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Review Article

Bombax Ceiba

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Therapeutic Potential of Bombax ceiba Linn. - A Review

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Shalmali, botanically identified as Bombax ceiba Linn., a robust long-lived tree found abundantly growing across country, has been in the focus of pharmacotherapeutic applications in Ayurveda since time immemorial. Almost every plant part like root, stem bark, leaves, flowers, Gum exudate have been described with different type of pharmacological properties and therapeutic potential in classical texts of Ayurveda to treat a number of diseases. According to Ayurveda, it has stimulant, astringent, hemostatic, aphrodisiac, diuretic, antidiarrheal, emetic, demulcent, anti-dysenteric, and antipyretic properties. Numerous pharmacological properties of the Shalmali have been shown in both in vitro and in vivo research, including analgesic, immunomodulatory, anti-inflammatory, antioxidant, anti-acne, antimicrobial, hypotensive, hypolipidemic, and antihyperglycemic effects. Present review is an attempt to bring forth the pharmaceutical and nutraceutical potential of various plant parts of Shalmali.

Keywords: Shalmali, Mochras, Bombax ceiba, Ayurveda, Pharmacological properties

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Introduction

According to *Acharya Charak* "There is no *Dravya* in creation that does not possess therapeutic properties, which means medicinal value of a *Dravya* is determined by rationale of its usage"**.** Medicinal plants played an essential role in socio-economic, spiritual and physical existence of rural Indians. The geographical origin, time and stage of development when collected, and post-harvested management-all have an impact on quality of herbal medicine. A durable tree in Bombacaceae family is *Bombax ceiba* Linn. Syn. *B. malabaricum* DC., *Salmalia malabarica* Schott. & Endl. The plant has a great therapeutic potential being utilized for treatment of a number of disease conditions in *Ayurveda*. Almost every plant part is reported to be utilized for treatment purposes since evolution of *Ayurveda*. An in-depth review of pharmacotherapeutic potential of plant has been done in present paper.

Materials and Methods

A thorough literary survey has been undertaken. Literary review includes ancient Vedic & Ayurveda texts to contemporary texts, including indexed & peer-reviewed journals, for collection of information regarding pharmacotherapeutic potential of different parts of plant. Information collected from different sources has been critically analyzed to validate ancient claims with evidence from pharmacological screening studies.

Observations

On reviewing available Vedic, Classical, and contemporary texts, it was observed that *Bombax malabaricum* DC is identified as botanical source of classical drug *Shalmali* by scholars of Ayurveda. In Rigveda, *Salmali* fruits have been considered to be toxic, while its wood has been used to prepare chariot during marriage rituals and is considered as tallest among trees.**[1]**

Morphology[2]

Tall, deciduous trees forming spreading crown and buttressed trunk. Leaflets 5-7, elliptic-lanceolate, acuminate, entire, glabrous. Flowers large, bright red, Capsules woody. Seeds smooth, surrounded by white silky cotton.

Flowers and Fruits: March-May

Distribution[3]

Temperate Asia, tropical Asia, Africa, and Australia are all home to *Bombax ceiba*. It is found up to 1,500 meters above sea level in India.

The tree is frequently found in the dry and moist deciduous forests, as well as by rivers in the Indian peninsula.

Vernacular Name[4]

Bengali: Pagun, Roktosimul, Simul, Shimul; **English:** Silk Cotton Tree; **Gujarati:** Sawar, Shimalo, Ratoshemalo; **Hindi:** Semar, Kaantisenbal, Pagun, Shimal, Rakatsenbal, Semul; **Kannada:** Booruga, Kempubooruga, Mullelava, Mullubooruga; **Malayalam:** Mullilabpoola, Mullilavau, Mocha, Mullulavamarum, Samparuthi, Poola; **Marathi:** Sanvar, Kantesavar, Saur, Simalo, Semul; **Oriya**: Bouroh, Nuagart; **Punjabi:** Simble; **Tamil:** Illavam, Mullilavau, Pulai; **Telugu:** Buruga, Boorugachettu, Kondabooruga-chettu, Mundlaboorugachettu

