ISSN- 2394-5125 VOL 7, ISSUE 10, 2020

AN OVERVIEW OF PHYTOCHEMICAL AND PHARMACOLOGICAL POTENTIAL OF Baccaurea SPECIES

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ABSTRACT

Herbal plants and plant products have been used for treatment of many diseases from ancient times in the folklore medicine globally. Plants are used in medicine, providing many drugs and also as the feedstock for many industrial products including timber and paper as well as a wide range of chemicals. Traditionally, humans have used crude extracts of different parts of plants as curative agents. One such plant is Baccaurea. Among the genus Baccaurea, some species are taken for the review because of their phytochemical and pharmacological properties which includes Baccaurea angulata, Baccaurea sapida, Baccaurea ramiflora, Bacccaurea racemosa, Baccaurea macrocarpa, Baccaurea courtallensis, Baccaurea motleyana, Baccaurea parviflora. The species are considered to be good source of vitamins, minerals, fibres as well as have many pharmacological activities. This review describes the phytochemicals and detailed pharmacological properties of selected Baccaurea species.

Keywords: Euphorbiaceae, Baccaurea, Phytochemicals, Pharmacological Properties, Traditional Uses, Medicinal Plants.

INTRODUCTION

From the long prehistoric period, plants are used for various medicinal purposes. As we know, traditional systems of medicine are still widely practised. Moving through history and ancient civilizations, India has been known for its rich flora and fauna. The Indian forest is the main arena of a huge number of medicinal plants which are to a great extent used as raw materials for the manufacture of various drugs and the aromatic plants being part of various perfumery products. This is mainly due to the population growth which results in inadequacy of synthetic drugs and multidrug resistance [1].

Baccaurea (family Euphorbiaceae**)** is a genus of small and dioecious trees where the flowers are borne mainly as clustered spikes or racemes, some cauliflorous. The fruit has a solid pericarp which is also fleshy and which sometimes splits, and it has 1–6 large seeds, each with a juicy and sour jacket. Several species are found edible whereas some are cultivated. There are about 80 species of the plant present from Malasyia to the Pacific islands in the low land rain forest [2].

The review has outlined the various species of Baccaurea with profitable importance. The different species taken for the review are Baccaurea angulata, Baccaurea sapida, Baccaurea ramiflora, Bacccaurea racemosa, Baccaurea macrocarpa, Baccaurea courtallensis, Baccaurea motleyana and Baccaurea parviflora which are few of the significant species in the genus.

ECOLOGY

B.angulata

It is seen along Southeast Asia -parts like Indonesia and Malaysia. It was also randomly distributed in the areas of west Kalimantan, East Kalimantan, Central Kalimantan. .These plants grow well at an attitude of 45-170 metres as with soil pH of 6-6.5 [3].

B.sapida

B.sapida found all around the world including India, Bangladesh, Bhutan, Cambodia, China South-Central, Hainan, Laos, Malaya, Myanmar, East Himlaya Thailand, Vietnam and the distribution of the plant in India is in Andaman and Nicobar Islands, West Bengal, Sikkim, Arunachal Pradesh, Assam, Meghalaya, Mizoram, Tripura, Orissa [4].

ISSN- 2394-5125 VOL 7, ISSUE 10, 2020

B.ramiflora

Wild distribution of this species occurs in India, China (Yunnan, Hainan), Burma, Vietnam, Laos, Thailand, Andaman and Nicobar Islands, Peninsular Malaysia. It is generally seen cultivated in backyards of homes in Peninsular Malaysia, Thailand and Burma [5].

B.racemosa

The species is native to Thailand, parts of India, Peninsular Malaysia, Sumatra, Java, Borneo (Sarawak, Brunei, Sabah, and West-, Central- and East-Kalimantan), Celebes, Moluccas, and also cultivated in Sumatra, Java and Bali [6].

B.macrocarpa

The spread and diversity of B.macrocarpa found in different parts of India and places like Sarawak has the highest number, followed by Sabaha and Pahang. The trees are also found in Kelantan, Negeri, Sembilam, Perak, Kedah and Melaka [7].

B.courteallensis

Wild distributions of the species found in Indian states are Karnataka, Tamilnadu and Kerala. The distribution of these plants is also seen through the west pacific to Indo-Malaysia. Tropical evergreen forests, mainly the Southern Western Ghats serves as the living place of this evergreen tree [8].

