

## Vaibidang (*Embelia ribes*): A Potential Herbal Drug in Ayurveda with Anthelmintic Property

Shailja Choudhary<sup>1</sup>, Hemlata Kaurav<sup>2</sup> and Gitika Chaudhary<sup>3</sup>

<sup>1</sup>Shuddhi Ayurveda, Jeena Sikho Lifecare Pvt. Ltd., Zirakpur 140603, Punjab, INDIA

<sup>2</sup>Shuddhi Ayurveda, Jeena Sikho Lifecare Pvt. Ltd., Zirakpur 140603, Punjab, INDIA

<sup>3</sup>Shuddhi Ayurveda, Jeena Sikho Lifecare Pvt. Ltd., Zirakpur 140603, Punjab, INDIA

<sup>3</sup>Corresponding Author: Shuddhi.research@jeenasikho.co.in

### ABSTRACT

*Embelia ribes* is commonly known as vaibidang or false black pepper is a significant medicinal plant that belongs to the family *Myrsinaceae*. The ancient Ayurveda physician, Sushruta described that the fruit of *E. ribes* plant possesses anthelmintic property and is used as a tonic along with the licorice root, which prevents aging and helps in strengthening the body. The fruit of the plant is used in various ayurvedic formulations where it is used as a carminative, anthelmintic, alterative and as stimulant. Due to the overexploitation of the plant, it is considered a threatened medicinal plant. Traditionally, the plant is used as an analgesic, antibacterial, antipyretic, antifertility and anthelmintic agent. Various parts of the plant like roots, berries and leaves of *E. ribes* plant are used in different herbal formulations. In Ayurveda, it is used to cure skin diseases, abdominal pains, flatulence, worms, mental disorders, tumors, bronchitis, jaundice, cardio disorders and is used as a brain tonic. Embelin is considered as the major chemical constituent isolated from the *Embelia ribes* plant. In this review, a brief view of the plant is briefly described related to its ayurvedic and folk uses. The reported pharmacological properties of the plant are also defined.

**Keywords-** Vaibidang, *Embelia ribes*, Anthelmintic, Rasapanchak, Ayurveda.

### I. INTRODUCTION

The herbal plants are used for medicinal purposes since ancient times for the prevention and treatment of various diseases. The herbal remedies and the preparation made from herbal plants are already described in ancient books such as Vedas and the Bible [1]. The traditional medicinal system has been widely accepted by the developed countries in recent years [2]. Traditionally, the crude extracts of the herbal plants are used by the local communities or rural people for medicinal and other purposes [3]. In India, about 15000 plant species are used as a source of medicine because of the presence of its various chemical constituents like saponins, tannins, alkaloids, alkenyl phenols, flavonoids, etc. [4].

The herbal plant named *Embelia ribes* is a woody climber plant that belongs to the family *Myrsinaceae*. It is commonly called as Vidanga or false

black pepper. The brief description of the *E. ribes* plant is described in the three ancient Indian ayurvedic books namely Charaka Samhita, Sushruta Samhita and Ashtanga hridayam [5]. As per the Medicinal Board, Govt. of India, the *E. ribes* plant is considered as the most significant plant out of the 32 medicinal plants for its large-scale cultivation and commercial use [6]. The fruit of this plant is used as a carminative, anthelmintic, alterative and as stimulant. The fresh juice of the plant isolated from the fruit of the plant is used as a diuretic, cooling and as a laxative agent. The major chemical constituent extracted from this plant is embelin, which carries great medicinal value and is used to cure various ailments and diseases. The plant extracts are used to treat diseases like abdominal pain or disorder, constipation, lung disease, mental disorders, epilepsy, indigestion, sore throat, pneumonia, heart diseases, lungs disorders, mouth ulcers, fungus infections, cough and obesity [7]. Traditionally, the plant is used to treat diseases like vomiting, arthritis, tonsillitis, flatulence, jaundice, bloating, gastritis, contraceptive, skin diseases, toothache and blood detoxification [8]. In the Unani medicinal system, the seeds of the plant are specifically known for their anthelmintic property that is used to expel out phlegm and black bile from the joints. Besides this, due to the presence of various phytochemicals, it carries various therapeutic and pharmacological properties like antibacterial [10], antifertility [9], analgesic, hepatoprotective, cardioprotective, antioxidant, neuroprotective, anti-inflammatory [11], antitumor, wound healing and anthelmintic property. Table no. 1 and table no. 2 represents the vernacular names and the taxonomical classification of the *E. ribes* plant.

**Table 1: Vernacular names of *Embelia ribes* [12]**

Hindi	Baberang, Karkannie, Vayvarang, Viranga
Assamese	Biakol-lata
Bengali	Biranga, Babarang, Bhai-birung
Urdu	Bao badang
Sanskrit	Chitra-tandula, Janthunashana, Suchitra-vija, Vrishanusana, Vidanga
Malayalam	Vayuvilangam, Visha-al, Vizhal

Marathi	Amti, Ambat, Vaivarang, Vavdinga
Tamil	Vaividangam, Vayu-vilamgam
Telugu	Vaividungalu, Vayu velangam, Vellal
Arabic	Abranj, Barnaq, Biranj kabuli
English	Baoberang, Embelia fruits, False black pepper, Vidanga
Nepal	Himalcheri
Persian	Birang kabuli
Kannada	Vayuvilanga, vayuvidanga
Gujarati	Vavding, vavading, vayavadang
Punjabi	Babrunj, Vavaring
Oriya	Bidanga, Vidang

**Table 2: Taxonomical classification of *Embelia ribes***

Taxonomical rank	Taxon
Kingdom	Plantae
Phylum	Angiosperms
Order	Ericales
Family	<i>Myrsinaceae</i>
Genus	<i>Embelia</i>
Species	<i>ribes</i>
Common name	Vay vidang

