

Antioxidant potential of some lesser known wild edible fruits of Odisha

Jyotimayee Nayak and Uday Chand Basak*

*Seed Bank & Seed Biology Division, Regional Plant Resource Centre, R&D Institute of Forest and Environment
Department, Govt of Odisha, Bhubaneswar, Odisha, India*

ABSTRACT

Wild edible fruits can be considered as nutraceuticals as they provide a wide range of necessary supplement including a variety of antioxidant compounds apart from its nutritional value. Though not so popular, wild fruits like *Antidesma acidum*, *Artocarpus lacucha*, *Bridelia retusa*, *Carmona retusa*, *Carissa spinarum*, *Melastoma malabathricum* and *Streblus asper* are mainly consumed by tribal, forest dwellers and rural people of Odisha. In spite of their several nutritional and medicinal properties, adequate literature and scientific evidences regarding their importance is still lacking. Hence this study has been undertaken to determine antioxidant potentials in above mentioned wild fruits. Amongst all the fruits analyzed, fruits of *Melastoma malabathricum* was found to possess highest total antioxidant activity (FRAP) $5878.35 \pm 0.05 \mu\text{M AEAC/g dry wt.}$ and total phenolic content 1.92 g GAE/100 g whereas *Carissa spinarum* recorded best DPPH activity ($1013 \text{ mg AEAC/100g dry wt.}$) and highest carotenoid content 72.19 mg/100g . *Carmona retusa* possessed highest ascorbic acid content (285.71 mg/100g). In case of antioxidant enzymatic assays, *Melastoma malabathricum* yielded highest peroxidase activity i.e. $0.1 \Delta \text{ O.D / min / g fwt.}$ while *Bridelia retusa* possessed highest catalase activity ($3.5702 \pm 0.011 \text{ U/ml}$). In case of Superoxide Dismutase enzyme assay *Antidesma acidum* showed highest activity ($0.916 \Delta \text{ O.D / min / g tissue wt.}$). From all the given experimental data, it can be appraised that *Melastoma malabathricum*, *Carissa spinarum*, *Carmona retusa* and were the most promising fruits and these fruits required to be popularized as nutraceuticals.

Key words: Wild edible fruits, antioxidant, *Melastoma*, DPPH, Catalase

INTRODUCTION

Wild edible fruits can serve as functional foods due to presence of essential vitamins, minerals and fibres which can provide necessary dietary supplements and therapeutic usage. However the ethnomedicinal knowledge about these wild edible fruits is vanishing due to lack of proper documentation and scientific evidences. As a result, the usage of these wild fruits is limited to tribals, forest dwellers and villagers residing close to forests. In 21st century food and nutritional security are the key concerns worldwide due to its less availability and poor access in underdeveloped countries [1, 2]. Feeding in excess of 800 million undernourished people depends not only on increased productivity of the limited number of domesticated crops of the modern world but also the use of underutilized wild species [3]. The usage of non cultivated fruits especially wild fruits can cope with food shortage and thereby provide an important safety net for the rural people [4, 5].

Besides, providing nutritional appurtenance, these wild fruits also can serve as natural antioxidants. Synthetic antioxidants like butylated hydroxyl anisole (BHA), butylated hydroxyl toluene (BHT), tertiary butylated hydroquinone and gallic acid esters show low solubility and moderate antioxidant activity [6]. Hence, currently research has now been focused on isolation and characterization of natural antioxidants from plants [7, 8].

Natural antioxidants are basically of two types i.e. enzymatic and non-enzymatic antioxidants. Antioxidant enzymes include catalase (CAT), superoxide dismutase (SOD), peroxidase (POX), glutathione peroxidase, glutathione reductase, glucose-6-phosphate dehydrogenase and ascorbate oxidase etc. [9] while non-enzymatic antioxidants includes α -Tocopherol (vitamin E), Ascorbic acid (vitamin C), carotenoids, flavonoids and related polyphenols, α -lipoic acid, glutathione etc. which all together work in synergy to counterbalance oxidative stress [10].

The beneficial aspects of wild edible fruits had already been validated by tribals and rural people but there is no much concrete report regarding the antioxidant potential of wild edible fruits in Odisha, many of them remain undocumented, unexploited and understudied except very few of them [11,12]. Moreover, there is a continuous search for naturally derived antioxidants and recognition of fruits with high antioxidant activities. The present study had been undertaken to evaluate the antioxidant potentialities in comprehensively lesser known wild edible fruits species viz. *Antidesma acidum*, *Artocarpus lacucha*, *Bridelia retusa*, *Carmona retusa*, *Carissa spinarum*, *Melastoma malabathricum* and *Streblus asper* by using following parameters i.e. SOD, CAT, POX, DPPH, FRAP, Carotenoid, Phenol content, Ascorbic acid content.

MATERIALS AND METHODS

Specimen collection

A general account on 7 lesser known wild fruits is presented in Table 1. To evaluate the antioxidant properties present in these wild edible fruits, healthy and disinfected ripe fruits (edible stage) were collected from various forest reserves of Odisha during year 2013–14. Fruits were botanically identified with the help of Reference Book [13] and also compared with authentic herbarium specimens belonging to Regional Plant Resources Centre, Bhubaneswar, Odisha. These wild fruits were washed in running water and dried with tissue paper. Fruit samples used for estimation of Phenol, Carotenoid, Ascorbic acid content, POX, Catalase and SOD were kept at - 20°C until required for analysis. For total antioxidant content (DPPH and FRAP assays), fruit samples were cut into small pieces and dried at 55°C to 60°C in hot air oven [14]. After drying, the samples were ground in a mortar and pestle and stored in air tight container in cool and dark place until required.