B.motleyana

Baccaurea motleyana popularly called Rambai, is a fruit species indigenous mainly to Malaysia. It is diffused from Peninsular Malaysia to Sumatera, Borneo and Halmahera. Currently, it is widely cultivated in the home lawns of these areas and many of these trees are still found in the forest also [9].

B.parviflora

It is distributed in Malaysia, Singapore, Thailand, and Borneo. Most of it is found in Sumatra and north eastern parts of India [10].

BOTANICAL DESCRIPTION

B.angulata

A perennial, medium-sized tree grows upto 6–21 m high. Leaves are elliptic to obovate, 12–40 cm by 4–14 cm, thick and coriaceous, with cuneate to attenuate base with cuspidate to acuminate apex which is dark green and borne on 2–12.5 cm long petioles with glabrous to hairy stipules. B. angulata is a tree with a dense crown growing 6-21 metre tall. The bowl is unbuttressed, it can be 10-40cm in diameter the tree is harvested from the wild for its edible fruit which is eaten locally. The taste is appealing. This fruit has a lot of potential in the market as an exotic commodity but is still quite rare is collections [11].

Fig 1: B.angulata

Fig 2: B.sapida

B.sapida

B.sapida is a medium sized tree. Bark darkish grey in color with vertical lenticels, exfoliating in pieces, 0.3 in. thick which is blaze brownish and wood cream coloured. The shape of leaves are elliptic-oblong or obovate or elliptic-lanceolate which has acuminate, membranous, glabrous, lateral nerves 5-10 numbers on

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either half, which is base narrowed, petiole is thick, and is geniculate. Flowers are dioecious, apetalous, and shortly pedicellate, in densely fascicled racemes from old wood or below the leaves. Male bracts arelonger than clusters and the female bracts are much smaller. Fruit are globose, capsular, yellowish-brown, and the endocarps are not separable. Seeds are orbicular and embedded in rose-coloured fleshy pulp [12].

B.ramiflora

B.ramiflora is evergreen trees with sympodial type of branching. The petiole has a prominent bulged base and top. Flowers are exclusively unisexual and cauliflorous. Fruits are usually flesh and show the colour shade from orange to purple. Small evergreen tree of more than 10 m high, branches are sympodially developed. Trunk crookes and slightly fluted at base. Bark is pale cream or orange brown, smooth or slightly fissured and flaking. Branches are found terete and glabrous.[13] Leaves are simple, alternate and spirally-clustered at intervals along the twigs, narrowly elliptic or obovate, apex acuminate, base acute, margin entire or slightly undulate, reddish when young, becoming dark green and shiny when mature. Midrib is flat above, prominent below and secondary veins are arranged as oblique to the midrib, widely parallel, looped and are joined at margin. Flowers are small grouped in raceme, axillary and cauliflorous. Males are smaller arranged in slender clusters of 10 cm. The fruit which is a berry is ellipsoid or ovoid in shape. It is of 2.5-3.5 cm in diameter which is hanging along old branches and main trunk. B.ramiflora fruit has 2-4 large seeds are found which is surrounded by the fleshy pulp [14].

Fig 3: B.ramiflora

Fig 4: B.racemosa

B.racemosa

The tree is normally 3to15 metre height and buttresses are absent; branchlets are glabrous to scarcely hairy. When dry, the young shoots turn to reddish-black to reddish brown. Bark is whitish to creamy to grey to pale brown to fawn when fresh and greyish to brown when dry, up to 3 mm thick, smooth, papery, flaky, soft; inner bark white to yellow to creamy to ochre to brown, 1-2 mm thick, soft. In leaves the petiole are 12-77 mm long, glabrous to sparsely hairy, red to brown when dry; stipules from elliptic to triangular. Staminate inflorescences which are cauline to just below the leaves, solitary to five clustered together. Fruits are globose, 1-3-seeded, berries or fleshy capsules. Seeds are obovoid to ellipsoid in shape, laterally flattened [15].

B.macrocarpa

Treelet or tree 5-29 m high, buttresses absent to low to small, branchlets glabrous, young shoots blackish, Bark dark to pale (red) brown to grey to orange when fresh, greyish-brown when dry. In leaves petiole are 22-145 mm long, glabrous to sparsely hairy, brown to blackish when dry. Stipules are 2-9 by 1-5 mm,from glabrous to tomentose outside and glabrous inside. Staminate are inflorescences ramiflorous to cauline, solitary to few clustered together, 0.5-13 cm long. The pistillate of flowers are 2-4.5 mm diameter. Seeds are globose to ellipsoid and laterally flattened. Testa looks yellow to brown. Fruits are soft, juicy, with a sweet to sour flavour. The golden to yellow spherical fruit ranges in diameter from 25-60mm. and is borne in small clusters of 3-5 fruits in numbers [16].