Table 1: Synonyms of *Shalmali*

SN	Synonyms / Texts	D.Ni. [5]	MP.Ni.[6]	K.Ni. [7]	BP.Ni.[8]	R.Ni. [9]	Sh.Ni. [10]	Ni.Ad. [11]
1.	Rochan	-	-	-	+	-	-	+
2.	Kutashalmali	-	-	-	+	-	-	+
3.	Kutashalmalik	-	-	-	+	-	-	-
4.	Rakta Pushpa	+	+	-	-	+	-	-
5.	Kukkuti	+	+	+	-	-	+	-
6.	Chirjeevika, Chulini	+	-	-	-	-	-	-
7.	Pichhila	+	-	+	-	+	+	+
9.	Mocha	+	+	+	-	-	+	+
10.	Kantakadhaya	+	+	-	-	-	-	-
11.	Supoorani	+	-	+	-	-	-	-
12.	Shalmali	-	+	+	-	+	+	+
13.	Chirjivi, Kantakdruma	-	-	-	-	+	+	-
14.	Raktphala	-	-	-	-	+	-	-
15.	Ramyapushpa, Bhauvirya	-	-	-	-	+	+	-
16.	Yamadruma	-	-	+	-	+	+	-
17.	Tulini	-	+	+	-	-	+	+
18.	Semal	-	+	-	-	-	+	+
19.	Sthulphala	-	+	+	-	-	+	-
20.	Chirjeevni	-	+	-	-	-	-	-
21.	Sthiragauh, Purani	-	-	-	-	-	+	+
22.	Semer	-	-	-	-	-	-	+
23.	Sthirjiveeka, Kantakhaya, Mandruma	-	-	+	-	-	-	-
24.	Tuliphala, Rakta-Puspak	-	-	-	-	-	+	-
25.	Rakta-Pushpika	-	-	+	-	-	-	-

Table 2: Synonyms of *Shalmali Niryas* (*Mochras*)

SN	Synonyms/Texts	D.Ni. [5]	MP.Ni. [6]	K.Ni. [7]	BP.Ni. [8]	R.Ni. [9]	Sh.Ni. [10]	Ni.Ad. [11]
1.	Shalmali Niriyas	-	-	-	+	-	+	-
2.	Pichha	+	+	+	+	-	+	-
3.	Shalmalivestaka	+	+	+	+	+	+	+
4.	Mochshrav	+	-	+	+	+	+	+
5.	Mochrasa	+	+	+	+	+	+	-
6.	Mocha	-	-	-	-	+	-	-
7.	Piccchilsara	-	-	-	-	+	+	-
8.	Surasa, Mocasara	-	-	-	-	+	-	-
9.	Shalmali	-	-	-	-	-	+	-
11.	Mochak	-	+	+	-	-	-	-
12.	Vestak, Mochsravi	-	+	-	-	-	-	-
13.	Mochniryasa	+	-	+	+	-	+	+

Etymological Derivation[3]

***Shalmali*:** It is a handsome tall tree.; ***Kantakadhya*:** It has hard conical thorns.; ***Kukkuti*:** Flowers are red in colour.; ***Chirajivika*:** The tree has a long life.; ***Tulaphala*:** The fruits yield cotton.; ***Picchila*:** It has shiny juice or resin.; ***Purani*:** It has resinous exudates.; ***Puranii*:** The plant lives for many years.; ***Bahuvirya*:** An efficacious drug used in many disorders.; ***Manadruma*:** It is a very tall tree.; ***Mocha*:** It has exudates.; ***Raktapuspa*:** This is a tree with beautiful red flowers.; ***Sthirayu*:** The plant lives for many years.

Table 3: *Rasa-Panchaka* of *Shalmali*

SN	Text Name	Rasa	Guna	Virya	Vipaka
1.	Dhanwantri N.[5]	-	Snigdha	Sheet	-
2.	Kaiyadev N.[7]	Madhur	Ruksha, Guru, Snigdha	Sheet	Madhur
3.	Bhavprakash N.[8]	Madhur	-	Sheet	Madhur
4.	Raj Nighantu[9]	Madhur, Kashaya	Pichhila	Sheet	-
5.	Shaligram N.[10]	Madhur, Kashaya	Snigdha, Laghu, Pichhila	Sheet	-
6.	Nighantu Adarsha [11]	Madhur, Kashaya	Snigdha, Laghu	Sheet	Madhur

Rasa-Panchaka* of *Mochrasa

All the *Nighantu* text have considered presence of *Kashya Rasa* and *Sheet Virya* in *Mochras*. There is slight difference in the views of scholars regarding its properties. *Kaiyadev Nighantu***[7]** and *Nighantu Kalpdrum***[12]** have considered *Ruksha*, *Guru*, *Snigdha* and *Acharya Bhav Mishra* considered it *Snigdha*, *Dhanwantri Nighantu***[5]** considered it *Grahi*, *Raj Nighantu***[9]** considered it *Pichhila*.