Table 1: General account of 7 lesser known wild edible fruit plants and their ethno-medicinal uses

S. No.	Botanical Name (Local name)	Part Used	Ethnomedicinal Uses	References
1	<i>Antidesma acidum</i> (Murmuri)	Leaves	Leaves are eaten as vegetable and also preserved. Fruits are edible. Seeds yields fatty oil.	[15]
2	<i>Artocarpus lacucha</i> (Jeuta)	Fruit Pericarp of fruit	The lacucha fruits are generally eaten fresh. The edible fruit pulp is believed to acts as a tonic for the liver. The raw fruits and male flowers spikes (acidic and astringent) are utilized in pickles and chutneys.	[15]
			Pericarp of fruit showed antibacterial, antioxidant, anthelmintic and insecticidal properties.	[16]
			Pericarp extract showed anticarcinogenic activity, Pancreatic Lipase Inhibitory Activity and Cytotoxic Activity.	[17]
3	<i>Bridelia retusa</i> (Pani Kasi)	Leaf Stem bark	Paste of leaf and stem bark is used in treatment of wounds, skin diseases and fever. Fruits are edible.	[18] [20] [15]
4	<i>Carissa spinarum</i> (Khira koli)	Fruit	Ripe berries are eaten raw or as cooked preservatives.	[19]
5	<i>Carmona retusa</i> (Panamari)	Roots Leaf	Fresh roots are used as antidote.	[15]
			Decoction of leaves is used for cough and stomach troubles. Powder of leaves, unripened fruit and root is mixed the leaves of <i>Acacia nilotica</i> , <i>Piper betel</i> and seeds of <i>Areca catechu</i> and used to cure toothache and give strength to the teeth.	[18]
6	<i>Melastoma malabathricum</i> (Karati)	Fruits	Fruits yield a black or purple dye. Fruit is sweet and slightly astringent.	[19]
7	<i>Streblus asper</i> (Sahara)	Stem bark	Stem bark decoction is administered for diarrhoea and dysentery.	[20]

Determination of Total Phenolics

Phenol content was estimated following the method of [21] modified by [22]. Sample was prepared in 60% methanol and centrifuged at 5,000 rpm at 4°C for 30 minutes (Eppendorf cold Centrifuge, 5430 R). The supernatant was collected for phenol analysis. 0.1ml and 0.2 ml of sample extraction was added to 1ml of 0.1 N HCL and allowed to stand for few minutes. 1ml of sodium nitrite molybdate mixture was added and shaken well and allowed to stand for few minutes. 5ml of distilled water was added to test tube. After that 2ml of 1NaOH was added and allowed to stand for 5-20 minutes. Methanol was taken as blank reference and optical density (OD) was measured in UV-Vis spectrophotometer (Spekol 2000, Analytik Jena, Germany) at the wavelength 515 nm. A standard calibration curve was plotted using gallic acid (100-1000 µg/ml). The results were expressed as grams of gallic acid equivalents (GAE)/100 g.

Evaluation of antioxidant properties of fruits

Five different *in vitro* assays viz. Ferric reducing power assay, DPPH free radical scavenging activity, Peroxidase enzyme activity, Catalase enzyme activity, Superoxide dismutase enzyme activity, were used to evaluate the antioxidant potential of the different studied fruit samples.

Ferric reducing power assay (FRAP)

The ferric reducing antioxidant power (FRAP) assay provides a measure of the reducing ability of the fruit extracts. This method was established by [24]. Briefly, the FRAP reagent was freshly prepared by mixing 5 ml of a 10 mM 2,4,6-tris (1-pyridyl)- 5-triazine (TPTZ) solution in 40 mM HCl with 5 ml of 20 mM FeCl₃. 6H₂O and 50 ml of 0.3 M acetate buffer, pH 3.6. FRAP reagent should be pre-warmed at 37°C and should always be freshly prepared. The reaction mixture was prepared by mixing 100µL of test sample and 3mL of FRAP reagent and incubated at 37°C for 15minutes. After that, the optical density (OD) was recorded at 593 nm against a blank that was prepared using distilled water and FRAP. A calibration curve was prepared using an aqueous solution of ascorbic acid (100 µM to 1000 µM). FRAP values were expressed on dry weight basis as micromoles of ascorbic acid equivalent per gram of sample (µM AEAC/g dry wt.).

DPPH radical scavenging assay

The total antioxidant activity of the fruit extracts was estimated on the basis of the radical scavenging effect of the stable DPPH free radical as per the protocol of [23]. DPPH solution (0.006% w/v) was prepared in 95% methanol. Methanol fruit extracts (1 ml) were mixed with 2ml of DPPH solution, so that the final volume was 3 ml and discoloration was measured at 517 nm using UV-Vis Spectrophotometer (Spekol 2000, Analytik Jena, Germany) after incubation for 30 min in dark. In case of control, methanol was taken instead of the fruit sample. Ascorbic acid was used as a reference standard. DPPH values were expressed on dry weight basis as milligrams of ascorbic acid equivalent per 100 grams of sample (µM AEAC/100g dry wt.).