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Fig 5: B.macrocarpa **Fig 6: B.courtallensis**

B.courtallensis

B.courtallensisis an evergreen tree grows upto 15m high, bole uneven with tubercles, bark greyish yellow**,**branchlets round; young shoots are brown in colour– puberulous and furfuraceous. Leaves are simple, alternate, often clustard towards the tip of branchlets; stipules 3-5mm long, lateral, lance shaped. Leaf stalk is 10-60mm long, slender, grooved,above becoming hairless or puberulous. Flowers are unisexual in dark crimson colour, in densely clustered slender racemes on old stem. The capsule of fruit is 15-30 x 15-25mm, sulspherical, ovoid, ellipsoid or obovoid, pale yellow when ripe, brown when dry, often varicose, velvet-hairy, and tardily dehiscent. Seeds are oblong and arillate [17].

B.motleyana

B.motleyana is an evergreen, dioecious and small to medium-sized trees that canmeasure up to 30 m in length. It is having no branches measuring up to 20m. The bark is very slim with minute papery scales on it and it is red to orange-brown in colour. The inner part of the bark is softly fibrous and often deep red-brown shade. The leaves are arranged spirally, often congested towards the end of twigs, simple and seems entire. The petiole of this species is often long and narrow at the top. The stipules are early caduceus.[18] The inflorescence is an axillary to cauliflorous. The male inflorescence is narrowly thyrsoid while the female inflorescence is narrowly racemose. The flowers of B.motleyana are unisexual and small. The male flowers are with 4 to 8 stamens in number. The fruit is variably fleshy and indehiscent else sometimes dry and dehiscent. A juicy, brightly coloured outer layer encapsulates the seeds usually. The seedling is with epigeal germination. [19].

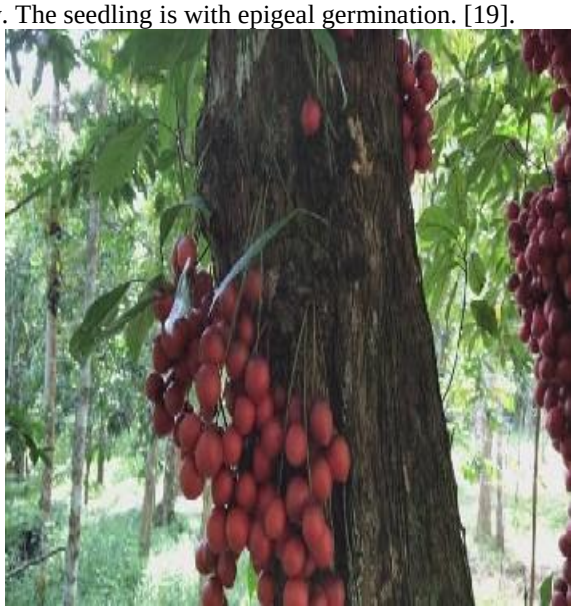

Fig 7: B.motleyana **Fig 8: B.parviflora**

B.parviflora

The tree grows upto 6m high with ellptic, glabrous leaves (10-20cm). The spirally arranged leaves have long petioles swollen at the top. The leaves of the tree are pinkish in colour when young. It has small, yellowish

ISSN- 2394-5125 VOL 7, ISSUE 10, 2020

green, unisexual flower on racemes which have a lemon like scent. Female inflorescences are found on reddish stalks at the base of tree trunks whereas male inflorescences are smaller and are on ring-like burs found on the trunk. The fruit, which is oblong and pulpy, turns from dark red to purplish black when ripe. It splits into three valves, exposing1-3pulpyarillate seeds. The fruit is edible [20].

PHYTOCHEMISTRY

B.angulata

Baccaurea angulata, locally known as belimbing dayak or belimbing hutan. Different studies indicate the whole fruit part contains flavonoid and condensed tannin, the skin contains strong flavonoid, alkaloid saponin, triterpine and steroid [21]. Phytochemicals like flavonoid and tannin with high vitamin A and vitamin C can be useful to treat many chronic diseases along with phenolic compounds [22, 23].

