Nutritional and Antinutritional Properties of *Carissa carandas* and *Cordia dichotoma*, two Medicinally Important Wild Edible Fruits of Odisha

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**ABSTRACT**

The aim of this study was to estimate and compare major nutritional and antinutritional properties of *Carissa carandas* and *Cordia dichotoma* fruits collected from various agro-climatic forest zones of Odisha. Nutritional results showed that *Cordia dichotoma* from Malkangiri region contain maximum amount of moisture (80.24±2.14 % fwt.), acidity (0.31±0.01 % fwt.), total protein (2.26±0.19 % fwt.), total carbohydrate (31.6±0.91% fwt.), total sugar (14.11±0.39 % fwt.), reducing sugar (7.28±0.39 % fwt.) and non-reducing sugar (6.83±0.39 % fwt.) whereas in *Carissa carandas*, highest moisture (90.59±3.07 %fwt.) and titrable acidity (0.53 ± 0.06 %fwt.) was seen in Khorda region. Maximum total carbohydrate (13.75%fwt.), total sugar (8.46% fwt.) and reducing sugar (4.62% fwt.) found in Malkangiri region. From antinutritional analysis, results showed that *Cordia dichotoma* contain least amount of saponin (0.193±0.008 % dry wt.) and phytate (1.25±0.13 mg/g dry wt.) from Malkangiri region whereas least oxalate (3.00±0.33 mg/g dry wt.) and tannin (0.045±0.001 TAE g/g dry wt.) content was observed in *Carissa carandas* from Kalahandi region. Thus, the impact of different geographic locations on nutrients and antinutrients composition in the studied fruits was also evident from the analysis.

**KEYWORDS:** Wild edible fruits, Nutritional, Antinutritional, Regional variation.

**1. INTRODUCTION**

Forests play a large and indispensable role in improving food security for rural and mainly tribal aboriginals. Since immemorial, wild edible fruits of Odisha are being utilized by various tribal communities like Santal, Kolha, Munda, Lodha, Bathudi, Bhumij, Gond, Mundari, Mankidia, Mahali, Sounti, Saora, Juang, Banjara, Bhottada, Bhumij, Binjhal, Dal, Kandha, Mirdha, Paroja, Shabar etc. in various traditional forms as food, fodder, condiment, medicine, beverages etc. [1,2,3, 4]. Wild edible fruits provide nutritional and nutraceutical opportunities. The variable climate and diversified topography of the state contribute to its rich and varied flora [4]. *Carissa carandas* and *Cordia dichotoma* are distributed in different regions of Odisha, composition of its nutritional and antinutritional properties vary greatly depending on their geographic locations and various other factors. This is mainly due to the prevailing favourable climate for growth of wild edible fruits, availability of abundant irrigation water. Climate, water balance and life form have more shaped the patterns in fruit nutrients as well as antinutrients. According to the reports, *Carissa carandas* and *Cordia dichotoma* fruits were found medicinally important illustrated in Table 1. Malnutrition is a major health burden in developing nation and recognition of these wild edible fruits which are nutritionally potent can provide dietary supplement to the human body [5,6]. Antinutritional factors interfere with the bioavailability of nutrients required by the body; it may be wise to analyze the antinutritional contents according to their nutritional properties so that the users can be informed to make right decision to consume [7,8]. Wild edible fruits have escaped recognition and scientific enquiry. Hence, sustainable utilization of these potential species can add value addition to poorest household and can be further used in pharmaceutical industries. Considering the multifarious usefulness of these wild fruits, the present study was undertaken for generating baseline data on the nutraceutical potential of these wild fruits as influenced by various agro-climatic regions of Odisha to facilitate its potential use in preparation of dietary supplement and processed food products or functional foods.