Peroxidase (POX) enzyme activity

Peroxidase activity was determined by the method of [25]. Enzyme extraction was done by grinding 0.5 gm. of fresh wild edible fruit sample in 5ml of phosphate buffer (pH 6.5) in pre-cooled mortar and pestle and centrifuged at 7500 rpm at 4°C for 30 minutes (Eppendorf cold Centrifuge, 5430 R). The supernatant was collected in eppendorf and stored at 4°C. To measure the peroxidase activity, a reaction mixture consisting of 3.5 ml 0.1 M phosphate buffer (pH 6.5), 0.2 ml of 0.1% Methanolic solutions of O-dianisidine and 0.5 ml sample extract were incubated in a water bath at a constant temperature of 28 °C for 10 min. Then 0.2 ml of 0.2 M hydrogen peroxide was added to the reaction mixture and the optical density (OD) was recorded at 530 nm in 1 min intervals up to 10 min with UV-Vis spectrophotometer (Spekol 2000, Analytik Jena, Germany). The enzyme activities were expressed in terms of an average increment in absorbance per minute per gram fresh weight (Δ O.D / min / g fwt)

Catalase (CAT) enzyme activity

The enzyme extract was prepared by grinding 0.5 gm. of fresh wild edible fruit sample in 5ml of phosphate buffer (pH 7) in pre-cooled mortar and pestle and centrifuged at 4000 rpm at 4°C for 15 minutes (Eppendorf cold Centrifuge, 5430 R). The supernatant was collected in eppendorf and stored at 4°C for Catalase enzyme assay which was done following the method of [26]. 3 ml of 50m M phosphate buffer (pH 7) was taken in clean test tube. 0.1 ml enzyme extract and 0.4 ml of 30% H₂O₂ was added to the test tube. The optical density (OD) was measured at 240 nm in 1 min interval up to 4min in UV-Vis spectrophotometer (Spekol 2000, Analytik Jena, Germany).

Calculation

Calculate the average decrement per min of the sample.

Activity can be calculated by using volume activity (U/ ml)

$$= (\Delta A_s - \Delta A_o) \times 3 \text{ ml} \times \text{dilution factor} / 0.0436 \times 2 \text{ ml} = \Delta A \times 3.4 \times \text{dilution factor}$$

Superoxide Dismutase (SOD) enzyme activity

Enzyme extract was prepared by grinding 0.2 g of plant fruit sample with the help of pre chilled mortar and pestle by adding 5 ml of phosphate buffer (pH 7.8). The crushed material was then centrifuged for 30 min at 7500 rpm at 4°C (Eppendorf cold Centrifuge, 5430 R). Supernatant was collected for SOD assay. The SOD activity was assayed by measuring its ability to inhibit the photochemical reduction of nitroblue tetrazolium (NBT) according to the method [27] with some modification by [28]. The reaction mixture (3 mL) contains 0.1M potassium phosphate buffer (pH 7.8) 13 mM methionine, 75 µM NBT, 0.1 mM EDTA, 100µM riboflavin and 0.1 mL of enzyme extract. Samples were illuminated using 40W fluorescent lamps for 10 min. The absorbance of reaction mixture was recorded at 560 nm using UV-Vis spectrophotometer (Spekol 2000, Analytik Jena, Germany). A non-irradiated reaction mixture was served as control. Identical solutions that were not illuminated served as blanks.

Determination of Carotenoid content

Carotenoid content was estimated following the method of [29]. Test fruit sample was prepared in 80% acetone and centrifuged at 5,000 rpm at 4°C for 20 minutes (Eppendorf cold Centrifuge, 5430 R). The supernatant was used for Carotenoid analysis by taking absorbance at 400 nm, 645 nm and 663 nm using UV-Vis spectrophotometer (Spekol 2000, Analytik Jena, Germany).

Calculation

The quantity of pigments was calculated by the formula

$$\text{Carotenoids} = [\text{OD}_{480} + 0.11 (\text{OD}_{663} - 0.638(\text{OD}_{645}))] \times 400$$

Determination of Ascorbic acid content

Ascorbic acid was estimated following the method of [30]. Sample extraction was done by grinding 0.5g of sample material in 6% oxalic acid solution followed by centrifugation at 3000 rpm for 10 mins. Transferred the aliquot and made up the volume to 100ml. 5ml of supernatant was added to 10ml of 0.6% oxalic acid solution and it was titrated against dye solution (standard indophenols solution) till pale pink colour was seen. Standardization of dye was done with standard ascorbic acid (1mg/ml). Total ascorbic content (mg/100g) of fruits is calculated by = (0.5mg/volume 1) × (volume 2/5ml) × (100ml/ wt. of the sample) × 100, where, volume 1 is burette reading of titration of dye against standard ascorbic acid and volume 2 is burette reading of titration of dye against sample.

RESULTS AND DISCUSSION**Phenols verses Total antioxidant activity**

Polyphenols are group of secondary metabolites that had been source of natural antioxidants in fruits, vegetables and other plants. Phenolic acid had also been recognised as a strong antioxidant against human Low Density Lipoprotein (LDL) oxidation [31]. From the analysis, the total phenolic content in fruits of *Melastoma malabathricum* was recorded highest 1.92 ± 0.001 g GAE/100g among studied fruits (Fig.1, Table 2). In a report, *A. ghaesembilla* was found to contain 5 fold more phenol content (1.22 ± 0.36 g GAE/100g) than the studied *Antidesma acidum* (0.24 ± 0.015 g GAE/100g) [34]. The high phenolic content may be a reason behind the usage of ripe fruits of *Antidesma* species for commercial fruit juice production and consumption [35].

