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RESEARCH ARTICLE

A GLIMPSE ON *Baccaurea ramiflora*, A LESS APPEALING, UNDERUTILIZED MEDICINAL PLANT OF WEST-BENGAL (AN EXTENSIVE REVIEW)

***Purnima Dey and Imana Pal**

Department of Home Science, University of Calcutta 20B Judges Court Road, Kolkata-700027, India

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ABSTRACT

Baccaurea ramiflora Lour. syn. *Baccaurea sapida* (Roxb.) Muell. Arg locally known as Latkan or Anshfol is a versatile though underexploited plant with number of health benefits. In West Bengal the fruit plant is grown mainly in homestead condition. It is a mild acidic fruit and mainly consumed fresh. This extensive review encompasses all the available literature with respect to habitat, physical characteristics, ethenomedicinal and traditional uses, physiochemical and nutritional composition, active constituents ,therapeutic role which helps to put a glimpse on this underutilized less appealing medicinal plant of West-Bengal.

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INTRODUCTION

Plants have been a source of medicinal substances for thousands of years. Plants and phytoproducts continue to play a vital role in the treatment of various diseases. Drug discovery from plants is a multi-disciplinary approach which combines various botanical, ethnobotanicals, phytochemical and biological and chemical separation techniques. However, despite these observations, about 80% of the world's inhabitants' problems are treated by medicinal herbal drug for their primary health care (Ali *et al.*, 2013). Local people in different parts of the country have so learnt to live on many wild fruits available around their localities. Many renowned vegetable drugs of today would have gone into wider usage decades ago, if folklore and tradition about plants had been taken more seriously. The properties of many of these plants were known in some form or other to primitive man. Current interest in broad-based and inexpensive health care, new drugs and new or supplementary nutritious foods has prompted ethnobotanical studies in several undeveloped societies of the world (Jain, 1986). Burmese grape (*Baccaurea ramiflora Lour*/ *Baccaurea sapida* Muell. Arg.)

****Corresponding author: Purnima Dey,***
Department of Home Science, University of Calcutta 20B Judges Court Road, Kolkata-700027, India.

Is such an underexploited fruit crop grown mainly backyard plantation and as forest plant. *Baccaurea ramiflora* Lour, a member of the Euphorbiaceae family, is found in the tropical forests of south and south-east Asia, and is an important tree for local people and forest ecology (Goyal, 2013). The generic name is derived from Latin 'baccaurea' referring to the golden-yellow colour of the fruits (Chakrabarty and Gangopadhyay, 1997) The fruits of *B.ramiflora* are a food source, and the hard and durable wood is often used in furniture production. It is also planted as an ornamental and to provide shade .Research on *Baccaurea ramiflora* has included its ethnobotanical uses, seed biology, and chemical constituents of essential oil. *Baccaurea ramiflora* fruit finds its importance as a novel food additive because of its high content of vitamin C, protein and iron. The fruit juice is mainly used for the treatment of constipation, whereas different parts of the plant are used to treat arthritis, abscesses and injuries. They are also stewed or made into wine (Goyal *et al.*, 2013). Keeping in view the hidden potentialities of the underutilized plant *Baccaurea ramiflora*, the present comprehensive review aims to explore the following fields which include:

- Studying the scientific literature of *Baccaurea ramiflora* Lour syn. *Baccurea sapida* (Roxb.)Muell.-Arg. (Family: Euphorbiaceae).

- Mapping out the information regarding ethenomedicinal and traditional uses of *Baccaurea ramiflora / Baccurea sapida.*
- Compilation of the therapeutic and physiological role of different parts of the plant.
- Studying the nutritional components and bioactive phytochemicals and other constituents present in it.
- Focusing the future area of work on *Baccaurea ramiflora.*

Plant Description

Scientific name

Baccaurea ramiflora Lour,synonyms to. *Baccaurea sapida* (Roxb.) Muell.-Arg (Goyal *et al.*, 2013).

