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Nutritional profiling of wild edible fruits of *Meyna laxiflora* Robyns

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Abstract
The wild edible ripe and unripe fruit of *Meyna laxiflora* was analyzed for various proximate like moisture content (6.07±0.094)% for the ripe wild fruit flesh and (7.48±0.01)% for the unripe wild fruit flesh. The ash contain was high in the unripe fruit (0.55±0.02)% than the ripe (0.065±0.012)%. Ripe flesh protein content of *M. laxiflora* was high (3101±1.527) % as compared with in unripe fruit flesh was low (2403±1.154) %. The amount of reducing sugar in the ripe fruit was (3239±0.92)% and in the unripe fruit flesh was (1305±0.57)%. The Phenol content of the ripe fruit flesh of *M. laxiflora* was high (3219±0.95) % and the unripe fruit flesh was (2230±0.85)%. The total Ascorbic acid in the ripe fruit flesh was (82.6±0.28)% as in the unripe fruit flesh was (59.53±0.41)%. The Antioxidant potential in the ripe fruit IC50 value was (114.6±0.11)% & the unripe fruit flesh IC50 value was(110.6±0.25)%. Trace element's nutritive potential has been evaluated by using inductively coupled plasma optical emission spectrometry (ICP-OES). In this study, 12 minerals N, P, K, S, Br, Fe, Mn, Mg, Zn, Cu, Ca, Na have been determined in the unripe and the ripe fruit flesh. N, P,K, S contain in the unripe fruit (0.0843)% , (183.2)%, (784.1)%, (341.44)% than ripe fruit (0.0643)%, (133.2)%, (574.96)% ,(36.94)% respectively. Other trace element Zn, Na, Fe, Cu, B, in the unripe fruit flesh (2.57)%, (11.84)%, (17.5)%, (2.43)%, (1.01)% and in the ripe fruit flesh (1.74)%, (5.29)%, (13.3)%, (1.15)%, (0.33)%.

Keywords: wild edible fruit, nutritional analysis, mineral content, antioxidant activity

Introduction
The global increase in population needs parallel increase in food and sources of nutrition including macro, micronutrients content and antioxidant activity (Hegazy*et al*., 2013) [10]. A Number of tribal people are dependent on wild plants for the source of food and medicines. From ancient time many wild plants have served as alternative as staple food during the period of food shortage and have provided important supplements for nutritionally balanced diet (Kayabas*et al*., 2018) [13]. Wild edible fruits are one of the basic alternative source of income for tribal communities and chiefly used for domestication (Deshmukh and Waghmode, 2011; Sahoo*et al*., 2016) [8, 24]. Wild fruits plays very important role in full fill demand of different essential nutrients for normal healthy growth and development of human body. Many wild fruits are cheapest source of protein, carbohydrates, vitamins, minerals, dietary fibers, tannin, phenols, reducing sugars and contain various medicinally active phytochemicals (Mahapatra*etal*., 2012) [16]. It is necessary to mention that the wild edible fruits include relatively high quantities of nutritional essential elements like Fe, Cu, Ca, Mn etc. Besides their proximate properties like protein, carbohydrate, sugar etc. (Hegazy*et al*., 2013) [10]. Wild plant fruits include many natural antioxidants compounds such as carotenoids, vitamins, phenols, tannins, flavonoids and many secondary metabolites; which have been found as a free radical or active oxygen scavengers (Zheng and Wang, 2001) [36].

Botanical Description: *Meyna laxiflora* Robyns (Rubiacae), Shrub or small tree, 3-10 meter tall, armed with thorns, 2.0-2.5 cm longer. Leaves 5.0-12.5 cm, elliptical, ovate or ovate- lanceolate, shining, apex acute, base cunate tapering in to 0.6-2.5 cm long petiole. Flowers greenish yellow, in axillary clusters calyx cup shaped teeth triangular, acute, corolla tube hairy at throat within. Drupes 2.5cm across, fleshy, chocolate colour when ripe, edible seed 5-6. Flowers and fruits March to June. (Flora of Maharashtra, Almeida M.R., 2003) [1].

Distribution: It is spread in tropical and subtropical region all over the globe. (CSIR. The Wealth of India. Vol. VI (L-M). New Delhi, CSIR; 2009.) In India it is available in Assam, Bengal, Konkan, Deccan etc. (Kritikarand Basu 1999) [14]. Indian medicinal plants. Vol. -I, 2nd edition. Dehradun: International Book Distributors; 1999). It is available on large scale throughout Satpuda region chiefly in Sawarimal, Umarpata, Morkaranja and Kondaibari villages of Nandurbar districtand Nashik district. (Quazi*et al*., 2014) [23].

Ethanomedicinal Importance of Meynalaxiflora
Root: The root paste is used for treatment of painful urination. (Wangmo*et al*., 2009) [33].