Melastoma malabathricum showed highest total antioxidant activity (FRAP) i.e. $5878.35 \pm 0.05 \mu\text{M AEAC/g dry wt.}$ followed by *Carmona retusa* ($4215.72 \pm 0.02 \mu\text{M AEAC/g dry wt.}$), *Artocarpus lacucha* ($3954.63 \pm 0.35 \mu\text{M AEAC/g dry wt.}$), *Carissa spinarum* ($2118 \pm 1 \mu\text{M AEAC/g dry wt.}$) (Fig.2, Table 2). The above fruit species also recorded moreover similar trend in phenolic content i.e. 1.92 ± 0.001 g GAE/100g, 0.68 ± 0.02 g GAE/100g, 0.69 ± 0.01 g GAE/100g, 0.73 ± 0.01 g GAE/100g respectively, which suggests that plants with higher phenolic contents showed superior antioxidant capability and this fact was also reported by Oki et al. [36]

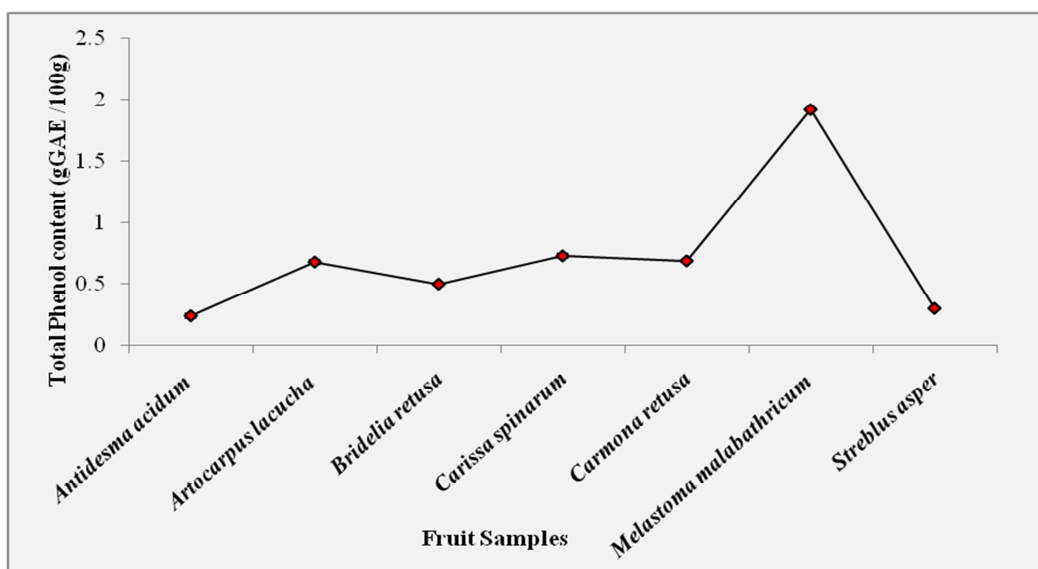


Fig 1: Total Phenol content of 7 wild edible fruits of Odisha

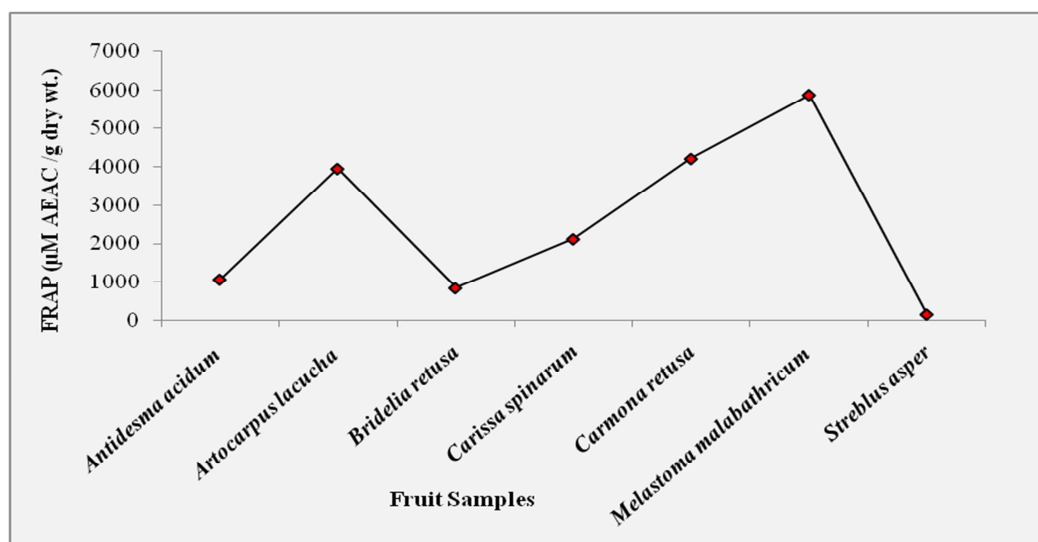


Fig 2: FRAP activity of 7 wild edible fruits of Odisha

Table 2: Total Phenol content and total antioxidant activity of 7 lesser known wild edible fruits of Odisha

Sl. No	Botanical Name	Total Phenol g GAE/100g	FRAP μM AEAC /g dry wt.	DPPH mg AEAC /100g dry wt.
1	<i>Antidesma acidum</i>	0.24 ± 0.015	1066.15±0.84	240.5±0.50
2	<i>Artocarpus lacucha</i>	0.68 ± 0.02	3954.64±0.35	82.85±1.70
3	<i>Bridelia retusa</i>	0.5 ± 0.01	842.64±0.35	50.64±0.35
4	<i>Carissa spinarum</i>	0.73 ± 0.015	2118±1.00	1013±2.00
5	<i>Carmona retusa</i>	0.69 ± 0.01	4215.72±0.02	389±1.00
6	<i>Melastoma malabathricum</i>	1.92 ± 0.001	5878.35±0.05	157.15±1.15
7	<i>Sireblus asper</i>	0.30 ± 0.01	153.09±1.62	273.5±0.5

Each value in the table was obtained by calculating the average of three determinants (n=3) and data are presented as Mean ± SD

The total antioxidant capacity determined by DPPH assay also revealed good free radical scavenging capacity of wild fruits, however there was wide variation in DPPH activity which ranged from 50.64 ± 0.35 mg AEAC /100g dry wt. in *Bridelia retusa* to 1013 ± 2.00 mg AEAC /100g dry wt. in *Carissa spinarum* (Fig.3). In the present study,

Carissa spinarum (1013 ± 2.00 mg AEAC /100g dry wt.) showed DPPH activity at par with *A. ghaesembilla* (1020.66 ± 3.21 mg AEAC /100g dry wt.) reported by [11]. Similarly, DPPH activity found in *Antidesma acidum* (240.50 ± 0.5 mg AEAC /100g dry wt.) corroborated with the activity found in *Morinda tinctoria* (235 ± 13.20 mg AEAC /100g dry wt.) [11].