**2. MATERIALS AND METHODS**

**2.1 Sample collection**

Fresh ripened fruits were collected from 3 different agro-climatic forest zones of Odisha i.e. (i)South Eastern Ghat represented by ‘Malkangiri’ district (17° 52.426 " N and 081° 31.675" E), (ii) Western Undulating
zone represented by ‘Kalahandi’ district (19° 26’ 821’’ N, 082° 48’ 882” E) and (iii) East and South-Eastern Coastal Plain represented by ‘Khorda’ district (20° 29’ 91’’ N, 85° 80’ 22” E) during the month of May-July, 2016. Collection of fruit samples for both the species has been done by random sampling from their respective region. Immediately after collection, fruits were brought to the laboratory. The fruit samples were authenticated with the help of Ref. Books e.g. Flora of Odisha [9], Wild Edible Fruit Plants of Eastern India [10, 11] and Lesser Known Crops and Wild Edible Fruits of Uttarakhand [12]. It was also compared with authentic herbarium sheets belonging to the Herbarium section of Regional Plant Resource Centre, Bhubaneswar.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Name of fruit species</th>
<th>Flowering &amp; Fruiting season</th>
<th>Medicinal Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Fruiting: July- October</td>
<td>Antiscorbutic, antidiabetic and antimicrobial [14]. Good source of vitamin-c and pectin. Mature fruit are rich in pectin [15].</td>
</tr>
<tr>
<td></td>
<td>Family: Apocynaceae</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Local name: Karanda koli</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Cordia dichotoma Forst.</td>
<td>Flowering: March- April,</td>
<td>Fruits used in wound healing activity [16], anthelmintic [17] and antidiabetic [18]. It has gastroprotective and antulcer activity [19]. Fruit gum contains anti-inflammatory activity and acts as emulsifier [20].</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fruiting: July- October</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Family: Ehretiaceae</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Local name: Guala koli</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2.2 Methodology for nutritional evaluation

2.2.1 Estimation of Moisture content

The collected fruit samples were determined for moisture content [21]. An empty dish was dried and weighed. 3 gm of fresh fruit added to the dish. The sample was spread uniformly and kept in hot air oven for 3 hours at 105ºC. After drying, the sample was kept for cooling and the dish was reweighed. Moisture (%) = \( \frac{(W_1-W_2) \times 100}{W_1} \)

Where: \( W_1 = \) weight (g) of sample before drying
\( W_2 = \) weight (g) of sample after drying

2.2.2 Estimation of Acidity content

Acidity content of the sample was determined by using Phenolphthalein indicator and sodium hydroxide [22]. Fresh sample (0.5gm of deseeded pulp) was weighed and 10ml of distilled water was added to it. The sample was homogenized with the help of mortar pestle and kept in a beaker. 5ml of sample extract was taken in a conical flask and 2 drops of Phenolphthalein indicator was added and titrated against 0.1 N NaOH solution. A faint pink colour appeared and that is the end point. The burette reading was noted and calculated as per details given below.

Titrable Acidity was expressed as Tartaric Acid = \( \frac{ml \text{ of alkali} \times \text{Normality of Alkali} \times 7.5}{\text{Weight of Samples in Grams}} \)

2.2.3 Estimation of Total Protein content

Protein was estimated using Folin Phenol reagent [23]. Fruit samples (1 gm) was homogenized with cold Tris–Glycine buffer solution at a pH of 7.9. It was then centrifuged at 10000 rpm for 20 minutes at 4ºC (Eppendorf cold centrifuge).
After centrifugation, the pellet was discarded and to the supernatant equal volume of pre-chilled TCA solution was added and stored overnight to precipitate out all the debris at 4°C. Next day the supernatant and TCA mixture was again centrifuged at 10,000 rpm for 15 minutes at 4°C. After centrifugation the supernatant was discarded and the tight, creamy-white coloured pellet was collected. It was then treated with 1 ml of 0.1 N NaOH solutions and kept as protein stock solution.

For quantification, 50µl of sample was taken and adjusted to 1ml by adding distilled water. Then to that sample, 4 ml of (0.1N NaOH, 2% Na₂CO₃, 1% CuSO₄, 2% Sodium Potassium tartrate) solution was added and allowed to stand in room temperature for 10 minutes. 0.5 ml of Folin phenol was added and it was incubated in room temperature for 30 minutes. After 30 minutes, absorbance was measured at 750 nm in spectrophotometer (Spekol 2000, Analytik Jena Make). Total protein content was calculated against the BSA standard.