Therapeutic Uses of *Shalmali* in Classical Texts

Shalmali has been reported to be used for a number of therapeutic purposes in classical texts of Ayurveda. In Charak Samhita, *Shalmali* is mentioned in *Pureesh Virajaneeya Mahakashaya* (Correctives of Fecal Pigment), *Kashaya Skandha*, its flowers classified under the *Shaka Varga* and considered good for *Raktapitta*, also serves as a stool binder. Various plant parts of *Shalmali* have been reported to be utilized for therapeutic purposes in classical texts of Ayurveda. Plant parts used are being listed below-

1. Root**[13]** / Tender Root (*Semal Musali*)**[8]**
2. Stem Bark**[13,14]**
3. Gum exudate / Resin (*Mochras*)**[13-16]**
4. Flowers**[13-15]**
5. Leaves / *Patra Vrinta* (Petiole)**[13,14]**
6. Thorns (*Shalmali Kantaka*)**[15]**

Classification, Formulations and Therapeutic Indications / Uses of *Shalmali*

Root

1. Shalmali Moola Churna has been used along with *Kritvedhana* and other drugs for the preparation of *Piccha* (Slimy formulation) used to induce emesis *(Vaman)* (Ka.6.8).

2. Tender Roots of *Shalmali* popularly known as *Semal Musali* are reported to be utilized as a potent aphrodisiac and general tonic. The tender roots of 1-1.5 years old small tree are taken out and dried. It is said to be lubricating, astringent, nutritious, rejuvenator and aphrodisiac. It has some stimulating action on the genitals.**[8]**

3. In Ethnomedicinal practices, root is reported to be used as general tonic**[17,20]**, in syphilis**[21]**, as stimulant, aphrodisiac, demulcent, hemostatic, astringent, antidiarrheal, alterative, anti-dysenteric and in menorrhagia.**[22]** Root bark is used as emetic**[17,23]**, stimulant**[17-19,24,25]**, in common cold**[26]**, liver diseases**[27]**, as aphrodisiac**[18,25]**, in impotency**[18,19,25]**, spermatorrhea**[28]**, on boils**[29]**, as expectorant, blood purifier, demulcent, in biliousness**[30]**, leucorrhea**[31,32]**, gonorrhea**[33]**, as analgesic**[34]** and in bed wetting.**[32]**

4. Many tribal cultures have traditionally used the young roots of *ceiba*, commonly referred to as *Semal-Musli* or *Semar-Kanda*, as an aphrodisiac and to treat impotence, spermatorrhea, and frequent nocturnal seminal emission.

Its juice is regarded as a sexual stimulant, restorative, and nutritious.**[35]**

Stem Bark

1. Shalmali stem bark has been grouped in *Vaman Dravya* (CS.Vi.8.135). It has been reported to be used as a constituent in preparation of various formulations like *Chandanadi Tel* for treatment of fever (CS.Ci.3.258), *Udumbaradi Tel* in *Yoni Vyapad Chikitsa* (Diseases of female genital organs) (Ci.30.73,75), for *Avpeedan* (Squeezing) of abscess for local application (CS.Ci.25.63), *Asava, Arista, Ayaskriti* for treatment of *Prameha* (SS.Ci.11.10), *Mahasugandhi Agada* in snake poison (SS.Ka.6.21), *Kapitthadi Yog* in Diarrhoea (SS.U.40.113), *Priyaladi Tawacha Pichha Basti* in Dysent. (SS.U.40.119,142), for *Vrana Ropana* (SS.Ci.2.64). *Shalmali Churn* with goat milk in Piles (AH.Ci.8.114), *Yavagu* and *Kwath* indicated for treatment of Dysentery, Biliary diarrhoea (AH.Ci.9.24,61).