Common name

The common names include

- Leteku(Hindi),
- Latkan or Bhubi(Bengali)
- Mafai (Thai)
- Burmese grape (English)

In West Bengal it is also known as 'Latka'/'Latkan'/'Lotko'/'Notko',Anshfol (Goyal *et al.*, 2013;Bhowmick, 2010)

Habitat

It grows in evergreen forests on a wide range of soils. This fruit tree is native to the Southeast Asian region and found growing wild as well as under cultivation in Nepal, India, Myanmar, South China, Indo-China, Thailand, the Andaman Islands and Peninsular Malaysia. In West Bengal it is treated as an underutilized fruit crop, and mainly grown in the northern parts, like Cooch Behar,Jalpaiguri, Darjeeling, Uttar and Dakshin Dinajpur districts,and some part of Dakhin 24 pgs,Howrah under homestead cultivation. (Dutta *et al* 2013; Bhowmick, 2010).

Physical Appearance and Characteristic

Baccaurea ramiflora (Lour.), (family: Euphorbiaceae) is a slow-growing evergreen tree growing to 25 m, with a spreading crown and thin bark. Plant is dioecious in nature and bearing habit is cauliflory i.e flower and fruit directly coming from stems and flowers are appearing on bunches.

Flowers appear during mid March and fruit set occurs during mid April in West Bengal. Immature fruits are green in colour and require 3 to 4 months for maturity. On maturity, oval shaped fruits become yellow or yellowish brown in colour and fruits are available during the rainy season. The fruit of *B. ramiflora* is 1-2″ around,2-3 cm in diameter, velvety with leathery pericarp, three seeded arillus embedded in pinkish white pulp (Brandis,D,1906). The average fruit weight, peel weight is 9.0 g and 3.75 g respectively. Fruit shows around 10 ^{O} brix total soluble solid (TSS), 4.42 percent total sugar and 2.1 percent acidity. Average yield varies from 70 – 80 kg/plant/year (Pal *et al.,* 2008). The leaf is simple, alternately arranged, with petiole. It is ovate to ovatelanceolate in shape and 10-20 × 4-9 cm in size. The petiole is 1-8 cm long with lanceolated and fimbriated stipules.. Tree shows to some extent mild bienniality in cropping pattern. (Pal *et al*., 2008; Hoang *et al*., 2008)

Propagation

Burmese grape is conventionally propagated by seed in worldwide. But the dioecious nature of plant is limiting factor. Attempts had been made to propagate the plant by means of mature stem cutting (Abdullah *et al*., 2005). In West Bengal it is also traditionally propagated by seed.

Taxonomical Classification

Botanical Name : *Baccaurea ramiflora* Lour
Family: Euphorbiaceae /Phyllanthaceae
Genus: Baccaurea
Species: *Baccaurea ramiflora*
Kingdom: Plantae
Division: Magnoliophyta
Class: Magnoliopsida
Order: Malpighiales

Synonym: *Baccaurea cauliflora* Lour., *Baccaurea sapida (*Roxb.) Mull.Arg.*Baccaurea flaccid Baccaurea propinqua* Mull.Arg.etc (Lim, 2012)

Ethanobotanical and traditional uses

In Chinese Dai medicine, the whole plant of *Baccaurea ramiflora* is utilized as an antiphlogistic and anodyne against rheumatoid arthritis, cellulitis, abscesses and to treat injuries (Lin *et al.*, 2013). The plant is also used as medicine by hill-tribes in Northern Thailand (yang *et al.*, 2007). Young leaves of *Baccaurea ramiflora* are used as vegetable, flavoring agent with curries and minced meat in Bangladesh (Hasan *et al* 2009).