2.2.4 Estimation of Total carbohydrate content
Total Carbohydrate content was estimated by Anthrone method [24]. The fruit extract was prepared by taking 100 mg of fruit sample and hydrolyzing the fruit sample with 2.5N HCl for 3 hours in water bath at 100°C. After heating, it was neutralized with sodium carbonate. The sample extract was then centrifuged at 3000 rpm for 20 min (Eppendorf cold Centrifuge, 5430 R) and the supernatant was stored at 4°C. To 0.5 ml of test sample, 4 ml of Anthrone reagent was added to test tubes and heated for eight minutes at boiling temperature in water bath. It was cooled rapidly before measuring OD at 630 nm in spectrophotometer (Spekol 2000, Analytik Jena Make). A standard graph was made by plotting different concentrations of the D-Glucose standard on the X-axis versus corresponding absorbance on the Y-axis. From the graph the amount of carbohydrate present in the fruit sample was calculated.

2.2.5 Estimation of Total Sugar content
Total sugar value of the sample was evaluated as described [22]. To estimate sugar content in wild edible fruits, 0.5 g of fresh fruit pulp was homogenised with 10 ml of ethanol (80%). The obtained homogenate was then centrifuged at 5000 rpm for 20 mins (Eppendorf cold centrifuge, 5430 R) at 4°C. The supernatant was collected and few ml of distilled water was added to it. It was heated until the smell of ethanol got disappeared. Then volume of this alcoholic extract was made up to 100 ml by adding distilled water. One ml of alcoholic extract was taken in a test tube and chilled the same. Then, 4 ml of Anthrone reagent was added carefully to the test tubes containing the test extract. Then it was placed in hot water bath for 10 mins. After proper cooling (to the room temperature), the absorbance was measured at 630 nm in spectrophotometer (Spekol 2000, Analytik Jena Make). The amount of reducing sugars was estimated using D-Glucose standard curve.

2.2.6 Estimation of reducing sugar content
Reducing sugar was performed as illustrated [25]. Fresh sample (500 mg of seedless pulp) was homogenized with 10 ml hot 80% ethanol using mortar and pestle. Then the homogenate was brought to room temperature and then it was centrifuged at 5000 rpm for 20 min (Eppendorf cold centrifuge). Evaporation was done by keeping the supernatant in water bath at 80°C. The residue obtained was dissolved with 10 ml of distilled water to get Stock Test Solution/sample for reducing sugar. From the stock solution, 0.5 ml of test sample was pipette out and made up to 3ml with distilled water. After volume make up, 3ml of Dinitrosalicylic acid (DNS) reagent was added and heated for 10 min in boiling water bath. After heating, 1 ml of 40% Rochelle salt (sodium potassium tartarate) solution was added to the test sample and cooled down. The absorbance was measured at 510 nm in spectrophotometer (Spekol 2000, Analytik Jena Make). The amount of reducing sugars was estimated using D-Glucose standard curve.

2.2.7 Estimation of Non-Reducing sugar content
Non-reducing sugar content was calculated by subtracting the amount of reducing sugar from that of total sugar.

2.3 Methodology for antinutritional evaluation

2.3.1 Estimation of Oxalate content
Total oxalate content was followed according to the procedure through titration method [26]. 1g powder sample was mixed with 75 ml of 3M H₂SO₄. It was stirred for 1 hr using magnetic stirrer (Tarsan make). Then filtration was performed using a Whatman No 1 filter paper. The collected filtrate of 25ml was titrated against 0.05M KMnO₄ solution for at least 30 seconds until visibility of a light pink colour. Calculation of oxalate content was done by taking 1ml of 0.05M KMnO₄ equivalent to 2.2 mg oxalate and expressed as milligram per gram dry wt.

2.3.2 Estimation of Tannin content
Tannin was determined by extracting 0.25g of powder sample with 37.5ml distilled H₂O and kept in water bath for 100°C for 30min. Then the extracted samples were centrifuged at 2000 rpm for 20 min (at RT) and the supernatant
was collected and made up to 37.5ml with distilled water. 500µl of the test sample was analyzed with 1ml of Folin-Denis reagent and 2 ml of sodium carbonate. It was allowed to stand for development of colour. The absorbance of the reaction mixture was measured at 700nm in a UV-Vis Spectrophotometer ((Spekol 2000, Analytik Jena Make). Tannin content was calculated using tannic acid as standard. It was expressed as Tannic acid equivalents (TAE) in gram per gram dry wt. [27].