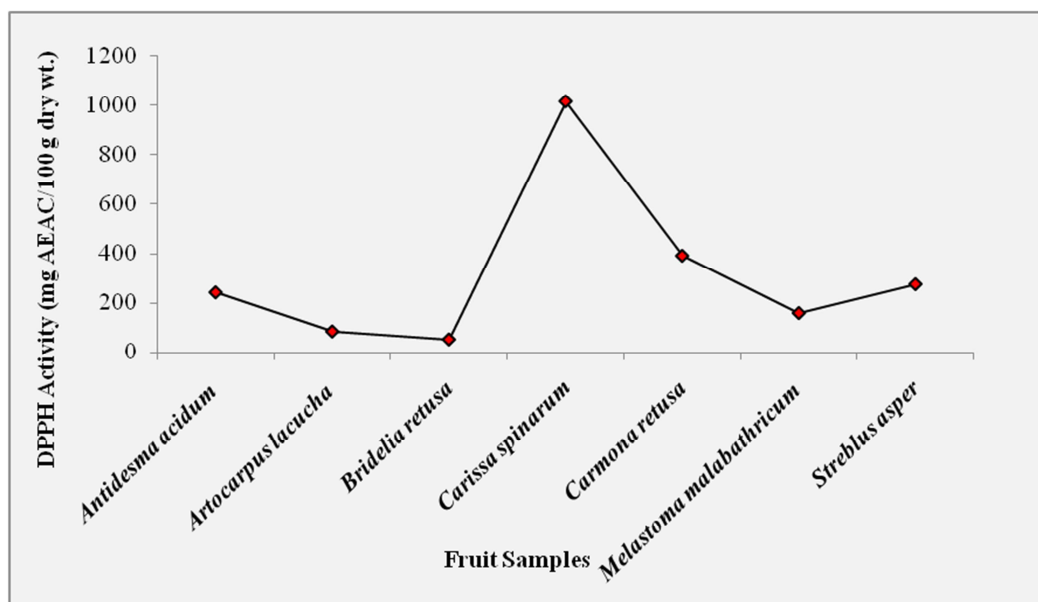


Fig 3: DPPH activity of 7 wild edible fruits of Odisha

Antioxidant Enzyme activities

Antioxidant enzymes viz. Peroxidase (POX), Catalase (CAT) and Superoxide Dismutase (SOD) showed considerable potentiality in their activities. *Melastoma malabathricum* showed highest POX activity ($0.10 \pm 0.0007 \Delta \text{O.D} / \text{min} / \text{g fwt}$) while *Carissa spinarum* showed minimal value ($0.001 \pm 0.0003 \Delta \text{OD} / \text{min} / \text{g fwt}$). Peroxidase activity in *Antidesma acidum* was $0.09 \pm 0.01 \Delta \text{OD} / \text{min} / \text{g fwt}$, followed by $0.05 \pm 0.0006 \Delta \text{OD} / \text{min} / \text{g fwt}$ in *Carmona retusa*, $0.023 \pm 0.0006 \Delta \text{OD} / \text{min} / \text{g fwt}$ in *Artocarpus lacucha*, $0.016 \pm 0.001 \Delta \text{OD} / \text{min} / \text{g fwt}$ in *Streblus asper* and $0.004 \pm 0.04 \Delta \text{OD} / \text{min} / \text{g fwt}$ in *Bridelia retusa* respectively (Fig.4, Table 3).

Catalase enzyme plays an important role in breaking down hydrogen peroxide into water and oxygen. Catalase activity was found highest in *Bridelia retusa* (3.5705 ± 0.01 U/ml) followed by *Antidesma acidum* (2.9701 ± 0.06 U/ml), *Carissa spinarum* (1.1119 ± 0.004 U/ml), *Melastoma malabathricum* (0.3732 ± 0.5 U/ml), *Artocarpus lacucha* (0.1538 ± 0.06 U/ml), *Carmona retusa* (0.1092 ± 0.5 U/ml) and *Streblus asper* (0.0207 ± 0.006 U/ml) (Fig.5, Table 3).

SOD catalyzes the breakdown of endogenous cytotoxic superoxide radicals to H_2O_2 which is further degraded by CAT. Thus, they play a crucial role in maintaining the physiological levels of O_2 and H_2O_2 [37]. In the present study, SOD enzyme activity in wild fruits ranged from $0.0536 \pm 0.004 \Delta \text{O.D} / \text{min} / \text{g tissue wt.}$ in *Artocarpus lacucha* to $0.916 \pm 0.001 \Delta \text{O.D} / \text{min} / \text{g tissue wt.}$ in *Antidesma acidum*. SOD activity in *Streblus asper* ($0.275 \pm 0.001 \Delta \text{O.D} / \text{min} / \text{g tissue wt.}$) was followed by *Carmona retusa* ($0.18 \pm 0.01 \Delta \text{O.D} / \text{min} / \text{g tissue wt.}$), *Carissa spinarum* ($0.151 \pm 0.001 \Delta \text{O.D} / \text{min} / \text{g tissue wt.}$), *Melastoma malabathricum* ($0.119 \pm 0.001 \Delta \text{O.D} / \text{min} / \text{g tissue wt.}$), *Artocarpus lacucha* ($0.053 \pm 0.004 \Delta \text{O.D} / \text{min} / \text{g tissue wt.}$) and *Bridelia retusa* ($0.004 \pm 0.001 \Delta \text{O.D} / \text{min} / \text{g tissue wt.}$) respectively (Fig.6, Table 3). Similar kind of work had been reported in various other wild fruit species earlier by [11, 12, 38 and 39].

