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Review of *Shorea robusta* with special reference to Traditional Siddha Medicine.

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ABSTRACT

The concept of Single herbs as Therapeutic agents is widely recognized nowadays. In Traditional Siddha system of Medicine, there is a concept known as, 'Yegha Mooligai Prayogam (Yega – single, Mooligai – herb and Prayogam – application)' which deals with single herbs and their clinical application. Unlike poly herbal formulas consisting of herbs, metals and minerals, single herb therapy is safe, convenient, economical and time tested. In that way the use of *Kungliyam* (Resin of *Shorea robusta*) is well documented in Traditional Siddha literatures especially for conditions such as Menorrhagia, Leucorrhoea and all types of wounds including burns and scalds. This review paper gives a complete insight of this resin including its Pharmacognosy, Habitat, Types in Siddha Medicine, Phyto-chemistry, Traditional uses and results of In-vivo studies carried throughout the World.

Taxonomic Hierarchy ^[1,2]

Kingdom	:	Plantae
Subkingdom	:	Viridiaeplantae
Infrakingdom	:	Streptophyta
Division	:	Tracheophyta
Subdivision	:	Spermatophytina
Infra division	:	Angiospermae
Class	:	Magnoliopsida
Superorder	:	Rosanae
Order	:	Malvales
Family	:	Dipterocarpaceae
Genus	:	<i>Shorea</i>
Species	:	<i>Shorea robusta</i> C.F. Gaertn.

Shorea robusta in Siddha Medicine:

Types of *Kungliyam* ^[4,46].

1. *Parangi sambirani* – indian olibanum (*Boswellia serrata*)
2. *Vellai kungiliyam* – conkany resin (*Boswellia serrata glabra*)
3. *Kundrukam* – White or pinney dammer(*vateria indica*)
4. *Karuppu kungiliyam*- Black dammar – (*Canarium strictum*)
5. *Poonai kan kungiliyam* – Cats eye resin (*Pistacia lentiscus*)
6. *Gugglu* – Indian bdellium (*Balsamodendron roxburghii*)
7. *Mai satchi*- (Foreign guggal) (*Balsamodendron mukal*)
8. *Seemai kungiliyam* (Australian dammar) (*Agathis australia*)

There are also other varieties such as amboyna dammar, Burma dammar, East Indian dammar, Rock dammar, Tambago dammar etc.

Vernacular names [3,7,8]

Tamil	:	Kungiliyam, Kungiligam, Saruva rasam, Gugglu, Kukkil
Sanskrit	:	Guggilam, Ashvakarna, Chiraparna, Sal, Sala, Sarja
English	:	Sal tree, Common Sal, Indian Dammer
Hindi	:	Dhuna, Damar, Jall, Sal, Salwa, Shal
Telugu	:	Guggilamu, Gugal, Saluva, Sarjmu
Gujarati	:	Ral
Bengali	:	Sakher, Sakhu, Sal, Salwa
Marathi	:	Guggilu, Rala
Oriya	:	Sagua, Sal, Salwa, Sekwa
Urdu	:	Ral
Assamese	:	Sal
Punjabi	:	Sal, Seral

Other Geographical names

Arabic	:	Qanquahar.
Burmese	:	Enkhyen.
Chinese	:	Suo Luo Shuang, Suo Luo Shuang Shu
French	:	Arbre, Sal, Balau Jaune, Dammar De Linde, Sal
German	:	Salharzbaum
Japanese	:	Sara Noki, Serangan Batsuu, Shara Noki
Nepalese	:	Sakhuvaa (Sakwa), Sal
Russian	:	Sal, Salovoe Derevo, Shoreia Moshchnaia
Sinhalese	:	Dammala.

Geographical distribution

Species of tree native to Western ghat countries [4], southern Asia, ranging south of the Himalaya, from Myanmar in the east to India [4], Bangladesh, and Nepal. In India it extends from Assam, Bengal and Jharkhand west to the Shivalik Hills in Haryana, east of the Yamuna [9, 10, 11].

