Review Article

An Indian Wild Edible Plant and it's potential: the *Meyna Laxiflora* Robyns fruit: A Review

ABSTRACT

Wild edible plants (WEPs) are all those uncultivated plants that have meaning and value in the culture of each people. *Meyna laxiflora* Robyns is considered a wild plant, whose edible fruits, harvested in nature, are consumed by different populations. Leaves, fruit, and seeds of this species are considered, by several authors, to be organs rich in compounds that are important from a nutritional and medicinal point of view. The plant is highly located in tropical and subtropical areas all over the world and the fruit is consumed by triable communities in the Western Ghats sector of Maharashtra. This review introduces in a detailed survey of the literature on taxonomy, morphology, traditional use, medicinal, phytochemical-pharmacological properties of leaves, fruit, and seeds, which will be beneficial for exploring their properties. The fruit of this species contains different chemical compounds, such as carbohydrates, starch, protein, minerals, anti-nutritional factors and has traditional values for its medical purpose, for treatment of Gastrointestinal and other disorders etc. Although the demand for these wild forms of fruits has declined, so this review brings unique and notable attention must have to be paid on Meyna fruit to preserve, process, and improve awareness regarding the important source of food supply.

***Keywords*:** WEPs, Properties, Potential importance, food resource, fruit products

1. Introduction

The species of Wild edible plants (WEPs) are neither domesticated nor cultivated but growing wild and are however edible [1]. The traditional WEP consumption is still supplemented today with staple crop

plants by many agrarian societies around the world [2]. Wild edible plants (WEPs) introduce some species that are gathered or harvested from their wild natural habitats and utilized for humans as food [2,3,4]. About 5% of the absolute plant types of the world are utilized for consumption in that in excess, 12,000 plant species are considered consumable by people [5]. It is assessed that around 800 species of WEP are consumed in India alone [3]. Several researchers [6,7,8,9] have documented the WEPs used in the diet by tribes in different parts of India, describing their nutritional and chemical properties. Numerous examinations have been described in exploring the consumption of WEPs by local people in the Northern Western Ghats region of Maharashtra. The northern areas of Western Ghats include the districts Pune, Satara, Sangli, Kolhapur, Thane, Raigad, Nashik, Ahmednagar, Nandurbar, Dhule, Ratnagiri, and Sindhudurg. The rural and local communities of these districts utilize wild edible plants in their day-to-day consumption [10,11,12,13,14,15,16,17,18]. The cultivation of WEP trees for fruit production promotes the prevention of permanent stands in a barren land. These trees often represent attributes of desert landscapes and form the basis of the traditional agroforestry land system. Several authors described the diversity and nutritive value of WEP fruit and their consumption, especially in underdeveloped countries [19,20,21].

Indeed, in the past, WEPs have performed a very vital part in supplementing the diet of people. As more exotic fruits have been introduced but the dependence on these fruits has gradually declined. As a supplement to their basic need for food, most of the people in tribal areas still use them. Some of them are sold in the rural market or preserved by curing for use in a dry period as candied form. From the nutritional point of view, these fruits from forests are rich in terms of protein and energy and more helpful in treating protein energy deficiencies. In the diet, WEP is known to be an excellent source of nutrients such as vitamins and minerals [22] like potassium, magnesium, iron, sodium, calcium, phosphorus etc. Deshmukh et al. (2010) reported a detailed survey, research and future potential of 29 WEFs plants which were highly useable by triable people from Kalsubai-Harishchandragad Wildlife Sanctuary falls in Maharashtra state, India. They have collected many species from the study areas that are of high-value economic food. Several plants showed that they are utilized in the different

formulations of "Ayurveda'' in Indian folk medicine. In most cases, WEP provides fibers and it helps in the prevention of constipation [23,24]. Particularly, WEP is generally accepted as a good source of nutrients and supplements for food in a world faced with the problem of food scarcity. The utilization and consumption of these fruit in arid zones supply dietary supplements in addition to commercial opportunities. It is considered that special concentration should be paid to preserving and enhancing this important source of food supply [25].

So, in this review, we collected data regarding *Meyna laxiflora* Robyns about all aspects like plant description, taxonomy, and diffusion of the species, but also nutritional, medicinal, phytochemicals, and food products. It stated that *Meyna laxiflora* Robyns has played a valuable role in triable people as food and medicine, but no exhaustive information is available for identification and standardization of plant. Hence, there is a need to undergo an exhaustive diversity study which will be very useful in further research mainly regarding Meyna fruit processing. We hope so, *Meyna laxiflora* Robyns review provides more additional information that will be helpful for improving the economy in triable areas, and food scarcity, and helps in the regeneration of barren lands. Hence, through this review, we concluded that unique and notable attention must have to be paid to Meyna fruit to preserve, process, and improve awareness regarding the important source of food supply.

2. *Meyna laxiflora* Robyns: Taxonomy, diffusion, and morphological description

Deshmukh and Waghmode (2011) studied the role of WEP fruits as a food resource traditionally. In his work author reported the wild edible fruit *Meyna laxiflora* Robyns and tried to explore food scarcity and the situation regarding the economy in tribal areas about the underutilized fruits: that could help in regeneration. Recently the genus Meyna has been separated and classified into eleven distinct species in that *Meyna laxiflora* Robyns is one of them [26].

The taxonomy of this species is reported in **table no.1**.

