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Review Article

REVIEW ON WOUND HEALING ACTIVITY OF *ROPANA TAILA*

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ABSTRACT

Wound is a break in the integrity of the skin or tissue often, which may be associated with disruption of the structures and functions. Wound healing is a complex series of events that begin when an individual gets affected by a wound. It is a mechanism whereby the body attempts to re-establish the integrity of the injured part. In modern biomedical sciences, research on wound healing agents is one of the developing areas. Natural compounds are used in skin wound care from many years due to their therapeutic activities, including anti-inflammatory, antimicrobial, and cell-stimulating properties. Various herbs, oils and natural resources have been described in Ayurveda with wound healing properties. Acharya Sushruta has explained many drugs and formulations for the treatment of *Vrana* (wound). One such formulation named *Ropana Taila* has been described in *Sushsruta Samhita* for Wound healing. The present review article is undertaken to discuss about the wound healing activity of *Ropana Taila*.

INTRODUCTION

Wounds are physical injuries that results in an opening (or) break of the skin that cause disturbance in the normal skin anatomy and function.[1] The science of wound healing has had an existing journey over the ages.[2] Wound healing is defined as a complex and elaborate biological action which start off in response to an attack on the anatomy and functioning of normal healthy skin.[3] The wound healing process consists of four highly integrated and overlapping phases: hemostasis, inflammation, proliferation, and tissue remodeling or resolution.[4] There are many factors that can affect wound healing which interfere with one or more phases in this process, thus causing inappropriate or impaired tissue repair. Inflammation is a normal part of the wound healing process. Several natural and plant products which are composed of active principles like flavonoids, triterpenes, alkaloids and other biomolecules influence one or more phases of the healing process.[5]

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The proper oxygen level is essential for optimum wound healing. Oxygen is necessary to sustain the healing process.[6] Ayurveda, known as the Indian traditional system of herbal medicine, has given substantial importance to wound healing and the use of Indian medicinal plants to treat skin damage.[7] Many of the synthetic drugs currently used for the treatment of wounds are not only exorbitant but also cause problems such as allergy, drug resistance etc. and this situation has forced scientists to seek alternative drugs.[8] In Ayurveda wound is known as *Vrana*.

"*Vrana Gatravichurnane, Vranayateti Vranah*" (Su.Chi.1/6)

"*Gatra*" means body tissue. "*Vichurnane*" means destruction, break, rupture and discontinuity of the body or tissue[9]. Break/rupture or discontinuity of body tissue or part of the body, is called *Vrana*. Management of *Vrana* is major and important challenge in *Shalya Tantra* since ancient times[10]. Depending on the conditions of *Vrana*, various formulations for debridement are mentioned such as *Kwaatha* (decoction), *Kalka* (paste), *Churna* (powder), *Taila* (medicated oil), *Ghrita* (medicated clarified butter) etc. *Acharya Sushruta* has described *Shasti Upkarma* for the treatment of *Vrana*. One of the *Upkarma* is *Ropana*.

Ropana Taila is explained in Sushruta Samhita chapter 37 verse 26.[11] It is used to heal wound. It contains *Haridra* (*Curcuma longa*), *Daruharidra* (*Berberis aristata*), *Devdaru* (*Cedrus deodara*), *Priyangu* (*Callicarpa macrophylla*), *Agar* (*Aquilaria agallocha*), *Tagar* (*Valeriana wallichii*), *Lodhra* (*Symplocos racemosa*) and *Til Taila* (*Sesamum indicum*). Most of the herbal drugs present in *Ropana Taila* have *katu, tikta rasa* and have anti inflammatory, analgesic and immunomodulatory action.

AIM AND OBJECTIVES

To critically analyze the wound healing properties of ingredients of *Ropana Taila*.

MATERIALS AND METHOD

Classical text books of Ayurveda and the published works on various scientific journals are reviewed for documenting the information about wound healing properties of ingredients of *Ropana Taila.*

Mechanism of Wound Healing

Body takes action to sustain a normal state after wound. Blood vessels to the wound constrict reducing blood loss. Platelets congregate at the site to form a clot. Once the clot has formed, blood vessels dilate, allowing maximum blood flow to the site which causes inflammation. WBC starts cleaning the site of bacteria, microorganisms and other foreign agents. Then new layers of collagen are laid at the site of the wound. To service the new skin tissue capillaries are formed. At the edges of the wound, contraction occurs to reduce the size of the wound. Surface skin cells move from one side of the wound to the other, enveloping the wound with cells to form the new skin. Depending on the injury, the site is left with a scar.[12] For wound healing drug should possess one or more actions like anti-inflammatory anti-oxidant, analgesic, antimicrobial action.