Fig.1. (a) *Baccaurea ramiflora* flower

Fig.1. (b) *Baccaurea ramiflora* fruit

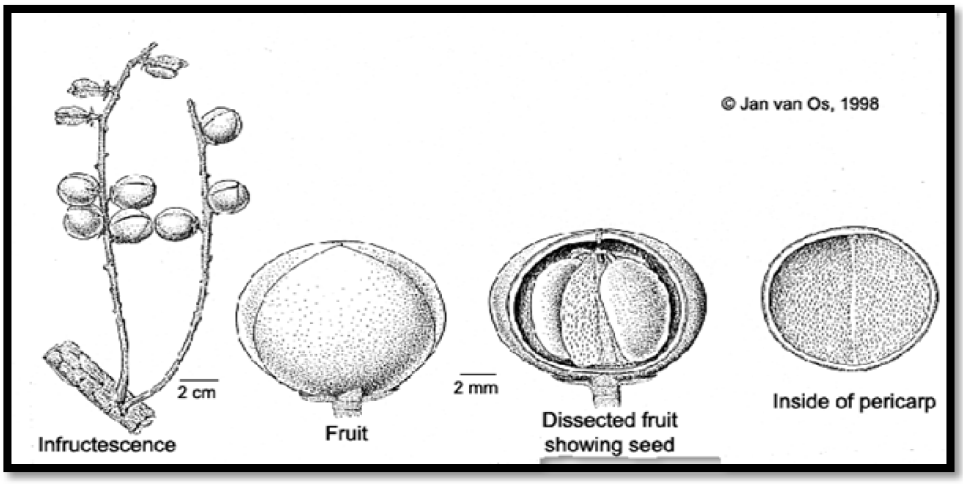


Fig.2. (a) Infructescence,dissected fruit and pericarp

Table.1 Potentially active constituents present in *Baccaurea ramiflora*

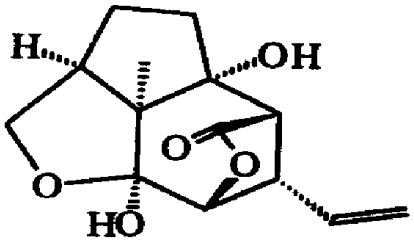
Parts of plant	Active Constituents
Leaf extract	• Total polyphenol(79.06 ± 0.03 mg GAE)/g) • Flavonoid(28.80 ± 0.01 mg QE)/g) • Proanthocyanidin(29.42 ± 0.01 µg cathechin equivalent/g.) • Rosmarinic acid(8 mg/kg)) (Usha,*et al*,2014) • 6'-O-vanilloylisotachioside(newly found phenols) • 6'-O-vanilloyltachioside (Yang, et al ,2007)
Stem	• 4'-O-(6-O-vanilloyl)-β-D-glucopyranosyl tachioside D, • 6'-O-vanilloylpicra-quassioside D, • 6'-O-vanilloylicariside B5. .(Yang *et al*,2010)
Fruit peels	• 2,3,4-tri-O-Me xylose, • 2,3-di-O-Me xylose • 2-O-Me xylose (alkaline extraction of pretreated fruits Peels) (Haq *et al*,1994).
Fruit	• total phenolic contents (TPC) (51.4 mg/g GAE) (Prakash *et al* ,2012) • flavonoids, polyphenols, tannins and phenolic terpenes(in hydromethanol extract of the fruit pericarp) (Hasan *et al*,2009;Rahman *et al*,2007) • sesquiterpene glycoside ramifloside(2-one-6α-hydroxy-13-nor-11-picrotoxen-3(15β)-olide 10-O-β-d-glucopyranoside) • sapidolide A • picrotoximaesin.(Zheng-Hong Pan et al,2015)
Wine and fruit juice	• total phenols (141.27-313.78 mg GAE/L) • flavonoids(149.2-531.2 mg QE/L) • flavonols(103.2-179.2 mg QE/L) • proanthocyanidins (1.46-8.45 µg catechin/L)(Goyal *et al.*, 2013)
Seed	• tetrahydrofurano-lactone meroisoprenoid (sapidolide A) in the medium polar fraction of the crude extract of seed kernels.(Bordolai *et al*,1996)

In India, fresh bark is chewed or juice is used orally for constipation (Khan, 2008). The fruit is profusely used by the local people for ritual purpose during the Holy Chariot Procession of Lord Jagannath. People pay their homage to God by throwing the latka fruit along with other rituals. (Goyal, 2013).In Bangladesh, apart from fresh consumption, it is cultivated chiefly for production of valuable dye annatto from seeds. Seeds contain 4.8 – 6 percent annatto dye. Annatto is used for colouring silk, cotton and other textile materials for orange colour (Abdullah *et al.*, 2005).

Potentially active constituents

The traditional uses of *Baccaurea ramiflora* for various medicinal purposes,demand the isolation and identification of active principles and thorough bioassay.

Further researches on that field identify the following constituents in different parts of plant.