Table 1. Taxonomy of *Meyna laxiflora* Robyns [27]

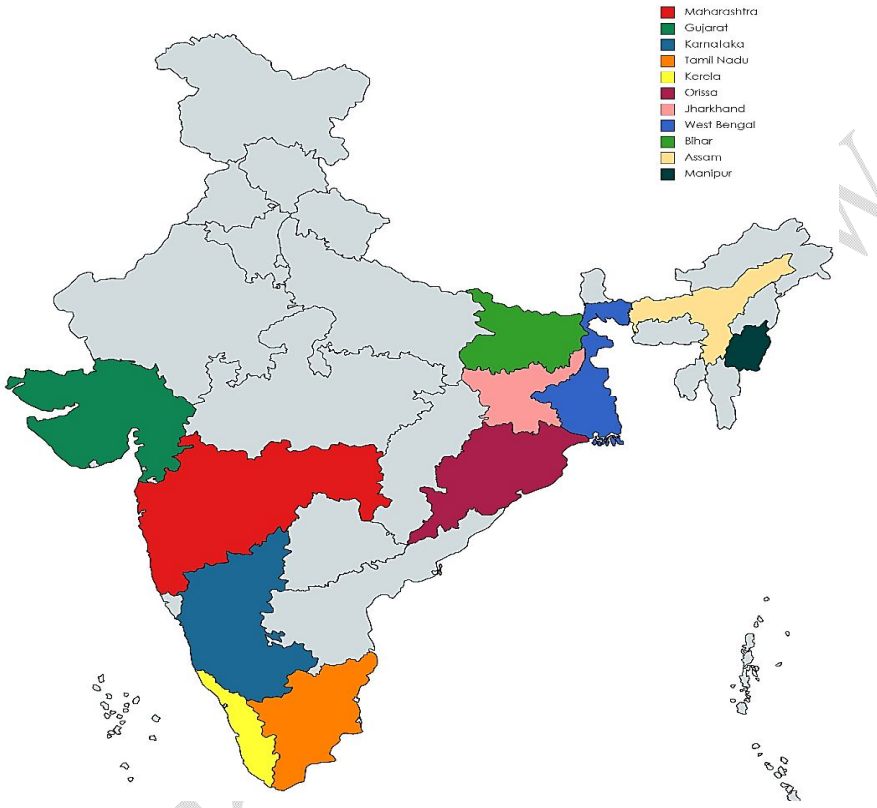
(https://indiabiodiversity.org/species/show/230388)

Domain	*Eukaryota*
Kingdom	*Plantae*
Subkingdom	*Viridaeplantae*
Phylum	*Tracheophyta*
Subphylum	*Euphyllophytina*
Infraphylum	*Radiatopses*
Class	*Mangoliospida*
Subclass	*Asteridae*
Superorder	*Gentiananae*
Order	*Gentianales*
Family	*Rubiaceae*
Genus	*Meyna*
Species	*Meyna laxiflora* Robyns
Habit	*Tree/Shrub*

Meyna is a worldwide distribution in tropical and subtropical regions. It is a shrub or a small tree and is commonly found in evergreen forests, where local people use its fruits (**Figure.2**)

All over the world, the Meyna tree is located in tropical and subtropical regions [26]. Mainly in India, it is available in Assam, Meghalaya, Bengal, Bihar, Orissa, Nepal, Maharashtra (Konkan) Deccan etc. [28, 29], but it is broadly available all over the Maharashtra (MH), districts Nashik, Sangli, Kolhapur, Thane, Raigad, Nandurbar, Dhule, Ahmednagar, Pune, Satara, Ratnagiri, and Sindhudurg) and in Satpuda region, particular in Sawarimal, Umarpata, Morkaranja and kondaibari villages of Nandurbar district [30], also available in Karnataka, Kerala, Tamil Nadu, Gujarat [31] (**Figure 1**).

Figure 1: ~~Spread~~ Distribution of *Meyna laxiflora* Robyns in India



Meyna laxiflora Robyns is also mentioned in a study of the biodiversity of woody plant species at Chandoli National Park, an under–explored area from Northern Western Ghats [32]. The morphological description of this species is reported in **table 2**.

Meyna laxiflora Robyns is a small or medium size tree, with light black bark, and smoothness, which has traditional values for the treatment of Gastrointestinal disorders, and inflammation as medicinal uses [33]. Leaves are whorled or opposite 3.5-15x, 1.2-10 cm, shining, globous, elliptic-oblong. Singh, P. K., & Devi, M. H. (2015) reported that Singju is an indigenous delicacy of Meitei community of Manipur State mainly used leaves as a green vegetable, especially with gall formation and the market value is Rs. 3-5/bunch. The flower is greenish yellow, in axillary cymes or fascicled

on leafless wood. The fruits (**Figure.2**) are nearly globose, fleshy, smooth, purplish dark brown when ripe and green when unripe [26] and the seeds are albuminous. A detailed description of the morphological characteristics of *Meyna laxiflora* Robyns is reported in **table no.2**.

Table 2: Summary of the morphological characteristics of *Meyna laxiflora* Robyns

Part of plant	**Description**
Tree	A large perennial or big shrub or small tree, stem with straight opposite, spines 1.5-2 cm long and sharp [35]. Small or moderate size tree, the bark is light black-dark brown to grey. The tree is 2.5-7 meters tall [29]
Leaves	Leaves opposite or whorled, 3.5-15X1.2-10 cm, elliptic-oblong, acuminate at apex, cuneate at base, shining, smooth, glabrous on both surfaces, petiole 1–1.6 cm long; stipules 2–4 mm broad, triangular, with 3–5 mm long acuminate; Color: green; odor: characteristics; taste: characteristics and size: varying [36, 37].
Flower	Flowers in pedunculate cymes or rarely in fascicles from the old scars below the leaves [35]. Greenish yellow white color, in axillary cymes or fascicled on leafless wood, pedicels 2-3 cm. Flowering March-April [37]
Fruit	Medium size drupe ellipsoid, green color when in the unripe stage. Nearly globular, fleshy, smooth, purplish light-dark brown color when ripe [35]. When cut 5 or 6 fruit segments. Season of fruit Nov- Dec in Manipur and April to Jun in Maharashtra. Alu fruits are small and medium size (Weight around 35 gm to 46 gm and height 34 mm to 38 mm), and the shape is circular.
Seeds	Seeds are albuminous with membranous Testa. Around 5 or 7 seeds in one fruit, dark brown color, and kidney bean-like shape. One seed weight around 0.25 to 0.71gm. A faintly pungent smell, Taste: Seeds are bitter. The seeds' outline was vertically oblong and oval. The surface is smooth and membranous [38].

