ABSTRACT:
Plants from the ancient time have been consumed as a part of food and sidewise for the prevention and treatment of diseases. Indian literatures mention the use of plants in treatment of various human ailments. In traditional system of drugs various plant parts such as stem, stem bark, roots, root bark, leaves, fruits and exudates are used in dysentery, diarrhea, diabetes, leucorrhoea, menorrhagia, leprosy, jaundice, fever, aphrodisiac and anti-HIV activity, anti-Helicobacter pylori, antiangiogenic, analgesic, antioxidant activity and hypotensive, hypoglycemic and antimicrobial activity. Bombax malabaricum DC (Bombacaceae) or semal is a tall deciduous tree. It is distributed throughout the hotter parts of the country upto 1500 meter or more. Many parts of the plant (root, stem bark, gum, leaf, prickles, flower, fruit, seed and heartwood) are used by various traditional healers for medicinal purposes.

KEYWORDS: Bombax malabaricum, semal, Antiangiogenic, Anti HIV, Traditional healers.

Introduction
Plants from the ancient time has been used for the traditional healing remedies and the literature has explained the use of various parts of plants in different dosage forms for the diseases of different origins including those of infectious nature. Natural products of plant origin are well known for the potent pharmacological activities. As plants are the sources of medicines for the hundreds of years. All plants contain active chemical constituents and combinations of secondary plant metabolites such as alkaloids, steroids, glycosides etc. The Indian sub continent has been blessed by nature and strength of local traditional healers, which helps the society to have full fruit of the nature. This brief article aims to have an overview of the active constituents present in various parts of Bombax malabaricum and their traditional uses and established pharmacological actions.

Habitat
Bombax malabaricum DC syn. Salmalia Malabarica Schott. And Endl., B.ceiba Linn. belongs to the family Bombacaceae. It is commonly known as Salmali, Moca, Picchila, Raktapushp, katakdhya, Tulini, semul, shimul, Semal, kapok, Silk cotton tree. It is deciduous tree attaining a height upto 40 meters and a
girth up to 6 meter or more and in India; it is distributed throughout the hotter parts of the country up to 1500 meter or more\(^5\). Its young stems and branches are covered with stout and hard pickles; its leaves are large, spreading, glabrous and digitate; leaflets are 5-7, lanceolate and 10-20 cm long; its flowers are numerous, large, fleshy, bright crimson, yellow or orange containing many seeds with long, dense silky hairs\(^6\).

**Taxonomical classification\(^7\)**
- Kingdom: Plantae
- Division: Magnoliophyta
- Class: Magnoliopsida
- Order: Malvales
- Family: Malvaceae (Bombacaceae)
- Genus: Bombax
- Species: ceiba
- Binomial name: *Bombax ceiba* L.; *Bombax malabaricum* D.C.; *Salmalia malabarica* (D.C.) Schott & Endl.

**Traditional uses:**

**Pregnancy Termination**
Tribal people throughout India are well-acquainted with the knowledge of the plant’s usage. Plants seeds powder was used with other drugs containing resins for abortifacient activity in Eastern states\(^8\).

**Sexual diseases and Rejuvenator**
*B. malabaricum* ethanolic extract of bark and flower was used for men and women with sexual diseases like hydrocele, impotency, spermatorrhea, sterility, nocturnal emission leucorrhoea, gonorrhea and was also used to check menstrual disorders in women\(^9\). It is also prescribed to increase sperm count and to act as aphrodisiac \(^10\). An ethnobotanical study has very often resulted in the discovery of important drug plants. An infusion of the bark of *B. malabaricum* is used as a tonic \(^11\).

**Anti-inflammatory activity**
Ancient literature has revealed the traditional use of this plant as anti-inflammatory plants use by the Lohit community of Arunachal Pradesh. The paste of bark of *B. malabaricum* was used for anti-inflammatory activities \(^12\).