2.3.3 Estimation of Saponin content
The saponin content was evaluated using ethyl alcohol [28]. The powder sample (3 g) was dispersed in 30 ml ethyl alcohol. The mixture was kept on a hot plate (Spinot, Tarson make) and stirred for 12hrs at 55°C with a constant stirring. Filtration was done where the filtrate was collected for further extraction and residue was re-extracted with another 30 ml of 20% ethyl alcohol. Then the combined filtrates were kept in a boiling water bath until the extract was reduced to 15 ml. The concentrated sample extract was transferred into separating funnel. 10 ml of diethyl ether was added and vigorously shaken. The ether layer was discarded where the aqueous layer was recovered. The purification process was repeated twice. After purification, 20 ml of n-butanol was added to the combined aqueous. The mixture of n-butanol extracts were washed twice with 10 ml of 5% aqueous NaCl. The remaining solution was heated in a water bath. The concentrated sample was dried using dry bath to a constant weight after evaporation. The saponin content was calculated using the formula stated below:

\[
\text{% Saponin} = \frac{(W_2-W_1)}{W_{\text{t. of Sample}}} \times 100
\]

Where, \(W_1\) = Weight of evaporating disc
\(W_2\) = Weight of disc + Sample

2.3.4 Estimation of phytate content
Phytate content was carried out by taking 3gm sample in 25 ml of 10% TCA and stirred in a mechanical shaker for 2 hrs. This mixture was centrifuged at 3000 rpm for 20 min. To a 10 ml of the supernatant, 4 ml of FeCl3 solution was added. The solution was heated in water bath at 100°C for 45 min. To clear the supernatant, one or two drops of 3% sodium sulphate was added and continued heating, then centrifuged at 3000 rpm for 15 min. Finally the clear supernatant was decanted. The obtained precipitate was washed twice in 25 ml 10% TCA. It was heated again in boiling water bath for 10 min and centrifuged after cooling to room temperature. The precipitate was again dispersed in a few ml of distilled water and 3 ml of 1.5 N NaOH was added and made the volume upto 30 ml with distilled water. The solution was filtered after heating in boiling water bath for 30 min; the filtrate was discarded and the precipitate was washed with 70 ml hot water. The precipitate obtained on the filter paper was then dissolved with 40 ml hot HNO3 (3.2 N). A 5ml aliquot was diluted to 70 ml with distilled water and 20 ml 1.5 M potassium thiocyanate was added. The pinkish red colour so obtained was measured within 1 min at 480 nm. The phytate content was calculated using ferric nitrate as standard. The phytate content was expressed as milligrams per gram dry weight [29].

3. RESULTS AND DISCUSSION

3.1 Nutritional evaluation
Nutritional factors like moisture, acidity, total protein, total carbohydrate, total sugar, reducing sugar and non-reducing sugar has been screened in \(C.\ carandas\) and \(C.\ dichotoma\) fruits collected from 3 different agro-climatic wild sources to estimate the variation of nutrients according to the regions distributed. The nutrient content present in these fruits has been compared to its relevancy reports studied earlier.

3.1.1 Moisture
Highest moisture content was revealed in \(C.\ carandas\) fruits from Khordha region i.e. 90.59±3.07 % fwt. whereas maximum amount of moisture content in \(C.\ dichotoma\) fruits was found in Malkangiri region (80.24±2.14 % fwt.). In the current work, least moisture content was observed in Kalahandi region i.e. 76.33±1.96 % fwt. Low moisture content within the acceptable range has a high self life and helps in good keeping period. Among the studied fruits collected from various forest zones depicts that the moisture variation was less. \(C.\ carandas\) fruits were reported to contain 83.17-83.24g/100g fwt. [30] whereas \(C.\ dichotoma\) fruits contain 70.00 %fwt. [31] according to the reports studied earlier. Moisture content values were found less than the present studied values. Analysis of moisture is important regarding nutritional point of view due to its stability and quality of foods (Table-2, Figure-2).
3.1.2 Titrable Acidity