Bark: The stem bark paste is used as a cure for boils (Wangmo*et al*., 2009) [33].

Leaves: The tribe such as Pawara, Bhil, Tadavi and Vanjara of Satpuda uses foilage as food (Patil andpatil , 2005 ; Deshmukh*et al*.,2011) [20, 8]. The tribe called Chothe of Bishnupur and Chandel districts of Manipur uses fresh leaves as chutney time to time to enhance blood purification and skin texture and fruits for constipation (Yuhlung*et al*.,2014; Purbashree*et al*.,2012) [35, 22]. Throughout India leaves are used for treatment of diphtheria, dysentery and indigestion and for removal of worms and the seed powder is used as a narcotic (Wangmo*et al*, 2009) [33]. Tribes of Nashik district use leaves for goiter or swellings by making smear of fresh leaves with coconut oil by slight heating (Patil and patil2005) [20]. In North West Maharashtra people use leaves for abdominal distention (Kamble *et al*., 2008) [12].

Fruit: The tribal community in Western Ghats region of Maharashtra use young fruits as vegetable. Ripe fruits consumed as a food and dried fruits as narcotic and anti-dysentery (Deshmukh*et al*., 2011) [8]. The people of Golghat district of Assam use fruits for anti-fertility activity (Barikial*etal*, 2011) [3]. The tribes of Khasi Garo and Jaintia hills of Meghalaya use fruit mainly as food and rarely in brewing of wine (Chhetri R.B., 2006) [7].

Seed: Seed powder, five pinches, is mixed with water and given twice a day for around 15 days for kidney stone in Nashik district (Patiland patil, 2005) [20]. The tribes found in Tinsukia district of Assam use seed powder with water as Abortifacient (Buragohain, 2008) [6]. However there is no specific report about the nutritional potential of wild edible fruits of *Meyna laxiflora* from the study area. That's why, the study was undertaken.

Materials and Methods

a. Plant material collection and Authentication

Several field trips were undertaken in tribal areas of Western Gnats regions of Maharashtra, mainly Salher Fort, Nashik district, Maharashtra, at each time different season was chosen to collect the information about the study material. Plant specimen were collected and identified with regional plant life of Almieda 2003. We have collected wild fruits unripe and ripe from study area for further research study.

Methods

Analysis of samples: All samples were cleaned thoroughly to remove any attached soil and other impurities and were blotted dry. For analyzing the nutrient parameters various standard methods as mentioned below were followed.

Estimation of Ash: Sample, each of 5 gm, was weighed in a silica crucible and heated in muffle furnace for about 5-6 h at 500 °C. Further, it was cooled in desiccators and weighted. Again it was heated in the furnace for half an hour. Cooled and weighed. Constantly, this was repeated till the weight became (Ash became white or grayish white) Weight of Ash gave the ash content (Vanessa *et al*., 2016; Ping*et al*., 2016) [30, 21].

Estimation of Moisture: Sample each of 2 gm was taken in flat bottom dish and kept overnight in an air oven at 100-110 °C and weighed. The weight loss was regarded as a measure of moisture content (Vanessa *et al*., 2016; Ping *et al*., 2016) [30, 21].

Reducing Sugar (RS): Using Dinitrosalicylic acid (DNS) reagent RS was estimated (Miller, 1972) [18]. DNS reagent of 3 ml was added to 3 mL of sample in a lightly capped test tube. The mixture was heated at 90º C for 5-15 minutes to get a red brown color. Thereafter, to stabilize the colour, 1 mL of Rochelle's salt solution was added. On cooling to room temperature in cold water bath, absorbance was recorded at 575 nm.

Protein: Protein was estimated using the method of Lowery – folin phenol reagent method and Ping *et al* (2016) [21].

Phenol: Phenol was estimated following the method of Swain and Hills (1959) [27] and Basak*et al.* (1996) [4].

Ascorbic acid: Ascorbic acid was estimated using titration method developed by Vasanth Kumar *etal*, (2013) [31].

Antioxidant Activity: Using DPPH assay, the free radical scavenging capacity of the aqueous and methanol extracts of fruit of *M. laxiflora* was determined. DPPH solution (0.004% w/v) was made in methanol. Using methanol, Stock solution (1mg/ml) of each extracts and standard ascorbic acid (0.5mg/ml) were prepared. Different concentrations (100µg/ml) of the extracts and ascorbic acid were taken in test tubes and 1ml of freshly prepared DPPH solution was added. With aluminum foil covering, the test tubes were protected from the light. The final volume in each test tube was made to 2ml with methanol and incubated at room temperature, in dark for 30 minutes. After incubation process, using a spectrophotometer, the absorbance was read at 517nm (UV-2700). Control sample was made containing the same volume of methanol and DPPH without any extract and reference ascorbic acid. Methanol was served as blank (Hegazy*et al*., 2013) [10].
Calculated by using the following equation:

% scavenging effect = [(ADPPH − AS) / ADPPH] × 100

Mineral Analysis

Reagents and chemicals

Analytical reagents-grade chemicals were used while making all solutions. All the plastic and glasswares were cleaned by soaking in dilute nitric acid (1 + 9) and were rinsed with distilled water before using. Nitric acid (65%) and hydrogen peroxide (30%) were provided by Merck (India) (Vel*et al*., 2014) [32].

