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ORIGINAL ARTICLE

Pharmaceutical Evaluation and Standardization of *Dantashodhana* Paste: An Herbal Ayurvedic Formulation for Dental Plaque Management via Phytochemical and HPTLC Analysis

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ABSTRACT
In Ayurvedic scriptures, a variety of oral cavity ailments are referred to as Mukha Roga. These diseases include conditions that affect the teeth (Danta) and gums (Dantamula). Dantasharkara, or dental plaque, is one such condition that contributes significantly to the development of several oral disorders, including periodontitis, gingivitis, and tooth loss. In order to eliminate plaque without damaging the gums, Ayurveda emphasises the value of oral hygiene techniques like Pratisarana, or local application. Modern dentistry, on the other hand, uses scaling techniques to remove calculus and plaque, however, they can cause pain, gum recession, and nerve damage. Laksha, or Laccifer lacca, and Madhu, or honey, were used as the main ingredients in the creation of Dantashodhana paste in order to get beyond the scale constraints. Establishing a standard operating procedure (SOP) for the production of Dantashodhana paste and standardizing it through several analytical tests are the main objectives of this work. High Performance Thin Layer Chromatography (HPTLC) fingerprinting, phytochemical analysis, physicochemical parameter evaluations, and organoleptic evaluations are all part of the study. The purity and efficacy of the herbal formulation for oral health care are guaranteed by this all-encompassing approach.
Keywords- *Ayurveda, Dantashodhana Paste, Dental plaque, HPTLC, Organoleptic analysis, Phyto-chemical analysis, Physico-chemical parameters.*

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INTRODUCTION

Ayurvedic texts classify dental ailments as Danta (tooth) and Dantamula (gum) illnesses, which also characterize the Mukha Roga (oral cavity diseases). The Mukha (oral cavity), which is the entry to the alimentary canal, is considered to be one of the most important parts of the Urdhvajatru since it reflects the state of the body. The importance of oral and dental hygiene in maintaining one's appearance and overall health has been stressed. Having healthy teeth is essential to a healthy body. Dantasharkara, or dental plaque, is one of eight types of Danta Rogas, or oral ailments, that are described in the samhithas like Ashtanga and Sushrutha. As a life science, Ayurveda prioritises sickness prevention over illness treatment. All Ayurvedic literature have instructions for daily oral cavity care in the 'Dinacharya' section. Poor oral hygiene can lead to the development of a number of oral illnesses. [1] Dantasharkara is the term for when gravel-like debris is accumulated and adhered to teeth, damaging the teeth's natural characteristics. There is a correlation between dental plaque and dantasharkara because of their comparable symptoms. According to the classics, poor dental hygiene causes vitiated vata to dry out the kapha and Dantamala, which is how Dantasharkara, which is described in mukharoga under Danta roga illnesses, is caused. We can associate Dantasharkara with dental plaque based on the symptoms. One of the contributing elements to the development and advancement of numerous oral disorders is dental

plaque.[2] According to Ayurveda, the first step in treating Dantasharkara is to remove it without damaging the gingiva, then use Pratisarana locally. In Ayurveda, numerous practices for maintaining good oral hygiene have been documented, including Dantadhavana, Jihvanirlekhana, Pratisarana, Gandusha, and Tambula Bhakshana. Pratisarana is using the tip of a finger to softly massage over teeth.[3] Dental calculus is defined by contemporary science as a hard deposit that is created when dental plaque mineralises and is typically covered in a layer of unmineralized plaque. Microorganisms colonise and grow on the surface of teeth to form plaque, which can worsen the condition and cause periodontal illnesses, gingivitis, and even tooth loss if left untreated. Plaque deposition typically results in the development of calculus, gingivitis, periodontitis, and other oral disorders that cause bone resorption, gingival recession, tooth mobility, and eventual tooth loss.[4][5] The scaling process is the primary treatment for dental calculus in modern medicine. Another name for it is the supragingival scaling method. Because dental plaque recurs so frequently, patients seek scaling, which is not recommended more than twice a year. In addition, there are certain drawbacks to improper scaling, including as the potential for nerve injury, the inability to ensure gum reattachment to teeth, the potential for gum recession, the risk of infection in individuals with weakened immune systems, and discomfort and sensitivity. For this reason, it is not recommended for maintaining proper oral hygiene.[6][7] Dantashodhana paste is therefore created to address this shortcoming. The Dantashodhana Paste preparation method was followed, and the corresponding analytical tests were carried out.