### Botanical description of *Embelia ribes*

*Embelia ribes* is a large woody flexible, long shrub also called a climber that belongs to the *Myrsinaceae* family. The roots are hairy, brownish grey with reddish rootlets. The leaves are elliptical, lanceolate, coriaceous, obtusely acuminate, alternating, pale and somewhat silvery beneath, completely glabrous with length 6-14 cm and breadth 2-4 cm. Petiole is cylindrical, 1.0cm-0.8 cm margined. The stem is studded with lenticels, whitish-grey with girth diameter 45-72 cm. Flowers are small, pentamerous, numerous, paniced racemes which are terminal from the upper axils, more branched with more or less glandular-pubescent, deciduous, bracts minute, setaceous. The calyx is about 1-2.5 mm long, sepals connate are about 1/3rd of the

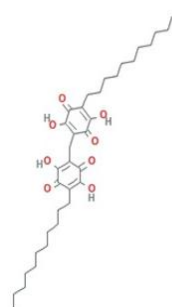
way up, broadly triangular-ovate, ciliate. Petals are free, greenish-yellow, long, elliptical, sub-obtuse, about 4 mm long and pubescent on both sides. Fruits are smooth, succulent, globose, 3-4 mm in diameter, black when ripe, tipped with the persistent style [13]. The seeds are horny, reddish covered enclosed in a brittle pericarp covered by a thin membrane depressed at the base with ruminated endosperm [14].

### Geographical Distribution of *Embelia ribes*

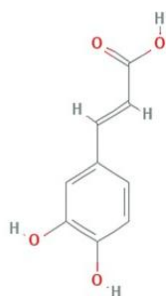
The plant is distributed in countries like Sri Lanka, Singapore, South China and the Malayan archipelago. *Embelia ribes* are native to hilly parts of India grown up to an altitude of 1500 m elevated from the outer Himalayas to the Western Ghats. In India, it is mainly found in the semi-evergreen and the moist deciduous forests of the Western Ghats of South India and the states of Jammu and Kashmir, Arunachal Pradesh, Madhya Pradesh, Himachal Pradesh, Assam, Uttar Pradesh and Maharashtra [15,16,17,18]

### Phytochemical constituents of *Embelia ribes*

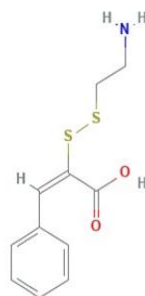
There are various chemical constituents present in the *E. ribes* plant. The vilangin compound was extracted from the dry ripe berries of *E. ribes* plant [19]. The other constituents isolated are volatile oils, fixed oil, resin, tannin, christembine (alkaloid), phenolic acids such as caffeic acid, vanillic acid, chlorogenic acid, cinnamic acid, o-cumaric acid from the berries of *E. ribes* plant [20]. The new compounds detected from the seeds of *E. ribes* plant are embelinol, embeliaribyl ester and embeliol. The embelin found is 4.33% in the fruit part [21]. It also contains components like potassium embelate, 2-5 dihydroxy-4-undecyl-3-6-benzoquinone, quercitol and fatty ingredients [22,23]. The seeds also contain Cr, K, Ca, Cu, Zn and Mn along with carbohydrates, steroids, cardiac glycosides, alkaloids, anthraquinones, tannins and phenolics [24,25]. The roots of *E. ribes* plant consists of nitrogen-containing 3-alkyl-1, 4-benzoquinone derivative, N- (3-carboxylpropyl) -5-amino-2-hydroxy-3-tridecyl-1, 4-benzoquinone and gomphilactone derivatives 5,6-dihydroxy-7-tridecyl-3-[4-tridecyl-3-hydroxy-5-oxo-2(5H)-furylidene]-2-oxo-3(2H)-benzofuran, daucosterol and sitosterol [26,27,28]. The stem and leaves contain embeliphenol A and embelanide [29]. The structures of some major phytochemicals are shown in figure no. 2



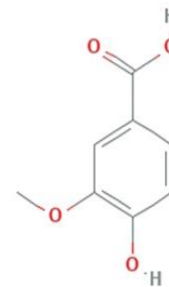
a) Vilangin



b) Caffeic acid



c) Cinnamic acid



d) Vanillic acid

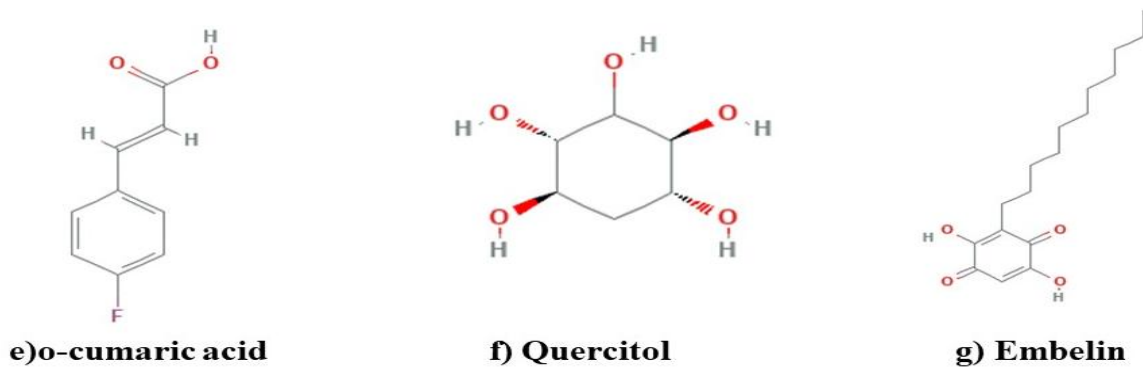


Figure 2: Chemical structures of some major phytochemicals of *Embelia ribes*

## II. TRADITIONAL AND MODERN VIEW

### a) Vay vidang in Ayurveda

The plant *E. ribes* is used since ancient times and are mentioned in the ancient Indian ayurvedic texts names Charaka Samhita, Sushruta Samhita and Ashtanga hridayam. It balances the Kapha and Vata dosha. The Plant *E. ribes* are used in the form of drug 'Vidanga' or 'Baibidanga' which is considered as an important ingredient in the ayurvedic formulations [30]. The ancient Ayurveda physician, Sushruta described that the fruit of *E. ribes* plant possesses anthelmintic property and is used as a tonic along with the licorice root which prevents aging and helps in strengthening the body. It is defined as bitter, pungent, hot, appetizing, astringent and light in the Niganthus [31]. It is used to cure diseases like skin diseases, abdominal pains, flatulence and worms [32]. Besides this, it is used to cure mental disorders, tumors, bronchitis, jaundice, cardio disorders and is used as a brain tonic [33]. The fruit of this plant possesses properties like carminative, anthelmintic, alterative and stimulant. The fresh juice of this plant acts as a cooling, diuretic and laxative agent. Also, it is very effective in killing, roundworms, tapeworms and pinworms. It cures arthritis and gargling with the decoction of this plant gives beneficial results in tonsillitis [34]. The plant is specifically used for its anthelmintic property. The rasapanchak (properties) of the plant is shown in table no. 3.