In this present study, titrable acidity was found more in *C. carandas* collected from Khorda region (0.53±0.06 %fwt.). *C. dichotoma* fruit samples collected from Malkangiri region showed highest amount of acidity (0.31±0.01 %fwt.). The presence of acidity contributes to the sour taste of fruit. The organic acids present in fruits directly affect the flavour, colour, stability and quality (Table-2, Figure-3).
3.1.3 Total Protein
Highest total protein percentage was recorded in *C. carandas* from Kalahandi (3.21±0.35 % fwt.) and maximum amount of protein value was noted in *C. dichotoma* from Malkangiri region (2.26±0.19 % fwt.). The previous reports regarding total protein content in *C. Carandas* were less than the present reports (1.1 g/100g) [32]. It denotes that these fruits can be used for regulating body processes and formation of antibodies to fight infection. Protein acts as a major energy supplier containing essential amino acids which cannot be synthesized by human body [33] (Table-2, Figure-4).

![Fig.4. Total protein content in two wild edible fruits collected from varying regions](image)

3.1.4 Total Carbohydrate
*Cordia dichotoma* and *Carissa carandas* both had highest total carbohydrate (31.60±0.91 %fwt. and 13.75±0.60 % fwt.) from Malkangiri region. From earlier reports it was observed that *Carissa carandas* and *Cordia dichotoma* contain 2.90g/100g [34] and 18.00g/100g [31] respectively which was less than the present work. From the current study, the results revealed that *Cordia dichotoma* fruits contain rich amount of carbohydrate which can be a good source of nutrition. It can be helpful to the human diet consumption as it support bodily functions (Table-2, Figure-5).

![Fig.5. Total carbohydrate in two wild edible fruits collected from varying regions](image)
3.1.5 Total sugar
Total sugar content was found more in Malkangiri region present in both *Carissa carandas* (8.46±0.30 % fwt.) and *Cordia dichotoma* (14.11±0.39% fwt.) wild edible fruit samples (Figure 6). Lowest sugar content was observed from Khorda region in *C. carandas* (4.26±0.41% fwt.) and *C. dichotoma* (8.85±0.30 % fwt.). However, according to the reports, total sugar value in *C. spinarum* had 8.37±0.40 % fwt. [5]. It is used in central metabolic pathway as it plays a key role in our body and provides stored form of energy as glycogen in liver and muscles [35] (Table-2, Figure-6).

![Fig.6. Total sugar content two wild edible fruits collected from varying regions](image)

3.1.6 Reducing sugar
*Carissa carandas* and *Cordia dichotoma* collected from Malkangiri forest region recorded higher reducing sugar content i.e. 4.62 ±0.37 % fwt. and 7.28±0.39 % fwt. respectively. *C. spinarum* contain 8.2 ±0.29 % fwt. [5] reducing sugar which was nearly double the value obtained than the current study. Reducing sugars like glucose, fructose, maltose etc. are readily absorbed into the body. (Table-2, Figure-7)

![Fig.7. Reducing sugar content in two wild edible fruits collected from varying regions](image)
3.1.7 Non-Reducing sugar
As regard to non-reducing sugar content, highest value was observed in Cordia dichotoma collected from Malkangiri forest region i.e. 6.83±0.39 % fwt. Non-reducing sugar content for Carissa carandas showed more in Kalahandi region (3.92±0.57 % fwt.) followed by Malkangiri region i.e. 3.84±0.33 % fwt. (Table-2, Figure-8).

![Fig. 8. Non-reducing sugar in two wild edible fruits collected from varying regions](image)