MATERIAL AND METHODS

Collection, Identification and Authentication of Raw Drugs:

Laksha and Madhu, the raw ingredients, were gathered at the Parul Institute of Ayurveda's GMP-certified pharmacy. At the Parul Institute of Ayurveda's pharmacognostical laboratory, the pharmaceuticals were authenticated under the supervision of the raw drug authentication committee. On October 12, 2024, the Parul Institute of Ayurveda's GMP-certified pharmacy made the Dantashodhana paste according to the recommended procedure.

Ingredients of the formulations

1. *Laksha (Laccifer lacca)*
2. *Madhu* (honey)

Method Of Preparation-

The drug was crushed and ground to create the powder. The powder was then filtered using a sieve with a mesh number of 120 to produce a uniform mixture. The resulting mixture was then mashed with honey to get a semisolid consistency. Glycerine, sodium lauryl sulphate, gum tragacanth, methylparaben, and peppermint oil were added to the mixture to make it into a paste. weighted independently. After that, the tube was carefully filled with the paste and sealed. Analytical studies were conducted at the Pharmacy of Parul Institute of Ayurveda, which included assessing organoleptic properties and physicochemical parameters. The HPTLC and phytochemical study was carried out at the Centre for Research and Development at Parul University in Vadodara on December 19, 2024. Several analytical criteria were used to examine the Dantashodhana paste. Colour, odour, taste, and consistency were evaluated as organoleptic properties. Additionally, physicochemical characteristics were measured, such as pH, total ash, acid-insoluble ash, water-soluble extractive, loss upon drying at 110°C, and solubility tests.

Preliminary phytochemical tests [8,9]

The standard protocol was followed for conducting the initial phytochemical screening.

High Performance Thin Layer Chromatography [10,11]

The HPTLC fingerprint analysis for the Methanol extract of *Danthashodhana* paste at 3 different concentrations 5.0µL, 10.0µL and 15.0 µL was carried out. The test solution was prepared by weighing 2.5g of sample in a beaker and to it 20 mL of Methanol was added. The solution was refluxed for 30 minutes. It was then cooled and filtered with filter paper. The obtained methanol was then filtered with 0.45-micron membrane filter. The Test solution thus obtained was used for HPTLC analysis. The Chromatography was performed on 10 × 10 cm thin layer chromatography (TLC) plates coated with 0.2 mm layers of silica gel F254 (Merck). The samples were applied to the plate as 6 mm wide bands by means of a Linomat 5 sample applicator (CAMAG, Switzerland). The plate was developed to a distance of 8.0 cm with Toluene: Ethyl acetate: Methanol: Formic acid (6:3:0.5:0.5 v/v/v) as mobile phase in a CAMAG twin-trough chamber saturated with mobile phase vapor. The plate was then dried and scanned at 254 nm and 366 nm by use of a CAMAG TLC scanner 3 using winCATS 4 software (CAMAG, Switzerland).

RESULTS

Several analytical parameters were used to analyse the dantashodhana paste. Colour, odour, taste, and consistency were evaluated as organoleptic properties. Additionally, physicochemical characteristics were measured, such as pH, total ash, acid-insoluble ash, water-soluble extractive, loss upon drying at 110°C, and solubility tests. Tables 1 and 2 present the findings.

Preliminary Phytochemical Tests

The phytochemical screening results showed the presence of Flavonoids, Tannin, Saponins and Alkaloids, and Terpenoids.