Figure 2: Flowering to fruiting Stage of *Meyna laxiflora Robyns* ~~*Meyna laxiflora* Robyns Fruit~~

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[39]

Meyna laxiflora Robyns fruit, commonly known as Alu or Huloo (Marathi), muduna (Hindi, Bengali), manakkarai (Tamil), muyna, and gobergally (Kannada), and its name depending on the territory (**Table 3.**). The fruit is 2.5 cm long, brown chocolate color when ripe – green in the unripe stage, and contains 5-6 seeds and fruit segments. The flowering and fruiting seasons are on January - July in Maharashtra and November- December in Manipur [40, 41]. The ripe fruit is fleshy slightly sour, sweet, and soft. Fruits are rich in carbohydrates, vitamins, proteins, and minerals like calcium, iodine, iron etc. The fruit contains the highest amount of potassium (1278 mg/100 gm), calcium (325 mg/100 gm), iodine, etc. It is more highly rich in iron than other wild fruits i.e., about 35 mg per 100 gm fruit [25, 42]. The mineral composition and antinutritional factor from wild edible fruits from Kolhapur district were carried by Valvi et al. (2011a) and Rathod et al. (2011), *Meyna laxiflora* Robyns fruit is become on and the results showed that this fruit is rich in Iron and Saponin. Fresh and young fruits are consumed as a vegetable in cooked form. Dried fruits are narcotic and are used for the treatment of dysentery. Ripe fruits are eaten as food when it's raw and is also sold in the market when its ripe and ripe fruits are also dried after applying salt and kept in plastic bags [25]. The regional names of the Meyna fruit are reported in **table no 3**.

Table 3. Regional names of *Meyna laxiflora* Robyns [26,28,39]

Territory	Regional Names
Assamese	Kutkura, Moin
Bengal	Mainphal, Muduna, Muyna, Muyuna, Moynakanta (West Bengal, India) [33]
English	May-nuh
Gujrati	Alu, Atu
Hindi	Moina, Moyna/Mayan (Manipur), Muduna, Muyuna, Pundrika, Bahu-vij, Dal-amal
Kannad	Mullakare, gundkare, gobergally, Chegu gedde
Marathi	Alu, Huloo/Helu, Aliv/Alav, Halawn
Sanskrit	Pindi, Pinditaka, Pindituka, Pindu, Nagakesarah, Phenil, Pichuk, Taskar, Shalya, Vrishchika
Tamil	Manakkarai
Telgu	Segagadda, Veliki, Vichikilamu, Chega, Manga,
Urdu	Main
Local name	Alive, Alav, Olami, Awala, Ulama, Heibi (in Manipur, India [28, 34] Samatan (Pnar-in Meghalaya) [29, 44]

Vartak and Ghate (1994) focused only on *Meyna laxiflora* Robyns, which is a promising WEP fruit from tribal areas of Western Maharashtra. In his paper, the Author presented a checklist to bridge the gap between the wild edible plants enumerated and those consumed by the rural and local communities of the Northern Western Ghats of Maharashtra, in that checklist *Meyna laxiflora* Robyns also mentioned. The checklist provided the details of the botanical name, important synonym, habit, edible part, mode of consumption, vernacular name, family, flowering and fruiting season, nutritional evaluation, and habitat. Golulapriya (2017) studied the nutritional analysis and

germination techniques of *Meyna laxiflora* Robyns fruit plant for the reason of commercial applications in the northern western ghats with special emphasis on the Kolhapur district. The author examined around 50 no. of seeds and results showed that zero (No) % of germination was observed by Meyna fruit seeds. The author also analyzed the nutritional content of Meyna fruit pulp by the AOAC method.

2.1 Genetic Relationship of *Meyna laxiflora* Robyns

There are 11 species of Meyna known to exist, including *M. maxiflora* and *M. spinosa* in Meghalaya. [44]. Previously, *Pyrostria spinosa* (Roxb. ex Link) Miq. and *Vangueria spinosa* Fl. Br. Ind. covered the same group of plants. But recently, using molecular phylogenetics, the species have been divided into eleven distinct species of Meyna [26]. The two species known to grow in India are *Meyna laxiflora* Robyns and *Meyna spinosa* Roxb.ex Link. *Meyna laxiflora* Robyns and *Meyna spinosa* Roxb.ex Link accessible in India, but there is a difference between both plants is only in flowers which are observed as inseparable. Only the blooms differ between the two closely related species. *Meyna spinosa* Roxb.ex Link's flowers are more tightly packed into fascicles and have shorter petioles and pedicels than *Meyna laxiflora* Robyns' [26].

3. Traditional Uses of *Meyna laxiflora* Robyns

The tribe societies, such as Pawara, Bhil, Tadavi and Vanjara of Satpuda use foliage as food [21, 46]. A recent ethnomedicinal survey reveals that tribes of Satpuda hills from many villages are using plants for the treatment of inflammation, gastrointestinal disorder, kidney stone and some other disorders etc., or are also used as food ingredients. Most ailments such as stomachache, menstrual problems, urinary problems, and diarrhea, can be cured by oral administration of powder, while the inflammation can be cured by topical application [47].

Leaves

The Chandel districts of Manipur and the Chothe tribe of Bishnupur utilize young and fresh leaves as chutney. Furthermore, Meyna leaves are believed that will enhances and improve blood purification and skin texture. The Meitei community of the Imphal valley uses leaves as an ingredient to make Chinghi an herbal shampoo while young leaves and fruits are used in the treatment of helminthiasis and hoarseness (abnormal change in voice due to throat infection) [48]. In North West Maharashtra, people use leaves for the treatment of gastrointestinal disorders: leaves are masticated for abdominal distention [49]. Tribes of Nashik district utilize leaves for goiter or swellings by making smears of fresh leaves with coconut oil as a paste by slight heating [17, 40, 50]. Wangmo et al. (2009) carried out a pharmacognostic study on the leaf and stem which reveals that the leaf presents a high amount of carbohydrates, protein, alkaloids, glycosides, tannin, and saponin as compared to the stem. Everywhere in India leaves are used for the treatment of dysentery, diphtheria, and indigestion and for the removal of worms, the stem bark paste is used as a cure for boils and the root paste is used for the treatment of painful urination. Decoction of the leaves was used against diphtheria. The saponaceous nature of the leaves prompted people of certain parts of Assam to use it as antidandruff shampoo. The stem was recommended with other drugs in the case of snakebite and Scorpio-sting [52]. The main component of this Singju kind is *Meyna laxiflora* Robyns (*Heibi*) leaves and another regularly prepared meal is *Ngari*, with or without leaves. *Heibi mana Singju* is a traditional recipe that is one of the delicacies served to the Diety of the Meitei community's Birth Ceremony (*Ipan thaba*) and New Year Ceremony (*Cheiraoba*) [34]. The Meitei community of India used a traditional and unique haircare lotion called as '*Chengi*', derived from wild *Meyna laxiflora* Robyns (*Heibi*) leaves.