Habitat

Shorea robusta is a large deciduous tree 18-30m in height with smooth 'or' longitudinally fissured reddish brown 'or' grey bark [12]. Base cordate, 12-14 pairs of lateral veins; stalks 2- 2.5 cm long. Flowers yellow, in large showy branched clusters. Fruit ovoid, with five wings, three long and two short the longer up to 7.5 cm long [13].

Physio-chemical properties

Organoleptic characters

Oleo resin (gum) of *Shorea robusta* Gaertn is Whitish brown in Colour, Bitter, Acid taste.

Macroscopy

The resin of *Shorea robusta* has brittle pieces, rough having a faint resinous, Whitish brown, freely flowing in the surface of water.

Microscopy

Powder microscopical studies shows the presence of resin with irregular shape, translucent, and reddish tannin contents, yellow coloured oil globules are also present.

Physical Properties:

Appearance	:	solid, brown nuggets
Color	:	brown
Total ash	:	0.54±0.005
Total moisture	:	
Content	:	3.968±0.050
Acid Soluble	:	
Mater (%w/w)	:	Negligible

Alcohol Soluble	
Mater (%w/w) :	56.016±0.010
Water Soluble	
Mater(%w/w) :	0.1440±0.003
Alcohol Extract :	57.640±0.015
Melting Point :	85-115 Deg. C
Volatile :	negligible

Phyto-chemical Screening ^[48]

Phyto-chemical screening also reveals the presence of flavonoids, saponins, steroids, tannins, phenols etc mainly tri-terpenoids which plays the prominent role for their therapeutic potential in the drug as reported in the literature.

Phyto constituents	Ethanollic extract
Alkaloid:	+++
Flavanoids:	+++
Terpenoids:	++
Resins:	++
Tanins:	+

Parts Used:

Resin ^[4].

Actions:

Stimulant, Expectorant, Diuretic, Anti-Vatha, Styptic^{3, 4, 5}.

Traditional Uses ^[3, 4, 44,46]

- The resin obtained from the plant is considered as an astringent and a detergent and is used with honey or sugar in dysentery and bleeding piles and also for fumigating the rooms of ill people. It is also given in gonorrhoea and for weak digestion. Its bark decoction is used as drops for ear problems and the fruits for diarrhea.
- India dammar resin- *Shorea robusta*. It exudes from the fissure made in the bark of the tree in the form of a gum resin. It is a useful drug in European pharmacopeia. It consists of two kinds viz, white and red
- It is used for fumigating like frankincense and is soluble in alcohol. Mixed with sulphur. It is used as an ointment for wound source etc. And mixed with wax it, is used as plasters for wounds. It is bitter, pungent and nauseating.
- Traditional Physicians prescribe it for venereal complaints as Gonorrhoea, Gout etc. Mixed with boiled milk it is a useful remedy in cough, piles, bronchitis, and leucorrhoea.
- It is capable of absorbing all morbid fluid from the system. The resin is also used on increase in several Hindu households, temples, sick rooms.
- The powdered stem bark 'or' bark paste is applied to stop bleeding and promote healing of cuts among the tribal inhabitants of southern Bihar & the Kondhs of south western Orissa ^[14]

In Unani medicine

The resin is used for treating Menorrhagia, enlargement of the spleen and for relieving eye irritations.

In Ayurveda

The leaves are used as Anthelmintic and Alexiteric.

Table 1: Siddha Medicinal Preparations with *Kungiliyam* as a Main Ingredient:

Name of the Medicine and physical form	Other Ingredients	Uses	Reference
<i>Kungiliya parpam</i> (powder)	Tender coconut	Burning micturation, Oliguria	[41]
<i>Kungiliya vennai</i> (Butter)	Water	Leucorrhoea.	[42],[46]
<i>Kungiliya Kalimbu</i> (Paste/ointment)	Wax	Leucorrhoea, Burns & scalds.	[41],[46]
<i>Pachai Eruvai</i> (Dusting powder)	Purified White arsenic.	Wounds,	[4]
<i>Pinda thailam</i> (Medicated oil – External use)	Hemidesmus indicus	Burns & scalds. Wounds, hypertrophy of wounds.	[41]
<i>Sivappu ennai</i> (Medicated oil – External use)	<i>Pongamia pinnata</i>	Vatha diseases.	[3],[46]
<i>Vidathaari Chooranam</i> (Powder)	<i>Rubia cordifolia</i>	Skin diseases.	[39]
<i>Vasa Ennai</i> (Medicated oil – External use)	<i>Aloe vera extract</i>	Urticaria	[39]
<i>Vathiranjana pugai</i> (Fumigation)	Purified <i>Argentum</i>	Varma diseases	[39]
<i>Seendhil podi</i> (Powder)	<i>Tinospora cordifolia</i>	ENT diseases, Migrane	[40][45]
<i>Errulli ennai</i> (Medicated oil – External use)	<i>Allium cepa</i>	Diabetes mellitus, Diabetic neuropathy.	[42]
<i>Kutta pugai</i> (Fumigation)	Purified Cinnabar,	Aphthous ulcer, Angular stomatitis.	[40],[45]
<i>Thubar ennai</i> (Medicated oil – External use)	<i>Ficus Racemosa</i>	Lecoderma, Venereal diseases.	[40]
		Cuts & Wounds.	[40]

Chemical Constituents

S. robusta resin has been reported to contain several mono-, sesqui- and tri-terpenoids includes ursolic acid, tri and tetrahydroxy ursenoic acid, asiatic acid, α and β -amyrin, α -amyrenone, mangiferonic acid, benthamic acid and uvaol [15]. In general triterpenoids like ursolic acid and amyrin are well known for their antiulcer properties [16, 17]. (Table 2).

Experimental pharmacology:

The efficacy of *Shorea robusta* was proved through the following In-vivo studies.

Anti-Microbial activity:

Bhargava et al reported the Microbial activity of *Shorea robusta* (SHALA) with Methanol, Ethanol and Toluene extracts. Out of these three solvent used for preparation of resin, methanol extraction showed highest response in term of sensitivity (high zone inhibition), while the least sensitivity was observed with toluene extract. They aimed to finding safer microbicide and need for preventing environment degradation. On increasing concentration *Streptococcus pyogen*, *Salmonella typhi* showed slight high sensitivity (>12mm) inhibition Zone²³. And On increasing concentration *Staphylococcus aureus*, *Escherichia coli* showed moderate sensitivity (<12mm) inhibition Zone.

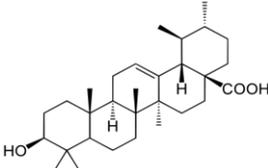
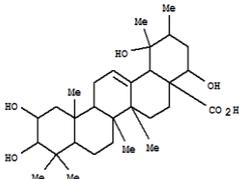
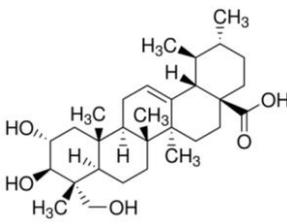
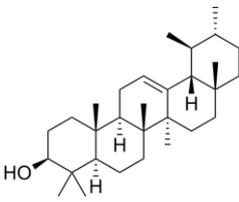
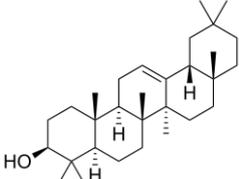
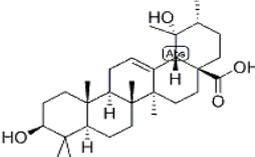
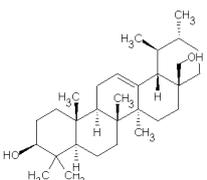
By well diffusion method (*Kaladhar et al.*, 2010), The 6 mm wells on inoculated agar plates were filled with 40 μ l of the aqueous extract at the concentration of 4mg/well. The antibacterial activity aqueous extract of *Shorea robusta* floral parts was examined against Gram negative(*Klebsiella pneumonia* and *Serratia marcescens*) and Gram positive(*Staphylococcus aureus*, *Bacillus subtilis*) bacteria tested and their inhibitory activity was quantitatively assessed with penicillin as standard [24,25]. Thus the result shows significant inhibitory activity on different bacterial species.