**Asthma and small-pox boils**
A powder of *B. Malabaricum* stem prickles was used to treat asthma and seed paste prepared in water was applied on small-pox boils \(^13\).

**Wounds**
Traditional books of useful plants from Mysore and Coorg districts, Karnataka included using the paste of *B. malabaricum* bark externally for cattle wounds \(^14\).
Anti-diarrheal
Bark juice of *B. malabaricum* was applied locally for the treatment of wounds; the bark juice was mixed with the bark juice of mango and guava and drunk to cure dysentery and intestinal spasm. The resins were also taken orally to treat worms and diarrhea; root juice was consumed to treat abdominal pain and gonorrhea [15].

Leprosy
An ethnobotanical survey of medicinal plants used by traditional practitioners and religious healers of Bangladesh has shown that seeds and roots of *B. malabaricum* were used in the treatment of serious skin diseases like Leprosy [16].

Pimples and skin disease
The ethnobotanical records of infectious diseases of Banda district in uttar Pradesh revealed the applications of *B. malabaricum* in the treatment of skin diseases and in folk cosmetics. Fresh rubbed bark of *B. ceiba* was applied topically on pimples, acne and boils [17].

Miscellaneous Uses
An ethnomedicinal and ethnopharmacostatistical studies in Eastern Rajasthan shows multiple uses of *B. malabaricum*. The tender twig was used as a toothbrush to cure mumps. Powdered flowers along with honey were used for menorrhagia. Root bark extract were used as a tonic in case of sexual debility and also as nervine rejuvenator. Root powder mixed with sucrose and milk was taken to avoid impotency [18].

PHYTOCONSTITUENTS OF PLANTS
Roots:
From the roots of *B. malabaricum* new glycosides 3', 4', 5, 7-tetra hydroxyl-6-methoxy flavan-3-o-β-D glucopyranosyl-α-D-xylopyranoside, tracontanol and β-sitosterol was isolated. 1, 6-dihydroxy-3-methyl-5-isopropyl-7-methoxy-8-naphthalene carboxylic acid (8 1) lactone was also isolated [19]. Mixture of polysaccharide (L-arabinose, D-xylose, with traces of L-rhamnose, uronic acid) along with 2, 3, 4, 6-tetra -o-methyl glucose and 2, 3, 6-tri-o-methyl glucose, 2-o-methyl glucose and 3-0-methyl glucose were also isolated from roots [20]. Phytochemical investigation of the chemical constituents of the roots of *B. malabaricum* afforded 9 cadinane sesquiterpenoids (5 new compounds and 4 known compounds). New new sesquiterpenoids (Bombamalones A-D, I-IV) and bombamaloside V} and known (isohemigossypol-1-Me ester, 2-o-methyl isohemisylactic acid lactone, bombaxquinone B, lacinilene C and checked for HGC-27 gastrointestinal cancer cell line but all were inactive [21].

A sesquiterpene lactone isolated from *S. malabaricum* roots was previously identified as hemigossylic acid lactone-7-methyl ether. 2D-NMR reveals that it is actually isohemisylactic acid lactone-2-methyl ether [22].

Root bark: 4 new aromatic sesquiterpenoid was isolated from root bark of *B. ceiba* [19]. Lupeol, β- sitosterol, naphthaquinone and pot. Nitrate was isolated from root bark [23]. Petroleum ether extract of root bark contains lupeol, β-sitosterol, and a pure crystalline compound suggesting a naphtha quinone structure [24]. Root bark also contains isohemigossyopol-1,2-dimethyl ether,8-formyl-7-hydroxy-5-isopropyl-2-methoxy-
3-methyl-1,4-naphthaquinone, 7-hydroxycadalen [25].