Table 3: Rasapanchak (properties) of *Embelia ribes* [36]

Sanskrit / English	Sanskrit / English
Veerya / Potency	Ushna / Hot
Vipak / Metabolic property	Katu / Pungent
Guna/ Physical property	Laghu / Light, Ruksa / dry, Teekshna / strong, piercing
Rasa / Taste	Katu / Pungent, Kshaya / Astringent

### Formulations of *E. ribes*

The ayurvedic formulations of *E. ribes* plant include Sara, Krumihara, Krumikushta, Pramehahara, Shirorogahara, Vahnikara, Shulahara, Adhmanahara, Udarahara, Shleshma Krumihara, Vatahara, Artinut, Agnimandyahara, Aruchihara, Vibhantihara, Shirovirechana, Vidanghrista, Vidanga, Lauha, Vidangadi Lauha, Abhayarisham, Ayaskrithi, Pippallyasavam, Anuthailam, Kachuradithailam, Brahmarasayana, Ardrakakhanavaleha, Eranda paka, Krimighna Kashaya churna, Taramandura guda, Vidangadi churna, Guduchi lauha, Abhayarishtha, Manibhadra yoga, Eladi ghrita, Kasisadi ghrita, Chandraprabha vati, Pippalyasava [35].

### Actions and Properties of *E. ribes* (Vay vidang) [37]

#### Jantugna

It is used against microbial and worm infections where it acts as an anthelmintic agent.

Kushthgna (कुष्ठघ्न): It is used to treat skin disorders.

Shirovirochan: It is used to eliminate out the doshas accumulated above chest level especially from the neck and throat.

Deepana: It is used as an appetizer.

Pachan: It is used to treat digestive disorders.

Balya: It strengthens the brain functioning.

Anuloman: It is used to treat digestive flatulence.

Raktashodhak: It is used as a blood purifier.

Mootravaah: It makes the urine acidic by increasing its pH level and is diuretic in nature.

Dantshool and Krimidant: It is used to cure toothache and cavities of teeth.

Kamla: It is used to treat jaundice disease.

Shirorog: It is used to treat CNS and head related disorders like headache, migraine etc.

Apsmaar: It is used to cure epilepsy.

Pakshaghaat: It is used in the treatment of paralysis.

Udrashool: It is used to treat abdominal pain.

Arsha: It is used to treat piles.

#### b) Folk Uses of *E. ribes*

The *E. ribes* plant is used as a good appetizer, carminative, anthelmintic, alexiteric, laxative and alterative agent. It is used to cure the tumor, ascites, bronchitis, mental disorders, dyspnea, heart diseases,

jaundice, urinary discharges, hemicranias and worms in wounds. The fruit berries are used in the preparation of the various components and are used in ringworm and other skin-related diseases. The seeds of the plant are highly effective against tapeworm and act as an anthelmintic agent. The fresh juice of the plant acts as a cooling, diuretic and laxative agent. The pulp of the fruit acts as a laxative agent. The seed's mucilage is used against ringworm and other skin diseases. Gargling of leaves of *E. ribes* with ginger is effective against ulcers of the mouth, sore throat and aphthae [38]. Decoction of the root plant is used to cure influenza which is taken thrice a day. The dried root bark in powder form is used to treat toothache. The paste of the root bark is used to cure lung diseases. The fruit berries with butter are used to cure headache where it is applied in the paste form over the head [39]. The Vidanga oil which is mainly composed of *Croton tiglium*, *E. ribes* and carbonate of sodium helps in relieving headache or hemicranias [40]. The fruit of the plant possesses analgesic, purgative, vulnerary and anthelmintic properties. It is used to treat bronchitis by thickening phlegm and drying, dries wound discharge, removes bad humor from the body and reddens the urine. It is also given to children with milk to cure flatulence. It is used to treat cough, diarrhea, chest disorders, ringworm, fever and skin disorders [41]. The berries of *E. ribes* along with *Piper longum*, *Emblica officinalis* and *Terminalia bellerica* in a powder form when mixed in equal amount with honey show effective results on the infected carbuncle for relief [42]. In the Jalgaon District of Maharashtra, the fruits of *E. ribes* are used to treat wound healing. The tagin people of Arunachal Pradesh used the leaves and fruits of *E. ribes* to cure stomach disorders [43]. It is also used to treat age-related cognitive disorders and dementia. In the eastern region of Shimoga district, 1-3 teaspoonful of the roots of *E. ribes* with lemon juice or buttermilk is taken orally with sugar/jaggery twice for 2 days to treat cough and cold [44]. The leaves of *E. ribes* with the roots of *Withania somnifera* and *Asparagus racemosus* in a paste form is taken orally with a cup of hot water twice a day for a month possesses effective results in paralysis. The mixture of *Withania somnifera* root, the bark of *E. ribes*, seeds of *Croton tiglium*, leaves of *Plumbago zeylanica* and fruit pulp of *Casia fistula* along with cow's urine is used against leukoderma by applying the prepared paste over white patches for 2-3 months.