Analgesic activity:

Wani TA et al, has reported the analgesic activity of *Shorea robusta* in Swiss mice by by Hot plate test, Tail flick method etc. *Shorea robusta* Resin extract produced a significant ($P < 0.001$) increase in the mean reaction

time throughout the observation period in both hot plate test, tail flick method. In view of the need for new, safe and effective therapies, and taking into account the adverse effects associated with the drugs currently used, *Shorea robusta* Resin represents an important and promising source of herbal medicine for the treatment of pathologies for which no efficacious treatment exists, such as chronic pain. From this we concluded that *S. robusta* leaf, resin extracts was found to possess significant analgesic activity, potential in wound healing [26].

Table 2: Phyto-chemical constituents of *Shorea robusta*.

Chemical name	Structure	Reference
Ursolic acid		[15] [16] [17] [18]
Tetra-hydroxy ursenoic acid		[15] [19]
Asiatic acid		[15] [20]
α -amyrin		[15] [16] [17] [21]
β -amyrin		[15] [16] [17] [21]
Benthamic acid or Pomolic acid		[15] [22]
Uvaol		[15] [43]

C Debprasad et al has also reported that the Analgesic activity of *Shorea robusta* by Inhibition of TNF- and iNOS Expression. The acetic-acid-induced writhing and tail flick tests were carried out for analgesic activity. The acetic-acid-induced vascular permeability, erythrocyte membrane stabilization, release of pro-inflammatory mediators (nitric oxide and prostaglandin E₂), and cytokines (tumor necrosis factor- α , and interleukins-1 β and -6) from lipopolysaccharide-stimulated human monocytic cell lines were assessed to understand the mechanism of action. The results revealed that both aqueous and methanol extract (400 mg/kg) caused significant reduction of

writhing and tail flick, paw edema, granuloma tissue formation (), vascular permeability, and membrane stabilization. Interestingly, the aqueous extract at 40 µg/mL significantly inhibited the production of NO and release of PGE₂, TNF-α, IL-1β, and IL-6 [27]. Thus aqueous extracts of *S. robusta* young leaves might be through the inhibition of leukocyte activations and reduced release of inflammatory mediators (PGE₂, NO) and pro-inflammatory cytokines (TNF-α, IL-1, and IL-6). It proves the efficacy of having Analgesic activity [27].

Hyper-Lipidemic Activity

Supriya et al, evaluated the anti-obesitic effect of hydro-alcoholic extract of *Shorea robusta* (HASR) leaves on high fat diet induced obesity in albino rats. Obesity was induced by administration of high fat diet for 4 weeks along with normal diet and obtained obese rats were treated with *Shorea robusta* in a dose of 200, 400 and 600mg/kg p.o for next 4 weeks. At th same time periodically they noted serum glucose, triglyceride, cholesterol, LDL-C, HDL-C, VLDL-C, atherogenic index, SGPT and SGOT. Besides this, the drug administered to treat HFD induced obesity rats showed a significant reduces in blood glucose levels and the other serum lipids such as TC, TG, LDL, VLDL levels, AI and also increases the HDL levels. These observations concluded that the HASR possess anti-obesity effects [28].

Sudha et al, reported the anti hyper-lipidemic activity in ethanolic bark extract *Shorea robusta* Gaertn.f was investigated in alloxan-induced diabetic rats. Alloxan induces the serum glucose, triglyceride, cholesterol, LDL-C, HDL-C, VLDL-C, SGPT and SGOT. At last, the rat was treated with extract of *Shorea robusta* (500mg/kg b.wt). After the treatment, the raised parameters were significantly altered near to normal. Thus the author concluded that SRE having significant hyperlipidemic activity [29].

