

Screening of antinutritional factors of nine underutilized wild edible fruits of Odisha

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ABSTRACT

Screening of anti nutritional properties of nine underutilized and unexplored wild edible fruit of Odisha were investigated. Maximum oxalate content was found in *Solanum torvum* (6.08 ± 0.83 mg/g dry wt.) and minimum value was recorded in *Phyllanthus acidus* (0.95 ± 0.12 mg/g dry wt.). Phytate content ranged from 5.35 ± 0.12 mg/g dry wt. (*Antidesma acidum*) to 9.475 ± 0.21 mg/g dry wt. (*Phyllanthus acidus*) among nine edible fruits. Maximum value for tannin content was exhibited in *Carmona retusa* (0.142 ± 0.003 mg/g dry wt.) and lowest was recorded in *Antidesma acidum* (0.046 ± 0.001 mg/g dry wt.). The saponin content revealed that highest was recorded in the fruits of *Artocarpus heterophyllus* (0.414 ± 0.003 g/g dry wt.) while the lowest value was noted in *Carmona retusa* (0.019 ± 0.006 g/g dry wt.). The present results suggest that fruits obtained lower amount of all the antinutrients analyzed, hence they are highly recommended for consumption for human health.

Keywords- wild edible fruits, anti nutrient, oxalate, phytate

INTRODUCTION

In our developing countries, traditionally wild edible fruits are the only fruits consumed by rural people as famine or hunger food. The indigenous fruits collected from wild play significant role in the food and nutrient security of rural poor in general and tribal mass in particular. As a result, in recent years, a growing interest has emerged to evaluate various wild edible fruits for their nutritional value [1-4].

In the other hand, some wild fruits have nutritional as well as antinutritional properties, which are adversely affect to human health. Keeping in mind the need for evaluation of antinutritional properties of these wild fruits is necessary so that the knowledge derived can be used to encourage adequate consumption for human body. The antinutritional factors such as phytic acid, tannin, saponin, oxalic acid, have adverse affect on nutrients required by the body that inhibition protein digestion, growth, iron and zinc absorption [1, 5]. Oxalic acid binds to calcium and is found naturally in a variety of fruits, vegetables, nuts, grains and legumes. It has also been reported that oxalates causes irritation and swelling in the mouth and throat [6]. Phytate is an organic acid as well as major component of plant storage organs where it serves as phosphate source for germination and growth [1]. It decreases calcium bioavailability and form calcium Phytate complexes that inhibit the absorption of Fe, Zn [7]. Tannins have a capacity to precipitate to certain protein and it forms a complex that inhibits the digestibility and palatability. [5,8]. Saponin is natural glycoside that generally believed to be nonpoisonous to warm blooded animals, but they are dangerous when injected into the blood stream and quickly haemolyse red blood cells [9].

Wild edible fruits are the major source of minerals, vitamins and fiber, which provides essential nutrients for human health. The nutritional value of many wild edible fruits found to be comparable with cultivated commercial fruits [2]. On the other hand, many wild edible fruits are reported to have antinutritional properties like oxalate, Phytate, tannin and saponin [10]. Though sporadic reports on levels of antinutritional factors of some underutilized and unexplored wild edible fruits are available, yet, scientific information of these fruits regarding their antinutritional properties is lacking especially in case of the wild edible fruits of Odisha, India. In the present study revealed that to assessment of anti nutritional properties of nine underutilized wild edible fruits of Odisha.

MATERIALS AND METHODS

Collection and treatment of samples

Fruits (at edible stage) of *Artocarpus heterophyllus*, *Antidesma ghaesembilla*, *Antidesma acidum*, *Carmona retusa*, *Calamus guruba*, *Eugenia rothii*, *Glycosmis pentaphylla*, *Phyllanthus acidus* and *Solanum turvum* (Figure-1 (a, b, c, d, e, f, g)) were collected from various reserve forests of Odisha. All the fruits were collected in two phases during the month of May-June and September-October, 2013-14 according to their seasonal availability in the wild. Fruit samples were dried at 50^o C in hot air oven after necessary surface cleaning. Dried fruit samples were powdered with grinding machine and stored in air-tight container at 4^o C for further analysis.

Analysis of Samples for anti-nutritional factors

Estimation of oxalate content

Oxalate content was determined through titration methods according to [11]. One gram sample was weighed into 100 ml conical flask. 75 ml of 3 M H₂SO₄ was added and stirred for 1h with a magnetic stirrer. This was filtered using a Whatman No 1 filter paper. 25 ml of filtrate was then titrated while hot against 0.05M KMnO₄ solution until a faint pink colour appeared and persisted for at least 30 sec. The oxalate content was then calculated by taking 1 ml of 0.05 M KMnO₄ as equivalent to 2.2 mg oxalate [12, 13]. Oxalate content was expressed as milligram per gram dry wt.