Fruit

The Jaintia hills of Meghalaya and the tribes of Khasi Garo use fruit, particularly as food and rarely in the brewing of wine [53]. Fruits are consumed as food in both forms ripe and unripe. Also, fruits are used as a treatment for constipation [17, 40, 54]. The tribal community in the Western Ghat region of Maharashtra prefer young fruits as a vegetable for kitchen recipe [29] and dried fruits as narcotic. The

fruit is used as an anti-dysentery and in Fruit-cholagogue, a-decoction used in biliary complaints and hepatic congestion [25, 55]. Also, the fruit is applicable as Ethnomedicinal uses Intestinal worms and hoarseness [40, 41]. *M. laxiflora* Robyns especially raw fruit used for abortion as a therapeutic indication by the indigenous tribal communities (Galo) of Arunachal Pradesh, India [56].

Seeds

The tribes of the Tinsukia district of Assam utilize a seed powder infusion as an abortifacient [57]. Five pinches of seed powder are blended with water and given twice a day for 15 days for treatment of kidney stones in Nashik District [58]. *M. laxiflora* Robyns is accounted as a wild medicinal plant of Assam. The seeds of the plant were reported to be a female antifertility agent and also chemical properties of the seeds were investigated' by Gogoi et al. (1997).

4. Chemical composition of *Meyna laxiflora* Robyns

Only S. Wangmo et al. (2009) performed a pharmacognostic study on the leaf and stem of the Meyna plant. In that examination involved macroscopic and microscopic studies such as percentage extractives, quantitative microscopy, ash values, fluorescence analysis, histochemistry and phytochemistry. Whereas several authors worked on fruit and seeds characterization.

Leaves

The qualitative and quantitative evaluation of the leaf and stem of plants reported it to be contained in phytochemicals, such as carbohydrates, starch, proteins, tannins, saponins and alkaloids. Thus, indicating the essential value of the plant in pharmaceuticals and in indigenous systems of medicine [50]. The phytochemical analysis of leaves of *Meyna laxiflora* Robyns results showed that the leaf is rich in various phytochemicals like carbohydrates, proteins, amino acids, steroids, some glycosides, alkaloids, flavonoids, tannins saponin and total phenols etc. [36]. Leaves also carry a flavonoid, (−)–epicatechin–3–O–β–glucopyranoside [59], and essential minerals i.e., Fe (1.02 ± 0.005), Zn (0.4342

± 0.014), Cu (2.30 ± 0.02), Mo (0.011 ± 0.001), Cr (4.27 ± 0.097), and Mn (0.014 ± 0.002) [60]. Bag et al. (2016) found that total flavonoid content (expressed in terms of quercetin equivalent (QE) and methanolic extract) from leaf extract recorded the highest (80.45 µg ± 0.16 /100 g of dried extract) and total phenolic content (in aqueous and methanolic leaf extracts according to the gallic acid equivalent) was 100.50 and 111.86 mg/g, respectively. The same author analyzed the total antioxidant activity of the methanolic extract of the leaf at the highest concentration (150 µg/ml concentration) used for the experiment was 34.95 and 60.75 µg/ml.

Fruit

Fruit is composed of different molecules, but the constituents more important are Oxalate (0.8667 ± 0.1527 mg/100 gm), Phytate (0.2667 ± 0.0577 mg/100 gm), Tannin (1.06 ± 0.0529 mg/100 gm), and Saponin (53.366 ± 0.472 mg/100 gm) [43]. Valvi and Rathod (2011a) have analyzed mineral concentration from ripened Meyna fruit. The mineral content noticed in mature and ripened fruits of *Meyna laxiflora* Robyns are Nitrogen (in mature fruits is 2 + 0.02 mg/100 g DW and in ripened 0.44 + 0.049 mg/100 g DW); Phosphorus (in mature fruit is 1.36 + 0.025 mg/100 g DW and in ripened fruit 0.15+ 0.043 mg/100 g DW); Potassium (in mature fruit is 1563.3 + 0.35 mg/100 g DW and in ripened fruit is 1278.4 + 0.51 mg/100 g DW; Ca (in matured fruit is 219.6 + 0.57 mg/100 g DW and in ripened fruit is 325.1 + 0.6 mg/100 g DW; Mg (in matured fruit is 138.7+ 0.2 mg/100 g DW in ripened fruit is 99.5 + 0.90 mg/100 g DW; Sodium (in matured fruit is 220.3 + 0.57 mg/100 g DW and in ripened fruit is 222.1 + 0.28 mg/100 g DW, Iron (in matured fruit is 35.5 + 0.4 mg/100 g DW and ripened fruit is 27.5 + 0.11 mg/100 g DW; Zinc (in matured fruit is 5.34 + 0.33 mg/100 g DW and in ripened fruit is 5.21 + 0.09 mg/100 g DW; Copper (in matured fruit is 0.84 + 0.032 mg/100 g DW and in ripened fruit is 0.54 + 0.040mg/100 g DW. Manganese (in matured fruit is 1.15 + 0.015 mg/100 g DW and in ripened fruit is 0.94 + 0.045 mg/100 g DW. Among all minerals, in mature fruits potassium is higher and copper is lower. In ripened fruits, potassium and iron are higher, and nitrogen is lower. The ripe fruit pulp is composed of condensed tannin and phenolic compounds [62]. Bag et

al. (2016) found that total flavonoid content (expressed in terms of quercetin equivalent (QE) and methanolic extract) from fruit pulp recorded the 51.70 µg ± 0.15 /100 g of dried extract and total phenolic content (in aqueous and methanolic fruit pulp extracts according to the gallic acid equivalent) was 94.18 and 129.54 mg /g, respectively. The same author analyzed the total antioxidant activity of the methanolic extract of the fruit pulp at the highest concentration (150 µg/ml concentration) used for the experiment was 37 and 77.4 µg/ml of extract. Around twenty wild edible fruits grown in Manipur were done by Haripyaree et al. (2012); *Meyna laxiflora* Robyns is one of them. The result stated that the *Meyna laxiflora* Robyns fruit showed 118.87 % DPPH activity (Methanolic and dichloro methane extracts of fruit)**.**