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R= H, Ac

Fig-2(b) Sapidolide A

Nutritional composition and Physiochemical properties of *Baccaurea ramiflora*

Gas chromatographic analysis of *Baccaurea ramiflora* seeds oil showed that saturated fatty acids such as palmitic acid (33.67%), stearic acid (19.38%) and arachidonic acid (9.69%) account for more than 60% of total fatty acids judging by its low iodine value. Oleic (24.48%) and 11-transeicosenoic (12.75%) acids are the unsaturated fatty acids found in *Baccaurea ramiflora.* **(**Dutta *et al.,* 2013).

Table 2. Proximate Fruit Composition Of Burmese grape, *Baccaurea ramiflora* per 100 gm of pulp

Proximate	%	Minerals	mg
Water	35.6	Calcium	75
Protein	5.58	Magnesium	504
Lipid	0.73	Phosphorus	132
Carbohydrate	51.9	Potassium	730
Fibre	20.4	sodium	35
Ash	3.85	Iron	100
Vitamins		mg	
Ascorbic acid		273	

(Sundriyal *et al* ,2004;Kermasha *et al*,1987)

Table 3. Bio-chemical properties of Burmese grape fruits, *Baccaurea ramiflora*

S. No	Bio-chemical Parameters	Range	Average Value
1	Total soluble solids (TSS)	9.4-13.8 ^{O} Brix	10.5 ^{O} Brix
2	Total Sugar	4.14 - 6.05 %	5.85 %
3	Reducing Sugar	2.72- 3.15 %	3.03 %
4	Non reducing sugar	1.35 - 2.76 %	2.68 %
5	Acidity	1.8-2.2 %	1.9 %

(Bhowmick, 2010)

Table 4. Some physicochemical properties of *Baccaurea ramiflora* seed oil

S. No	Parameters	Observed values
1	Colour	Light brown
2	Oil content (wt %)	25
3	Density (g/cm3)	0.8674
4	Acid value (mg KOH/g)	1.127
5	Iodine value (gI2/100 g)	80.32
6	Refractive index	1.4672
7	Moisture (%)	0.103

(Dutta *et al.,* 2013)

Review on therapeutic role

Baccaurea ramiflora Lour. (Family: Euphorbiaceae), locally know as Latkan, is a versatile plant with number of uses. The whole plant is considered to be a medicinal one as researches on its different parts like leaves,roots,seeds,fruits prove to have some notable health benefit.

Cytotoxic property

Leaves and stem

Ethanolic extracts of the leaves and stems of *Baccaurea ramiflora* was assayed for their cytotoxic effect using brine shrimp lethality bioassay. The cytotoxic property of the plant extractives was determined by applying in vitro lethality test-Brine shrimp lethality bioassay technique (Meyer *et al.,* 1982). using brine shrimp nauplii eggs i.e. *Artemia salina*. In case of Brine Shrimp Lethality Bioassay, the lethality of the n-hexane leaves fraction (NHLF), chloroform leaves fraction (CHLF), n-hexane stems fraction (NHSF), chloroform stems fraction (CHSF) and carbon-tetrachloride stems fraction (CTCSF) of *Baccaurea ramiflora* were evaluated against A. salina. LC50 values of different fractions of leaves and stems extracts of the studied plant clearly indicate the presence of potent bioactive principles in these extractives, which might be very useful as antiproliferative, antitumor, pesticidal and other bioactive agents. (Howladar *et al*., 2012)

Hypoglycemic and hypolippidemic effects

Leaves

Methanolic extract of *Baccurea ramiflora* leaves (200 mg/kg) as a single dose per day to the alloxan induced (120 mg/kg i.p) diabetic rats for 14 days produced substantial hypoglycemia and reduced the elevated blood glucose level. Diabetic rats become normal and it was statistically highly significant ($p<0.005$). Except HDL, the methanolic extract decreased the level of cholesterol, triglycerides and LDL and this reduction was statistically highly significant ($p<0.005$). The present study on this plant established that the leaves of B. ramiflora possess hypoglycemic, hypolipidemic (Obayed ullah *et al.*, 2012).

Bark

The methanolic extract of the bark of *Baccaurea ramiflora* showed significant hypoglycemic activity compared to control ($P<0.01$) with a significant 24.89% and 29.19% inhibition at 200 mg/kg and 400 mg/kg body weight respectively (Howlader *et al*., 2009).

