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Nutritional and Antioxidant Assessment of Fruits of *Antidesma acidum* Retz.

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Poonam Patil and Varsha Jadhav*

Assistant Professor, Dept. of Botany, S. G. M. College Karad.

**Associate Professor, Dept. of Botany, Shivaji University, Kolhapur 416 004.*

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ABSTRACT

The present study was focused on the nutritional and antioxidant profiling of fruits of *Antidesma acidum*. Mature and ripened fruits were collected from Tillari Ghats of Kolhapur District. Proximate analysis was done by using methods of Association of Official Analytical Chemists while macronutrients and micronutrients were analyzed using atomic absorption spectrometry. The antioxidant capacity was determined by evaluating the scavenging activity using the 1, 1, diphenyl-2- pycrylhydrazyl (DPPH), Ferrous reducing antioxidant power (FRAP), Ferrous ion chelating ability Reducing power assay and total antioxidant capacity (TAC) using the methanolic extract. Extracts were also analyzed for total phenolic content (TPC) and total flavonoids content (TFC). Ripened fruits show high amount of carbohydrates, total phenolic content and total flavonoids content, while mature fruits show high amount of minerals as well as antioxidant activity.

INTRODUCTION

In developing countries, wild plants are exploited as sources of food and other life-supporting materials. Thus it provides adequate level of nutrition to the human beings (Aberoumandand and Deokule, 2010). Presently many people are using mostly of the ancient lineage ones as major crops. There has been hardly single food crop domesticated in modern times which leads to less diversity in human diets. It has been observed that various types of nutritional ailments occur in the zones where there plenty of wild edible fruits and leafy vegetables with rich nutritive potential, provide variety of our diets (Pradheep *et al*. 2003).

The collection and consumption of wild fruits have played an important role in rural peoples in daily life. Wild fruits are usually used as an important supplement against starvation. In the process, there has been substantial accumulation of knowledge (Jin *et al*. 1999). Wild edible plants have rich in source of nutrition. They have almost all of the minerals and organic components essential for human nutrition. They provide carbohydrates, minerals, fibers, vitamins, pigments and other secondary metabolites like alkaloids, polyphenols, gums, resins. In addition, they have anti-bacterial, antifungal, antidiabetic and hepatoprotective bioactive properties, therefore they have medicinal value.

With the increasing interest in the wild edible plant revolution, we need to focus on more research work on nutritional determination of them. *Antidesma acidum* Retz. is one of the wild edible plants of western Ghats of Maharashtra belongs to family Euphorbiaceae. In Western Ghats region traditionally its leaves are used as vegetable while mature fruits used in preparation of pickle and ripened fruits eaten by people as Ranmeva. Medicinally *Antidesma acidum* leaves and mature fruits decoction are used in treatment of stomachache of children and in case of digestion. Leaves are used against dysentery and in case of appetizer. Boiled extract of leaf used in antidiabetic treatment (Khan and Yadava 2010), tender shoot of *A. acidum* eaten boiled with chili and salt (Kar and Borthakur 2008). A plant bearing sour foliage, which is used especially in Udupi district, under traditional practice in the form of various diet preparations, in chronic disease (Mallya *et al*. 2012). Ripened fruits of these plants eaten by children (Bandyopadhyay and Mukherjee, 2009; Chandra *et al*. 2013; Pegu *et al*. 2013; Kumar *et al.* 2013; Reddy *et al*. 2007; Suksri *et al.*, 2005) and mature fruits used in preparation of pickle (Rijal 2011; Yadav *et al*. 2012).

Sustainable utilization of these wild food plants, there is an urgent need to explore their nutritional composition. The present study was undertaken to investigate the nutritional

composition of *Antidesma acidum* fruits to ascertaining their suitability for use as supplementary food plants.