Recently Bhamare et al. (2022) analized the nutritional and mineral profile of wild edible ripe and unripe fruit of *Meyna laxiflora*. In this study author analized various proximate such as moisture, ash, protein, reducing sugar, ascorbic acid, antioxidant activity and phenols. The author found that ripe fruit (mg·100 g–1 fresh weight) showed the highest reducing sugar (3239±0.92), protein content (3101±1.52), phenol (3219±0.95) and antioxidant activity (114.6± 0.11) compare to unripe fruit. In this study, 12 minerals N, P, K, S, Br, Fe, Mn, Mg, Zn, Cu, Ca, and Na has been determined in the unripe and ripe fruit flesh. N, P, K, and S contain in the ripe fruit (0.0643) %, (133.2) %, (574.96) %,(36.94) % respectively. Other trace elements Zn, Na, Fe, Cu, B, in the ripe fruit flesh (1.74) %, (5.29) %, (13.3) %, (1.15) %, (0.33) %.

Seeds

Ganesh et al. (2010) carried out the antioxidant activity of *Meyna laxiflora* Robyns seeds. The author studied the extract of the seeds for in vitro antioxidant activity. They determined IC50 values and are found to be 84.2 ± 2.1, 91.0 ± 3.0, and 104.5 ± 3.4 µg/ml for DPPH, H_2O_2, and NO radical scavenging method, respectively. Seeds contain carbohydrates, glycosides, alkaloids, steroids, tannins, saponins, terpenoids, gums and mucilage which is by methanolic extract. By Benzene extracted, Meyna Seed

contains fats around 38.5 % [66]. Azam et al. (2005) examined the potential and prospectus of fatty acid methyl esters of some non-traditional seed oils for use as biodiesel. A total of 75 plant species having 30% or more fixed oil in their seed/kernel were analyzed by them. Among seventy plant species, *Meyna laxiflora* Robyns is one of them. From the *Meyna laxiflora* Robyns, they analyzed 38.5 % oil, 202.8 saponification numbers, 101.3 iodine values and 50.42 cetane number from the seeds of the Meyna [67, 68]. The seeds contain linoleic, oleic, palmitic, and stearic acids sated by MPDV113-sastra-scbt (http://scbt.sastra.edu/apmp/indl.php?id=MPDV113).

Janarthanan. L, Venkateswarlu B.S. (2018) focused on seed of *Meyna laxiflora* Robyns. In the work, the author observed that the microscopical examination indicates an elliptical form with a thin dark seed coat encompassing enormous perisperm and cellular endosperm and a central embryo. The seed powder contains a large number of seed coat sclereids and cotyledon parenchyma cells. The foaming index value of powdered *M.laxiflora* Robyns seeds was less than 100. Phytochemical Quality of Alkaloids, Tannins and Phenolic chemicals, Flavanoids, Seroids, Proteins, and amino acids were found in ethanolic and aqueous extracts of powdered seeds of *M.laxiflora* Robyns. Bag et al. (2016) found that total flavonoid content (expressed in terms of quercetin equivalent (QE) and methanolic extract) from seed extract noted the 35.21 µg ± 0.12 /100 g of dried extract and total phenolic content (in aqueous and methanolic seed extracts according to the gallic acid equivalent) was 91.66 and 50.3 mg/g, respectively. The same author analyzed the total antioxidant activity of the methanolic extract of the seed at the highest concentration (150 µg/ml concentration) used for the experiment was 35.4 and 44.1 µg/ml of extract respectively.

5. Pharmacological Properties of *Meyna laxiflora* Robyns

Leaves

A flavonoid extracted and separated from the leaf is significantly active against *Staphylococcus aureus, Escherichia coli, Klebsiella pneumoniae and Pseudomonas aeruginosa* [58].

Fruit

The levels of antioxidant enzymes like catalase, peroxidase and superoxide dismutase are carried out in eight wild edible fruits by Valvi et al. (2011b) in the Kolhapur district. *Meyna laxiflora* is one of them. The highest activity was found in the case of superoxide dismutase, followed by peroxidase and catalase. Peroxidase activity is found to be higher in ripened fruits, while Catalase and Superoxide dismutase is more in mature fruits and then activity decreased during the ripening of the fruit. The highest SOD activity was shown by mature (0.007533 + 0.000252) and ripened (0.004767 + 0.000115) fruits of *Meyna laxiflora* Robyns. The highest peroxidase activity was observed in ripened fruits *Meyna laxiflora* Robyns (0.006333 + 0.004619). In mature fruits, again the highest peroxidase activity was found in *Meyna laxiflora* Robyns (0.0096 + 0.000265) and less in others. They have concluded that antioxidants are absolutely critical for maintaining optimal cellular and systemic health and well-being.

Traditional herbal plant *Meyna laxiflora* is useful for the treatment of inflammatory bowel disease. Bhandole A.B., and Kakrani H.N. (2022) analysed *Meyna laxiflora* crude extract against Trinitrobenzenesulfonic Acid (TNBS) induced colitis in rats. The author found that petroleum ether extract of *Meyna laxiflora* was discovered to be protective against TNBS induced-colitis by preventing macroscopic and microscopic damage to the colon, weight loss, diarrhea, Myeloperoxidase assay (MPO), Lipid Peroxidase assay (MDA), and Nitric oxide scavenging assay (NO) levels, as well as by raising levels of the natural antioxidant Glutathione assay (GSH) in rats.

6. Technological Application of Meyna Fruit

Some authors have already used WEP fruits for the formulation of food products. For example, Dhodade and co-workers (2019) used the fruit of Aliv (*Meyna laxiflora* Robyns) for the production of jam. The authors showed that the aliv jam has maximum consumer acceptance, probably due to its high antioxidant activity, taste, and sensory properties. Chothe et al. (2014) noted that the tribal people

consume wild fruit resources such as Bhokar, Kakad, Aliv, and Pendhra. The author used their own processing methods for the preservation of fruits for example salting, drying, and pickle making. Sometimes these preserved products may spoil because of unhygienic conditions. Four types of fruits were used for pickle preparation and one fruit of Aliv was used for the drying method and then prepared pickle by using fenugreek seed, mustard seeds, red chili powder, salt, asafoetida, oil, turmeric powder, and other spices. The author processed this fruit because of additional benefit to local people for strengthening the tribal economy and leading to new plantations. Singh, P. K., & Devi, M. H. (2015) stated that Meyna plant is a priority for commercialization and conservation because its wild, cultivated, in high demand and has habits as a tree.