<table>
<thead>
<tr>
<th>Name of fruit species and its varying regions</th>
<th>Carissa carandas</th>
<th>Cordia dichotoma</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kalahandi</td>
<td>Moisture (% fwt.)</td>
<td>82.82±1.28</td>
</tr>
<tr>
<td></td>
<td>Titrable Acidity (% fwt.)</td>
<td>0.15±0.02</td>
</tr>
<tr>
<td></td>
<td>Total Protein (% fwt.)</td>
<td>3.21±0.35</td>
</tr>
<tr>
<td></td>
<td>Total Carbohydrate (% fwt.)</td>
<td>11.33±3.47</td>
</tr>
<tr>
<td></td>
<td>Total Sugar (% fwt.)</td>
<td>6.52±0.72</td>
</tr>
<tr>
<td></td>
<td>Reducing sugar (% fwt.)</td>
<td>2.60±0.42</td>
</tr>
<tr>
<td></td>
<td>Non-reducing sugar (% fwt.)</td>
<td>3.92±0.57</td>
</tr>
<tr>
<td>Khordha</td>
<td>Moisture (% fwt.)</td>
<td>90.59±3.07</td>
</tr>
<tr>
<td></td>
<td>Titrable Acidity (% fwt.)</td>
<td>0.53±0.06</td>
</tr>
<tr>
<td></td>
<td>Total Protein (% fwt.)</td>
<td>2.56±0.14</td>
</tr>
<tr>
<td></td>
<td>Total Carbohydrate (% fwt.)</td>
<td>10.83±2.09</td>
</tr>
<tr>
<td></td>
<td>Total Sugar (% fwt.)</td>
<td>4.26±0.41</td>
</tr>
<tr>
<td></td>
<td>Reducing sugar (% fwt.)</td>
<td>1.88±0.54</td>
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<tr>
<td></td>
<td>Non-reducing sugar (% fwt.)</td>
<td>2.38±0.47</td>
</tr>
<tr>
<td>Malkangiri</td>
<td>Moisture (% fwt.)</td>
<td>88.76±1.33</td>
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<tr>
<td></td>
<td>Titrable Acidity (% fwt.)</td>
<td>0.45±0.03</td>
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<tr>
<td></td>
<td>Total Protein (% fwt.)</td>
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<tr>
<td></td>
<td>Total Carbohydrate (% fwt.)</td>
<td>13.75±0.60</td>
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<tr>
<td></td>
<td>Total Sugar (% fwt.)</td>
<td>8.46±0.30</td>
</tr>
<tr>
<td></td>
<td>Reducing sugar (% fwt.)</td>
<td>4.62±0.37</td>
</tr>
<tr>
<td></td>
<td>Non-reducing sugar (% fwt.)</td>
<td>3.84±0.33</td>
</tr>
</tbody>
</table>

Values expressed as mean±standard deviation (from 3 determinants)

3.2 Antinutritional evaluation
Antinutritional factors i.e. Tannin, Oxalate, saponin and phytate were studied in C. Carandas and C. dichotoma wild edible fruits of Odisha, India. The antinutrients factors studied in this present research work were compared according to its relevancy available so far.
3.2.1 Tannin content
Least level of tannin content was noted in *C. carandas* (0.041±0.001 TAE g/g dry wt.) and *C. dichotoma* (0.104±0.002 TAE g/g dry wt.). *C. spinarum* wild edible fruits contain 0.042±0.005 TAE g/g dry wt. [7]. The values obtained were at par with the previous reports. Presence of tannin inhibits the activities of digestive enzymes and therefore presence of low tannin is not desirable [36]. It reduces the digestibility of protein, hence acts as antienzymatic activity [37] (Table-3, Figure-9).

![Fig. 9. Tannin content in two wild edible fruits collected from varying regions](image)

3.2.2 Determination of oxalate content
Results showed that less oxalate content was recorded in *Carissa carandas* from Khorda i.e. 2.64±0.44 mg/g dry wt. while highest oxalate value was observed in *Carissa carandas* from Malkangiri i.e. 6.38±0.44 mg/g dry wt. (Fig. 10). Oxalate content in *C. spinarum* (2.27±0.33 mg/g dry wt.) was found less than the present studied value [7]. Oxalate and its contents have deleterious effects on human nutrition and health, mainly by decreasing calcium absorption and aiding the formation of kidney stones [38] (Table-3, Figure-10).