### c) Modern View of *E. ribes*

The herbal products are originated from natural sources. The formulations made from herbal products make them more effective in the modern scenario, adulteration in herbal products is a major crisis that is dangerous to the herbal drug industry and the research going on these important natural products [45]. Due to the increased demand for herbal products, the risk with the herbal medicines also rises as the quality of the end product compromises because of the contaminated raw material with toxic metals, microbes, and other residues,

adulteration (addition of fake or inferior plant material, orthodox drugs, foreign material) which results in the poor quality of raw material and end product [46]. Lack of standardization techniques is also responsible for the poor quality of drugs as it fails to detect the original drug which exploits its usage in the conventional system of medicines. The demand for herbal medicines rises due to which the original product is mixed with inferior defective, spoiled, useless and harmful substances which adversely affect the health of people [47]. Nowadays, people are money-minded and only think of their benefit. Due to which they have started substitution of cheaper inferior drugs of the same morphology with the original drug [48]. Due to the overexploitation, deforestation and loss of habitat, herbal industries are facing the unavailability of the genuine plant as a result of which adulteration rises. Adulteration in natural products results in the poor quality of the product which can cause serious health problems like severe allergies [49,50]. It can lower down consumer confidence in herbal products and also result in a decrease in the market value of the product. So, it is necessary to develop an Herbal Authentication System (HAS) which can serve as a regulator and also helps in improving the quality of herbal trade [51]. The herbal plant named *E. ribes* is the most important herbal plant known for its anthelmintic property. Due to the excessive harvesting and overexploitation, the plant comes under the list of endangered species as per Red Data Book as the plant is used in almost 75 types of ayurvedic formulations. The artificial regeneration of the *E. ribes* plant is very difficult because of its low rate of germination, poor seed viability and poor rooting from stem cutting. So, it is necessary to utilize the plant in a very significant way instead of its overexploitation as it carries great medicinal importance in both allopathy and ayurvedic drugs.

### III. REPORTED THERAPEUTIC AND PHARMACOLOGICAL USES

The reported studies on the *E. ribes* plant have shown its therapeutic and pharmacological properties like analgesic, antibacterial, antifertility, antiprotozoal, indigestion, fungus infections, pneumonia, antioxidant, anti-inflammatory, anthelmintic, anticancer, anticonvulsant, wound healing and anti-hyperlipidemia. A brief view of these properties of the *E. ribes* plant is described below.

#### **Antibacterial**

The methanolic and aqueous extract isolated from the *E. ribes* plant showed moderate antibacterial activity against multi-drug resistant *Salmonella typhi* [52]. The embelin component isolated from the *E. ribes* plant showed significant antibacterial activity by inhibiting the growth of *Staphylococcus aureus*, *Streptococcus pyogenes*, *Shigella flexneri*, *S. sonnei* and



*Pseudomonas aeruginosa* [53]. The ethanolic extract isolated from the seeds of the *E. ribes* plant show mild antibacterial activity against *Staphylococcus aureus*, *Enterobacter aerogenes* and *Klebsiella pneumonia* but did not produce anti-microbial activity against *Pseudomonasaeruginosa*, *Staphylococcus aureus* and *Escherichia coli* [54].

#### **Anthelmintic**

The seed oil of the *E. ribes* plant was examined for its anthelmintic activity against *Pheritima posthuma*. The seed oil was given orally at three doses i.e. at 10 mg/ml, 50mg/ml and 100mg/ml which showed a significant death of the worms (*Pheretima posthuma*). In the bioassay, the three concentration of oil were studied in which the time of paralysis and time of death of the worm was determined. The *E. ribes* showed the best anthelmintic property when compared to the other plants like *Gynandropsis gynandra*, *Impatiens balsamina*, *Celastrus paniculata* and *Mucuna pruriens* [55]. The ethanolic extract isolated from the fruit part of the plant showed an anthelmintic activity up to 93% against gastrointestinal nematode larvae named *Haemonchus contortus* [56]. The preparation made of *Vernonia anthelmintica* seed and the fruit extract of *Embelia ribes* was studied for its antinematodal activity against goats. The EPG (egg per gram) count was made in the feces before and on the 3rd, 10th and 15th days of the treatment. The data of the 15th day of administration showed that the 2g/kg of powder, its equivalent amount of the methanol extract and 0.01 g/kg of morantel significantly decrease the fecal eggs per gram (EPG) counts in the goats suffering from mixed gastrointestinal nematode infections [57,58].

#### **Analgesic**

The embelin component and its salts showed analgesic activity in which the 2:5 isobutyl amine embelin showed the significant analgesic property. After the intraperitoneal administration, the analgesic effect was noticed but not after subcutaneous, intramuscular, or oral administration. After the intravenous injections, a significant analgesic effect was observed in dogs and cats. The antipyretic and anti-inflammatory activity of the embelin and 2:5 isobutylamine component was also noted [59]. Another study was conducted in rats and mice where the embelin component of the *E. ribes* plant was studied for its analgesic activity. The effective results of embelin were shown when it was administered orally, intramuscular and ICV (intracerebroventricular) routes and then compared with morphine. The potassium embellate acts centrally to create an analgesic effect that is not antagonized by naloxone indicating a different central site of action. Due to its high oral efficacy and non-narcotic property, this plant is more accepted than morphine. The potassium embellate is highly considered for its analgesic property because of its fewer side effects, high therapeutic index, absence of abstinence and long-term safety [60]. Another study conducted by Zutshi et. al., revealed that the analgesic activity of

potassium embellate is due to the involvement of mu and kappa binding sites in the brain [61]. In another study, it was observed that the mono and dipotassium salts of embelin showed higher analgesic activity in visceral evoked response when compared with thermal evoked responses. It was also detected that potassium embellate possesses a strong affinity for the kappa type of opiate receptors. In another study, the effect of potassium embellate on neurotransmitter content in cerebrospinal fluid of dogs was observed where the drug significantly affected the levels of noradrenaline and acetylcholinesterase activity.