Fruits are not only consumed as fresh but are also processed in the form of valuable and consumable food products by advanced technology. As per WEP fruits way, it is very economical to preserve seasonal fruits to prepare different products such as jam, purees, and squash from the pulp. So, the technological application of *Meyna laxiflora* Robyns is a way to establish the orchard and green economy.

7. Conclusion

The present review paper is the first study and documentation of food essential of the traditional wild edible fruit Alu, which is eaten by tribal communities in Maharashtra, India. The present study presented the diversity of WEF and indigenous knowledge in this area. Native fruits play a valuable role in the nutrition of people and children mainly in rural and tribal communities. The wild Alu fruit is an excellent source of carbohydrates, proteins, vitamins, fibers and minerals and has enormous medicinal potential. Alu fruit from forests also contains a source of protein and energy. The production and utilization of Alu fruit in arid areas supply dietary supplements as well as commercial possibilities. The growing of trees for fruit production encourages the obstruction of permanent stands in bares land. Such trees are often a feature of desert landscapes and form the basis of traditional agroforestry land use systems. Wild edible Alu fruit is supplied as food and nutrients, which are

required to keep healthy and enhance immunity against diseases, infections other disorders in local communities. If properly produced, Wild edible Alu fruit could be a source of cash income for local people. The present study may provide valuable information for priority list preparation for domestication, conservation, possibly further exploitation, and processing of products and will preserve local traditional knowledge.

Data availability

I ensure that this review study data and materials integral to the papers are available to readers.

NOTE:

The study highlights the efficacy of "ayurveda" which is an ancient tradition, used in some parts of India. This ancient concept should be carefully evaluated in the light of modern medical science and can be utilized partially if found suitable.

References

1. Beluhan, S., & Ranogajec, A. 2011. Chemical composition and non-volatile components of Croatian wild edible mushrooms. *Food chemistry* 124(3):1076-1082.
2. Lulekal, E., Asfaw, Z., Kelbessa, E., & Van Damme, P. 2011. Wild edible plants in Ethiopia: a review on their potential to combat food insecurity. *Afrika focus* 24(2):71-122.
3. Singh, H. B., & Arora, R. K. 1978. Wild edible plants of India.
4. Heywood, V. H. 2011. Ethnopharmacology, food production, nutrition and biodiversity conservation: towards a sustainable future for indigenous peoples. *Journal of ethnopharmacology* 137(1):1-15
5. Kunkel, G. 1984. Plants for human consumption. Koeltz Scientific Books. Koenigstein, Germany (Vol. 39176).
6. Sundriyal, M., & Sundriyal, R. C. 2004. Wild edible plants of the Sikkim Himalaya: Nutritive values of selected species. *Economic Botany* 58(2):286-299.
7. Khyade, M. S., Kolhe, S. R., & Deshmukh, B. S. 2009. Wild edible plants used by the tribes of Akole Tahasil of Ahmednagar District (Ms), India. *Ethnobotanical leaflets* 10:12.
8. Mahapatra, A. K., & Panda, P. C. 2012. Wild edible fruit diversity and its significance in the livelihood of indigenous tribals: Evidence from eastern India. *Food Security* 4:219-234.
9. Konsam, S., Thongam, B., & Handique, A. K. 2016. Assessment of wild leafy vegetables traditionally consumed by the ethnic communities of Manipur, northeast India. *Journal of ethnobiology and ethnomedicine* 12:1-15.
10. Datar, R., & Vartak, V. D. 1975. Enumeration of wild edible plants from Karnala Bird Sanctuary, Maharashtra state. *Biovigyana* 1:123-129.
11. Vartak, V. D. 1981. Observations on wild edible plants from hilly regions of Maharashtra and Goa: resume and future prospects. Glimpses of Indian Ethnobotany. *Oxford & IBH, New Delhi* 261-271

12. Gunjatkar, N., & Vartak, V. D. 1982. Enumeration of wild legumes from Pune district, Maharashtra. *Journal of Economic and taxonomic botany* 3:1-9.
13. Gunjatkar, N. 1985. Studies on wild edible plants from Western Maharashtra and Goa. PhD thesis, University of Poona, Pune. http://hdl.handle.net/10603/169517.
14. Vartak, V. D., & Suryanarayana, M. C. 1995. Enumeration of wild edible plants from Susala Island, Mulshi reservoir, Pune district. *Journal of Economic and Taxonomic Botany* 19:555-569.
15. Patil, M. V., & Patil, D. A. 2000. Some more wild edible plants of Nasik district (Maharashtra). *Ancient science of life* 19(3-4):102.
16. Varsha, M.S.J. 2013. Traditional uses of some wild edible plants from Kolhapur district. *Life Sciences Leaflets* 39:19-26.
17. Yuhlung, C. C., & Bhattacharyya, M. 2014. Practice of ethno-medicine among the Chothe tribe of Manipur, North-East India. *Int J Pharm Biol Arch.* 5(3):138-149.
18. Mulay, J. R., & Sharma, P. P. 2014. Some underutilized plant resources as a source of food from Ahmednagar district, Maharashtra, India. *Discovery* 9 (23):58-64.
19. Reddy, K. N., Pattanaik, C., Reddy, C. S., & Raju, V. S. 2007. Traditional knowledge on wild food plants in Andhra Pradesh. *Indian Journal of Traditional Knowledge* 6(1):223-229.
20. Mishra, S. N., Tomar, P. C., & Lakra, N. 2007. Medicinal and food value of Capparis—a harsh terrain plant. *Indian Journal of Traditional Knowledge* 6(1):230-238. http://nopr.niscpr.res.in/handle/123456789/911.
21. Deshmukh, B. S., & Vidya, S. 2010. Fruits in the wilderness: a potential of local food resource. *International Journal of Pharma and Bio Sciences* 1(2).
22. Nahar, N., Rahman, S., & Mosihuzzaman, M. 1990. Analysis of carbohydrates in seven edible fruits of Bangladesh. *Journal of the Science of Food and Agriculture* 51(2):185-192.
23. Kumbhojkar, M. S., & Vartak, V. D. 1988. Ethno botanical studies on wild edible grapes from sacred groves in Western Maharashtra. *J. Econ. Tax. Bot.* 12(2):257-263.