2. In Ethnomedicinal practices stem bark is used for acne / pimples**[36]**, while the stem bark is used as a tonic**[37,39]**, in boils and acne / pimples**[40,42]**, as an anti-dysenteric**[17,24,37]**, as emetic**[25]**, for headache**[39]**, and in gonorrhea and syphilis.**[43]**

Gum Exudate / Resin (*Mochras*)

1. Gum exudate resin has been classified in *Sandhaniya* (union promotor), *Purish Sangarhaneeya, Purisha Virajaniya, Sonit Sthapan* and *Vednasthapan Mahakashaya* (Su.4). *Acharya Charaka* has classified as *Mochras* in *Kashaya Skandha. Acharya Sushruta* has classified it in *Priyanguadi Gana* indicated for the treatment of diarrhea, bone fracture, and wound healing (SS.Su.38). In *Astang Sangrah, Mochrasa* has been classified in *Shodanadi Gana, Sandhaniya Gana, Vidagrahana Gana, Vidavirajniya Gana* and *Rudhirsthapana Gana. (*AS.Su.14 & 15).

2. Mochrasa has been used as constituent in the preparation of various formulations like *Chandanadi Tel* indicated in fever (CS.Ci.3.258), *Kiratitkadi Churna - Raktapitta* (CS.Ci.4.76), *Urustambh Nasak Yoga* (Ci.27.29), *Pusyanug Churna, Atisara, Pradara.* (CS.Ci.30.91) *Sunishannaka Changeri Ghrita – Gudabhramsa* (Prolapse of The Rectum) (CS.Ci.14.237), *Niloutpaladi Yoga - Atisara* (Diarrhea) (CS.Ci.19.75), it has also been indicated as single drug as hemostasis (CS.Ci.4.86), for *Avpida Nasya* (CS.Ci.4.99).

Review of classical references reveals that *Mochras* has been one of the most reliable drugs for the treatment of hemorrhages, diarrhea, dysentery, bone fracture and irritable bowel syndrome (AH.Ci.2.39, 8.105, 8.112, 9.83).

3. In Ethnomedicinal practices, gum is reported to be used as aphrodisiac, demulcent, hemostatic, astringent, tonic, alterative, stimulant, antidiarrheal, antidysentery, in menorrhagia and leucorrhea **[17,19,22,25]**, in dental caries**[43]**, & hematinic.**[44]**

Flowers

1. Flowers of *Shalmali* are said to be Sweet in taste and *Vipaka,* indicated as Vegetable (CS.Su.27.99; SS.Su.46.281); has been said to be hemostatic (C.S.Su.27.104, Ci.4.70) indicated in the treatment of Hemorrhoids (CS.Ci.14.202), as a constituent of *Sunishannaka Changeri Ghrita* in the treatment of piles (Ci.14.236), powder of flower indicated as hemostatic (SS.Su.14.36), also indicated in Dysentery, Rectal prolapse, bleeding, and fever (AH.Ci.8.125).

2. In ethnomedicinal practices, flower is used in snake bite**[23]**, for permanent sterilization**[45]**, as diuretic, laxative**[46]**, in leukorrhea**[23,47]**, menorrhagia**[19,22,47]**, as an astringent, tonic, aphrodisiac, anti-dysenteric, antidiarrheal, stimulant, demulcent, hemostatic**[22]**, in premature ejaculation**[20]**, applied on swellings and boils**[48]**, in colitis**[25]**, for complete sterilization of the females.**[49]**

Leaves of *Shalmali*

1. Leaves are indicated as Hemostatic (Ci.4.39) and as vegetables (SS.Su.46.249). *Patra Vrinta* (petiole) are indicated as a constituent in preparation of *Pravahika Nashak Basti* (CS.Si.10.36), *Piccha Basti* for the treatment of diarrhea, obstruction of feces and urine, Dysentery (CS.Ci.19.64; SS.Ci.38.85; SS.U.40.142; AH.Ci.9.63); Cold infusion of petiole in Dysentery (SS.U.40.98). Leaf petiole has also been indicated as hemostatic in the treatment of complications of *Basti* treatment (CS.Si.7.60).

