57.2% w/w	50.1% w/w
Alcohol soluble extract	62.5% w/w	43.5% w/w	59.1% w/w

Published online in http://ijam.co.in

ISSN: 0976-5921

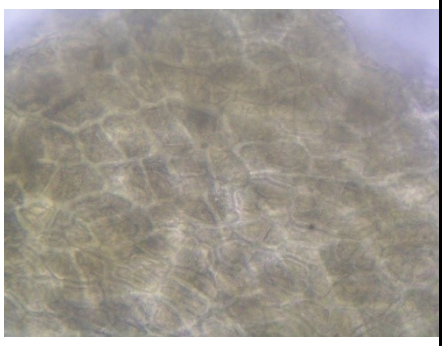
International Journal of Ayurvedic Medicine, 2015, 6(4), 321-328

Table 3: Rf value at 254nm and 366nm of samples - GH-1, GH-3 and GH-5

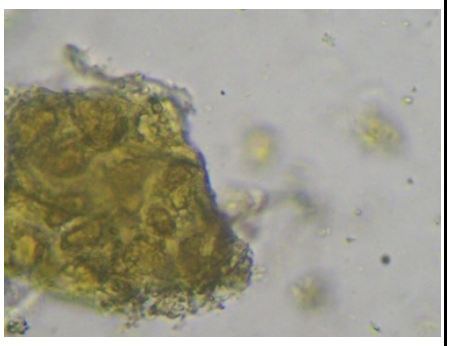
Samples- HPTLC	Rf value at 254nm	Rf value at 366nm
1. *Haritaki Churna* (GH-1)	0.17, 0.34, 0.40, 0.49, 0.89, 0.95	0.17, 0.34, 0.41, 0.55, 0.83, 0.87
2. *Haritaki* Boiled with *Go-mutra* (GH-3)	0.09, 0.36, 0.42, 0.48, 0.56, 0.68, 0.80, 0.93	0.11, 0.21, 0.36, 0.42, 0.49, 0.57, 0.79, 0.86
3. *Haritaki* Boiled with *Jala* (GH-5)	0.17, 0.40, 0.53, 0.89, 0.96	0.17, 0.42, 0.55, 0.89

Plate 1 to 9: Comparison of Microphotographs of GH-1, GH-3 and GH-5

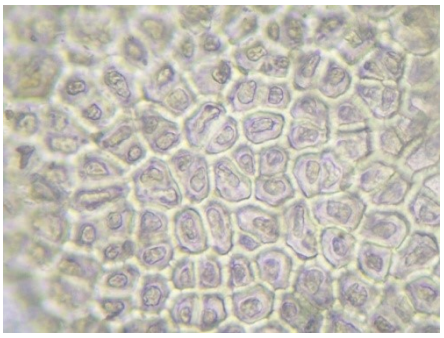
Plate 1: Epicarp cell of GH-1, GH-3 and GH-5



Epicarp cell of GH-1

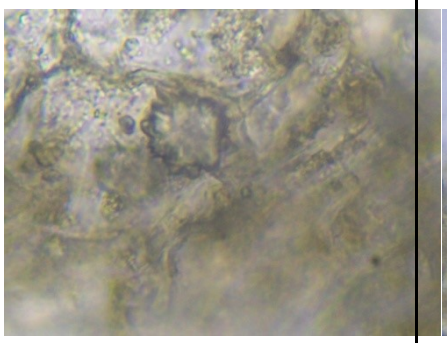


(b) Clumped epicarp cell of GH-3

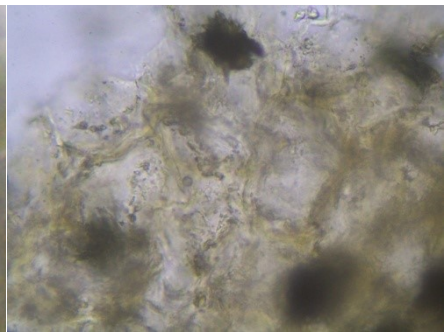


(c) Little bit squeezed inner wall of epicarp cell in GH-5

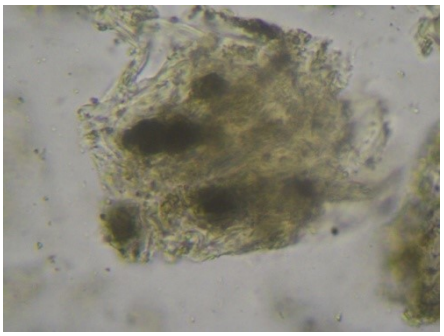
Plate 2: Mesocarp cell of GH-1, GH-3 and GH-5