24. Natarajan, B., & Paulsen, B. S. 2000. An ethnopharmacological study from Thane district, Maharashtra, India: Traditional knowledge compared with modern biological science. *Pharmaceutical Biology* 38(2):139-151.
25. Deshmukh, B. S., & Waghmode, A. 2011. Role of wild edible fruits as a food resource: Traditional knowledge. *International Journal of Pharmacy & Life Sciences* 2(7).
26. The Wealth of India. Vol VI (L-M). New Delhi, CSIR. 2007/2009.
27. Bhandole, A. B., & Kakrani, H. N. 2022. Traditional herbal plant useful for treatment of inflammatory bowel disease. *International Journal of Modern Pharmaceutical Research* 7(1):53-60. https://doi.org/10.30574/wjbphs.2022.12.3.0236.
28. Kritikar, K. R., & Basu, B. D. 1999. Indian Medicinal Plants. Vol 1. International Book Distributors.
29. Satpute, S. V., Sinkar, S. R., & Sarode, A. M. 2021. Wild edible fruit plants and their use by tribal people and local villagers: A survey-based study. *Int. Res. J. of Science & Engineering* A11:256-262.
30. Patil, D. A. 2003. Flora of Dhule and Nandurbar Districts (Maharashtra). M/S Bishen Singh Mahendra Pal Singh.
31. Nayar, T. S., Sibi, M., & Rasiya Beegam, R. 2014. Flowering Plants of The Western Ghats, India Jawaharlal Nehru Tropical Botanical Garden and Research Institute, St. Joseph's Press, Thiruvananthapuram. Vol, 1&2.
32. Kanade, R., Tadwalkar, M., Kushalappa, C., & Patwardhan, A. 2008. Vegetation composition and woody species diversity at Chandoli National Park, northern Western Ghats, India. *Current Science* 95(5):637-646.
33. Ghosh, S., Jana, M., Duary, J., Das, B. R., & Bhaumik, S. 2021. Floristic study of perennial flora and ethnomedicinal uses in annual ground fire affected part of dry deciduous forest, Godapiyasal Paschim Medinipur, West Bengal, India. *The Journal of Phytopharmacology* 10(6):484-489.

34. Singh, P. K., & Devi, M. H. 2015. Plants associated with Singju: a traditional salad delicacy of Meitei community of Manipur, India. © East Himalayan Society for Spermatophyte Taxonomy, ISSN: 0973-9467. *Pleione* 9(2):409 - 418.

35. Panda,S.P, Mohapatra, S. K, Jani, C, Sahu, A.K, Swain, K.K and Biswal, M. 2014. Extended Range of Distribution of Meyna laxiflora Robyns (Rubiaceae) from the Bhitarkanika National Park, Odisha, India. *International Journal of Innovative and Applied Research* 2(5):6 – 9. http://www.journalijiar.com/uploads/2014-05-29_154523_218.pdf.

36. Majaz, A. Q., & Khurshid, I. M. 2014. Preliminary phytochemical evaluation of leaves from Meyna laxiflora. *International Research Journal of Pharmacy* 5(9):676-678.

37. Gokulapriya V. 2017. Nutritional analysis and germination techniques of some edible fruit plants from northern western ghats with special emphasis on Kolhapur district. Indian science academic. https://edu.authorcafe.com/academies/6597/nutritional-analysis-and-germination-techniques-of-some-edible-fruit-plants-from-northern-western-ghats-with-special-emphasis-on-kolhapur-district

38. Janarthanan. L, Venkateswarlu B.S. 2018. Pharmacognostical, physicochemical investigations and phytochemicals of seeds of *Meyna laxiflora Robyns*. *Int. J. of Res. in Pharmacology &Pharmacotherapeutics* 7(4):455-465. https://ijrpp.com/ijrpp/article/download/199/206/.

39. e-Flora of India. 2011. Database of plant of India subcontinent developed by the members of e-Flora of India google group. efloraofindia.com/2011/03/13/meyna-laxiflora/. Efloraofindia Google Group. https://sites.google.com/site/efloraofindia/species/m---z/r/rubiaceae/meyna/meyna-laxiflora

40. Sanglakpam, P., Mathur, R. R., & Pandey, A. K. 2012. Ethnobotany of chothe tribe of Bishnupur district (Manipur). *Indian Journal of Natural Products and Resources* 3(3):414-425. http://nopr.niscpr.res.in/handle/123456789/14824

41. Singh, S. R., Phurailatpam, A. K., Wangchu, L., Ngangbam, P., & Chanu, T. M. 2014a. Traditional medicinal knowledge of underutilized minor fruits as medicine in Manipur. *International Journal of Agricultural Science* 4(8):241-247.
42. Valvi, S. R., & Rathod, V. S. 2011a. Mineral composition of some wild edible fruits from Kolhapur district. *International Journal of applied biology and Pharmaceutical technology* 2(1): 392-396.
43. Rathod, V. S., & Valvi, S. R. 2011. Antinutritional factors of some wild edible fruits from Kolhapur district. *Recent Research in Science and Technology* 3(5):68-72.
44. Rymbai, Heiplanmi; Mawlein, Joiedevivreson; Rymbai, Deimonmitre. 2022. Meyna Laxiflora Robyns a Potential Multipurpose Tree: An Underutilized Fruit and Medicinal Tree in Meghalaya. *Agri Journal World* 2(5). https://doi.org/10.6084/m9.figshare.20238237.v1.
45. Quazi, M. A., & Molvi, K. I. (2014). Ethnomedicinal survey of Meyna laxiflora in tribes of Akkalkuwa, Nandurbar District. *International Journal of Pharma and Bio Sciences*, *5*(3), 225-230.
46. Vartak, V. D., & Ghate, V. S. 1994. Alu-Meyna laxiflora Robyns a less known but promising wild fruit tree for tribal areas of Western Maharashtra. *Indian J.* 3:99-103.
47. Patil, D. A. 2012. Upliftment of Tribals of Dhule and Nandurbar Districts (Maharashtra, India). *Life Sciences Leaflets* 25:17-22. https://petsd.org/ojs/index.php/lifesciencesleaflets/article/view/276/244.
48. Singh, S. R., Phurailatpam, A. K., & Senjam, P. 2014b. Identification of plant use as natural herbal shampoo in Manipur. *African Journal of Traditional, Complementary and Alternative Medicines* 11(1):135-139.
49. Kamble, S. Y., More, T. N., Patil, S. R., Pawar, S. G., Bindurani, R., & Bodhankar, S. L. 2008. Plants used by the tribes of Northwest Maharashtra for the treatment of gastrointestinal disorders. *Indian Journal of Traditional Knowledge* 7(2):321-325. http://nopr.niscpr.res.in/handle/123456789/1594.