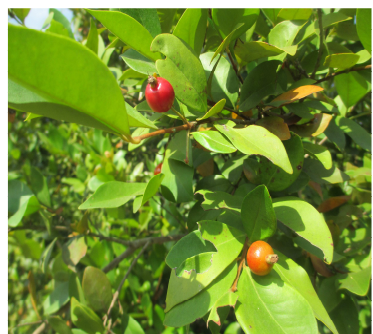
Estimation of Phytate content

Phytate content was estimated by the method with some modification [14]. Three grams samples were mixed in 25 ml of 10% TCA in a 125 ml flask and shaken the same with mechanical shaker for 2 hrs. This sample mixer was centrifuged at 3000 rpm for 20 min. To a 50 ml centrifuge tube, 10 ml of the supernatant was mixed with 4 ml of FeCl₃ solution by rapid blowing from the pipette. The solution was heated then in boiling water bath for 45 min. To make the supernatant clear, one or two drops of 3% sodium sulphate in 10% TCA was added and continued heating; then centrifuged for 10 to 15 min at 3000 rpm and finally the clear supernatant was decanted. The precipitate so obtained was washed twice by dispersing in 25 ml 10% TCA and heated again in boiling water for 10 min and centrifuged after cooling to room temperature. The precipitate was again dispersed in a few ml of water followed by addition of 3 ml of 1.5 N NaOH and made the volume up to 30 ml with distilled water. After heated in boiling water for 30 min, the solution was filtered with Whatman No 2 paper; the precipitate was washed with 70 ml hot water and the filtrate was discarded. The precipitate obtained on the filter paper was then dissolved with 40 ml hot HNO₃ (3.2 N) into a 100 ml volumetric flask. A 5 ml aliquot taken in 100 ml volumetric flask was diluted to 70 ml with distilled water followed by addition of 20 ml 1.5 M potassium thiocyanate (KSCN). The pinki-red colour so obtained was measured immediately (within 1 min) at 480 nm in a spectrophotometer (Specord 2000, Analytik Jena, Germany) with reference to the Ferric nitrate as standard. The phytate content was expressed as mg/g dry wt.

Estimation of tannin content

Tannin was analyzed using the method of [15]. Powder sample (0.25 g) was extracted with 37.5 ml distilled water and heated the flask gently and boiled for 30min. The sample mixer was centrifuged at 2000 rpm for 20min and the volume of the supernatant was finally made up to 37.5 ml with distilled water in a 100 ml flask. An aliquot of 500 µl of the sample was treated with 1 ml of Folin-Denis reagent followed by 2 ml of sodium carbonate and allowed to stand for colour development. The absorbance of the reaction mixture was measured at 700 nm in a spectrophotometer (Specord 2000, Analytik Jena, Germany). Tannic acid used as standard. Tannin content was expressed as Tannic acid equivalents (TAE) in gram per gram dry wt.

Figure-1. Few studied wild edible fruit species

Fig-1(a)-*Antidesma ghaesembilla*Fig-1(b)-*Antidesma acidum*Fig-1(c)-*Eugenia rothii*Fig-1(d)-*Glycosmis pentaphylla*Fig-1(e)-*Solanum turvum*Fig-1(f)-*Artocarpus heterophyllus*Fig-1(g)-*Calamus guruba*

Estimation of Saponin content

Saponin was determined using the method of [16]. The powder sample (3 g) was dispersed in 30 ml of 20% aqueous ethanol. The suspension was stirred for 12hrs with constant stirring at about 55⁰C on a hot plate (Spinot, Tarson make). The mixture was filtered and the residue was re-extracted with another 30 ml of 20% aqueous ethanol. The combined extracts (filtrates) were reduced to 15 ml over water bath at about 90⁰C. The concentrated sample extract was transferred into 250 ml separating funnel and 10 ml of diethyl ether was added and shaken vigorously. The aqueous layer was recovered while the ether layer discarded. The purification process was repeated twice. To the combined aqueous, 20 ml of n-butanol was added. The combined n-butanol extracts were washed twice with 10 ml of 5% aqueous NaCl. The remaining solution was heated in a water bath. After evaporation, the concentrated sample was dried in dry bath to a constant weight and saponin content was calculated as detailed below.

% Saponin = $(W2 - W1) / \text{Wt. of Sample} \times 100$

Where, W1 = Weight of evaporating disc

W2 = Weight of disc + Sample

Saponin content was expressed as gram per gram dry wt.