Flavonoids: Their potential effects on dental health have been investigated due to their antibacterial, anti-inflammatory, and antioxidant properties. Research suggests that flavonoids may play a role in preventing dental caries (by reducing acid production and biofilm formation, which prevents plaque buildup), periodontal diseases, and oral cancers by controlling the activity of oral pathogens, reducing oxidative stress, and improving the overall health of oral tissue.[12]

Tannin: In terms of oral health, tannins have been investigated for their ability to lower oral infections, support healthy gums, and stop dental caries from forming. It is commonly known that they can prevent periodontal disorders by reducing plaque formation and inhibiting the growth of oral bacteria.[13]

Saponins: These substances have been researched for their possible advantages in dental health and are well-known for their soap-like qualities. Because of its antibacterial, anti-inflammatory, and antioxidant properties, saponins may help prevent and treat oral health issues. They are a topic of interest in periodontal disease and dental care research because of their capacity to stop the growth of oral infections, lessen plaque production, and enhance gingival health.[14]

Alkaloids -Alkaloids are helpful in the prevention and treatment of oral illnesses because of their antibacterial, anti-inflammatory, and analgesic qualities. According to research, alkaloids' capacity to prevent the formation of dangerous oral bacteria can help treat periodontal diseases, reduce oral discomfort, and prevent oral infections.[15]

Terpenoids- They are useful in preserving oral hygiene since they have anti-inflammatory properties and can stop the growth of oral germs and lessen the production of plaque.[16]

Table no-1 (Organoleptic characters of *Dantashodhana paste*)

Parameters	Results
Color	Shining Brown
Odor	Pleasant
Test	Sweat
Consistency	Semisolid

Table no-2 (Physio-chemical parameters of *Dantashodhana paste*)

Sl No.	Parameter	Result
1	pH Value (10% Aqs)	5.6
2	Total Ash Value (%w/w)	10.01
3	Acid Insoluble Ash (%w/w)	5.61
4	Water Soluble Extractive (%w/w)	50.8
5	Water Soluble Extractive (%w/w)	40.2
6	Loss on Drying at 110 c(%w/w)	11.9
7	Solubility Test	Water Soluble

High Performance Thin Layer Chromatography

Figure 1,2 and 3 shows the HPTLC Chromatograms of *Dantashodhana* toothpaste at 3 different concentrations under UV 254 nm and UV 366 nm respectively using Toluene: Ethyl acetate: Formic acid (6:3:0.5 v/v/v) and Table 3 and 4 gives the Rf values of the same.

Table 3: Rf values of *Danthashodhana* paste at UV 254 nm at concentrations 5.0 µL, 10.0 µL and 15.0 µL;

Sl. No.	**5.0 µL**		**10.0 µL**		**15.0 µL**	
	Rf value	**Area%**	**Rf value**	**Area%**	**Rf value**	**Area%**
1	0.59	27.62	0.30	4.54	0.31	4.75
2	0.64	15.51	0.59	24.42	0.59	28.47
3	0.73	35.00	0.63	15.12	0.63	13.37
4	0.82	21.88	0.72	34.43	0.72	33.35
5	-	-	0.83	21.50	0.83	20.07

Table 4: Rf values of *Danthashodhana* paste at UV 366 nm at concentrations 5.0 µL, 10.0 µL and 15.0 µL;

Sl. No.	5.0 µL		10.0 µL		15.0 µL	
	Rf value	Area%	Rf value	Area%	Rf value	Area%
1	0.70	48.33	0.23	7.11	0.23	7.38
2	1.00	51.67	0.71	24.43	0.70	18.06
3	-	-	0.80	17.28	0.81	25.62
4	-	-	0.92	15.47	0.92	15.89
5	-	-	1.00	35.71	1.00	33.05

Figure 1: HPTLC Chromatogram of *Dantashodhana* paste at concentration 5.0 µL at UV 254 nm and 366 nm;