Haridra (Curcuma longa)

Turmeric has been used in Indian folk medicine for reducing pain, swelling, wound healing and inflammation[13]. *Haridra* has *Katu, Tikta rasa, Laghu guna* and *Ushna virya*. Its *Krimihara, Dahaprashamana* property is due to *Tikta rasa*. *Vranaropana* activity is due to *Katu rasa*. *Vedanashamak* property is due to *Ushna virya*[14].

Anti-inflammatory Activity

The efficacy of turmeric oil in reducing pain and inflammation is comparable to chemical drugs, such as phenylbutazone. The phenolics compound derived from the rhizome of C. longa such as curcumin has concluded anti-inflammatory activity in vivo and in vitro.[13] Turmeric oil showed significant anti-inflammatory activities in the acute and chronic models of inflammation.[15] In vivo study of water extract of curcuma longa proved that it has potent anti-inflammatory activity in carrageenan induced edema, granuloma pouch and cotton pellet implantation method in male albino mice.[16] Srimal and Dhawan (1973) examined the pharmacological actions of curcumin as an anti-inflammatory agent. In this work, the authors reported that the compound was effective in acute as well as chronic models of inflammation.[17] Another study also reported that the rabbit group treated with Curcuma longa showed a consequential higher mean value for contraction of the wound as compared to control group in a study. Furthermore the wounds showed less inflammation and an increasing trend in the formation of collagen.[18]

Antimicrobial Activity

Curcuma oil was tested against cultures of S. albus, B. typhosus and S. aureus, prohibiting the growth of S. albus and S. aureus in concentrations up to 1 to 5,000.[19]

Antioxidant Activity

The essential trace elements of turmeric plant such as Fe, Cu, Zn, Mn, Ca, Mg and Se are known to possess strong antioxidant effects.[20] It was observed in a study that water and fat-soluble extracts of turmeric and its curcumin component evince strong antioxidant activity as compared to vitamins C and E.[21] The effect of curcumin on lipid peroxidation has also been studied in various models by several researchers. Curcumin is a good antioxidant and inhibits lipid peroxidation in rat liver microsomes, erythrocyte membranes and brain homogenates.[22]

Daruharidra (Berberis aristata DC)

B. aristata also known as *Daruharidra* is from Berberidaceae family. It is an important herbal medicine which has been used for many years for various ailments. It is *Tikta, Kashaya* in *Rasa*, *Laghu, Ruksha* in *Guna*. It has *Ushna virya* and *Katu Vipaka*.[23]

Anti-inflammatory Activity

Aqueous extracts of the plant when instilled topically exhibit potent anti- inflammatory activity against endotoxin induced uveitis in rabbit. Alcoholic and aqueous extracts of B. aristata showed good activity against acute inflammation. Aqueous extract was effective in the early phase of acute inflammation and alcoholic extract in the later phase of acute inflammation.[24]

Antimicrobial Activity

Antifungal activity was tested in three extracts of B. Aristata (alcoholic, aqueous and powdered root in distilled water). All three extracts showed antifungal activity[25] and antibacterial activity against Gram positive bacteria S. aureus, S. epidermidis, S. Pyogenes, S. viridans etc.[26] The major alkaloid berberine may be responsible for antimicrobial activity.[27]

Antioxidant Activity

Evaluation of the activity of a crude extract formulation of *B. aristata* was carried out in experimental immune modulation studies. It was observed that T-cell counts remained unaffected in the animals treated with the formulation but cell-mediated immune response was stimulated as observed in the leukocyte migration inhibition (LMI) tests showing its immunomodulatory activity.[28]

Analgesic Activity

A study conducted by Shahid M. et al reported that extract of B. aristata showed analgesic activity.[26]

Devdaru (*Cedrus deodara* Roxb.)