Statistical analysis

The results were expressed as Mean \pm Standard deviation of triplicate observations. The means of all the parameters to species-specific antinutrient contents were analyzed for significance following two-way ANOVA using GraphPad Prism 6.0.

RESULTS AND DISCUSSION

The present study analyzed nine species for their anti-nutritional factors of wild edible fruits. Analysis of the data (**Table-1**) revealed that the oxalate content of the *Solanum torvum* was maximum (6.08 ± 0.83 mg/g dry wt.) followed by *Artocarpus heterophyllus* (4.32 ± 0.91 mg/g dry wt.). Minimum level of oxalate was found in *Antidesma acidum* (0.95 ± 0.25 mg/g dry wt.) (Table-1, Figure-2). There were significant differences ($P < 0.0001$) in oxalate content among all studied species. The highest level of Phytate (8.6 ± 1.47 mg/g dry wt.) was observed in *Artocarpus heterophyllus* closely followed by *Phyllanthus acidus* (9.475 ± 0.21 mg/g dry wt.). *Carmona retusa* had the lowest level of Phytate content (4.07 ± 0.01 mg/g dry wt.). (Table-1, Figure-3). There were significant differences ($P < 0.0001$) in phytate content among all studied species. Values for tannin range from 0.052 ± 0.003 TAE g/g dry wt. in *Glycosmis pentaphylla* to 0.142 ± 0.003 TAE g/g dry wt. in *Carmona retusa*. (Table-1, Figure-4). There were significant differences ($P < 0.0001$) in tannin content among all studied species. *A. heterophyllus* had the highest level of saponin (0.414 ± 0.002 g/g dry wt.) content, the lowest value observed in *Antidesma acidum* (0.03 ± 0.004 g/g dry wt.). (Table-1, Figure-5). There were significant differences ($P < 0.0001$) in saponin content among all studied species. A comparative study was attempted relating to anti nutritional status of nine underutilized wild edible fruits of Odisha. Oxalate content in *Glycosmis pentaphylla* ($1.64 \pm 0.052\%$) reported by [17] which was higher than the value obtained in the present study (2.05 ± 0.33 mg/g). The obtained values of anti nutritional factors in present study with *Artocarpus heterophyllus* viz oxalic acid (4.32 ± 0.91 mg/g) and phytic acid (8.6 ± 1.47 mg/g) is higher than values obtained by [18]. Anti nutritional factors like tannin and phytic acid, which was less than the value obtained in present study with *A. heterophyllus* fruit observed by [19]. As regard to the tannin content, higher value was recorded in *A. heterophyllus* (0.059 ± 0.006 g/g) in present study than value determined by [18, 20]. Anti nutritional values of some wild edible plants from Iran and India reported by [1]. They observed a phytic acid value of *Solanum indicum* was 695.8 mg/100g which was nearly equal to the present study with *Solanum torvum* (8.6 mg/g). The tannin and saponin content of *Solanum torvum* was 2.7 mg/g and 0.31 mg/g respectively evaluated by [21] which was less than the present study of *S. torvum*. The tannin (0.0045 mg/g) and phytate (123 μ g/g) level were reported by [22] in *Solanum aculeatissimum*, which was comparatively less than our present study. The anti nutrient levels i.e oxalate, tannin and saponin content were recorded in *Phyllanthus acidus* in present analysis which was less than in *Phyllanthus emblica* reported by [10] but highest Phytate content was observed in *P. acidus* than previous report.

Table-1 Comparative account of antinutritional analysis of nine wild edible fruits of Odisha.

Sl No	Name of Fruits	Oxalate Content (mg/g dry wt.)	Phytate Content (mg/g Dry wt.)	Tannin Content (TAE g/g dry wt.)	Saponin Content (g/g dry wt.)
1	<i>Antidesma acidum</i>	0.95 ± 0.25	5.35 ± 0.12	0.046 ± 0.001	0.03 ± 0.004
2	<i>Antidesma ghaesembilla</i>	1.83 ± 0.50	5.37 ± 0.17	0.059 ± 0.001	0.036 ± 0.003
3	<i>Artocarpus heterophyllus</i>	4.32 ± 0.91	8.6 ± 1.47	0.059 ± 0.006	0.414 ± 0.002
4	<i>Calamus guruba</i>	2.2 ± 0.95	8.74 ± 0.18	0.068 ± 0.0034	0.09 ± 0.011
5	<i>Carmona retusa</i>	2.64 ± 0.58	4.07 ± 0.01	0.142 ± 0.003	0.05 ± 0.010
6	<i>Eugenia rothii</i>	2.12 ± 0.12	6.74 ± 0.12	0.076 ± 0.001	0.019 ± 0.006
7	<i>Glycosmis pentaphylla</i>	2.05 ± 0.33	8.52 ± 0.48	0.052 ± 0.003	0.139 ± 0.009
8	<i>Phyllanthus acidus</i>	0.95 ± 0.12	9.475 ± 0.21	0.053 ± 0.002	0.05 ± 0.01
9	<i>Solanum torvum</i>	6.08 ± 0.83	8.6 ± 0.566	0.067 ± 0.004	0.06 ± 0.03