MATERIAL AND METHODS

Collection of plant material

Fruits of *Antidesma acidum* Retz. were collected from Tillari Ghats of Kolhapur district. Plant identified with the help of flora of Kolhapur district (Yadav and Sardesai 2002). These fruits washed thoroughly and blot to dry. After that, it was separated as mature and ripened fruits. Then fruits pulp and seeds separated with knife and dried under shade condition then oven at 40°C. These fruit pulp grind with mortar with pestle and it was used for further analysis.

Bromatological analysis

Dry matter and Moisture

Dry matter and moisture content of the plant material was determined with the help of moisture balance (Shimadzu MOC 63u).

Total ash and Crude Protein

Ash value was determined by the method of AOAC (1990).

Crude fat and crude fiber

Crude fiber content was carried out by using the method of Sadasivam and Manickam (1992).

Nutritional analysis

Carbohydrates (Starch, Reducing Sugar and Total Sugar)

The carbohydrates were estimated according to the method Nelson (1944).

Energy

The Atwater system was used to determine the energy values (WHO, 1985).

Mineral Analysis

The acid digestion method of Black *et al.* (1965) was used to analysis of inorganic constituents. The level of Calcium, Magnesium, Iron, Manganese, Zinc, and Copper was estimated by using Atomic Absorption Spectrophotometer. Phosphorus was estimated from the same acid digest by the method described by Sekine *et al.* (1965). Total nitrogen content was estimated according to the method of Hawk *et al*. (1948).

Antioxidant analysis

Extractions

Methanolic extract of fruits was obtained by homogenizing the fruit pulp in methanol (solvent ratio of 1:10). Extraction was carried out on an orbital shaker for 24 hrs at room temperatures. Then it was filtered through Whatman No.1 filter paper. Filtrate was vaporized in rotary evaporator concentrated to a small volume and allowed to dry. After drying, the respective extracts were weighed and subjected to determine antioxidant capacity.

DPPH Radical Scavenging Activity

Antioxidant activity of methanolic extract was evaluated by 1, 1-diphenyl-2- picrylhydrazyl (DPPH) by Lee *et al*. (2003).

Ferric reducing antioxidant power (FRAP)

The FRAP assay was performed as per the method described by Benzie and Strain (1996).

Ferrous ion chelating ability

The method proposed by Decker and Welch (1990) was used to determine the ferrous ion-chelating ability of plant extract.

Reducing power assay

The reducing power of the methanolic extract was determined according to the method given Oyaizu, (1986).

Total antioxidant capacity

The total antioxidant capacity of methanol extracts was evaluated by the method of Prieto *et al.* (1999).

Total phenolic content (TPC)

The total phenolic content of methanolic extract was determined spectrophotometrically using the Folin-Ciocalteu assay.

Total Flavonoid content (TFC)

Total flavonoid content was estimated by the method of Luximon-Ramma *et al*. (2002).

RESULTS

Traditional people lack information on the specific nutrients in a large number of the native plant species where they are found and consumed. *Antidesma acidum* Retz. is a one of the important medicinal plant belongs to family Euphorbiaceae. Its fruits and leaves are edible; fruits eaten by people of western Maharashtra as Ranmeva. In some region of Kolhapur district decoction of mature fruits of *A. acidum* used in case of stomach ache of children as well as leaves with rice used as an appetizer.

The present study was undertaken to investigate the nutritional composition of *Antidesma acidum* mature and ripened fruits. In this study, three analyses of each sample were made and each experiment was carried out in triplicate (n=3). The mean value and standard deviation were calculated from the data obtained.

The results of bromatological composition of mature and ripened fruits of *Antidesma acidum* are depicted in the graph no. 1. The mature fruits contain high amount of dry matter (22.10 ± 0.65%), total ash (11.33 ± 0.58%), crude fibre (6.3 ± 0.00%), and crude protein (14.50 ± 0.00%) than the ripened fruits (20.24 ± 0.60%), (7.33 ± 0.58%), (5.2 ± 0.01%) and (9.10 ± 0.00%), while the ripened fruit contain moisture (79.76 ± 0.60%) and crude fat (3.1 ± 0.01%) is higher than the mature fruits (77.90 ± 0.65%), (1.90 ± 0.00%).