Sample preparation

The samples were made using microwave digestion method (Model: ETHOS One, Make – Milestone). In microwave digestion system, the samples of approximately 1.0 gm were digested with 6 ml of HNO_3 and 2 ml of H_2O_2. The samples and acid mixture were kept in suitably inert polymeric microwave vessels. The vessel was sealed and heated in the microwave digestion system. The temperature program was as follows: 2 min for 400 w, 6 min for 400 w, 5 min for 400 w, 8 min for 800 w and 8 min for vent. The emerging solutions were cooled and diluted to 10 ml with distilled water. The metal contents determination in this clear solution was carried out by inductively coupled plasmaoptical emission spectrometry (ICP-OES). (Vel *et al*, 2014) [32].

ICP-OES (Inductively Coupled Plasma-Optical Emission Spectrometry) Analysis of Samples: In triplicates, all samples were analyzed by ICP-OES Perkin-Elmer; model Optima™ 2000 DV, using winLab32 software for the analysis. The analytical measurements were carried out with a simultaneous Perkin–Elmer ICP OES, model optima 2000DV, winLab32™, version 7.0 software equipped with a peristaltic pump, a cross-flow nebulizer (coupled to a ryton double pass spray chamber) and a ceramic central torch tube injector with an internal diameter of 2 mm. (Vel*et al*.,2014)[32].

Analysis of certified reference material (CRM) of Minerals and calibration: ICP multi element standard solution Aliquots (10 to 50 mg/L Merck) containing the elements such as (N, P, K, S, Br, Fe, Mn, Mg, Zn, Cu, Ca and Na) were used in the making of calibration solutions. Working standard solutions were made by dilution of the stock standard solutions to expected concentration in 1% HNO3. The ranges of the calibration curves (5 points) were chosen to match the desired concentrations for all the elements of the sample taken for study by ICP-OES. The correlation coefficient r^2 obtained for all cases was 0.9999.

Result and Discussion

The research findings related to the following parameters are given in Table 1 and 2.

Proximate analysis: According to our results related to the nutrient composition of the ripe or developed and the unripe or non-developed flesh of *M. laxiflora.* The chief component was moisture: (6.07±0.094) % for the ripe flesh and (7.48±0.01) % for the unripe flesh (Table 1). In our study, the moisture content of the ripe or developed flesh of *M. laxiflora* was lower than the unripe fruit. Moisture content of food is an index of water activity that shows the stability and susceptibility to microbial contamination. Moisture content of food is an index of water activity, that indicates the stability and susceptibility to microbial contamination, thus potentially short life (Osabor*et al*., 2008) [19]. The Ash contain was high in the unripe fruit (0.55±0.02) % than the ripe (0.065±0.012) %. In another studies resulted that higher amount of mineral ash present in seed kernel of wild edible *Prunus persica* (Maikhuri*et al*., 2021) [17].The amount of reducing sugar was higher in the ripe or developed fruit (3239±0.92) % than lower in the unripe fruit flesh (1305±0.57)%. In another *Prinsepia utilis* wild fruit seed kernel showed higher amount of carbohydrates and fibers (Maikhuri*et al*., 2021) [17]. The protein content of the ripe flesh of *M. laxiflora* was high (3101±1.527) % as compared with in the unripe fruit flesh was low (2403±1.154) %, respectively (Table 1). Moreover, the protein content in the ripe flesh of *M. laxiflora* was also relatively higher than that in the flesh of some local fruits such as durian (2.7%), Mangos teen (0.6%), papaya (0.5%), mango (2.1%), pineapple (0.5%) and Rambutan (0.7%) (Tee *et al*., 1997) [28]. In another studies noted that highest amount of proteins & amino acids were found in *Parkia biglobosa* & *Adansonia digitata* dry wild fruits (Bayang*et al.*, 2021) [5]. The Phenol content of the ripe flesh of *M. laxiflora* was high (3219±0.95) % as compared with in the unripe fruit flesh was low (2230±0.85) %, (Table 1). The total Ascorbic acid contain was found highest in the ripe fruit flesh (82.6±0.28) % as compared with in the unripe fruit flesh was (59.53±0.41) % (Table 1). In *M. laxiflora* ripe fruit flesh the IC50 value was higher (114.6±0.11) % than the unripe fruit flesh IC50 value was (110.6±0.25) %. The Antioxidant activity percentage in our analysis was the highest were compared with analysis of methanolic seed extract of *M. laxiflora* were IC50 values(84.2 ± 2.1)% , (91.0 ± 3.0)%, and (104.5 ± 3.4)% µg/ml for DPPH, H2O2, and NO radical scavenging method respectively reported by (Ganesh *et al*.,2010)[9] & leaf, fruit pulp, seeds methanolic and aqueous extract of *M. laxiflora* showed antioxidant activity(34.95 ± 0.02)%, (60.75 ± 0.05)%, (37 ± 0.1) %, (77.4 ± 0.05)%, (35.4 ± 0.1) %, (44.1 ± 0.09)% respectively (Bag *et al*.,2016) [2]. These values compared with our values showed higher antioxidant activity (Table 1). Vitamin C is known to have high antioxidant activity (Xu and Chang, 2008) [34]. Most of the phenolic compounds show extensive range of biological effects noted by Simonetti *et al*. 2001[26]. As per the report by Kumari and Kakkar (2008) [15], the synthetic antioxidants were found harmful to health while most of