Mesocarp cell of GH-1

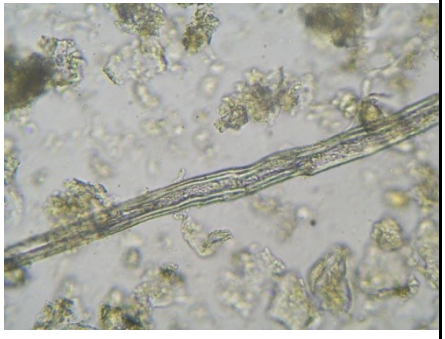


Mesocarp cell more squeezed of GH-3



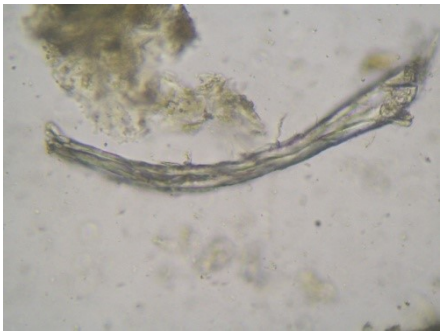
Mesocarp cell with clumped cluster crystals of GH-5

Plate 3: Fibers of GH-1, GH-3 and GH-5



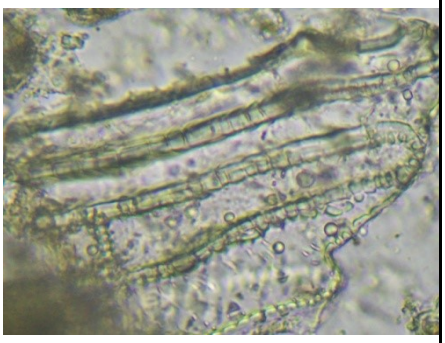
Fiber of GH-1

(b) Fiber with narrow lumen of GH-3

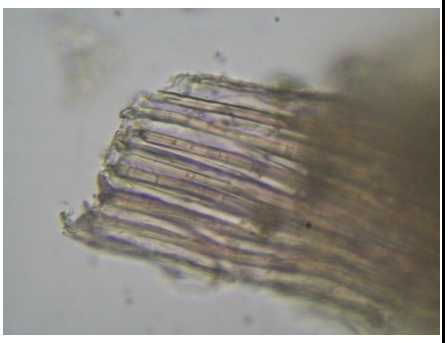


Fragment of fiber of GH-5

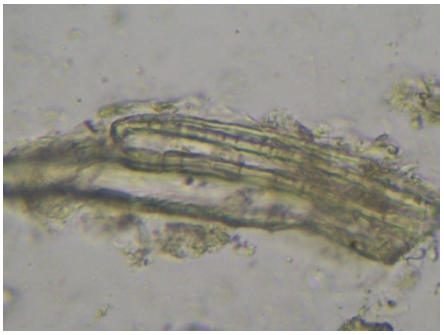
Plate 4: Scleroids of GH-1, GH-3 and GH-5



Pitted scleroids of GH-1

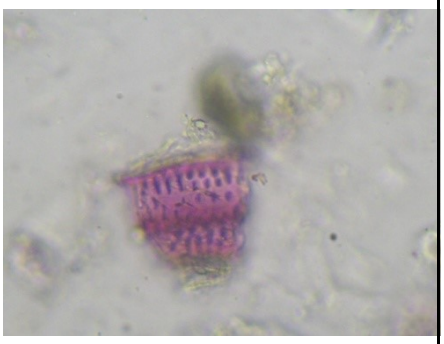


Groups of scleroids of GH-3

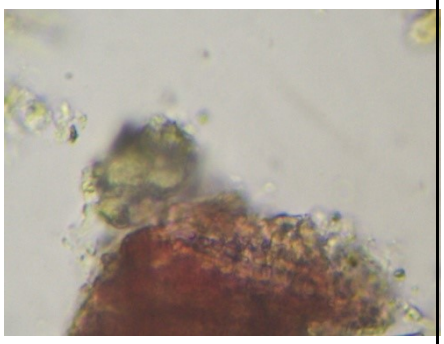


(c)Scleroids with wide lumen of GH-5

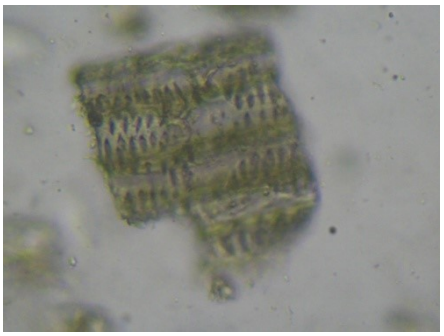
Plate 5: Pitted vessels of GH-1, GH-3 and GH-5