Cedrus deodara (Roxb.) Loud. commonly called as deodar, is a member of Pineaceae family. All parts of C. deodara have bitter, hot, slightly pungent, oleaginous properties which are useful in inflammations, dyspepsia, insomnia, cough[29] It has *Tikta rasa* and *Guna* is *Laghu, Snighdha. Virya* is *Ushna* and *Vipaka* is *Katu*.[30]

Anti-inflammatory Activity

The oil of *Devdaru* is antiseptic and used in skin diseases, sores, wounds and ulcers.[31] The essential oil extracted from the wood of the plant exhibited significant anti-inflammatory action.[32]

Antimicrobial Activity

Antibacterial effect of C. deodara oil was tested in three gram positive B. cereus, E. faecalis, S. aureus and three gram negative bacteria E. Coli, P. aeruginosa and K. pneumoniae. It was concluded that it showed broad range of antibacterial activity.[33] Extracts of the plant showed the presence of alkaloids, tannins, saponins, flavonoids and steroids. These phytoconstituents are responsible for the antihelmintic activity.[34]

Antioxidant Activity

The heartwood of the plant is used for similar purposes as it shows anti-inflammatory, antimicrobial, immunomodulatory and antioxidant activity[34].

Analgesic Activity

Wood oil of C*. deodara* was studied for its analgesic activity by acetic acid induced writhing response and hot plate reaction time model in mice. For control study Aspirin and morphine were used as reference. The oil of wood of C. deodara showed significant analgesic activity. [31]

Priyangu (Callicarpa macrophylla VAHL)

Callicarpa macrophylla is an evergreen tree, which is used as medicine for treatment of antipyretic, astringent, antidiarrhoeal, anti-inflammatory, skin diseases and tumours[35]. It has *Tikta, Madhura, Kashaya rasa* and *Laghu, Ruksha* in *Guna*. Its *Kledana, Ropana* and *Shodhan* action is due to *Kashaya rasa. Lekhana* and *Ropana* property is due to *Laghu guna*[36]. It has tetracyclic diterpenes as chemical constituents which act as antibacterial.

Anti-inflammatory Activity

It is traditionally used to treat inflammation, arthritis, vomiting, cardiac disorders, cough, asthma, leprosy and anorexia[35]. Several research studies have suggested that the plant possess anti-inflammatory. Ethanolic extract of C. macrophylla leaves have better anti-inflammatory profile than the aqueous extract and can be the option to be used as anti-inflammatory drug.[37]

Antimicrobial Activity

A study conducted by Yadav V. reported that ethanolic extract of the plant is active against both gram positive bacteria like S. pyogens, B. cereus, M. luteus, S. epidermidis, C. sporogens, S. faecalis, S. aureus, B. subtilis and gram negative bacteria such as A. tumifaciens, K. pneumoniae, S. typhimurium, P. aeruginosa, S. marcescens, E. aerogenes, P. vulgaris, E. coli.[38]

Antioxidant Activity

Phytochemical screening of ethanolic and methanolic extracts of leaf showed the presence of alkaloids, steroids, phenols, flavonoids, quinones, carbohydrates, fatty acids and saponins. Presence of flavonoids phenols, tannins bioactive compounds in crude extracts of leaf and stem exhibit antioxidant action.[39] A study conducted by Sharma N. Gaurav et al reported that ethyl acetate and ethanol extract of Callicarpa macrophylla exhibit antioxidant property.[40]

Analgesic Activity

Aqueous extract of leaves induced better analgesia and have anti-pyretic potential than ethanolic extract when compared to standard drugs.[41]

Agar (Aquilaria agallocha ROXB)

Aquilaria agallocha belongs to the thymelaceceae family. It is generally known as aloe wood or agarwood. The bark, root and heartwood of agarwood are used for their medicinal properties[42]. It is traditionally used to treat inflammation, arthritis, vomiting, cardiac disorders, cough, asthma, leprosy and anorexia[43]. It is *Katu, Tikta* in *Rasa*. *Guna* is *Laghu, Ruksha* and *Tikshana*. *Virya* is *Ushna* and *Vipaka* is *Katu*.[44]

Anti-inflammatory Activity

It was concluded in a study that *Aquilaria agallocha* oil possesses potent anti-inflammatory activity both in-vivo and in-vitro studies which is comparable to standard Diclofenac.[45]