the natural antioxidants from plant sources established themselves to be safer for health and possess better biological activities.

Mineral Analysis: Minerals composition of fruit flesh of *M. laxiflora* shown in Table 2. The present study carried out on mineral content analysis like N, P, K, Ca, Mg, Zn, Na, Fe, Mn, Cu and B were analyzed in unripe and ripe fruit flesh of *M. laxiflora.* The main macronutrients N, P, K and S contain were more in unripe fruit (0.0843)% , (183.2)%, (784.1)% and (341.44)% than ripe fruit (0.0643)%, (133.2)%, (574.96)% and (36.94)% respectively (Table 2). The Phosphorus content in fruit flesh in our result was higher (183.2)% as compared with (0.15 ± 0.004)% result obtained to (Sharat*et al*.,2015)[25]. The total amount of Ca present more in ripe fruit (80.32)% than unripe fruit (76.95)%. Amount of Mg present in unripe and ripe M. *laxiflora.* fruit flesh was higher (228.6)%, (208.6)% than Magnesium content in fruit pulp (99.5 ± 0.90)% to (Sharat*et al*.,2015) [25] (Table 2). Other trace element Zn, Na, Fe, Cu and B, were found in high amount in unripe fruit flesh (2.57)%, (11.84)%, (17.5)%, (2.43)% and (1.01)% and in ripe fruit flesh showed lower amount (1.74)%, (5.29)%, (13.3)%, (1.15)% and (0.33)%. (Table 2).The amount of Mn content high in ripe fruit flesh (1.15)% than low in unripe fruit of *M. laxiflora (*0.77)%.(Table 2).

Table 1: Nutrient composition comparison (mg·100 g–1 fresh weight) of ripe and unripe flesh of *Meyna laxiflora*

Plant Name	Maturation	Moisture content	Ash	Reducing Sugar	Protein	Phenol	Ascorbic acid	Antioxidant Activity
Meynalaxiflora	Unripe	7.48±0.01	0.55±0.02	1305±0.57	2403±1.154	2230±0.85	59.53±0.41	110.6±0.25
	Ripe	6.07±0.094	0.065±0.012	3239±0.92	3101±1.527	3219±0.95	82.6±0.28	114.6±0.11

Results are mean of triplicate ± standard deviation.

Table 2: Minerals composition comparison (mg·100 g–1 fresh weight) of ripe and unripe flesh of *Meyna laxiflora*

Plant Name	Maturation	N	P	K	S	Ca	Mg	Zn	Na	Fe	Mn	Cu	B
Meynalaxiflora	Unripe	0.0843	183.2	784.13	41.44	76.95	228.6	2.57	11.84	17.5	0.77	2.43	1.01
	Ripe	0.0643	133.2	574.96	36.94	80.32	208.6	1.74	5.29	13.3	1.15	1.07	0.33

Conclusion

The present study highlights that the wild edible ripe and unripe fruit of *Meyna laxiflora* Salher Fort, Nashik district, Maharashtra, were rich source of various diet supplementary factors like protein, reducing sugars, phenol, ascorbic acid, antioxidants and minerals analysis. These supplementary factors and minerals are required for normal body metabolism which helps in normal growth and development of human being. The extensive consumption of unripe and ripe fruit of *Meyna laxiflora* which in turn can lead to reduced health costs, prevention and cure of a number of prevalent diseases, and an improved diet. Simultaneously, the population can be made aware of the consumption values of these plants as a staple food owing to their good nutritional qualities and adequate protection can be obtained against disease arising from malnutrition.

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