Pitted vessels of GH-1

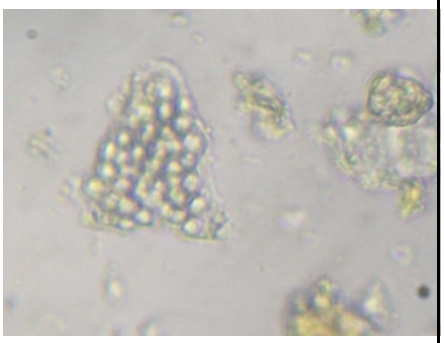


Fragment of pitted vessels of GH-3

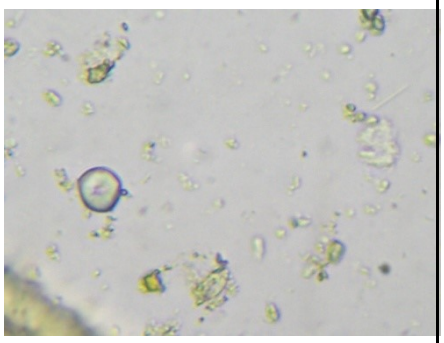


Fragment of pitted vessels of GH-5

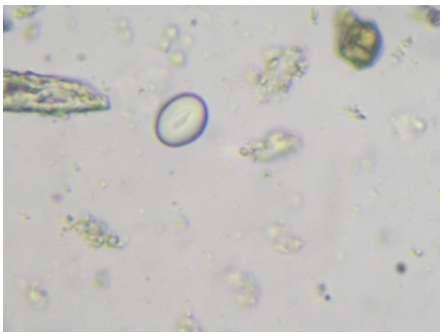
Plate 6: Simple starch grains of GH-1, GH-3 and GH-5



Simple starch grains of GH-1

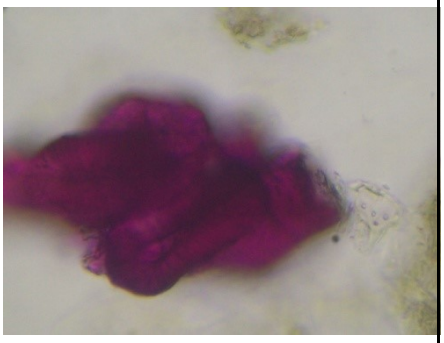


Simple starch grains with hilum of GH-3

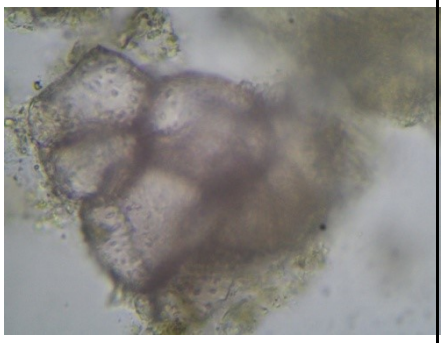


Simple starch grains with hilum of GH-5

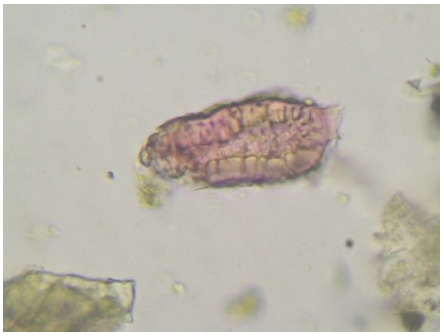
Plate 7: Stone cell of GH-1, GH-3 and GH-5