Nutritional assessment of fruits was done with the help of analysis of carbohydrates (Graph. 2) and mineral components (Graph 3 and 4). The present study shows ripened fruits of *A. acidum* content high amount of starch (2.43 ± 0.01 g/100g), reducing sugar (1.20 ± 0.14 g/100g) and total sugar (13.33 ± 0.10 g/100g) than the mature fruits (1.15 ± 0.01 g/100g), (0.43 ± 0.02), (11.65 ± 0.10 g/100g). Estimate available energy from protein, fat and carbohydrates of fruits which revealed in Kcal/100g. The mature and ripened fruit of *A. acidum* shows 126.29 ± 0.00, 127.33 ± 0.00 energy. Mineral analysis of mature and ripened

fruits represented in the form of g/100g. It was found that high amount of element found in mature fruits as compare to the ripened fruits; nitrogen (0.55 ± 0.02), (0.15 ± 0.01), potassium (2.51 ± 0.00), (1.92 ± 0.00), calcium (0.40 ± 0.01), (0.14 ± 0.00), magnesium (0.024 ± 0.00), (0.016 ± 0.00), sodium (0.36 ± 0.00), (0.24 ± 0.00), iron (0.055 ± 0.00), (0.037 ± 0.00), manganese (0.071 ± 0.001), (0.063 ± 0.000), zinc (0.008 ± 0.00), (0.006 ± 0.00), and copper (0.004 ± 0.00), (0.003 ± 0.00) respectively. The phosphorus content in ripened fruits (0.19 ± 0.00) is higher than the mature fruits (0.14 ± 0.00).

Antioxidant analyses of methanolic extract of fruits were undertaken with different type of assay; DPPH radical scavenging activity fruits shown in graph 5. Where radical scavenging activity increases remarkably with increasing of extract and inhibitory capacity of the fruit extracts was comparatively similar to the ascorbic acid. Mature fruits extract show higher percent radical scavenging activity than the ripened fruits. The ferric reducing antioxidant power (FRAP) of methanolic extract of fruits were carried out and values interpreted in the form of mg ascorbic acid equivalent (mgAAE) (graph 6). In the comparison between the mature and ripened fruits at 0.5 mg/ml extract showed higher ability to reduce $Fe3^{+}$ to $Fe2^{+}$ FRAP activity in mature fruits (0.454 ± 0.005 mgAAE) than the ripened fruits (0.418 ± 0.000 mgAAE). The chelating ability of an extract is nothing but its ability to inhibit the formation of ferrous-ferrozine complex by chelating iron, competing with ferrozine. It was observed that there was an increase in the iron chelating ability of the extracts with increasing concentration (graph 7). The extract with the highest chelating ability was found in ripened fruits (47.57 ± 0.13%) than the mature fruits (46.72 ± 0.05%). Reducing power assay is based on the principle that substances, which have reduction potential, react with potassium ferricyanide (Fe+3) to form potassium ferrocyanide (Fe+2), which then reacts with ferric chloride to form ferrous complex that has an absorption maximum at 700 nm. Reducing capacity of sample was served as an indicator of potential antioxidant power. Graph 8 shows the reducing power of methanolic extract of *A. acidum* mature and ripened fruits and ascorbic acid. On the observations, it was found that the absorbance of the extract increased with an increase in concentrations. Rather than that ripened fruits extract shows higher reducing capacity. Total antioxidant capacity by Phosphomolybdenum method assay is based on the reduction of Mo (VI) to Mo (V) by the sample analyte and the subsequent formation of green phosphate/Mo (V) complex at acidic pH. Total antioxidant capacity of mature and ripened fruits was represented in the form of mg ascorbic acid equivalent (graph 9). The antioxidant capacity was increased with an increase in concentrations of extract, ripened fruits show

higher antioxidant capacity than the mature fruits. Total phenolic content of mature fruits extract was found to be lower (0.0041 ± 0.0000 mg GAE/mg of extract) than the ripened fruits extract (0.0043 ± 0.0000 mg GAE/mg of extract) and total flavonoid content of mature fruits (0.803 ± 0.000 g/100g) was also lower than the ripened fruits (0.944 ± 0.004 g/100g).