2. In Ethnomedicinal practices, leaves are used in diarrhea, dysentery, menorrhagia and leukorrhea**[23]**, as antidysentery and hematinic**[44]**, laxative**[46]** and in rheumatism.**[50]**

Thorns (*Shalmali Kantaka*) - As a constituent of *Vyangadi Nasak Ubtan* in the management of acne vulgaris (AH.U.32.19).

Sharp thorns of *Salmali* powdered with milk are applied to the face. It makes the face handsome and smooth (VM.57.48).**[51]**

Fruits are used as Analgesic**[52]**, leucorrhea**[23]**, antidiabetic**[53]**, antidiarrheal**[44]**, and antidote to snake bite.**[25,54]**

Heartwood - Antidiabetic**[53]**, antidiarrheal**[44]**, antidote in snake bite.**[25,54]**

Seeds - Paste is applied on the skin in small pox and chicken pox.**[48]**

Biological Activities Reported

1. General Pharmacology - Ethanolic extracts of stem bark and flowers did not show antibacterial, antifungal, antiprotozoal, anthelmintic and anticancer activities and effects on respiration, CVS, CNS and isolated tissues.**[55,56]**

Hypoglycemic activity in rats and antiviral activity against Ranikhet disease virus was observed in flower extract. Stem bark extract did not show anti-spirochaetal activity. The MTD values of stem bark and flower extracts were found to be 50 and 250 mg/kg *p.*, respectively in mice.**[52]** L.D of the extract was found to be 681 mg/kg *i.p.*, in mice.**[56]** Ethanolic extract of root bark did not show antiprotozoal and antiviral activities.**[57]**

2. Enzyme Activity - Among leaf and stem / branch of seedling screened, cholinesterase activity was observed only in leaf.**[58]** The water, ethanolic and acetone extracts of bark exhibited angiotensin converting enzyme (ACE) inhibitory activity in-vitro. **[59]**

3. Hemolytic Activity - The seed extract exhibited hemolytic activity against human ABO red cells.**[60]**

4. Activity on Uterine, Heart and Gastrointestinal Muscles - Extract of fruit exhibited mild activity on the non-gravid adult female albino rat.**[61]** The hot aqueous extract of seeds had moderate oxytocic activity on gravid and non-gravid isolated rat uteri and on guinea pig and rabbit uterine strips. On isolated strips of human uterus obtained after hysterectomy, the extract was more effective in pregnant than in non-pregnant uterus. It was Musculo tropic to guinea pig ileum and was myocardial stimulant to frog's heart in situ. It had negligible blood pressure elevating action in anaesthetized dogs.**[62]**

The ethanolic extract of seeds showed spasmolytic activity on isolated strips of rabbit jejunum and dog ileum in situ and abolished spasm induced by ACh but had no effect on histamine and barium chloride induced spasms. The extract stimulated respiration of dog.**[63]**

5. Analgesic Activity - In a preliminary study, gum of the plant was reported to have analgesic activity as tested by the rated hot wire technique.**[64]** In mice's acetic acid-induced writhing and hot plate tests, extracts showed a strong analgesic effect. It was discovered that plant extract-induced analgesia was not dependent on the opioid receptor when naloxone was used. Mangiferin showed a minor neuronal impact along with a notable peripheral site contact with the receptor.**[65]**

6. Antimicrobial Activity - The tap root/latex extract was found to be inactive against Shigella flexneri and Salmonella typhimurium in vitro studies.**[65]** The aqueous, hexane and alcoholic extracts of the plant, tested against microbial strains were found to be inactive.**[67]** The leaf extract showed strong toxicity against ringworm causing fungi viz., Epidermophyton floccosum, Microupsorum gypseum and Trichophyton mentagrophytes.**[68]**

7. Hypotensive activity - Shamimin along with lupeol [lup-20 (29) en-3b-ol], which possesses potent hypotensive activity, have been isolated from *ceiba* stem bark.

BCBMM [filtrate from BCBM (Methanolic extract of defatted stem bark)] one of the most active fractions has revealed its adverse effects on heart, liver and kidneys of mice at the dose of 1000 mg/kg/d.**[69]**

8. Antioxidant activity - Methanolic extract of *ceiba* showed antioxidant activity when evaluated using antioxidant assays, in terms of its: (i) ability to scavenge DPPH (1, 1-diphenyl-2-picrylhydrazyl) and hydroxyl free radicals; (ii) action against lipid peroxidation (in rat liver microsomes and soy bean phosphatidylcholine liposomes), induced by ascorbyl radicals and peroxynitrite; and (iii) effect on myeloperoxidase activity.