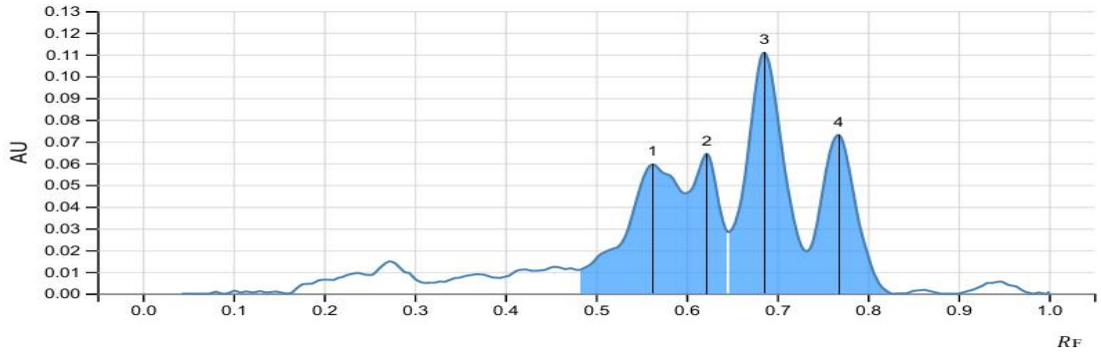

Fig 1(a): Under UV 254 nm

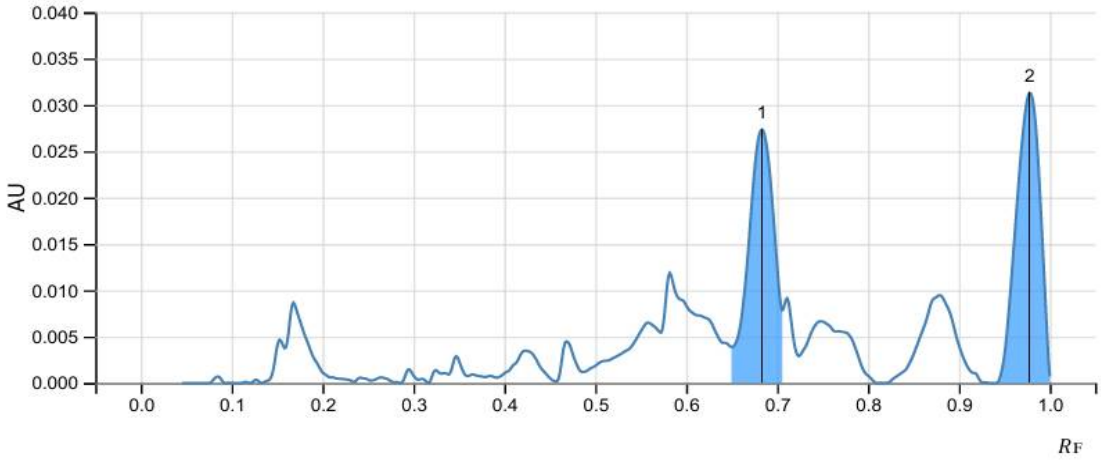

Fig 1(b): Under UV 366 nm

Figure 2: HPTLC Chromatogram of *Dantashodhana* paste at concentration 10.0 µL at UV 254 nm and 366 nm;