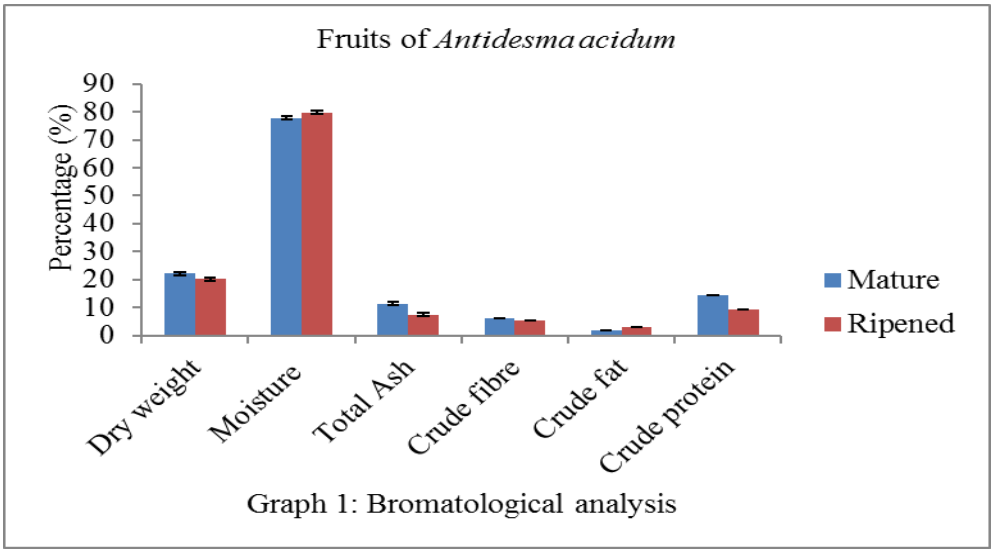
DISCUSSION

Moisture contains of *Antidesma acidum* mature and ripened fruits (77.90 ± 0.65%) (79.76 ± 0.60%) was higher than the *A. bunius* (72.1%) (Butkhup and Samappito, 2008). Jin *et al.*, (1999) reported lower amount of crude fiber (2.84%), total sugar (9.34 g/100g), starch (1.67 g/100g) and crude fat (2.09 g/100g) content in *A. acidum* fruits. Judprasong *et al.* (2013) determined the nutritional potential of three Thai indigenous fruits, *A. velutinosum* Blume. is one of them. They were noted the moisture (73.2 ± 5.1%), ash (2.1 ± 1.4%), protein (1.6 ± 0.3%) and total dietary fibre (15.6 ± 5.9%) in fruits; whereas in present work the higher total dietary fibre and lower moisture, ash and protein contents were found in mature and ripened fruits of *A. acidum*. *A. ghaesembilla* Gaertn. fruits shows lower amount of fat (0.95%), protein (1.81%), reducing sugar (0.011 g/100g), total sugar (0.012 g/100g), iron (0.00076 g/100g), sodium (0.0093 g/100g) and potassium (0.303 g/100g); while higher moisture content (82.83%) as compare to mature and ripened fruits of *A. acidum* (Nazarudeen, 2010). Similar results found in *A. velutinosum* fruits but it shows the higher amount of magnesium (0.115 g/100g) as compare to fruits of *A. acidum* (Judprasong *et al*., 2013 and Shajib *et al.*, 2012). The higher amount of starch, dry matter, reducing sugar and total sugar found in mature and ripened fruits of *A. ghaesembilla* (Valvi *et al.*, 2014).