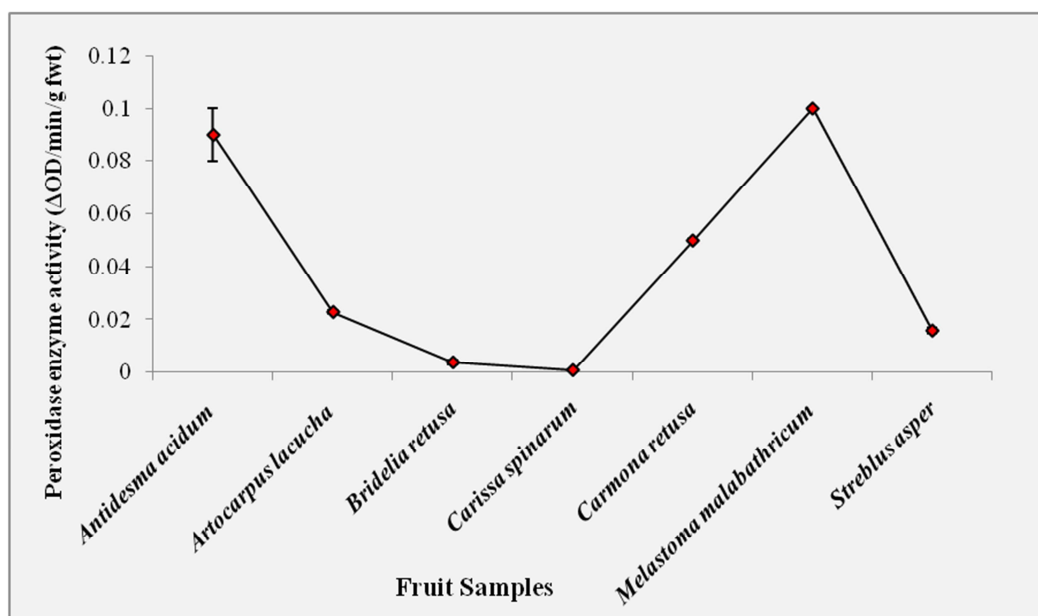


Fig 4: Peroxidase Enzyme activity of 7 wild edible fruits of Odisha

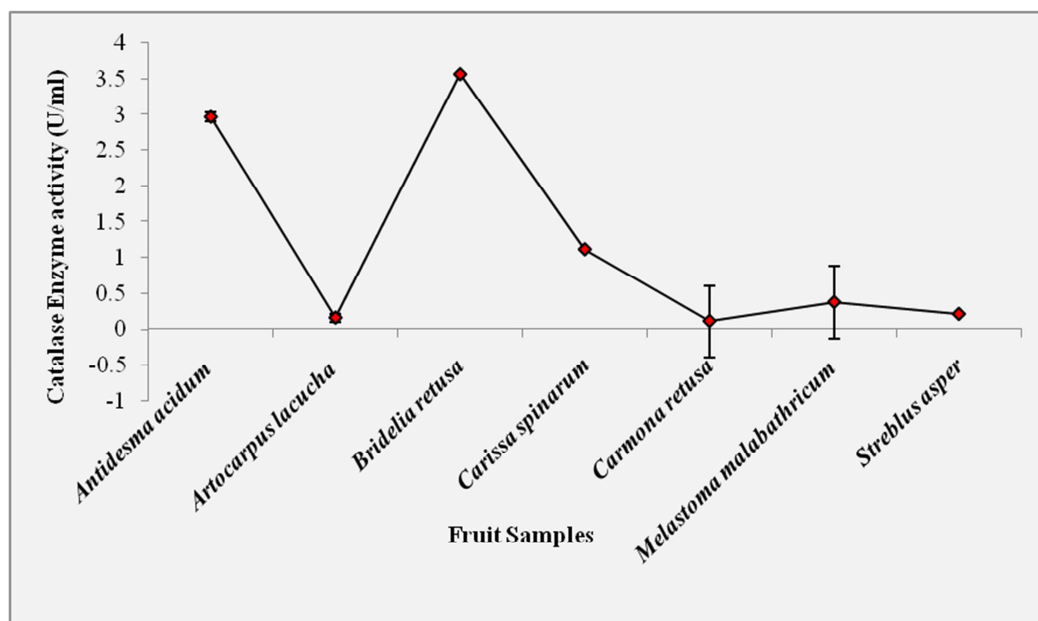


Fig 5: Catalase Enzyme activity of 7 wild edible fruits of Odisha

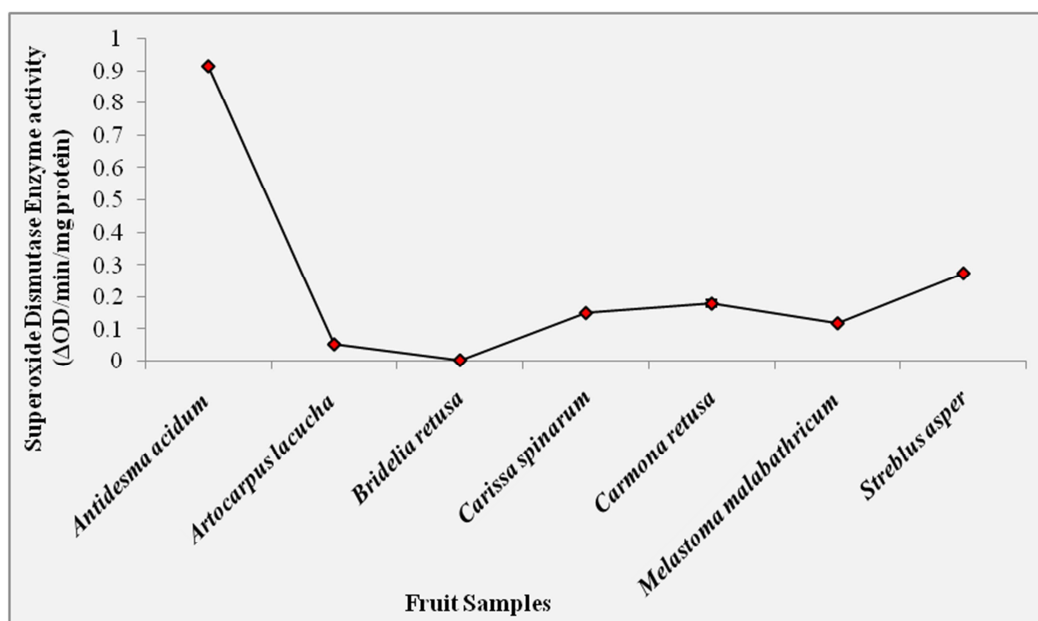


Fig 6: Superoxide Dismutase Enzyme activity of 7 wild edible fruits of Odisha

Table 3: Antioxidant enzyme activity of 7 lesser known wild edible fruits of Odisha

Sl. no	Botanical Name	POX Δ O.D / min / g fwt.	CAT (U/ml)	SOD Δ O.D / min / g tissue wt.
1	<i>Antidesma acidum</i>	0.090±0.01	2.97±0.06	0.916±0.001
2	<i>Artocarpus lacucha</i>	0.023±0.0005	0.1538±0.06	0.053±0.004
3	<i>Bridelia retusa</i>	0.004±0.001	3.5705±0.011	0.004±0.001
4	<i>Carissa spinarum</i>	0.001±0.0003	1.1119±0.004	0.151±0.001
5	<i>Carmona retusa</i>	0.050±0.0005	0.1092±0.5	0.18±0.01
6	<i>Melastoma malabathricum</i>	0.100±0.0006	0.3732±0.5	0.119±0.001
7	<i>Streblus asper</i>	0.016±0.001	0.207±0.006	0.275±0.001

Each value in the table was obtained by calculating the average of three determinants (n=3) and data are presented as Mean ± SD