Stone cell of GH-1



Pitted stone cell of GH-3



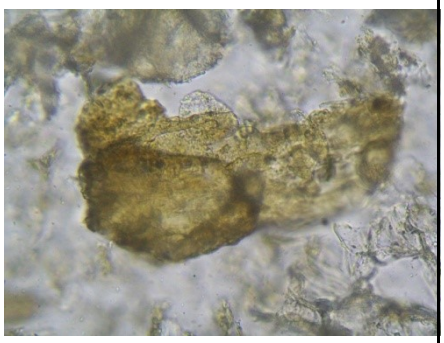
Stone cell of GH-5

Published online in http://ijam.co.in

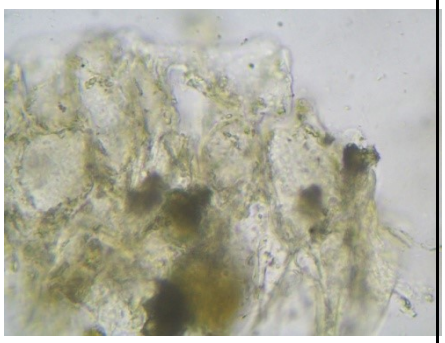
ISSN: 0976-5921

International Journal of Ayurvedic Medicine, 2015, 6(4), 321-328

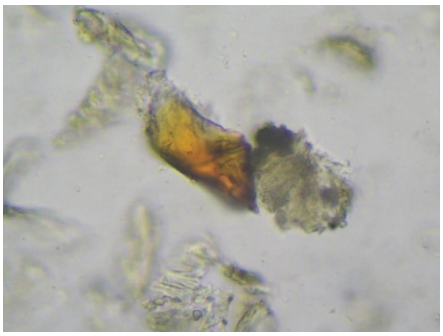
Plate 8: Brown content of GH-1, GH-3 and GH-5