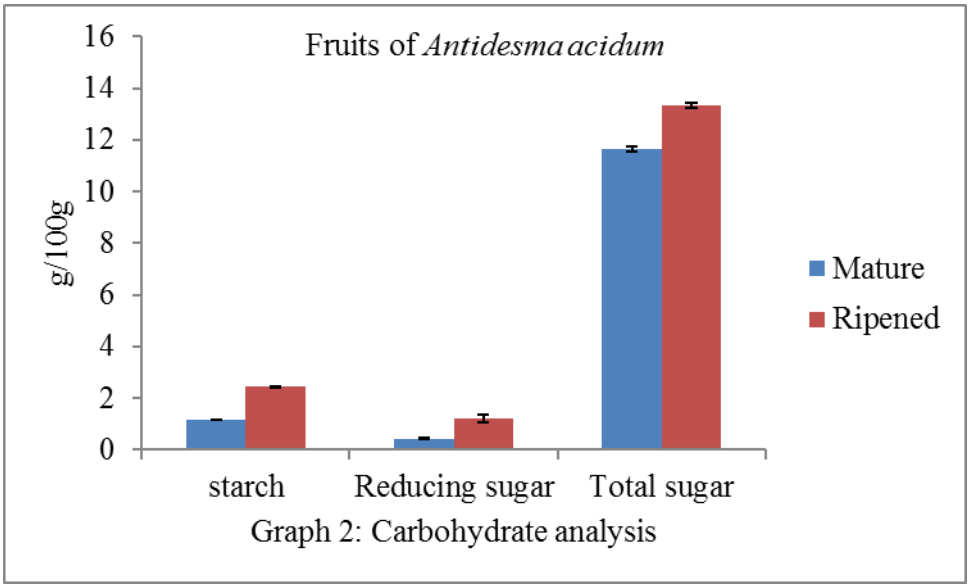
Antioxidant analysis of *Antidesma ghaesembilla* shows lower DPPH (1020.6 AEAC mg/100g dry weight) and FRAP (2114 ± 1.00 µM AEAC/g dry weight) activity than the *Antidesma acidum* DPPH activity of mature fruits (17363 mg/100g dry weight) and ripened fruits (11778 mg/100g dry weight), while FRAP activity of mature fruits (55.20 µg AEAC/g dry weight) and ripened fruits (39.5 µg AEAC/g dry weight) (Basak *et al*. 2013). Similar results of antioxidant activity while higher amount of total phenolic content and lower amount of flavonoids noted by Jorjong *et al.* (2015). Nayak and Basak (2015) reported the higher phenolic content (0.24 ± 0.015 g GAE/100g) and lower antioxidant activity in DPPH (240.5 ± 0.50 mg AEAC /100g dry wt.) and FRAP (1066.15 ± 0.84 µM AEAC /g dry wt.) in *A. acidum* fruits as compare to present investigation.