**Flowers:** 3 new biosides isolated from flower (24β-ethyl cholest-5-en-3β-o-α-L-arabinopyranosyl (1 → 6)-β-D-glucose pyranoside, 3,5 dihydroxy-4’-methoxy flavones-7-o-α-L-rhamnopyranosyl-(1 → 6)-β-D-glucopyranoside and 4’,5,7-trihydroxy-flavone-3-o-β-D-glucopyranosyl (1 → 4) – α-L-rhamnopyranoside. Anthocyanin-A and B was isolated and its structure was elucidated from flowers [23, 26]. Flowers also contain β-D-glucoside of β-sitosterol, free β-sitosterol, hetriacontane, hetriacontanol, kaempferol, quercetin and traces of essential oil [27]. Ethyl acetate fraction of alcoholic extract of flower were investigated by GC-MS and 46 compounds were identified like palmitic acid, ethyl palmitate, β-sitosterol etc [28]. 2 unusual 9’t-norneolignans i.e. bombasin and bombasin 4-o-β-glucoside and a novel D-gulono-γ-lactone derivative bombalin were isolated from flowers alongwith 3 known compounds. Dihydrodehydro di-coniferyl alcohol 4-o-β-d-glucopyranoside, trans-3-(p-coumaroyl) quinic acid and neochlorogenic acid and checked for HGC-27 gastrointestinal cancer cell line but all were inactive [29]. Quercetagetin a novel glycoside was isolated from flowers [30]. 2 new flavanoid compounds were isolated from petals of flowers and identified as pelargonidin-5-β-glucopyranoside and cyaniding-7-methyl ether-3-β-glucopyranoside [31]. N- hexane extract of flower contain 14 compounds including cholesterol, stigmasterol, campesterol, α-amyrin and 10 were hydrocarbons [32].

**Stem bark:** Lupeol, β- sitosterol, naphthaquinone and Pot. Nitrate was isolated from stem bark [37]. A new ferulic ester, trans-triacontyl-4-acetoxy-3-methoxy cinnamate alongwith known ferulates and triterpenes were isolated from spines of stem bark [33]. Methanolic extract of B. malabaricum contains 7 flavones, vicenin 2, linarin, saponarin, cosmetin, isovitexin, xanthomicrol, apigenin [32]. It also contains various amino acids like lysine, arginine, alanine, glutamic acid, glycocol, leucine, lysine, and sugars like fructose, glucose, galactose, sucrose, lactose, arabinose [34].

**Seeds:** N-hexacosanol and palmitic acid was isolated from seeds [23]. The seed oil contains phytosterol, palmitic acid, stearic acid, oleic acid and linoleic acid and lipase like enzyme [35-37]. Seed oil was glycericd mixture of myristic, palmitic, arachidic, behinic and linoleic acid alongwith carotenoids, α-tocopherol and various amino acids and sugars [38]. Seeds contain essential amino acids like threonine, valine, methionine, isoleucine, leucine, phenylalanine, lysine, histidine, arginine and tryptophan [39].

**Gums:** Hydrolysis of gum yields arabinose, galactose, galacturonic acid, rhamnose and partial hydrolysis yields 6-o-(β-D-galactopyranosyl-uronic acid)-D-galacto pyranose; 2,3,4,6-tetra-, 2,6-di and 2,4-di-o-methyl-o-D-galactose and 2,3,5-tri and 2,5-di-o-methyl-L-arabinose [40]. B. malabaricum gum can be substituted for gum tragacanth [41]. Methylated S. malabarica gum on hydrolysis has been found to yield 2,3,4,6-tetra-, 2,6-di-, and 2,4-di-o-methyl-D-galactose and 2,3,5-tri and 2,5-di-o-methyl-L-arabinose [42].
Table I: List of the chemical constituents isolated from the various part of *Bombax ceiba*