#### **Antioxidant**

The aqueous extract of the *E. ribes* plant was examined for antioxidant activity in the streptozotocin-induced diabetic rats where the extract was given orally at doses 100mg/kg and 200 mg/kg of the body weight. The result showed a significant decrease in the pancreatic superoxide dismutase level, catalase and glutathione level. At 200 mg/kg dosage, significant protection against DTZ-induced oxidative stress was observed [62]. The ethanolic extract of the *E. ribes* plant showed a protective activity of  $\beta$ -cells against reactive oxygen species-mediated damage by increasing cellular antioxidant defense and decreasing hyperglycemia in chemically induced diabetes [63]. The reported studies on the kinetics and mechanism of reactions of embelin with hydroxyl, one electron oxidizing, organo-haloperoxy and thiyl radicals using nanosecond pulse radiolysis technique proposed the use of embelin as a competitive antioxidant in physiological conditions [64].

#### **Antidiabetic**

The aqueous extract isolated from the fruit of the *E. ribes* plant was examined for antidiabetic activity against diabetic rats. The diabetic rats were administered orally with the extract at the doses of 100 to 200 mg/kg for 40 days. Results showed a significant reduction in the heart rate, systolic blood pressure, blood glycosylated hemoglobin, blood glucose, serum lactate dehydrogenase, creatine kinase and increase in the blood glutathione levels in streptozotocin (administered at a dose of 40 mg/kg intravenously single dose) induced diabetic rats.

The ethanolic extract isolated from the fruit berries was given orally for 6 weeks at a dosage of 100mg/kg and 200 mg/kg. Results showed a decrease in the blood glucose level, heart rate, systolic blood pressure in the streptozotocin-induced diabetic Wistar albino rats [65]. It was also revealed that the ethanolic extract decreased the pancreatic thiobarbituric acid reactive substances in the pancreatic tissues of diabetic rats [66].

#### **Hepatoprotective**

The ethanolic extract of the *E. ribes* plant was tested for hepatoprotective activity on paracetamol-induced liver cell damage using a mice model. Results showed a significant decrease in the serum glutamate pyruvate transaminase in a dose-dependent manner [67].

### Wound healing

The ethanolic extract and embelin compound isolated from the leaves of *E. ribes* plant was examined for the wound healing activity by excision, incision and dead space wound models against Swiss Albino rats. Results showed the wound healing activity of ethanolic and embelin components of the *E. ribes* plant. A significant wound healing activity was observed in the embelin treated groups where the epithelialization of the incision wound was faster with the high rate of wound contraction. The tensile strength of the incision wound was significantly enhanced than the ethanol extract. In the dead space wound model, the weight of the granulation was increased indicating an increase in collagenation [68].

### Antifertility

The contraceptive activities of the plant were examined against rats, mice and hamsters model where the extract was given orally at the dosage of 100-200 mg/kg. The preparation made from plants named *E. ribes*, *Borax* and *Piper longum* was found to have effective contraceptive activity. Another study was conducted in the male albino rats administered with embelin component. Results showed a significant rise in the levels of acids and alkaline phosphatases of the testis and prostate [69]. Another study was conducted in the

uterus of rats where 50% ethanol and benzene extracts of *Embelia ribes* *Burm* increased the glycogen, protein and non-protein nitrogen contents. The higher dose of benzene is toxic [70]. The petroleum ether, methanol, chloroform and benzene extracts isolated from the berries of the *E. ribes* plant showed antifertility effects [71].

### Antitumor

From various reported studies it was found that the embelin component of the *E. ribes* plant exhibits significant antitumor activity when tested against methylcholan-threne-induced fibrosarcoma in albino rats [72].

### Neuroprotective

The aqueous extract of the *E. ribes* plant increases the antioxidant defense against middle cerebral artery occlusion induced cerebral infarction in rats by a significant increase in the post-stroke grip strength activity. In another study, the ethanolic extracts were administered orally to methionine-induced hyperhomocysteinemic rats. Results showed a significant reduction in the homocysteine, LDH, total cholesterol, triglycerides, and LPO level in brain homogenates and a significant increase in serum HDL-C levels and GSH content in brain homogenates was observed when compared with pathogenic control rats.

**Table 3: Reported therapeutic and pharmacological uses of *E. ribes***

S. No.	Extract	Method <i>Invitro / invivo</i>	Pharmacological activities	References
1	Methanolic and aqueous extracts	<i>Salmonella typhi</i> , <i>Staphylococcus aureus</i> , <i>Streptococcus pyogenes</i> , <i>Shigella flexneri</i> , <i>S. sonnei</i> , <i>Pseudomonas aeruginosa</i>	Antibacterial	[52]
2.	Ethanolic extract	<i>Staphylococcus aureus</i> , <i>Enterobacter aerogens</i> , <i>Klebsiella pneumonia</i>	Antibacterial	[53][54]
3.	Ethanolic and methanol extract	<i>Pheretima posthuma</i> , <i>Haemonchus contortus</i>	Anthelmintic	[55][56][57][58]
4.	Embelin and potassium embellate	Dogs, cats, rats , mice	Analgesic	[59][60][61]
5.	Aqueous and ethanolic extract	Diabetic rat	Antioxidant	[62][63][64]
6.	Aqueous and ethanolic extract	Diabetic rat	Antidiabetic	[65][66][67]
7.	Ethanolic extract	Mice model	Hepatoprotective	[66]
8.	Ethanolic extract	Swiss albino rat	Wound healing	[68]
9.	Petroleum ether, methanol, chloroform, benzene and ethanol	Male albino rat and mice	Antifertility	[69][70][71]
10.	Embelin,	Albino rat	Antitumor	[72]

### Toxicity

The alcoholic and aqueous extract isolated from the fruit berries of *E. ribes* plant did not show any toxicity on male reproductive organs when tested on rats [73]. However, the retinal pathology and defects in the

visual behavior in the chicks treated with embelin, *Embelia ribes*, *Hagenia abyssinica* was noticed. The chicks given a high dosage of anthelmintics significantly decreases the visual ability of the chicks to detect a moving bead introduced into the peripheral field of

vision. The impairment in the performance on a visual discrimination task which required the discrimination of feed grains from pebbles was also noticed which showed that embelin was responsible for the visual defects. Moreover, no lesions treatment was observed in the animal models treated with low dosage. In a short-term toxicity study, the intake of Embelin component for 6 weeks causes severe pathological changes and perinuclear vacuolation. In embryotoxicity and teratogenicity studies, it was observed that the ayurvedic contraceptives like pippaliyadi vati, containing fruit berries or powdered seeds of *Embelia ribes* and *Piper longum* showed low birth weight, defects in the development of soft tissues and skeleton, herniation of the intestines into an umbilical cord in the fetus of the mother [74].