CONCLUSION

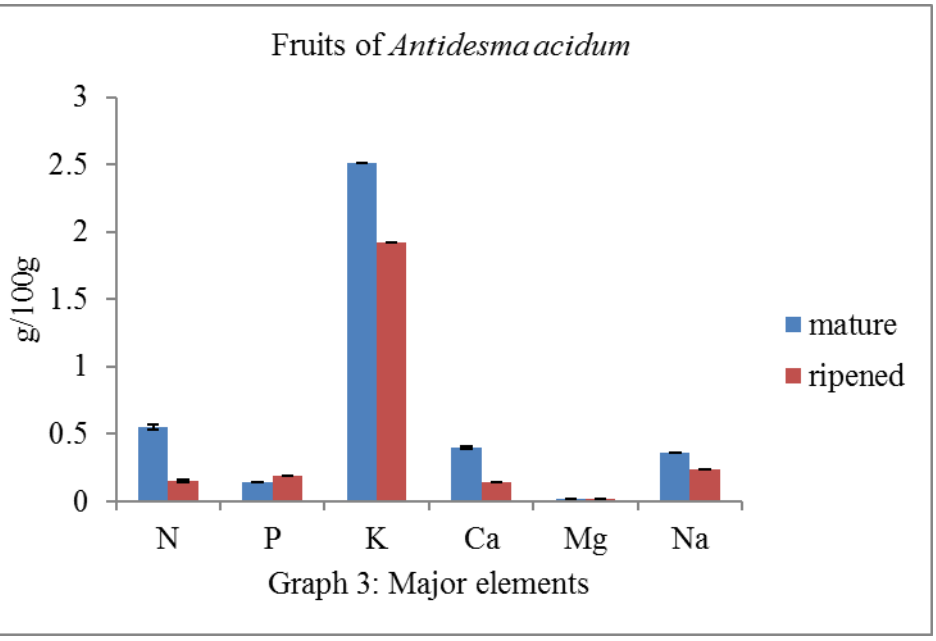
Wild edible plants are rich in minerals, vitamins and antioxidant activities. Rural people of Kolhapur district used the mature fruits of *Antidesma acidum* to prepare pickle, and ripened fruits as food. Thus, exploring the nutritional and natural antioxidants of these wild fruits will help to establish their use as food supplements and encourage their cultivation, conservation by user groups before these wild edible fruits get extinct due to environmental changes, deforestation and other anthropogenic activities. On the basis of nutritional and antioxidant evaluation of fruits, it showed that they are rich in carbohydrates, minerals and having antioxidant activity, therefore, they are safe for consumption. It helps for improving nutritional and health quality.