Values expressed as mean \pm standard deviation (from 3 determinants); TAE-Tannic acid equivalent

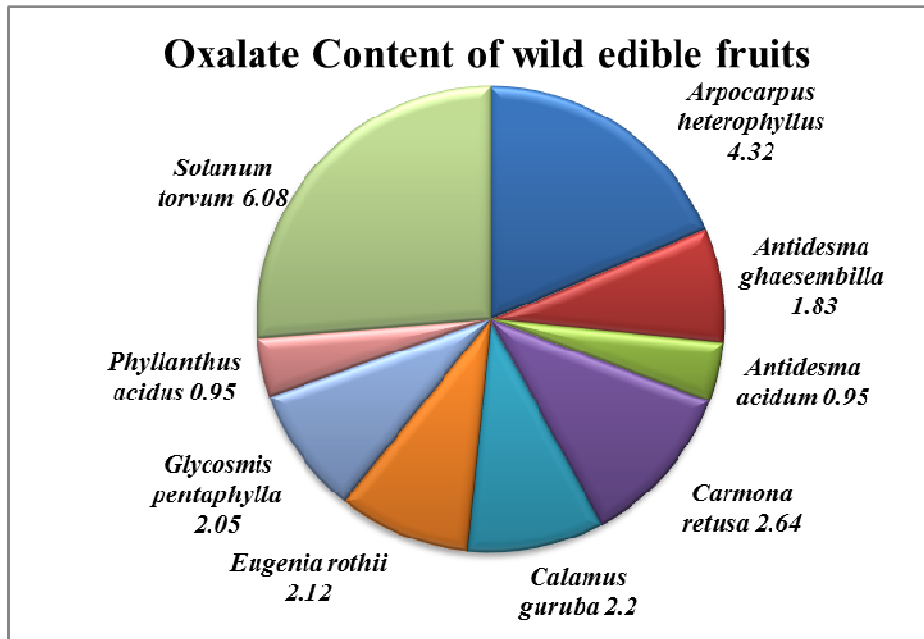


Figure-2:: Oxalate content of nine wild edible fruits of Odisha.

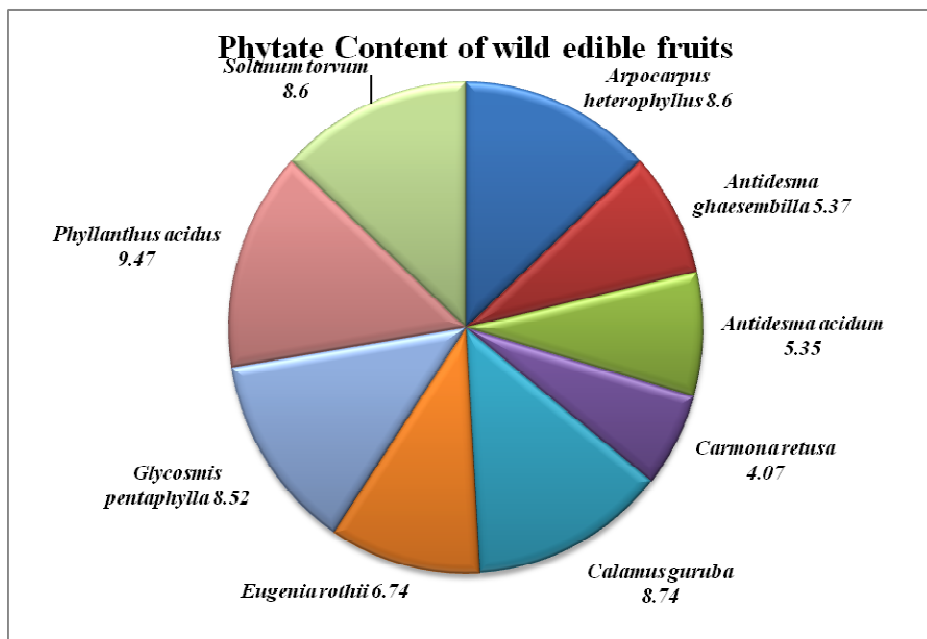


Figure-3:: Phytate content of nine wild edible fruits of Odisha.