#### IV. CONCLUSION

*E. ribes* is a woody climber herbal plant that belongs to the family *Myrsinaceae*. The main active constituent of this plant is embelin, which is used in various medical formulations to treat a variety of diseases. In Ayurveda, the plant is used to treat diseases like skin diseases, abdominal pains, flatulence, worms, mental disorders, tumors, bronchitis, jaundice, cardio disorders and is used as a brain tonic. Besides this, *E. ribes* plant contains various therapeutic and phytochemical properties as per the reported studies which include antibacterial, antifertility, analgesic, hepatoprotective, cardioprotective, antioxidant, neuroprotective, anti-inflammatory, antitumor, wound healing and anthelmintic property. The plant needs to explore more in the area of research to evaluate its more pharmacological properties.

#### REFERENCES

- [1] Hoareau L, DaSilva EJ. Medicinal plants: a re-emerging health aid. *Electronic Journal of biotechnology*. 1999 Aug;2(2):3-4.
- [2] Rai R, Nath V. Use of medicinal plants by traditional herbal healers in Central India. *Indian Forester*. 2005 Mar 1;131(3):463-8.
- [3] Olowokudejo JD, Kadiri AB, Travih VA. An ethnobotanical survey of herbal markets and medicinal plants in Lagos State of Nigeria.
- [4] Singh J, Singh AK, Pravesh R. Production and trade potential of some important medicinal plants: an overview. *Proceedings of the 1st National Interactive Meet on Medicinal and Aromatic Plants*. 2003:50.
- [5] Warriar PK, Nambiar VP, Ganapathy PM. Some important medicinal plants of the western ghats, India: a profile. 2000.
- [6] Street RA, Prinsloo G. Commercially important medicinal plants of South Africa: a review. *Journal of chemistry*. 2013 Jan 1;2013.
- [7] Chopra RN, Nayar SL, Chopra IC. *Glossary of Indian medicinal plants*. New Delhi: Council of Scientific & Industrial Research; 1956.
- [8] Chopra SR, Chopra IC, Varma BS. *Supplement to Glossary of Indian Medical Plants*. Publication and Information Directorate; 1969.
- [9] Krishnaswamy M, Purushothaman KK. Antifertility properties of *Embelia ribes*:(embelin). *Indian journal of experimental biology*. 1980 Nov;18(11):1359-60.
- [10] Kapoor VK, Chawla AS, Kumar M, Kumar P. Anti-inflammatory agent in Indian Laboratories. *Indian Drugs*. 1983;30:481-8.
- [11] ELLIOTT JH, LEIBOWITZ HM. The Influence of Immunosuppressive Agents Upon Corneal Wound Healing: I. Systemic Azathioprine. *Archives of Ophthalmology*. 1966 Sep 1;76(3):334-7.
- [12] Shankar R, Lavekar GS, Deb S, Sharma BK, Rawat MS. Distribution, conservation and folk uses of Vaibidang (*Embelia ribes* Burm. f.). *International Journal of Biodiversity and Conservation*. 2012 Oct 31;4(13):525-9.
- [13] Kirtikar KR, Basu BD. *Indian medicinal plants*. *Indian Medicinal Plants*.. 1935.
- [14] Latha C. Microwave-assisted extraction of embelin from *Embelia ribes*. *Biotechnology letters*. 2007 Feb;29(2):319-22.
- [15] Shankarmurthy K, Krishna V, Maruthi KR, Rahiman BA. Rapid adventitious organogenesis from leaf segments of *Embelia ribes* Burm.-a threatened medicinal plant. *TAIWANIA-TAIPEI*-. 2004 Sep 1; 49:194-200.
- [16] Warriar PK, Nambiar VP, Ganapathy PM. Some important medicinal plants of the western ghats, India: a profile.
- [17] Souravi K, Rajasekharan PE. Ethnopharmacological Uses of *Embelia ribes* Burm. F. A Review. *IOSR Journal of Pharmacy and Biological Sciences*. 2014 Jun;9(3):23-30.
- [18] Nadkarni K, Nadkarni AK. *Indian Materia Medica*, Popular Prakashan Pvt. Ltd., Bombay. 1976; 1:799.
- [19] Rao CB, Venkateswarlu V. Chemical Examination of *Embelia ribes*. I. Isolation of a New Constituent, "Vilangin," Its Constitution and Synthesis. *The Journal of Organic Chemistry*. 1961 Nov;26(11):4529-32.
- [20] Haq K, Ali M, Siddiqui AW. New compounds from the seeds of *Embelia ribes* Burm. *Die Pharmazie-An International Journal of Pharmaceutical Sciences*. 2005 Jan 1;60(1):69-71.
- [21] Indrayan AK, Sharma S, Durgapal D, Kumar N, Kumar M. Determination of nutritive value and analysis of mineral elements for some medicinally valued plants from Uttaranchal. *Current science*. 2005 Oct 10:1252-5.
- [22] Lin P, Li S, Wang S, Yang Y, Shi J. A nitrogen-containing 3-alkyl-1, 4-benzoquinone and a gompholactone derivative from *Embelia ribes*. *Journal of natural products*. 2006 Nov 27;69(11):1629-32.