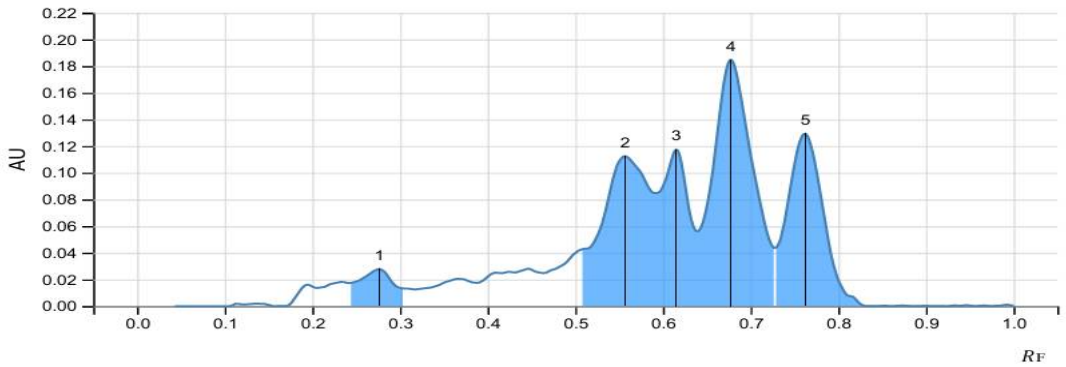

Fig 2(a): Under UV 254 nm

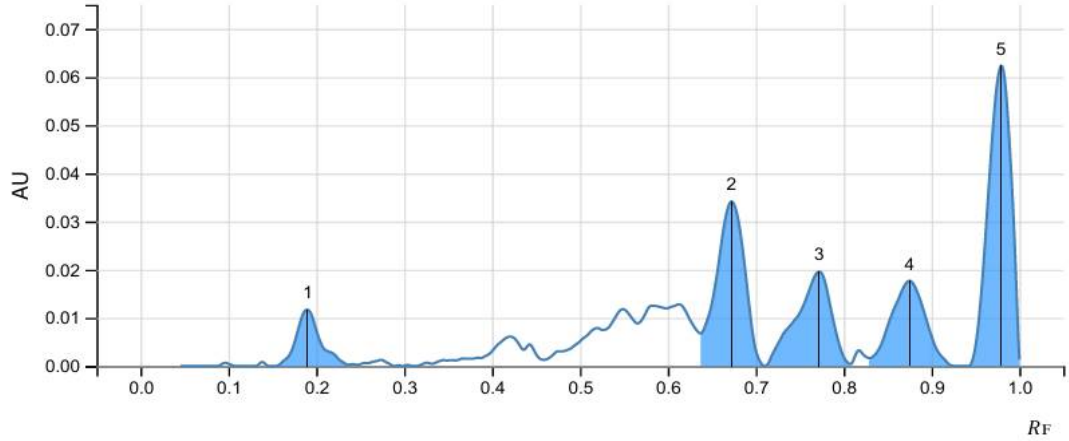

Fig 2(a): Under UV 366 nm

Figure 3: HPTLC Chromatogram of *Dantashodhana* paste at concentration 15.0 µL at UV 254 nm and 366 nm;