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Name of Compounds</th>
<th>Molecular formula</th>
<th>Parts of species</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>6-O-(β-D-galactopyranosyl uronic acid)-D-galactose</td>
<td>C_{13}H_{20}O_{12}</td>
<td>Gum</td>
</tr>
<tr>
<td>2.</td>
<td>Lupeol</td>
<td>C_{30}H_{50}O</td>
<td>Root Bark and Stem Bark</td>
</tr>
<tr>
<td>3.</td>
<td>β-sitosterol</td>
<td>C_{29}H_{50}O</td>
<td>Flower, root, root bark and stem bark</td>
</tr>
<tr>
<td>4.</td>
<td>Naphthaquinone</td>
<td>C_{16}H_{16}O_{5}</td>
<td>Root Bark</td>
</tr>
<tr>
<td>5.</td>
<td>Naphthol</td>
<td>C_{16}H_{18}O_{4}</td>
<td>Root Bark</td>
</tr>
<tr>
<td>6.</td>
<td>Naphthol ether</td>
<td>C_{18}H_{22}O_{4}</td>
<td>Root Bark</td>
</tr>
<tr>
<td>7.</td>
<td>Desmethyl naphthol</td>
<td>C_{15}H_{16}O_{4}</td>
<td>Root Bark</td>
</tr>
<tr>
<td>8.</td>
<td>Hemigossylic acid lactone-7-methyl ether</td>
<td>C_{16}H_{16}O_{4}</td>
<td>Root Bark</td>
</tr>
<tr>
<td>9.</td>
<td>Isohemigossypol</td>
<td>C_{15}H_{16}O_{4}</td>
<td>Root Bark</td>
</tr>
<tr>
<td>10.</td>
<td>Isohemigossypol-1-methyl ether</td>
<td>C_{16}H_{18}O_{4}</td>
<td>Root</td>
</tr>
<tr>
<td>11.</td>
<td>Isohemigossypol-2-methyl ether</td>
<td>C_{16}H_{18}O_{4}</td>
<td>Root</td>
</tr>
<tr>
<td>12.</td>
<td>Isohemigossypol-1, 2 - dimethyl ether</td>
<td>C_{17}H_{20}O_{4}</td>
<td>Root</td>
</tr>
<tr>
<td>13.</td>
<td>Isohemigossypolon-2-methyl ether</td>
<td>C_{16}H_{18}O_{5}</td>
<td>Root</td>
</tr>
<tr>
<td>14.</td>
<td>Isohemigossypol-2, 7-dimethyl ether</td>
<td>C_{17}H_{18}O_{5}</td>
<td>Root</td>
</tr>
<tr>
<td>15.</td>
<td>7- Hydroxycadalene</td>
<td>C_{15}H_{16}O</td>
<td>Root</td>
</tr>
<tr>
<td>16.</td>
<td>Hemigossylic acid lactone – 2, 7,-dimethyl ether</td>
<td>C_{17}H_{18}O_{4}</td>
<td>Root</td>
</tr>
<tr>
<td>17.</td>
<td>Hemigossylic acid lactone – 2-hydroxy- 7- methyl ether</td>
<td>C_{16}H_{16}O_{4}</td>
<td>Root</td>
</tr>
<tr>
<td>18.</td>
<td>Hemigossylic acid lactone – 7-hydroxy- 7- methyl ether</td>