B.sapida

B.sapidahas phenolic compounds with antioxidant properties which absorb and neutralize the free radical. The crude extract of B.ramiflora was analysed for total phenolic content by the method of follin ciocalteau method shows the presence of phenolic compounds [24].

B.ramiflora

Chemical profile of the fruit pulp of Baccaurea ramiflora has shown that it has 35.6 % of water content, followed by 20.4% of fibre, 5.58% of protein, and 51.9% of carbohydrate and trace amount of lipid content. Minerals such as iron, magnesium, phosphorus and potassium are existing n large amount along with Vitamin C. There is an appreciable amount of saponins and alkaloids are present in pulps [25]. Phytochemical evaluation shows the existence of many bioactive compounds like alkaloids, glycosides, carbohydrates, phenols, tannins, saponins, flavonoids, terpenoids, proteins, and fixed oils. Several polyphenolic compounds like flavonoids, phenolic acids, and tannins are seen as the chief constituents of plants [26]. Flavonoids are water-soluble polyphenolic molecules that have antioxidant, free radical scavenging, antimutagenic, antibacterial, antifungal, and antiviral activities. Tannins, the complex organic, non-nitrogenous compounds and polyhydroxy benzoic acid (polyphenols) derivatives have anticancer, antimutagenic, antimicrobial, astringent and anti-diarrheal properties [27].

B.racemosa

Sscavenging activity was reported in several species of Baccaurea other than racemosa, such as pulp of Baccaurea lanceolata and Baccaurea ramifolia [28]. B.racemosa has high Phenolic content and Flavonoid content including flavones, flavonoles and catechines [29]. These will destroy the free radical through donating the free radical through donating their hydrogen atom to radical [30]. High amount of flavonoids are seen in the pulp of Baccaurea racemosa which contributes to the antioxidant activity of the specified plant.

B.macrocarpa

B.macrocarpa contains various secondary metabolites such as alkaloids, flavonoids, phenolics, steroids and triterpenoids. The methanolic extract (80%) from the pericarp of fruits contained high amount of total phenolics, total flavanoids, total anthocyanin & total carotenoid [31].

B.courtallensis

The methanol and hexane extracts of Baccaurea courtallensis on phytochemical analysis has shown presence of steroids, flavanoids, terpenoids, glycosides, tannins, quinons, and volatile oils [32].

B.motleyana

Baccaurea motleyana has the potential of removing nickel ion from the aqueous solutions [33]. The leaves have the biosorption potential to remove the slight amounts of Hg and Cd from the aqueous extract [34]. B.motleyana fruit contains more phenols in comparison to B.motleyana peel. In the essential oil of B.motleyana, terpenes are found in trace amount. Baccaurea motleyana contains flavanol, low vitamin content (vitamin B1 and vitamin B2). It also contains minerals such as calcium and phosphorus. [35]

B.parviflora

Phytochemical profile of fruit pulp of the B.parviflora has fibre, potassium, magnesium and zinc. It shows larger phenolic and flavonoid contents [36]. High mineral contents especially Potassium (2420mg/100g), which was six times higher than banana. Potassium has known effects in lowering blood pressure, minimizing the risk of kidney stones and reducing salt sensitivity [37].

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PHARMACOLOGICAL STUDIES

B.angulata

Baccaurea angulata peel extract has the highest antimicrobial activity against Streptococcus pneumoni. Klebsiella pneumonia showed the highest bacteriostatic and bactericidal activity [38]. It has shown antioxidant activity and the fruit has proven to have anti-atherosclerotic activity [39]. The bark of this genus is used along with other ingredient as dyestuff to colour silk yellow, red or mauve, using the dyeing process known as pekan in malay [40].

B.sapida

B.sapida has saponin which has the property of coagulating the RBC and produce inhibitory effects. It also has cholesterol binding and hemolytic properties [41]. The presence of alkaloid shows analgesic, anti spasmodic and antibacterial properties [42].

B.ramiflora:

Baccaurea ramiflora is used in rheumatoid arthritis, cellulitis, abscesses, constipation and injuries, anticholinergic, hypoglycemic, hypolipidemic, antiviral, antioxidant, diuretic and cytotoxic activities [42]. Flavonoids and saponins has the inhibitory effects hence serves as anti–inflammatory compound [43]

B.ramiflora may cause hypoglycemia, insulin lowers lipid levels and normalizes plasma lipids in alloxan induced diabetic rats. The effect of B.ramiflora leaves on hyperglycemia and lipid profile is its potent free radical scavenging activity [44].