Tannin content cell of GH-1

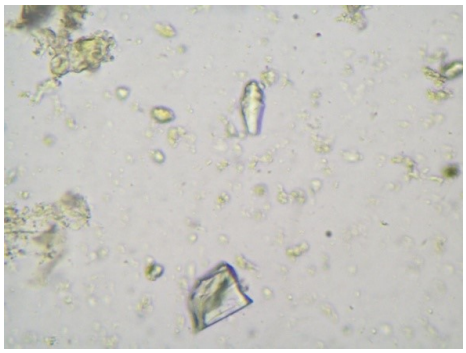


Paranchyma cell with brown content

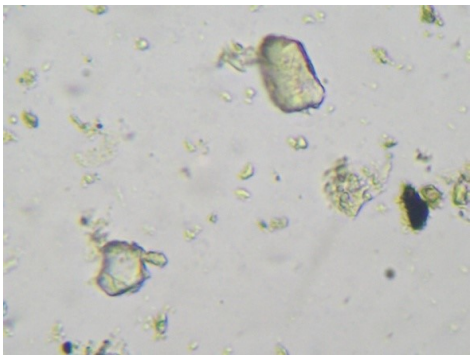


Unevenly distributed brown content all over body

Plate 9:Crystalline Material of GH-3

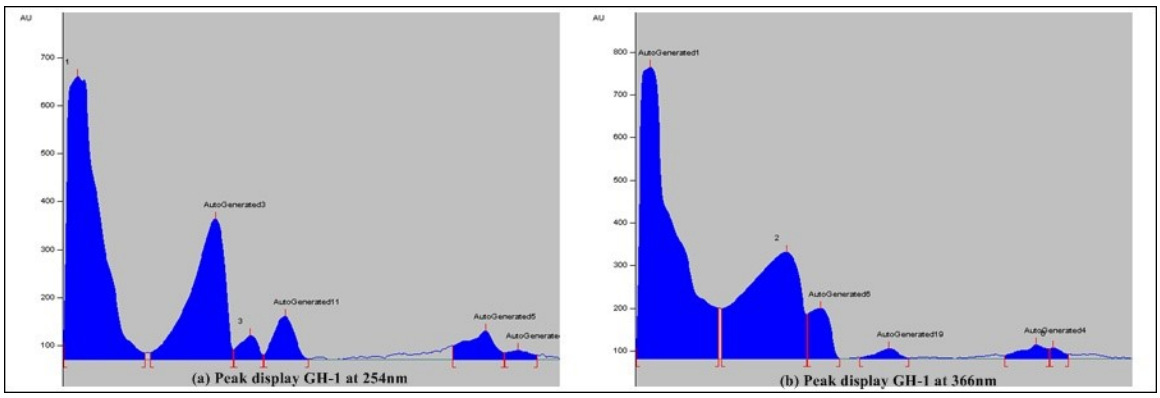


Crystalline material of GH-3

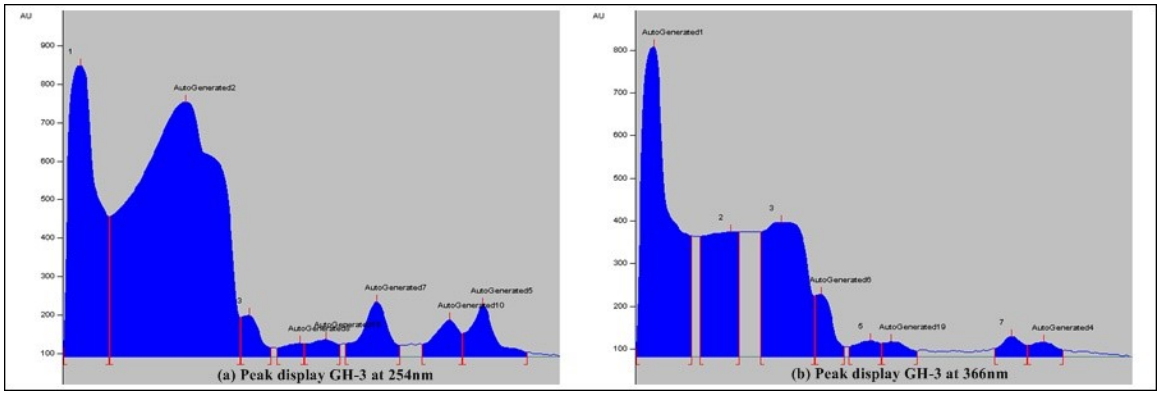


Crystalline material of GH-3(may be from *Gomutra*)

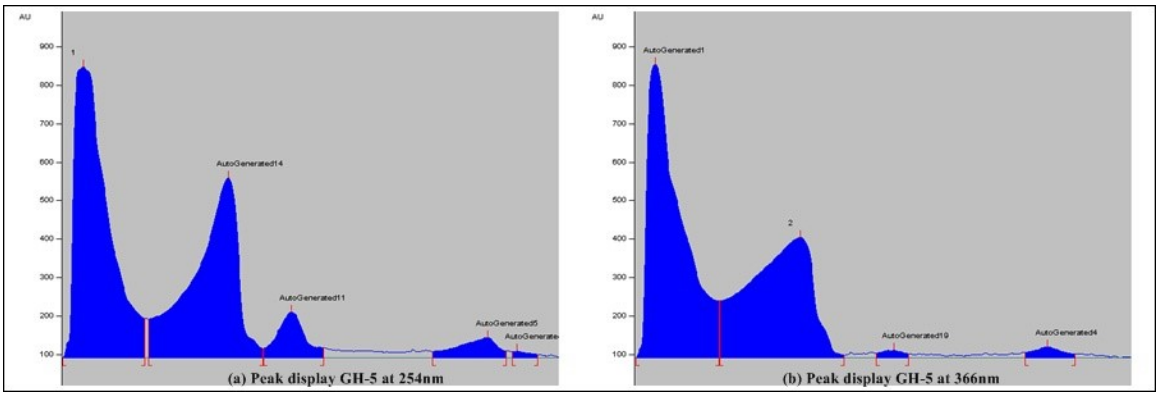
Plate 10: Peak display of Rf value GH-1, GH-3 and GH-5 at 254nm and 366nm