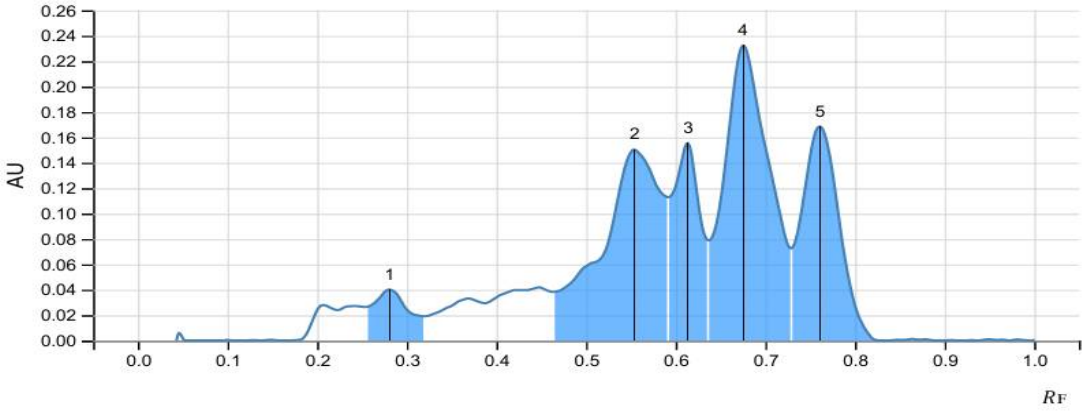

Fig 3(a): Under UV 254 nm

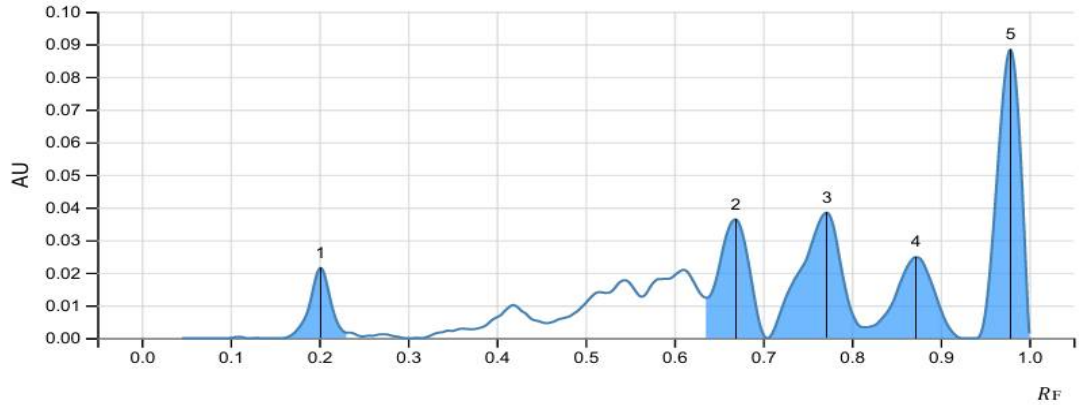

Fig 3(a): Under UV 366 nm

DISCUSSION

The HPTLC Analysis of the methanol extract of *Dantashodhana* paste shows similar Rf values at 0.30,0.59,0.63,0.72 and 0.83 under UV 254 nm and Rf values 0.23,0.70,0.81 and 0.92 under UV 366 nm. The highest intensity has been observed for Rf value 0.72 under UV 254 nm and for Rf value 0.70 and 0.81 under UV 366 nm. Lack of literature on the phytochemical analysis of *Laccifer lacca* using HPTLC instrumentation has been observed from literature survey. Thus, specifying and identifying a specific phytochemical in particular is difficult. All these Rf values suggests the presence of various phytochemicals, including flavonoids and terpenoids, which often exhibit fluorescence under UV light. Tannins can also be present with similar Rf values. Flavonoids, Terpenoids and Tannins possess potential anti-inflammatory, analgesic and anti-microbial activities. Flavonoids**:** Often exhibit Rf values ranging

between 0.06 and 0.82. Many flavonoids fluoresce under 366 nm UV light, and some may quench or absorb at 254 nm. Tannins**:** Can have Rf values ranging from 0.30 to 0.83 under 254 nm. Tannins typically absorb strongly at both 254 nm and 366 nm. Saponins**:** Can have Rf values ranging from 0.08 to 0.93. Saponins generally absorb at 254 nm and 366 nm. Alkaloids**:** Can have Rf values ranging from 0.23 to 0.92 under 366 nm. Some alkaloids fluoresce under 366 nm UV light, and others may absorb at 254 nm.

CONCLUSION

In conclusion, there are encouraging signs for dental health from the Dantashodhana paste made from Laksha (*Laccifer lacca*) and Madhu (honey). Numerous bioactive substances, including flavonoids, tannins, saponins, alkaloids, and terpenoids, are confirmed to be present by the results of a variety of analytical tests, including physicochemical and phytochemical evaluations. These substances are well-known for their antioxidant, antibacterial, and anti-inflammatory properties, which support good dental hygiene and the prevention of oral illnesses. The identification of these advantageous chemicals is further supported by the HPTLC study. With its chemical makeup supporting potential therapeutic advantages, dantashodhana paste thus seems to be a useful Ayurvedic formulation for oral care, providing an alternative to traditional oral hygiene procedures. In order to determine its effectiveness in maintaining oral health on a daily basis, more clinical research might be helpful.

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