- [23] Latha C. Microwave-assisted extraction of embelin from *Embelia ribes*. *Biotechnology letters*. 2007 Feb;29(2):319-22.
- [24] Haq K, Ali M, Siddiqui AW. New compounds from the seeds of *Embelia ribes* Burm. *Die Pharmazie-An International Journal of Pharmaceutical Sciences*. 2005 Jan 1;60(1):69-71.
- [25] Tambekar DH, Khante BS, Chandak BR, et al. Screening of antibacterial potentials of some medicinal plants from Melghat forest in India. *Afr J Tradit Complement Altern Med*. 2009;6:228-32.
- [26] McErlean CS, Moody CJ. First synthesis of N-(3-carboxylpropyl)-5-amino-2-hydroxy-3-tridecyl-1, 4-benzoquinone, an unusual quinone isolated from *Embelia ribes*. *The Journal of organic chemistry*. 2007 Dec 21;72(26):10298-301.
- [27] Raja SS, Unnikrishnan KP, Ravindran PN, Balach I. Determination of embelin in *Embelia ribes* and *Embelia tsjeriam-conttam* by HPLC. *Indian journal of pharmaceutical sciences*. 2005;67(6):734.
- [28] Dang PH, Nguyen HX, Nguyen NT, Le HN, Nguyen MT.  $\alpha$ -Glucosidase Inhibitors from the Stems of *Embelia ribes*. *Phytotherapy Research*. 2014 Nov;28(11):1632-6.
- [29] Dang PH, Nguyen NT, Nguyen HX, Nguyen LB, Le TH, Van Do TN, Van Can M, Nguyen MT.  $\alpha$ -Glucosidase inhibitors from the leaves of *Embelia ribes*. *Fitoterapia*. 2015 Jan 1;100:201-7.
- [30] Warriar PK, Nambiar VP, Ganapathy PM. Some important medicinal plants of the western ghats, India: a profile.
- [31] Bhandari U, Kanojia R, Pillai KK. Effect of ethanolic extract of *Embelia ribes* on dyslipidemia in diabetic rats. *International journal of experimental diabetes research*. 2002 Jul 1;3(3):159-62.
- [32] Thippeswamy BS, Mahendran S, Biradar MI, Raj P, Srivastava K, Badami S, Veerapur VP. Protective effect of embelin against acetic acid induced ulcerative colitis in rats. *European journal of pharmacology*. 2011 Mar 1;654(1):100-5.
- [33] Shirole RL, Shirole NL, Saraf MN. *Embelia ribes* ameliorates lipopolysaccharide-induced acute respiratory distress syndrome. *Journal of ethnopharmacology*. 2015 Jun 20;168:356-63.
- [34] Ansari MN, Bhandari U. Protective effect of *Embelia ribes* Burm on methionine-induced hyperhomocysteinemia and oxidative stress in rat brain.
- [35] Souravi K, Rajasekharan PE. Ethnopharmacological Uses of *Embelia ribes* Burm. F. A Review. *IOSR Journal of Pharmacy and Biological Sciences*. 2014 Jun;9(3):23-30.
- [36] Asadulla S, Ramandang R. Pharmacognosy of *Embelia ribes* Burm f. *Int J Res Pharm Chem*. 2011;1(4):1236-51.
- [37] Harish GU, Danapur V, Jain R, Patell VM. Endangered medicinal plant *Embelia ribes* Burm. F.-a review. *Pharmacognosy Journal*. 2012 Jan 1;4(27):6-19.
- [38] Nadkarni K, Nadkarni AK. *Indian Materia Medica*, Popular Prakashan Pvt. Ltd., Bombay. 1976;1:799.
- [39] Javed IJ, Akhtar MS. Screening of *Veronia anthelmintica* seed and *Embelia ribes* fruit mixed in equal parts against gastrointestinal nematodes. *Pak. J. Pharm. Sci*. 1990 Jul 1;3(2):69-74.
- [40] Nadkarni AK. *Indian material medica*, popular prakashan pvt ltd. Bombay, India. 1982;1:1199.
- [41] Saikia AP, Ryakala VK, Sharma P, Goswami P, Bora U. Ethnobotany of medicinal plants used by Assamese people for various skin ailments and cosmetics. *Journal of Ethnopharmacology*. 2006 Jun 30;106(2):149-57.
- [42] Chopda MZ, Mahajan RT. Wound healing plants of Jalgaon district of Maharashtra state, India. *Ethnobotanical leaflets*. 2009;2009(1):1.
- [43] Goswami P, Soki D, Jaishi A, Das M, Sarma HN. Traditional healthcare practices among the Tagin tribe of Arunachal Pradesh.
- [44] Rajakumar N, Shivanna MB. Ethno-medicinal application of plants in the eastern region of Shimoga district, Karnataka, India. *Journal of Ethnopharmacology*. 2009 Oct 29;126(1):64-73.
- [45] Shinde, A., Gahunge, P., & Rath, S. (2018). The real concept of substitution in Ayurveda literature and adulteration the misleading concept of modern era. *Journal of Ayurveda and Integrated Medical Sciences (ISSN 2456-3110)*, 3(3), 149-158.
- [46] Organización Mundial de la Salud, World Health Organization, Światowa Organizacja Zdrowia. WHO guidelines on good agricultural and collection practices [GACP] for medicinal plants. World Health Organization; 2003 Dec 16.
- [47] Yee SK, Chu SS, Xu YM, Choo PL. Regulatory control of Chinese proprietary medicines in Singapore. *Health policy*. 2005.
- [48] Menthe S, Menthe R. (2016). SUBSTITUTION AND ADULTERATION-PAST AND PRESENT.
- [49] Seethapathy, G. S., Ganesh, D., Kumar, J. U. S., Senthilkumar, U., Newmaster, S. G., Ragupathy, S., ... & Ravikanth, G. (2015). Assessing product adulteration in natural health products for laxative yielding plants, *Cassia*, *Senna*, and *Chamaecrista*, in Southern India using DNA barcoding. *International Journal of Legal Medicine*, 129(4), 693-700.
- [50] Urumarudappa, S. K. J., Gogna, N., Newmaster, S. G., Venkatarangiah, K., Subramanyam, R., Saroja, S. G., ... & Ramanan, U. S. (2016). DNA barcoding and NMR spectroscopy-based assessment of species adulteration in the raw herbal trade of *Saraca asoca* (Roxb.) Willd, an important medicinal plant. *International journal of legal medicine*, 130(6), 1457-1470.
- [51] Kumar, J. S., Krishna, V., Seethapathy, G. S., Ganesan, R., Ravikanth, G., & Shaanker, R. U. (2018). Assessment of adulteration in raw herbal trade of important medicinal plants of India using DNA barcoding. *3 Biotech*, 8(3), 1-8.