Sleep inducing property

Leaves

Melatonin (N-acetyl-5-methoxytryptamine) is a neuroendocrine hormone produced primarily by the pineal gland in the brain from the amino acid tryptophan, stimulated by darkness and suppressed by light. Melatonin is involved in circadian rhythm and regulation of diverse body functions, including sleep (Ansari *et al*., 2010). A validated bioanalytical method was used for determination of melatonin in seven traditional Thai sleeping aid herbs using HPLC-fluorescence detection. Melatonin was extracted from other interfering compounds using solid phase extraction. *Baccaurea ramiflora* showed an modest amount of melatonin (43.2 ng/g of dry sample weight).Melatonin content in the leaves is a promising result for future development of this overlooked part of *B. ramiflora* as a health food supplement (Padumanonda *et al*., 2014).

Anti-inflammatory property

Rosmarinic Acid, a new polyphenol from *Baccaurea ramiflora* Lour. Leaf found to be a probable compound for its Anti-Inflammatory activity. Results demonstrate that administration

of *Baccaurea ramiflora* extract (BME) at the dose of 200 mg/kg can reduce paw edema by over 63%, and it exhibits a dose-response effect. Depending on concentration, the extract exerted scavenging activity on DPPH radical (IC50 36.4 µg/mL), significantly inhibited IL-1β (4.4 pg/mg protein) and TNF-α (0.21 ng/µg protein). Therefore, it can be concluded that BME causes a substantial reduction of inflammation in *in vivo* models. Rosmarinic acid, detected by an HPLC method is thought to inhibit eicosanoids such as prostaglandin biosynthesis which is the end product of the cyclooxygenase pathway. The phytochemical also has the ability to inhibit the infiltration of neutrophils and its degranulation, thereby decreasing the level of arachidonic acid which is responsible for painful sensation. In conclusion this study supports the mechanism involved in the anti-inflammatory and antioxidant activity of *Baccaurea ramiflora*. (Usha *et al.*, 2014)

Antifungal activity

Fruits

A new picrotoxane sesquiterpene ramifloside isolated from the berries of *Baccaurea ramiflora* show antifungal activity against Colletotrichum gloeosporioides. (Zheng-Hong Pan *et al*., 2015).

Seeds

A novel anti-fungal tetrahydrofurano-lactone meroisoprenoid (sapidolide A) from the medium polar fraction of the crude extract of seed kernels of *Baccaurea sapida* has been isolated. Sapidolide A has exhibited strong inhibitory activity against pathogenic fungi such as Helminthosporium oryzae, Phytophthera oryzae, Alternaria solani, Curvularia eragrostidis, Collectotrichum gleosporioides. (Bordolai *et al*., 1996).

Antioxidant study

Leaves

Previous phytochemical investigations showed that two new phenols, 6'-O-vanilloylisotachioside and 6'-O-vanilloyltachioside, together with nine known compounds isolated from the leaves of this plant, among which seven compounds revealed potent antioxidant activities against H_2O_2-induced impairment in PC12 cells, and exhibited significant DPPH radical-scavenging activities.(Yang *et al.*, 2007). Antioxidant potential was also assayed by measuring the free radical scavenging activity using 1, 1-diphenyl-2-picrylhydrazyl (DPPH) with methanolic extract of leaves of *Baccaurea ramiflora.* Result showed potent free radical scavenging activity with IC50 value of 23.83 (µg/ml). The present study on this plant established that the leaves of *Baccaurea ramiflora* possess antioxidant activity. (Obayed ullah *et al*., 2012).

Fruits

In order to identify the potential sources of natural polyphenols with promising antioxidant (AOA) and free radical scavenging activities (FRSA), the fruits of *Baccaurea sapida* as a underutilized species were studied for total phenolic contents (TPC), AOA and FRSA. Result found that the total phenolic contents (TPC) of *Baccaurea sapida* is high i.e,51.4 mg/g GAE and also have high AOA(64.7%); low IC50, low EC50, reasonably good values of antiradical power (ARP) that support their effectiveness towards protection of DNA nicking and indicating strong FRSA (Prakash *et al.*, 2012).