50. Patil, M. V., & Patil, D. A. 2001. Folk Medicine of Nasik District (Maharashtra), India. *Ancient Science of Life* 20(3):26.

51. Wangmo, S., Malpathak, N. P., & Deokule, S. S. 2009. Pharmacognostic study of Vangueria spinosa (Roxb.) Hook, an important medicinal drug. *J Renew Nat Res Bhutan*. 5:127-137.

52. Gogoi, J., & Sarma, P. K. 1997. Chemical investigation of Meyna laxiflora Robyns syn. Vangueria spinosa Hook. II. *Indian drugs* 34(10):610-611.

53. Chhetri, R. B. 2006. Trends in ethnodomestication of some wild plants in Meghalaya, Northeast India. *Indian Journal of Traditional Knowledge* 5(3):342-347. http://nopr.niscpr.res.in/handle/123456789/6920.

54. Qazi Majaz, A., & Molvi Khurshid, I. 2015. A comprehensive review on meyna Laxiflora robyns (rubiaceae). *Int. J. Pharm. Sci. Rev. Res.* 35:22-25.

55. Khare, C. P. 2008. Indian medicinal plants: an illustrated dictionary. Springer Science & Business Media. PP 412,696.

56. Bharali, P., Singh, B., & Sharma, C. L. 2016. Ethnomedicinal knowledge of Galo Tribe from Arunachal Pradesh, India. *Int J Curr Res Biosci Plant Biol.* 3(6):139-48

57. Purkayastha, J., Dutta, M., & Nath, S. C. 2007. Ethnomedicinal plants from Dibru-Saikhowa biosphere reserve, Assam. *Indian Journal of Traditional Knowledge* 6(3):477-480. http://nopr.niscpr.res.in/handle/123456789/983.

58. Patil, M. V., & Patil, D. A. 2000. Some more wild edible plants of Nasik district (Maharashtra). *Ancient science of life* 19(3-4):102.

59. Chatterjee, S. K., Bhattacharjee, I., & Chandra, G. 2011. Isolation and identification of bioactive antibacterial components in leaf extracts of Vangueria spinosa (Rubiaceae). *Asian Pacific journal of tropical medicine* 4(1):35-40.

60. Singh, N. K., Radhapiyari, W., Choudhury, M. A., Singh, T. B., Bonny, K., Devi, T. S., ... & Singh, N. R. 2015. Spectroscopic study of antioxidant property and trace elements of Meyna

spinosa Roxb. ex Link leaves. *Indian Journal of Natural Products and Resources* 6(1):51-55. 10.56042/ijnpr.v6i1.4768

61. Bag, G. C., Devi, P. G., & Bhaigyabati, T. H. 2016. Phytochemical screening and antioxidant activity of Meyna laxiflora species found in Imphal West District of Manipur. *Int J Pharm Sci. Rev Res.* 36(1):137-143.
62. Mali, S., & Borges, R. M. 2003. Phenolics, fibre, alkaloids, saponins, and cyanogenic glycosides in a seasonal cloud forest in India. *Biochemical Systematics and Ecology* 31(11):1221-1246.
63. Haripyaree, A., & Guneshwor, K. 2012. Original Article Total Antioxidant Capacity of Twenty Wild and Cultivated Fruits. Imphal, India. *Int J Agric Food Sci*. 2(4):146-148.
64. Bhamare, M., Shinde, V., Khalkar, K., Khandbahale, D., and Gaikwad, K. 2022. Nutritional profiling of wild edible fruits of Meyna laxiflora Robyns. *International Journal of Botany Studies* 7(2):368-373. https://www.botanyjournals.com/download/2411/7-2-49-241.pdf.
65. Ganesh, T., Saikat, S., Chakraborty, R., Suresh Kumar, S. V., Raghavendra, H. G., & Sevukarajan, M. 2010. In vitro antioxidant activity of Meyna laxiflora seeds. *Int J Chem Pharm Sci.* 1:5-8.
66. Airan, J. W., & Shah, S. V. 1942. The Fat from The Seeds of Vangueria Spinosa (No Rubiaceæ). *Current Science* 11(10):400-400.
67. Azam, M. M., Waris, A., Nahar, N. M. 2005. Prospects and potential of fatty acid methyl esters of some non-traditional seed oils for use as biodiesel in India. *Biomass and bioenergy* 29(4):293-302.
68. Sharma, Y. C., Singh, B., & Upadhyay, S. N. 2008. Advancements in development and characterization of biodiesel: A review. *Fuel* 87(12):2355-2373.
69. Valvi, S., Yesane, D. P., & Rathod, V. S. 2011b. Isolation of antioxidant enzymes from some wild edible fruits at mature and ripened stage rhizome. *Current Botany* 2(1).

70. Dhodade, P. N., Dhaygude, Y. P., Tiwari, A. K., & Birwatkar, V. R. 2019. Development of Jam from Under Exploited Fruit Aliv (Meyna laxiflora Robyns). *Int. J. Curr. Microbiol. App. Sci.* 8(3):1143-1152.

71. Chothe, A., Patil, S., & Kulkarni, D. K. 2014. Unconventional wild fruits and processing in tribal area of Jawhar, Thane District. *Bioscience discovery* 5(1):19-23.