- [52] Ansari MN, Bhandari U. Antihyperhomocysteinemic Activity of an Ethanol Extract from *Embelia ribes*. in Albino Rats. *Pharmaceutical Biology*. 2008 Jan 1;46(4):283-7.
- [53] Chitra M, Shyamala Devi CS, Sukumar E. Antibacterial activity of embelin. *Fitoterapia*. 2003 Jun 1;74(4):401-3.
- [54] Gajjar UH, Khambholja KM, Patel RK. Comparison of anti microbial activity of Bhallataka Rasayana and its ingredient. *International Journal of PharmTech Research*. 2009;1(4):1594-7.
- [55] Jalalpure SS, Alagawadi KR, Mahajanashetti CS, Shah BN, Singh V, Patil JK. In vitro anthelmintic property of various seed oils against *Pheritima posthuma*. *Indian journal of pharmaceutical sciences*. 2007;69(1):158.
- [56] Tambekar DH, Khante BS, Chandak BR, Titare AS, Boralkar SS, Aghadte SN. Screening of antibacterial potentials of some medicinal plants from Melghat forest in India. *African Journal of Traditional, Complementary and Alternative Medicines*. 2009;6(3).
- [57] Hördegen P, Cabaret J, Hertzberg H, Langhans W, Maurer V. In vitro screening of six anthelmintic plant products against larval *Haemonchus contortus* with a modified methyl-thiazolyl-tetrazolium reduction assay. *Journal of Ethnopharmacology*. 2006 Nov 3;108(1):85-9.
- [58] Javed IJ, Akhtar MS. Screening of *Veronia anthelmintica* seed and *Embelia ribes* fruit mixed in equal parts against gastrointestinal nematodes. *Pak. J. Pharm. Sci*. 1990 Jul 1;3(2):69-74.
- [59] Gupta OP, Ali MM, BJ RG, Atal CK. Some pharmacological investigations of embelin and its semisynthetic derivatives. *Indian journal of physiology and pharmacology*. 1977 Jan 1;21(1):31-9.
- [60] Atal CK, Siddiqui MA, Zutshi U, Amla V, Johri RK, Rao PG, Kour S. Non-narcotic orally effective, centrally acting analgesic from an Ayurvedic drug. *Journal of ethnopharmacology*. 1984 Aug 1;11(3):309-17.
- [61] Zutshi U, Johri RK, Atal CK. Possible interaction of potassium embelate, a putative analgesic agent, with opiate receptors. *Indian journal of experimental biology*. 1989 Jul 1;27(7):656-7.
- [62] Bhandari U, Ansari MN. Antihyperglycaemic activity of aqueous extract of *Embelia ribes* Burm in streptozotocin-induced diabetic rats.
- [63] Bhandari U, Jain N, Pillai KK. Further studies on antioxidant potential and protection of pancreatic  $\beta$ -cells by *Embelia ribes* in experimental diabetes. *Experimental Diabetes Research*. 2007 Jan 1;2007.
- [64] Joshi R, Kamat JP, Mukherjee T. Free radical scavenging reactions and antioxidant activity of embelin: biochemical and pulse radiolytic studies. *Chemico-biological interactions*. 2007 Apr 25;167(2):125-34.
- [65] Bhandari U, Jain N, Ansari MN, Pillai KK. Beneficial effect of *Embelia ribes* ethanolic extract on blood pressure and glycosylated hemoglobin in streptozotocin-induced diabetes in rats. *Fitoterapia*. 2008 Jul 1;79(5):351-5.
- [66] Nazam Ansari M, Bhandari U, Islam F, Tripathi CD. Evaluation of antioxidant and neuroprotective effect of ethanolic extract of *Embelia ribes* Burm in focal cerebral ischemia/reperfusion-induced oxidative stress in rats. *Fundamental & clinical pharmacology*. 2008 Jun;22(3):305-14.
- [67] Swamy HK, Krishna V, Shankarmurthy K, Rahiman BA, Mankani KL, Mahadevan KM, Harish BG, Naika HR. Wound healing activity of embelin isolated from the ethanol extract of leaves of *Embelia ribes* Burm. *Journal of ethnopharmacology*. 2007 Feb 12;109(3):529-34.
- [68] Chauhan S, Agrawal S, Mathur R, Gupta RK. Phosphatase activity in testis and prostate of rats treated with embelin and *Vinca rosea* extract. *Experientia*. 1979 Sep;35(9):1183-5.
- [69] Prakash AO, Mathur R. Biochemical changes in the rat uterine tissue following *Embelia ribes* burm. extracts. *Indian Journal of Pharmacology*. 1979 Apr 1;11(2):127.
- [70] Kholkute SD, SD K, MB K. Antifertility effects of *Embelia ribes* Burm. 1978.
- [71] Chitra M, Sukumar E, Suja V, Devi S. Antitumor, anti-inflammatory and analgesic property of embelin, a plant product. *Chemotherapy*. 1994;40(2):109-13.
- [72] Seshadri C, Sitaram R, Pillai SR, Venkataraghavan S. Effect of aqueous and alcoholic extract of the berries of *Embelia ribes* on male reproductive organs in adult rats. A preliminary study. *Bull Med Ethnobot Res*. 1980;1:272-80.
- [73] Low G, Rogers LJ, Brumley SP, Ehrlich D. Visual deficits and retinotoxicity caused by the naturally occurring anthelmintics, *Embelia ribes* and *Hagenia abyssinica*. *Toxicology and applied pharmacology*. 1985 Nov 1;81(2):220-30.
- [74] Chaudhury MR, Chandrasekaran R, Mishra S. Embryotoxicity and teratogenicity studies of an ayurvedic contraceptive—pippaliyadi vati. *Journal of ethnopharmacology*. 2001 Feb 1;74(2):189-93.