B.racemosa

B.racemosa species has manifested its antioxidant activities. The β Carotene bleaching, flavanoid and phenolic content contribute to the antioxidant properties of the plant. Hence it can prevent diseases that happen due to oxidative stress [45]. The bark of Baccaurea racemosa has shown effective in preventing eye inflammation. The compound responsible for the prevention of eye inflammation is exactly not yet known [46]. Dyes are made from the bark. A fibre used for making paper is obtained from the species. The excellent timber is used for house and boat construction and furniture making [47].

B.macrocarpa

Several secondary metabolites including alkaloids, flavonoids, steroids, triterpenoids & phenolics are known to have antioxidant properties. B.macrocarpa has good antibacterial activity [48]. In common with other trees that produced their flowers and fruits on the trunk of the tree, members of these species are generally considered to be good support trees for the climbing palms. Rattans are used to provide material for basket making, weaving into furniture, making ropes, etc., [49].

B.courtallensis

Baccaurea courtallensis is used in diarrhoea, diabetes, dysentery, and mouth cancer [50]. This species also has antioxidant activity, antihyperlipidemic, and antibacterial activities [51].

B.motleyana

The extract of Baccaurea motleyana peel possesses antimicrobial activities and inhibits the growth of S.aureus, B.cereus, B.subtilis, E.coli, P.aeruginosa and P.vulgaris [52]. The fruit of B.motleyana has shown its ability to prevent cancer which should be taken as an regular diet as an preventive measure [53]. The fruit pulp varies considerably in its quality, ranging from rather acid to sweet and palatable. The squeezed cambium and inner bark are used as a remedy for sore eyes and stomach ache. Bark as lotion is very effective as it was claimed to cure many skin problems such as rashes, itching, ring worm and etc., [54]. The fruit is quite beneficial for keeping blood sugar levels under control. The fruit does not contain excessive sugar content so it will not raise blood sugar level in body. A dye is obtained from the tannin rich bark is mixed with the roots of Melastoma malabathricum to produce a dark red dye [55].

B.parviflora

The fruit of B.parviflora has antioxidant activity and also used in reducing eye inflammation [56]. The plant has more agroforestry and commercial uses than the known pharmacological uses. Timber from the setambun is hardwood, durable and is commonly used to make small utensils boxwood, gardening implements and walking sticks [57].

ISSN- 2394-5125 VOL 7, ISSUE 10, 2020

NAME OF THE PLANT	PHARMACOLOGICAL ACTIVITIES
Baccaurea angulata	Antibacterial, Antimicrobial, Antioxidant and Antiatherosclerotic activity
Baccaurea sapida	Coagulating RBC and produce inhibitory effects, Hemolytic and Cholesterol binging property, Analgesic, Antispasmodic and Antimicrobial property
Baccaurea ramiflora	Effective against Rheumatoid arthritis, Cellulitis, Abscesses, Constipation and injuries, Anticholinergic, Hypolipidemic, Hypoglycemic, Antiviral, Antioxidant, Diuretic and Cytotoxic activities
Baccaurea racemosa	Antioxidant, Prevents eye inflammation
Baccaurea macrocarpa	Antibacterial and Antioxidant property
Baccaurea courtallensis	Prevents diarrhoea, Diabetes, Dysentery and Mouth cancer and Antioxidant activity, Antihyperlipidemic, and Antibacterial activities
Baccaurea motleyana	Antimicrobial activity, Prevents cancer
Baccaurea parviflora	Antioxidant property, Prevents eye inflammation

CONCLUSION

Baccaurea family has different pharmacological uses including antioxidant, antidiarrheal, anti-inflammatory, analgesic, antidiabetic, hypolipidemic, cytotoxic and anticholinergic activity. Phytochemicals are rich in Baccaurea species like phenolic compounds, flavanoids, terpenes, alkaloids, saponins, etc., Though it has many valuable pharmacological properties, the plant is still an undervalued plant as its economic potentialities are still untapped. Since time immemorial, humankind has an ardours search for identification and utilization of biological resources, which is crucial to the survival, adaptation, and evolution of the human species. In this review article, effort has been taken to collect and compile the details of eight different species of Baccaurea family which has higher bio-prospection yet to be discovered.

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