Antimicrobial Activity

In a study the methanol extract of the leaf gave the highest zone of inhibition against B. subtilis and all other extracts showed moderate zones of inhibition against all the bacteria tested S. flexneri, B. brevis, P. aeruginosa.[46]

Antioxidant Activity

At different concentrations antioxidant activity of ethyl acetate extract of *Aquilaria agallocha* was tested. At lower concentration range EAA showed antioxidant activity.[47]

Analgesic Activity

A study was conducted in which the analgesic effect of ethyl acetate extract of the plant was tested in three different models of analgesia: formalin induced paw licking model, the acetic induced writhing test and tail flick model in mice. Positive results were found. The mechanism of analgesic effect of *Aquilaria agallocha* is possibly due to a blockade of capillary permeability or release of endogenous substances like prostaglandins.[48]

Tagar (Valeriana wallichii DC)

Valeriana wallichhi DC is a member of Valerianaceae family, grows wild in the temperament Himalaya at an altitude of 1500-3000 m and is an ingredient of herbal medicines in Indian System of Medicine[49]. The roots and rhizomes of Valeriana wallichhi are highly aromatic and contain valepotriates and essential oils both perhaps contributing towards its bioactivity[50]. It is *Tikta, Katu, Kashaya* in *Rasa. Guna* is *Laghu, Snigdha. Virya* is *Ushna* and *Vipaka* is *Katu*.[51]

Anti-inflammatory Activity

Valeriana wallichii showed anti inflammatory properties, similar to those observed for non-steroidal anti inflammatory drugs, such as aspirin.[52]

Antimicrobial Activity

The plant essential oil exhibited antimicrobial activity against large number of pathogenic bacteria and potent antifungal activity against different human plant fungal pathogens.[53] Crude extract of valeriana wallichii and its various fractions were tested for antimicrobial activity against 11 pathogens. It possessed inhibition activity against seven pathogens S. flexneri, S. typhi, B. subtilis, S. aureus A. flavus, F. solani, and M. canis studied.[54]

Antioxidant Activity

The extract of the plant contains various phytochemicals like flavonoids, terpenoids, tannins and alkaloids[55]. These phytochemicals present in the plant have shown to possess antioxidant activity.[56]

Analgesic Activity

Screening of the plant showed that its essential oil is dominated by sesquiterpenes. Several studies suggest analgesic activity of essential oils and sesquiterpenes ref in article. Essential oil and alcohol extract of *Valeriana wallichii* exerted good peripheral analgesic action via inhibition of prostaglandin synthesis on acetic acid induced writhing .[57]

Lodhra (Symplocos racemosa* Roxb.*)

Symplocos racemosa Roxb. is a small evergreen tree which belongs to the Symplocaceae family. It is well known Ayurvedic remedies in India, and its stem bark is useful in diarrhea, dysentery, eye disease, wound healing, fever, ulcers etc. [58] Lodhra has *Tikta, Kashaya rasa,* and *Laghu, Ruksha guna. Kandughana* and *Krimighana* property is due to *Tikta rasa*. *Kledhagna, Shodhan* and *Ropana* action is due to *Kashaya rasa. Lekhana* and *Ropana* property is due to *Laghu guna*.[59]

Anti-inflammatory Activity

Methanolic extract of *Lodhra* showed anti-inflammatory activity in vitro study so it was tested for evaluation of anti-inflammatory activity in vivo model. It was concluded in the study that methanolic extract possess significant anti-inflammatory activity in both models.

The activity may be due to the presence of one or more phytochemical constituents present in the extract.[60]

Antimicrobial Activity

Antibacterial study was performed on pethroleum ether and ethanol extracts of *Symplocos racemosa*. Ethanolic extract of the plant possess good antibacterial activity against many pathogens like E. Coli, S. aureus, K. pneumoniae and P. aeruginosa etc.[61]

Antioxidant Activity

Its aqueous extract has higher flavonoids and higher phenols. Phenolic compounds have redox properties, which allow them to work as antioxidants. Phytochemical constituents of the plant may act either individually or synergistically to elicit antioxidant activity.[62]

Til Taila (Sesamum indicum* Linn.*)