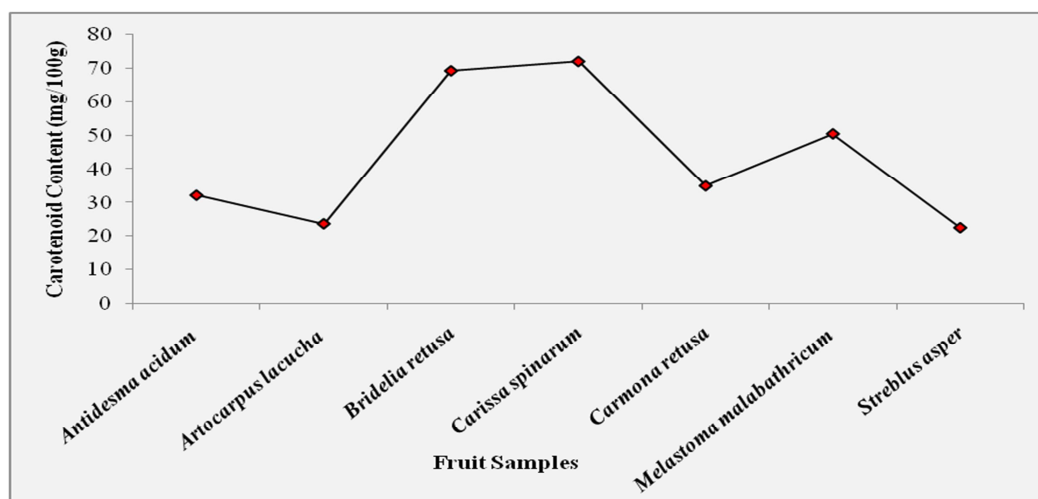


Fig 7: Carotenoid content of 7 wild edible fruits of Odisha

Carotenoid content and Ascorbic acid content

Carotenoids are class of phytochemical quenchers responsible for eliminating every free radical in the body by quenching the energy of the electron from the free radical and neutralizing it [40]. In the present study, *Carissa spinarum* showed highest carotenoid content 72.19 ± 0.01 mg/100g among all studied wild fruits. Near similar carotenoid content was found in *Streblus asper* (22.56 ± 0.015 mg/100g) and *S. taxoides* (21.97 ± 3.9 mg/100g) as reported by [41]. Moreover, the lesser known fruits like *Melastoma malabathricum* (50.56 ± 0.01 mg/100g), *Bridelia retusa* (69.42 ± 0.02 mg/100g), *Antidesma acidum* (32.19 ± 0.01 mg/100g), *Carmona retusa* (35.00 ± 0.01 mg/100g) were found to possess good amount of Carotenoid content which needs to be popularise within user groups (Fig. 7, Table 4)