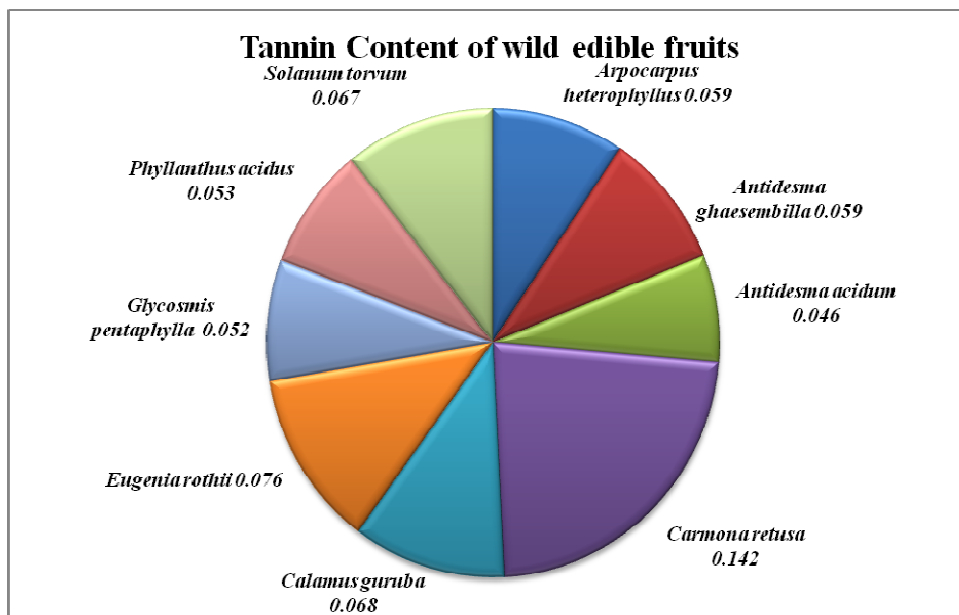


Figure-4: Tannin content of nine wild edible fruits of Odisha.

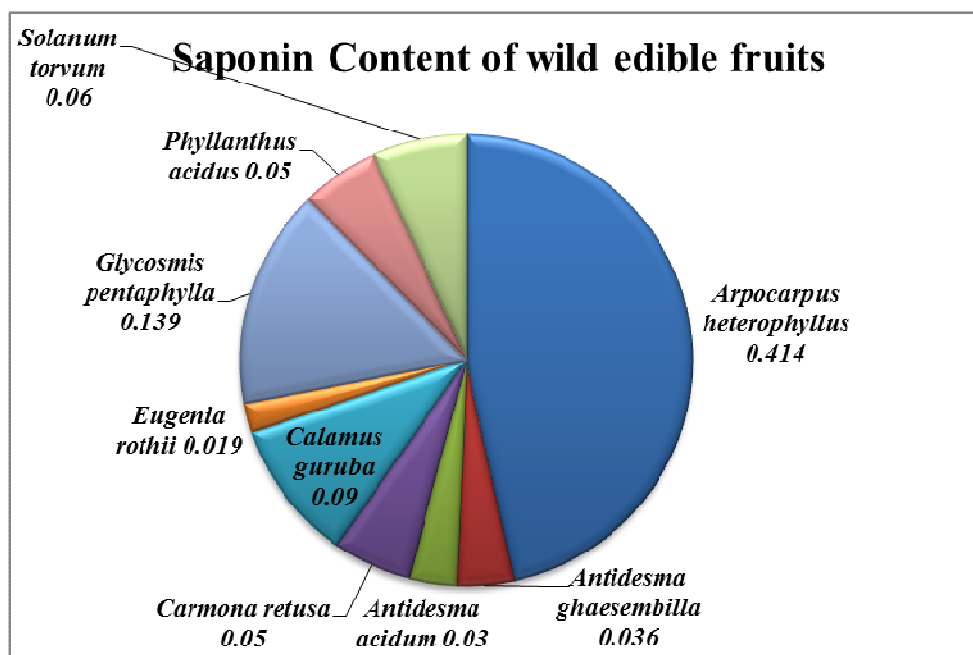


Figure-5: Saponin content of nine wild edible fruits of Odisha.

CONCLUSION

The selected wild edible fruits contained considerable amount of antinutrients viz. tannin, saponin, oxalate and phytate. However, amongst all, fruits of *Solanum torvum*, *Phyllanthus acidus*, *Carmona retusa* and *Artocarpus heterophyllus* contained comparatively higher amount of all the anti nutrients analyzed; hence excess consumption of these fruits may be avoided.

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