The cytotoxicity was monitored through the mitochondrial activity in the Vero cell line. The extract showed very low toxicity toward Vero cells. **[65]**

9. Hepatoprotective activity - The hepatoprotective activity of a methanolic extract of flowers of *ceiba* (MEBC) was investigated against hepatotoxicity produced by administering a combination of two anti-tubercular drugs isoniazid (INH) and rifampicin (RIF) for 10 and 21 days by intraperitoneal route in rats. From the results, it was concluded that the MEBC was not able to completely revert the hepatic injury induced by INH and RIF, but it could limit the effect of INH and RIF to the extent of necrosis.**[70]**

10. Anti-Acne Effect - Studies have demonstrated that alcoholic extract of bark and thorns have reduced P. acne-induced granulomatous inflammation on rats.**[66]** The thorns of *malabarica* are an important ingredient of Himalaya, "Acne-N-Pimple Cream", a polyherbal formulation recommended for the management of acne vulgaris. The study on cream observed significant reduction in the number of blackheads and whiteheads, in number of inflamed pustules and overall inflammation. "Acne-N-Pimple Cream" is clinically effective and safe in the management of acne vulgaris.**[71]**

11. Sexual disorders - The observation of the sexual behavior study shows that *Bombax ceiba* extract reduced ML, IL, EL and PEI significantly in both active and inactive male mice. *Bombax ceiba* extract also increased MF, IF and EF significantly in both active and inactive male mice. All these effects were observed from the 21st and 28th days of study. Sexually active and inactive animals showed increased and improved sexual performance, when *Bombax ceiba* root extract (400 mg/kg body wt.) was administered for a period of 21 to 28 days. Present study confirmed the claims of *ceiba* as an aphrodisiac agent.**[72]**

Result

From the review of classical texts, it is evident that *Shalmali* has been one of the most frequently utilized plants for therapeutic purposes in Ayurveda since long ago. Almost all plant parts have been reported to be used for therapeutic purposes, having detailed descriptions of their pharmacotherapeutic utility in ancient Ayurveda. Different plant parts are still being utilized in local health traditions by traditional healers in ethnomedicine.

Some of the pharmacological studies carried out substantiated classical claims, like the gum exudate of the plant has been found to carry analgesic activity, which substantiates the classification of *Mochras* in *Vednasthapan Mhakashaya* by *Acharya Charak.***[13]** The anti-acne potential of *Shalmali* thorns described in classical texts is substantiated by pharmacological screening studies.**[15]** Traditional claims regarding the aphrodisiac properties of *B. ceiba* root have been substantiated by animal studies.**[72]** All the plant parts reported to be utilized for therapeutic purposes in classical texts are being utilized in folklore and have been demonstrated to possess almost similar pharmacological potential in pharmacological screening studies.

Conclusion

From the present review it may be concluded that *Bombax ceiba* found growing abundantly throughout India is a promising tree with diversified pharmacotherapeutic potential. It stands out as a versatile medicinal plant deeply rooted in Ayurvedic and Local Health Traditions, with nearly every part of the plant used for diverse therapeutic purposes.

Abbreviations Used

CS.- Charak Samhita, SS. - Sushruta Samhita, AH. - Astang Hridaya, AS. - Aştanga Sangraha, DNi. - Dhanvantari Nighantu, MP.Ni. - Madanpala Nighantu, K.Ni. - Kaiyadev Nighantu, BP.Ni. - Bhavprakash Nighantu, R.Ni. - Raj Nighantu, Sh.Ni. - Saligrama Nighantu, Ni.Ad. - Nighantu Adarśa, VM. - Vrinda Madhav, Su. - Sutra Sthan, Ni. - Nidanasthana, Vi. - Vimanasthana, Sa. - Sarirsthana, Ci. - Cikitsasthana, Ka – Kalpasthana, U. - Uttar Sthana/ Uttar Tantra, Si. - Siddhi Sthana, ML- Mount Latency, IL- Intromission Latency, EL- Ejaculation Latency, MF- Mounting Frequency, IF- Intromission Frequency, EF- Ejaculation Frequency, PEI- Post-Ejaculatory Interval.

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