Anti-inflammatory Activity:

Jyothi et al was reported the methanolic extract of the dried leaves of *Shorea robusta* was investigated for anti-inflammatory. The extract (200 and 400 mg/kg, p.o) produced a dose dependent inhibition of carrageenan – induced paw edema in rats. The anti-inflammatory activity shown by the fruit extract of *S.robusta* (200 and 400mg/kg) in carrageenan –induced paw inflammation over a period of 4h was quite similar to that exhibited by the group treated with standard diclofenac sodium. These results indicate that the extract acts on both initial and later phases of inflammation. The results of the present study confirm the use of *Shorea robusta* traditionally for the treatment of painful inflammatory conditions [30].

C Debrasad et al demonstrated the Anti-inflammatory activity of *Shorea robusta* by the Inhibition of TNF- and iNOS Expression. Anti-inflammatory activity was evaluated in carrageenan-and dextran- induced paw edema and cotton-pellet-induced granuloma model by knowing the writhing and tail flick, paw edema, granuloma tissue formation. On the effect of extracts on Carrageenan - induced Rat Paw Edema aqueous and methanol extract of *S. robusta* against carrageenan-induced paw edema in rats showed that there was a gradual increase in the edema volume in the control group during the study period. However, both aqueous and methanol extract at 400 mg/kg p.o. produced a significant dose-dependent inhibition (61.90 and 65.23%) of paw edema, compared to Diclofenac disodium. From this, they concluded Anti-inflammatory activity of the aqueous extracts of *S. robusta* young leaves might be through the inhibition of leukocyte activations and reduced release of inflammatory mediators (PGE₂, NO) and pro-inflammatory cytokines (TNF-α, IL-1, and IL-6). Therefore, findings support this ethnomedicinal use of *S. robusta* young leaves in the management of inflammatory ailments via multilevel regulation of inflammatory reactions [27].

Anti-Diabetic activity

Sudha et al, reported the anti diabetic activity in ethanolic bark extract *Shorea robusta* Gaertn.f was investigated in alloxan-induced diabetic rats. Alloxan induces the serum glucose, triglyceride, cholesterol, LDL-C, HDL-C, VLDL-C, SGPT and SGOT. At last, the rat was treated with extract of *Shorea robusta* (500mg/kg b.wt). All the above parameters were significantly altered near to normal when the diabetic rat is treated with extract of *Shorea robusta* (500mg/kg b.wt) and all these effects were compared with reference anti-diabetic drug glibenclamide (600 mg/kg b.wt). These results suggested that *Shorea robusta* bark extract possessed anti-diabetic and anti-hyperlipidemic activity and these activities may be interrelated. It is stated that the ethanolic extract of *Shorea robusta* has beneficial effects on blood glucose levels [29].

Immuno-modulatory activity:

Kalaiselvan et al have reported the Immuno-modulatory activity of *Shorea robusta* in swiss albino rats. This was performed with a set of immunomodulation such as the humoral antibody response (hemagglutination antibody titers, immunoglobulins), cell mediated immune response (delayed type hypersensitivity and phagocytosis), nitroblue tetrazolium (NBT) reduction test, total lymphocyte count (TLC) and DCE. The Ethanolic extract of *Shorea robusta* bark was administered p.o. (orally) to the mice at a dose of 100mg and 300mg/kg body

weight per day for 14 days. In this study, *Shorea robusta* bark extract administered rat models at 300mg/kg per day, i.p should significant important in stimulating immunomodulatory response, thus *Shorea robusta* bark is an effective natural health product for in modulating immune system [31].

Kairomonal Activity

Kulkarni et al has reported the Kairomonal activity of *Shorea robusta* by cold percolation method against its dreaded pest Sal borer, *Hoplocerambyx spinicornis*, in laboratory. This kairomone defines the chemical substance emitted by an organism and detected by another of a different species which gains advantage from this chemical substance. Extract of the bark and its various isolates were prepared by the standard procedure and subjected to assays. Phase wise bioassays of the bark extract and its further isolated compounds were carried out against the beetles in choice conditions in laboratory. Behaviors exhibited by the beetles, Viz., orientation, walking movement, antennal activity [32], visits to the test compound treated surface, biting and feeding attempts to the particular compound and number of beetles attracted has been recorded. This result shows sufficient Kairomonal activity in this extract.