Sesamum indicum L. is from Pedaliaceae family. It is an annual plant, which has been domesticated for well over 5000 years.[63] It is *Madhura* in *Rasa*. Its *Anurasa* is *Tikta* and *Kashaya*. *Guna* is *Ushna, Tikshana, Vyavayi, Vikasi, Sukshma, Guru, Sara, Agneya. Virya* is *Ushna* and *Vipaka* is *Madhura*.[64]

Anti-inflammatory Activity

Traditionally, its seeds, seed oil, and different parts of the plant have been used to treat various diseases or conditions like ulcers, asthma, wound healing, amenorrhea, hemorrhoids, inflammations, etc.[63]

Antimicrobial Activity

Sesamolin a phytoconstituent of sesame seed has antimicrobial activity against Bacillus cereus, S. aureus, and P. aeruginosa.[65]

Antioxidant Activity

Natural antioxidants such as sesamolin, sesamin and sesamol are normally present in sesame oil.[66] It is well known to have antioxidant activity

because of the synergistic effect of tocopherol and lignans content present in it.[67]

Drug Review

Table 1: Ayurvedic Pharmacology of Drugs

Drug Name	*Ras*	*Guna*	*Virya*	*Vipaka*	*Dosha*	*Karma*
Haridra[14] (***Curcuma longa*** Linn.)	*Tikta, Katu*	*Laghu, Ruksha*	*Ushna*	*Katu*	*Kaphavata shamak*	*Vrana Shodhan, Vrana Ropana, Shothahar*
Daruharidra[23] (***Berberis aristata*** DC)	*Tikta, Kashaya*	*Laghu, Ruksha*	*Ushna*	*Katu*	*Kaphapita shamak*	*Vrana Shodhan, Vrana Ropana, Shothahar, Vedanasthapan*
Devdaru[30] (***Cedrus deodara*** Roxb.)	*Tikta*	*Laghu, Snigdha*	*Ushna*	*Katu*	*Kaphavata shamak*	*Vrana Ropana, Shothahar, Vedanasthapan*
Priyangu[36] (***Callicarpa macrophylla*** Vahl.)	*Tikta, Kashaya*	*Guru, Ruksha*	*Sheeta*	*Katu*	*Tridosha shamak*	*Vedanasthapan*
Agar[44] (***Aquilaria agallocha*** Roxb.)	*Katu, Tikta*	*Laghu, Ruksha, Tikshan*	*Ushna*	*Katu*	*Kaphavata shamak*	*Shothahar, Vedanasthapan*
Tagar[51] (***Valeriana wallichii*** DC.)	*Katu, Tikta, Kashaya*	*Laghu, Snigdha*	*Ushna*	*Katu*	*Kaphavata shamak*	*Vrana Ropana, Vedanasthapan*
Lodhra[59] (***Symplocos racemosa*** Roxb.)	*Kashaya*	*Laghu, Ruksha*	*Sheeta*	*Katu*	*Kaphavata shamak*	*Shothahar, Vedanasthapan, Vranaropana*
Tila Taila[64] (***Sesamum indicum*** Linn.)	*Madhur*	*Guru, Snigdha*	*Ushna*	*Madhur*	*Vatashamak, Kaphapita shamak*	*Vedanasthapa, Vranashodhan, Vranaropana Sandhaniya*

Table 2: Phytochemical Constituents and Mechanism of Action

Drug	Phytochemical constituents	Pharmacological actions
Haridra[68] (***Curcuma longa*** Linn.)	Curcuminoids, eugenol, saponins, flavonoids, terpenes	Anti-inflammatory, Antioxidant, Antimicrobial
Daruharidra[69] (***Berberis aristata*** DC)	Berberine, protoberberine, oxycanthine.	Anti-inflammatory, Antioxidant, Antimicrobial, Analgesic, Immunomodulatory
Devdaru[70] (***Cedrus deodara*** Roxb.)	Alkaloids, glycosides, flavonoids, triterpinoids, fixed oils	Anti-inflammmatory, Analgesic
Priyangu[71] (***Callicarpa macrophylla*** Vahl.)	Alkaloids, flavonoids, saponins, tannins, terpenoids	Antioxidant, Antimicrobial
AGAR[72] (***Aquilaria agallocha*** Roxb.)	Alkaloid, tannin, glycoside, terpenoid	Anti-inflammatory, Antioxidant, Analgesic, Antimicrobial
TAGAR[73] (***Valeriana wallichii*** DC.)	Flavonoids, terpenoids, tannins, alkaloids, Valeprotriates	Analgesic, Antioxidant, Antimicrobial, Anti-inflammatory, Antifungal
LODHRA[74] (***Symplocos racemosa*** Roxb.)	Flavonoids, Salerepin, Salereposide, four triterpenes, tannins	Antioxidant, Antiulcerogenic, Antimicrobial
TIL TAILA[75] (***Sesamum indicum*** Linn.)	Sesamin, Minerals, Proteins, Vitamins A, B, C, 5% olein	Anti-inflammatory, Antibacterial, Antioxidant