<td>C_{16}H_{16}O_{4}</td>
<td>Root</td>
</tr>
<tr>
<td>19.</td>
<td>Polysacchride</td>
<td>-</td>
<td>Flower</td>
</tr>
<tr>
<td>20.</td>
<td>β-sitosterol-3-O-β-D-glucopyranoside</td>
<td>C_{35}H_{60}O_{6}</td>
<td>Flower</td>
</tr>
<tr>
<td>21.</td>
<td>Hentriacontane</td>
<td>C_{31}H_{64}</td>
<td>Flower</td>
</tr>
<tr>
<td>22.</td>
<td>Hentriacontanol</td>
<td>C_{31}H_{64}O</td>
<td>Flower</td>
</tr>
<tr>
<td>23.</td>
<td>Kaempferol</td>
<td>C_{15}H_{16}O_{6}</td>
<td>Flower</td>
</tr>
<tr>
<td>24.</td>
<td>Quercetin</td>
<td>C_{15}H_{16}O_{7}</td>
<td>Flower</td>
</tr>
<tr>
<td>25.</td>
<td>Anthocyanin A</td>
<td>C_{21}H_{21}ClO_{10}</td>
<td>Flower</td>
</tr>
<tr>
<td>26.</td>
<td>Anthocyanin B</td>
<td>C_{21}H_{21}ClO_{11}</td>
<td>Flower</td>
</tr>
<tr>
<td>27.</td>
<td>24β-Ethylcholest-5-en-3β-yl-O-α-L-arabinosyl-(1-6)-β-D-</td>
<td>-</td>
<td>Flower</td>
</tr>
<tr>
<td>No.</td>
<td>Chemical Structure</td>
<td>Description</td>
<td></td>
</tr>
<tr>
<td>-----</td>
<td>-------------------</td>
<td>-------------</td>
<td></td>
</tr>
<tr>
<td>28.</td>
<td>3, 5-Dihydroxy-4’-methoxyflavon-7-yl-O-α-L-rhmnopyranosyl-(1 6)-β-D-glucopyranoside</td>
<td>Flower</td>
<td></td>
</tr>
<tr>
<td>29.</td>
<td>4’, 5, 7- Trihydroxyflavon-3yl-O-β-D-glucopyranosyl- (1 4)-α-L-rhmnopyranoside</td>
<td>Flower</td>
<td></td>
</tr>
<tr>
<td>30.</td>
<td>Palmitic acid</td>
<td>Seed</td>
<td></td>
</tr>
<tr>
<td>31.</td>
<td>Octadecyl palmitate</td>
<td>Seed</td>
<td></td>
</tr>
<tr>
<td>32.</td>
<td>n-Hexacosanol</td>
<td>Seed</td>
<td></td>
</tr>
<tr>
<td>33.</td>
<td>Gallic acid</td>
<td>Seed</td>
<td></td>
</tr>
<tr>
<td>34.</td>
<td>Tannic acid</td>
<td>Seed</td>
<td></td>
</tr>
<tr>
<td>35.</td>
<td>Ethyl gallate</td>
<td>Seed</td>
<td></td>
</tr>
<tr>
<td>36.</td>
<td>Flavan glycoside</td>
<td>Root</td>
<td></td>
</tr>
<tr>
<td>37.</td>
<td>7- Hydroxy- 5-isopropyl-2-methoxy-3-methyl-1,4-napthaquinone</td>
<td>Heart wood</td>
<td></td>
</tr>
</tbody>
</table>