Wound healing activity:

T A Wani et al have proved the Wound Healing efficacy on ethanolic extract of *Shorea robusta* resin in albino rats and swiss mice [37]. They were grouped into 5 groups of five animals each, in clean polypropylene cases as per the guidelines. Excision and incision wounds were created in rats under the anesthesia induced by Ketamine hydrochloride (100mg/kg body weight, ip) and Xylazine (15mg/kg body weight. im). The ethanolic extract of *S. robusta* resin (10 and 30 % w/w applied locally in excised and incised wound) produced a dose dependent acceleration in wound contraction and increased hydroxyproline content tensile strength of wounds in rats. Thus the study demonstrated that the ethanolic extract of *Shorea robusta* may be capable of promoting wound healing activity due to its ability to accelerate wound contraction, increased tensile strength and increased hydroproline content and suggest its therapeutic potential in wound healing [33, 36].

Anti-nociceptive activity

Jyothi et al demonstrated the Anti-nociceptive activity of methanolic extract of leaves of *Shorea robusta*. Antinociceptive define that which shuts the neural processes of encoding and processing noxious stimuli. The extract (200 and 400 mg/kg, p.o) produced a dose dependent inhibition of carrageenan – induced paw edema in rats. At the same doses, Anti-nociceptive effect was also observed with hotplate device maintained at 550C, Acetic acid induced writhing, formalin induced paw licking, Tail clip and Tail flick models in mice. The results of the present study confirm the use of *Shorea robusta* traditionally for the treatment of painful inflammatory conditions. Based on the investigations results, it can be concluded that and *S.robusta* [38] was endowed with peripheral and centrally acting analgesic properties as well as anti-inflammatory activity on acute inflammatory process [30].

Anti Ulcer Activity:

Anusuya et al reported the anti ulcerogenic effect of *Shorea robusta* in ulcer induced models. Gastroprotective potential of *S. robusta* resin (dissolved in water) at two different doses (150 and 300 mg/kg bw p.o.) was studied on ethanol and pyloric ligation (PL) induced gastric ulcer models in rats. Pretreatment with the resin (SRR) produced 62.69% inhibition of gastric mucosal damage in ethanol induced model and 64.55% inhibition in PL-induced model which was comparable to the reference drug omeprazole. The protective effect was associated with normalization of antioxidant markers (superoxide dismutase (SOD), catalase (CAT), glutathione peroxidase (GPx), glutathione-S-transferase (GST) and lipid peroxidation (LPO)) in ethanol induced model. In PL rats, SRR showed significant ($P < 0.001$) decrease in gastric juice volume (65.44%), free acidity (33.06%), total acidity (26.98%) pepsin (44.39%) and protein (23.82%) with subsequent increase in carbohydrate (22.67%) and mucin (41.46%) in gastric juice. Further, the pH of the gastric juice increased from 1.23 to 4.54. The current data clearly demonstrated that SRR dose dependently decreased the gastric acid, and pepsin secretion indicating that it has both gastric anti-secretory and gastric cytoprotective effects [35].

CONCLUSION

From this review paper, the Multi-faceted actions of the resin of *Shorea robusta* as an effective anti-inflammatory, analgesic, anti-ulcer, anti-nociceptive, anti-diabetic, immuno modulatory, anti-hyper lipidemic, kairomonal, anti-microbial agent, wound healing has been proved. It is also evident that the information found in the Traditional AYUSH (Ayurveda, Yoga, Unani, Siddha & Homeopathy) literatures regarding this resin are True and correlates with the modern scientific studies. So, it is apt time to do more research and explore the wonderful therapeutic and prophylactic properties of Single Herbs.

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