(A): Peak display of Rf value GH-1 at 254nm and 366nm



(B): Peak display of Rf value GH-3 at 254nm and 366nm



(C): Peak display of Rf value GH-5 at 254nm and 366nm

Plate 11: UV VIS NIR Reflectance of the samples

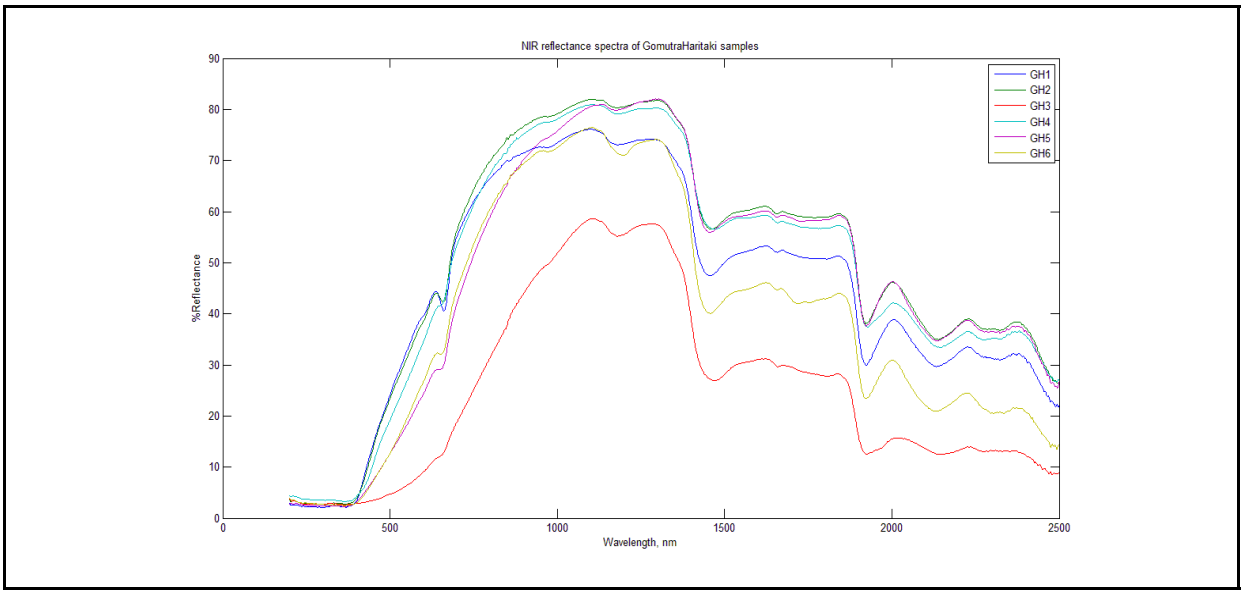


Figure (a) : raw spectrum of NIR reflectance of spectra

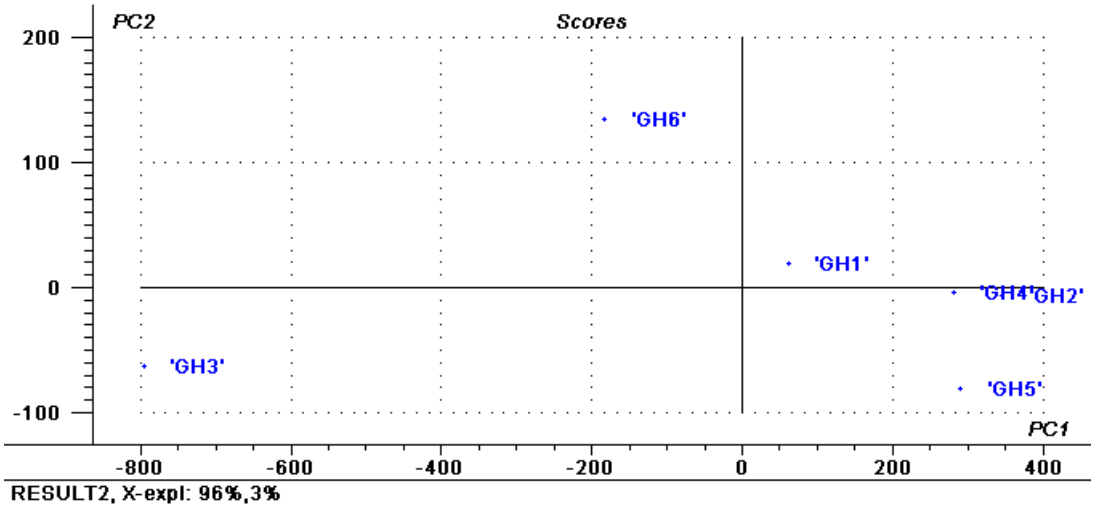


Figure (b) : NIR PCA score plot

[GH-1: *Haritaki Churna*, GH-2: *Klinna Sankarita Gomutra Haritaki*, GH-3: *Gomutra Swedita Haritaki* GH-4: *Gomutra Bhavita Haritaki*, GH-5: *Jala Swedita Haritaki*, GH-6: *Eranda Bhrista Haritaki*]

*****