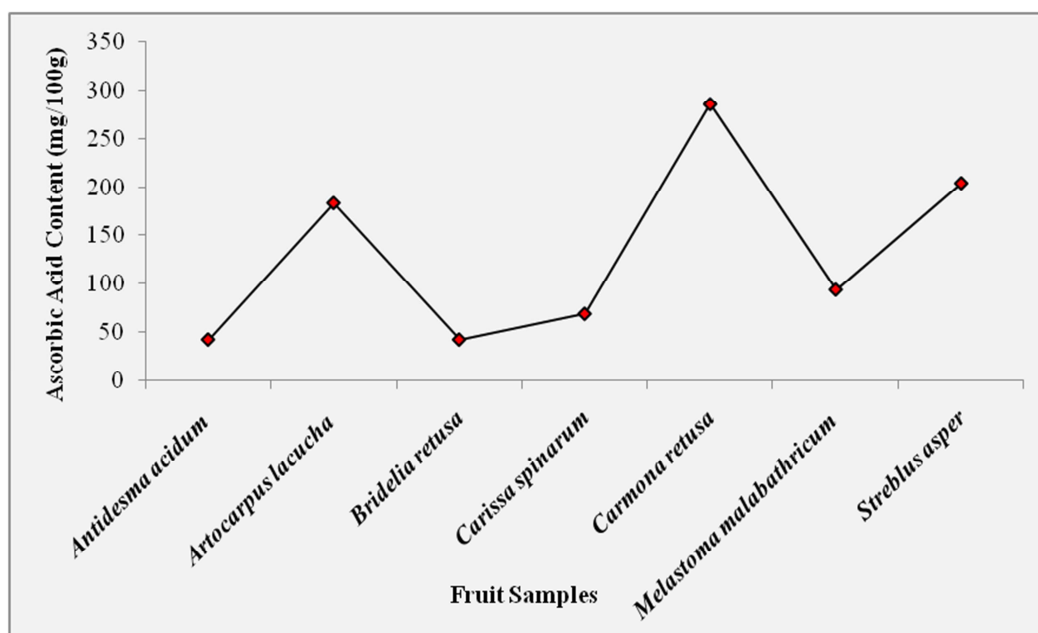


Fig 8: Ascorbic acid content of 7 wild edible fruits of Odisha

Table 4: Carotenoid content and Ascorbic acid content of 7 lesser known wild edible fruits of Odisha

Sl. no	Botanical Name	Carotenoid content (mg/100g)	Ascorbic acid content (mg/100g)
1	<i>Antidesma acidum</i>	32.19 ± 0.01	42.28 ± 0.72
2	<i>Artocarpus lacucha</i>	23.73 ± 0.01	183.46 ± 0.005
3	<i>Bridelia retusa</i>	69.42 ± 0.02	42.28 ± 0.001
4	<i>Carissa spinarum</i>	72.19 ± 0.01	68.80 ± 0.015
5	<i>Carmona retusa</i>	35 ± 0.015	285.71 ± 0.71
6	<i>Melastoma malabathricum</i>	50.56 ± 0.01	93.85 ± 0.01
7	<i>Streblus asper</i>	22.56 ± 0.015	204 ± 1.00

Each value in the table was obtained by calculating the average of three determinants ($n=3$) and data are presented as Mean \pm SD

From the analysis, the ascorbic acid content was found to be highest in fruit sample of *Carmona retusa* (285.71mg/100g) and lowest in *Antidesma acidum* (42.28 ± 0.72 mg/100g). The ascorbic acid content in other wild fruits were *Streblus asper* (204 ± 1.00 mg/100g) > *Artocarpus lacucha* (183.46 ± 0.005 mg/100g) > *Melastoma malabathricum* (93.85 ± 0.01 mg/100g) > *Carissa spinarum* (68.8 ± 0.015 mg/100g) > *Bridelia retusa* (42.28 ± 0.001 mg/100g). According to the results obtained, it can be suggested that these wild fruits can stand at par with commercial fruits like *Emblica officinalis* (379.7 mg/100g), grape juice (38mg/100g), oranges (50 mg/100g), strawberries (59 mg/100g) [42] limes (63 mg/100g), papaya (57 mg/100g), mausambi (50 mg/100g), lemon sweet (45 mg/100g), pineapple (39 mg/100g) [43] and Citrus fruit (50 mg/100g) [44]. It is reported [45] that *Emblica officinalis* (amla) is nutritionally and medicinally important fruit due to high contents of vitamin C. Amla fruits are used as a principle ingredient in the preparation of famous ayurvedic tonic chavyanpras [46]. Undoubtedly, the

contribution of ascorbic acid towards natural antioxidants in the studied fruits can be used as an important component in fruit juices (Fig.8, Table 4).

CONCLUSION

Wild edible fruits were studied for their antioxidant potentialities. To maintain optimum antioxidant level, external supplementation is necessary which generally filled by intake of fruits and vegetables. In Odisha, there are variety of wild edible fruits, including the presently studied species (*Antidesma acidum*, *Artocarpus lacucha*, *Bridelia retusa*, *Carmona retusa*, *Carissa spinarum*, *Melastoma malabathricum* and *Streblus asper*) belonging to different families, enriched with antioxidant properties like *Melastoma malabathricum* found to contain highest phenolic content (1.92 g GAE/100 g), highest FRAP activity (5878.35±0.05 µM AEAC /g dry wt.) and highest peroxidase activity i.e. 0.1 Δ OD / min / g fwt while *Carissa spinarum*, recorded best DPPH activity (1013 mg AEAC/100g dry wt.) and highest carotenoid content (72.19 mg/100g). *Carmona retusa* found to possessed highest ascorbic acid content (285.71 mg/100g). These wild fruits are mainly consumed by the tribals and villagers, which perhaps one of the reasons behind their long and disease free life. Thus, exploring the source of natural antioxidants in these wild fruits, which are found in different reserve forests of Odisha, will help to establish their use as food supplements and encourage their cultivation, conservation by user groups before these wild edible fruits gets extinct due to environmental changes, deforestation and other anthropogenic activities.

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