The chloroform soluble fraction of the methanolic extract of *B. ramiflora* fruits showed strong antioxidant activity with IC50 value of 49.78 µg/ml and petroleum ether soluble fraction showed good antioxidant activity with IC50 value of 75.31 µg/ml whereas standard antioxidant butylated hydroxytoluene showed IC50 value of 24.51 µg/ml.As fruits of *B. ramiflora* produce significant amount of antioxidants to prevent the oxidative stress caused by reactive oxygen species (ROS), it represent a potential source of new compounds with antioxidant activity. This study reveals that *Baccaurea ramiflora* fruit possesses cytotoxic and antioxidant activity hence can be a potential source for the isolation of active principle(s) for different therapies. Therefore consumption of the fruit could offer health benefits in terms of prevention of diseases caused by oxidative stress and cancer (Amin *et al.*, 2015).

The hydromethanol extract of the fruit pericarp of *Baccaurea ramiflora* also showed significant DPPH scavenging activity with IC50 of 31.38 µg/ml 5 which indicates presence of phenolic compounds such as flavonoids, polyphenols, tannins and phenolic terpenes (Hasan *et al.*, 2009; Rahman *et al.*, 2007).

Stem

From the stems of *Baccaurea ramiflora*, three new and four known compounds were isolated. The new compounds were identified as 4'-O-(6-O-vanilloyl)-β-D-glucopyranosyl tachioside D, 6'-O-vanilloylpicra-quassioside D, and 6'-O-vanilloylicariside B5. One of the compounds exhibited significant DPPH radical-scavenging activity with an IC50 value of 36.9 µM, while another compound revealed weak antioxidant activity against H_2O_2-induced impairment in PC12 cells. (Yang *et al*., 2010)

Future potentialities

The fruit is a rich source of pectin so an effort may be made to prepare the value added product like jam, jelly from this underutilized fruit crop. The peels of mature but unripe fruits yield 14.1 percent pectin and this pectin is useful in preparation of jellies and jams (Annonymous.1988). The scope of commercial extraction of pectin may be exploited. It is an acidic fruits so attempts may also be taken for preparation of beverages from fruit. Burmese grape is grown with no or very minimum care as homestead condition. Scientific package of practices for growing of this crop would be developed for regular cropping pattern and higher yield. The crop is dioecious in nature, so proper vegetative propagation techniques would be standardized. Traditionally the plant used widely for the treatment of various ailments, but scientifically few of them was screened out. Thus the scientific studies

should be conducted to investigate the unexploited potential of *Baccaurea ramiflora.* Exploration of future potentialities should needs attention in the following field.

- **In commercial field:** launching of diversified product like juice, wine, and jelly from fruits.
- **Medical research field:** finding out if any role in combating nerve disorder, obesity, liver disorder or not.
- **Nutritional field:** finding out the level of antioxidative trace minerals and vitamins in fruits, leaves, bark, stem. Further studies on those field will helps us to make this underutilized plant a valuable one in near future.

Conclusion

In the present comprehensive review, data are collected and compiled to obtain information based on taxonomy, origin, description, phytoconstituents, traditional and pharmacological claims on *Baccaurea ramiflora*. This review clearly establish *Baccaurea ramiflora* as a medicinal plant which is underutilized and though commonly available but due to its less appealing nature and taste not gain much attention in civilized society. Whereas in India, about 27% of the fruit production consists of a large number of minor fruits. There are nearly 150 of consumable species of minor fruits in India (Majumder, 2004) but cultivation of these fruits on a commercial scale is not yet attempted (Peter, 2007). The land holding pattern in West Bengal in general reveals that nearly 90% of the farmers are small and marginal; hence, the minor crops are ideal for cultivation because of their low input requirement, less production cost, higher nutritive value and high yield. On the other hand there is a common saying that 'Take minor fruits throughout the year to prevent under world journey' as these less exploited fruits are plenteous sources of minerals and vitamins. They can receive unfavorable ecological condition and can be grown in unfertile lands. These fruits have been used as folk medicines; quite a few of these are suitable for processed products. But most have not undergone any volitional stage of domestication and human selection.

Awareness should be created about *Baccaurea ramiflora,* its significance and wide spectrum medicinal activities.

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