Lupeol

Shamimicin

Quercetin

Palmitic acid
SUBSTANTIATIVE ACTIVITIES

Antiangiogenic activity

*B. malabaricum* stem bark’s methanolic extract was found to exhibit a significant antiangiogenic activity on *In vitro* tube formation of human umbilical venous endothelial cells (HUVEC). Lupeol fractionated product of the extract showed a marked inhibitory activity on HUVEC tube formation while it did not affect the growth of tumor cell lines such as SK-MEL-2, A549 and B16-F10 melanoma[43].

Antimicrobial and antibacterial activity

Plant extracts (acetone, methanol and aqueous) were assayed for their activity against multi-drug resistant *Salmonella typhii*. Strong antibacterial activity was shown by the methanol extracts of *Salmalia malabarica*. Methanol and acetone extracts showed potent antibacterial activity against *Klebsiella pneumonia* [44, 45].

Cytotoxicity:

Aqueous extracts of the plant *B. malabaricum* were screened for their cytotoxicity using the brine shrimp lethality test[46]. The research supports that brine shrimp bioassay is trustworthy and convenient method for assessment of bioactivity of medicinal plants.

Hypotensive activity:

Shamimicin, 1’’, 1’’’’’’’-bis-2-(3, 4-dihydroxyphenyl)-3,4-dihydro-3,7-di-hydroxy-5-O-xylopyranosyl-2H-1-benzopyran along with lupeol [lup-20 (29 en-3b-ol], which possesses potent hypotensive activity, have been isolated from *B. malabaricum* 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 when given by oral route [47].

Free radical scavenging activity:

Methanolic extract of roots of *B. malabaricum* was evaluated using DPPH (1, 1-diphenyl-2-picryl- hydrazyl) radical scavenging assay and reducing power assay. Methanolic extract of the roots showed a very good DPPH radical scavenging activity in a dose dependant manner. Research concludes that antioxidant activity was due the higher percentage of phenolic compounds and tannins. The reducing ability of methanolic extract was measured by transformation of Fe3+ to Fe2+ in the presence of extract at 700nm. The extract showed dose
dependant reduction ability in reducing power assay$^{[48]}$.

**Hepatoprotective activity**
The hepatoprotective activity of a methanolic extract of flowers of *B. malabaricum* was investigated. There was a significant decrease in alkaline phosphates (ALP), alanine transaminases (ALT), aspartate transaminases (AST) and total bilirubin levels, but increase in the level of total protein in comparison to control. MEBC significantly decreased the level of TBARS (thiobarbituric acid reactive substances) and elevated the level of GSH (reduced glutathione) at all doses as compared to control. The results obtained from the analysis of biochemical parameters and histopathological studies, resulted in the conclusion that the MEBC were not able to completely slip back the hepatic injury induced by INH and RIF, but it could limit the effect of INH and RIF to the extent of necrosis$^{[49]}$.

**Inhibitory effects on fatty acid synthesis**
Fatty acid synthesis (FAS) had been found to be over express and hyperactive in most cancers$^{[50]}$. Pharmacological inhibitors of FAS activity preferentially repress cancer cell proliferation and induce cancer cell apoptosis without affecting nonmalignant fibroblasts. These made FAS an excellent drug target for cancer therapy. The cancer cell A549 was used as a cell model to test the inhibitory effort of flavonoid extracts on FAS$^{[51]}$.

**Antipyretic**
The methanolic extract of *Bombax malabaricum* leaves was investigated for the antipyretic activity in rats$^{[52]}$. It possessed significant antipyretic activity in Baker’s yeast-induced pyrexia.

**Aphrodisiac**
The aphrodisiac activity of *B. malabaricum* root extract was investigated for Mount latency (ML), intromission latency (IL), ejaculation latency (EL), mounting frequency (MF), intromission frequency (IF), ejaculation frequency (EF) and post-ejaculatory interval (PEI) parameters for a month study. The extract reduced significantly ML, IL, EL and PEI (p < 0.05). The extract also increased significantly MF, IF and EF (p < 0.05). These effects were observed in sexually active and inactive male mice$^{[53]}$.

**CONCLUSION**
The review exposes the hidden medicinal values of *B. malabaricum* because of which it has a long history to be used by traditional healers for a extensive range of diseases. Researchers have exploited the plant to reveal its medicinal values successfully. The plant is used in cystitis and catarrhal affections bleeding piles, haemorrhoids, dysentery, skin troubles, for the treatment of snake bite and scorpion sting, boils, leucorrhoea, internal bleeding, calculus affections, chronic inflammation, ulceration of bladder and kidney, gonorrhea, influenza, enteritis, menorrhagia, pulmonary tuberculosis. The Pharmacological studies scientifically prove the potency of this plant against diseases. The presence of potent active chemical constituents indicates that the *Bomabax malabaricum* could serve as “lead compound” for development of novel medicines. Hence, further researches
are required to explore *B. malabaricum* for its potential in preventing and treating diseases.

REFERENCES


14. Kshirsagar RD, Singh NP. Some less known ethnomedicinal uses from Mysore & Coorg districts, Karnataka state, India. Journal of


46. Alluri V and Gottumukkala V. Assessment of Bioactivity of