Table 3: Study on Wound Healing Efficacy of Contents of *Ropana Taila*

Drugs	Study conducted	Findings	Ref.
Haridra	a. Comparative evaluation of anti-inflammatory activity of curcuminoids, turmerones, and aqueous extract of *Curcuma longa*. b. Immunomodulatory, anti-inflammatory, and antioxidant effects of curcumin.	a. Study concludes potent anti-inflammatory activity of COFAE of C. longa. b. b. Study concluded the effects of anti-inflammatory, antioxidant and immuno-modulatory action of curcumin.	[76,77]
Daruharidra	Study of phytochemical, antioxidant, antimicrobial and anticancer activity of *Berberis Aristata.*	The study showed the presence of phytochemicals and its antioxidant, antimicrobial and anticancer activity.	[78]
Devdaru	Studies on the anti-inflammatory and analgesic activity of *Cedrus deodara* (Roxb.) Loud. wood oil.	Study concluded that both the doses possess analgesic action. Also showed Anti inflammatory action.	[31]
Priyangu	Assessment of anti-inflammatory and analgesic activities of *Callicarpa macrophylla* Vahl. roots extracts.	Analgesic activity may be due to presence of flavonoids. Also showed significant anti inflammatory effect.	[37]
Agar	Analgesic and anti-inflammatory activity of heartwood of *Aquilaria agallocha* in laboratory animals	Study confirms Analgesic and Anti inflammatory action of the extract.	[48]
Tagar	Antimicrobial and anti-inflammatory activities of leaf extract of *Valeriana wallichii*.	The crude methanolic leaf extract of V. wallichii showed significant anti inflammatory effect in both phases of inflammation. Crude extract and subsequent polar fractions showed inhibition against seven pathogens.	[79]
Lodhra	Antidiarrhoeal, anti-inflammatory and analgesic activities of *Symplocos racemesa roxb*. Bark.	Results showed significant anti-inflammatory and analgesic effect at 300 and 500mg/kg doses.	[80]
Til taila	Wound healing activity of *Sesamum indicum L* seed and oil in rats.	Seeds and leaves of sesame possess good wound healing activity.	[81]

DISCUSSION

Ropana Taila mentioned in *Sushruta Samhita* is used in wound healing. Its external application heals the wound. Herbal drugs present in *Ropana Taila* have Anti inflammatory, analgesic, antimicrobial action as well as immunomodulatory action. These properties of ingredients of *Ropana Taila* are necessary for wound healing. These beneficial effects are due to presence of alkaloid, saponin, flavonoid, tannin, phenols and minerals in its ingredients. Polyphenols have several favourable effects on human health, such as the inhibition of the low density proteins oxidization. They also have anti-inflammatory activity and anti-carcinogenic properties. Terpenoid presence gives antibacterial property. Alkaloids play an important role against pathogens. Flavonoids and phenols give it antioxidant properties. Saponins which are antioxidant help in reepithelisation of wound. Tannin present in sesame oil makes it antibacterial, antiviral, and astringent. Hence, all these properties of ingredients of *Ropana Taila* make it favourable to use in wound healing.

CONCLUSION

In search of better drugs already mentioned in the classical texts, many studies have been conducted for evaluating the effectiveness of the formulations. As mentioned in Ayurvedic text *Ropana Taila* is used in wound healing. It has antimicrobial, anti-inflammatory and analgesic action which makes it suitable to use in wound. Phytochemical constituents of ingredients of *Ropana Taila* also add to its *Ropana* action. In this article, we have discussed the wound healing activity of contents of *Ropana Taila*. Hence, there is a vast scope for further research in this formulation.

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