![Fig.10. Oxalate content in two wild edible fruits collected from varying regions](image)
3.2.3 Saponin content in *Carissa carandas* and *Cordia dichotoma* fruits

From the present studied data of *Carissa carandas* and *Cordia dichotoma* wild edible fruits collected from 3 different agro-climatic regions was carried out to study the saponin content and more saponin content was present in *Cordia dichotoma* from Khorda (0.534±0.016 % dry wt.) and least saponin was assessed from Malkangiri i.e. 0.193±0.008 % dry wt. (Fig.11). A parallel study was done in *C. dichotoma* fruit species where they found 1.14±0.02 mg/g dwt. [39] of saponin which was very less than our findings. *C. spinarum* contain 0.073±0.01 g/g dry wt. [7] saponin which was very high than the present value of *C. carandas* which ranged from 0.203±0.008 % dry wt. to 0.343±0.006 % dry wt. Saponins reduce the uptake of certain nutrients including glucose and cholesterol at the gut through intra-lumenal physicochemical interaction (Table-3, Figure-11).

![Fig.11. Saponin content in two wild edible fruits collected from varying regions](image)

3.2.4 Phytate content in *Carissa carandas* and *Cordia dichotoma* fruits

In the present study, least phytic acid content was found in *Cordia dichotoma* from Malkangiri (1.25±0.13 mg/g dwt.). Phytic acid content in earlier studied reports had investigated that *C. spinarum* contain 5.27±0.30 mg/g dwt. which was nearly double the value obtained in recent study of *C. carandas* ranged from 2.14±0.02 mg/g dwt. (Malkangiri) to 3.27±0.03 mg/g dwt. (Kalahandi). Phytic acid content had also been determined in *Cordia dichotoma* (0.2%) which was at par with the present value [40] (Table-3, Figure-12).

![Fig.12. Phytate content in two wild edible fruits collected from varying regions](image)
Table 3. Antinutritional analysis in two wild edible fruits with its varying regions

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Name of the fruit species</th>
<th>Oxalate (mg/g dry wt.)</th>
<th>Saponin (% dry wt.)</th>
<th>Tannin (TAE/g dry wt.)</th>
<th>Phytate (mg/g dry wt.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Carissa carandas</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Kalahandi</td>
<td>3.00±0.33</td>
<td>0.34±0.006</td>
<td>0.045±0.001</td>
<td>3.27±0.11</td>
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<tr>
<td></td>
<td>Khordha</td>
<td>2.64±0.44</td>
<td>0.20±0.007</td>
<td>0.14±0.003</td>
<td>2.66±0.06</td>
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<tr>
<td></td>
<td>Malkangiri</td>
<td>6.38±0.44</td>
<td>0.203±0.008</td>
<td>0.142±0.002</td>
<td>2.14±0.07</td>
</tr>
<tr>
<td>2.</td>
<td>Cordia dichotoma</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Kalahandi</td>
<td>4.47±0.34</td>
<td>0.25±0.009</td>
<td>0.104±0.002</td>
<td>1.32±0.06</td>
</tr>
<tr>
<td></td>
<td>Khordha</td>
<td>5.06±0.44</td>
<td>0.53±0.016</td>
<td>0.138±0.002</td>
<td>3.17±0.11</td>
</tr>
<tr>
<td></td>
<td>Malkangiri</td>
<td>4.91±0.70</td>
<td>0.193±0.008</td>
<td>0.136±0.001</td>
<td>1.25±0.13</td>
</tr>
</tbody>
</table>

Values expressed as mean±standard deviation (from 3 determinants)

4. CONCLUSION

Healthy and ripen fruits of *Carissa carandas* and *Cordia dichotoma* were collected from three different wild sources of Odisha and screened for proximate analysis like moisture, total protein, total carbohydrate, total sugars etc. with a view to recommend for dietary consumption. The present investigation reveals that *Carissa carandas* and *Cordia dichotoma* were more potent in nutritional content. The nutritive composition varied much with reference to different locations. Malkangiri region showed promising nutritional and antinutritional properties. It may be due to the effect of geographic locations, soil and climatic conditions. The nutritional results obtained from our study justify the need to preserve the traditional use of wild edible fruits, and encourage research on wild edible species, from both the nutritional and medicinal point of view. The studied wild edible fruits possess less antinutritional content. Further phytochemical analysis among these fruits will determine the potential towards pharmaceuticals. We can conclude that these wild edible fruits can be a good alternative to the currently available range of commercialized fruits, for dietary supplements and can boost the economy of poor people if value addition is encouraged. Therefore, sustainable management of these resources as well as conserving biodiversity is of the utmost importance.

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