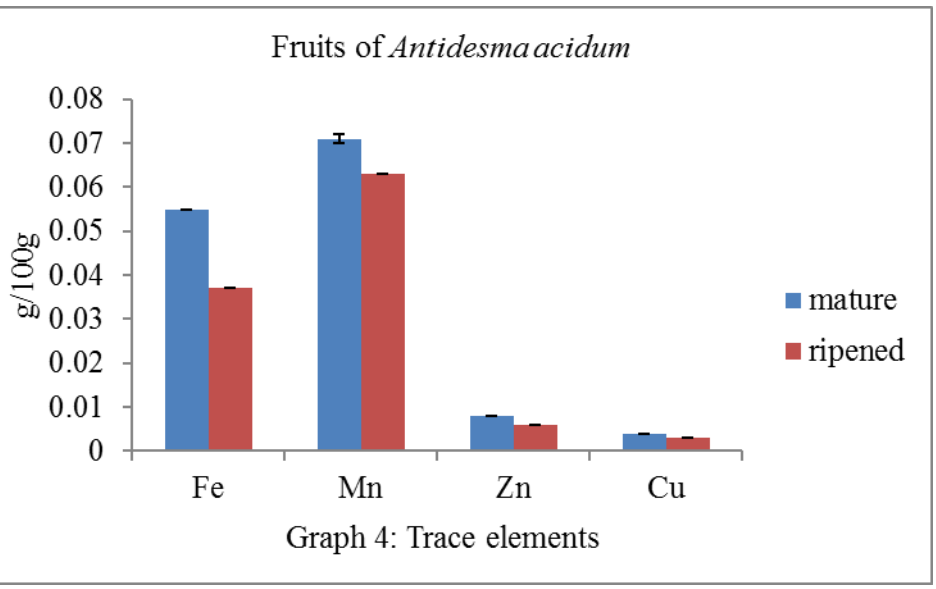
Graph 1: Bromatological analysis



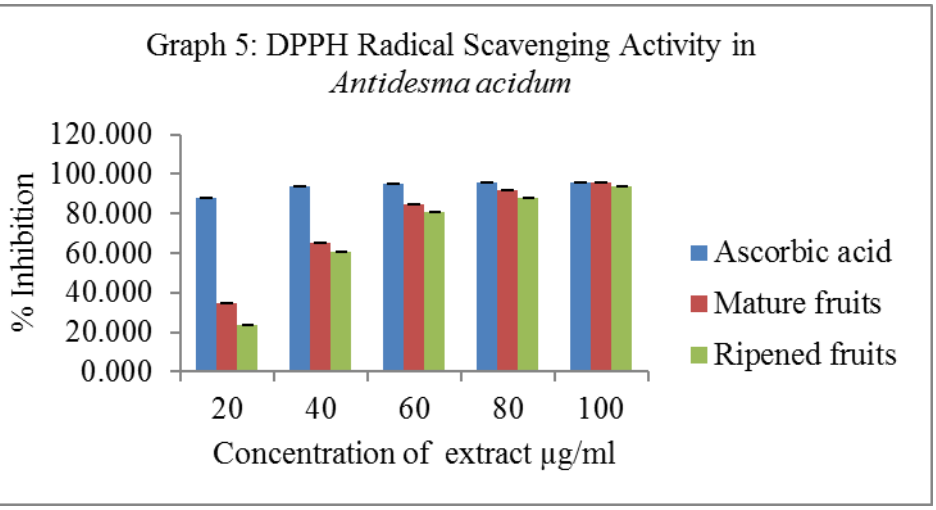
Graph 2: Carbohydrate analysis



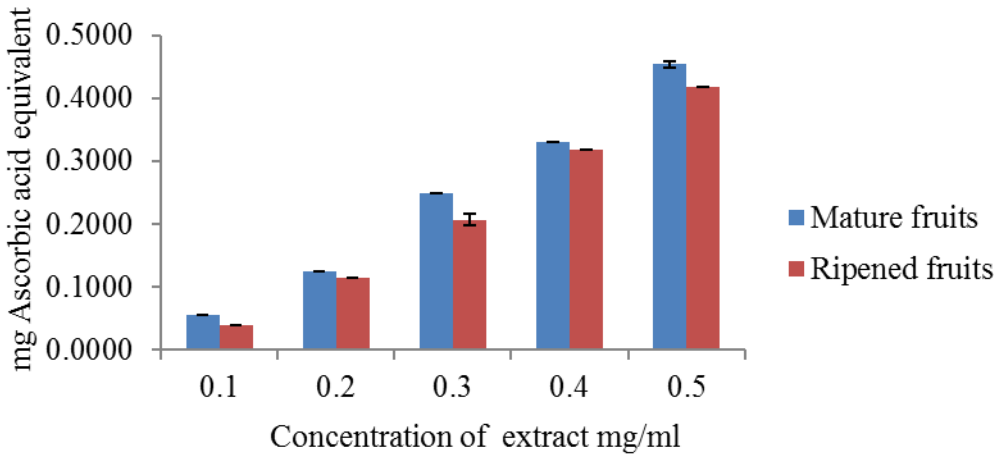
Graph 3: Major elements



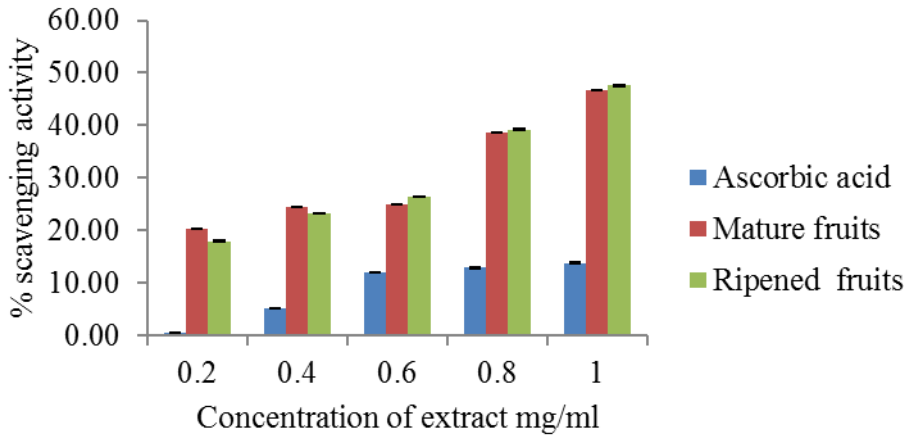
Graph 4: Trace elements



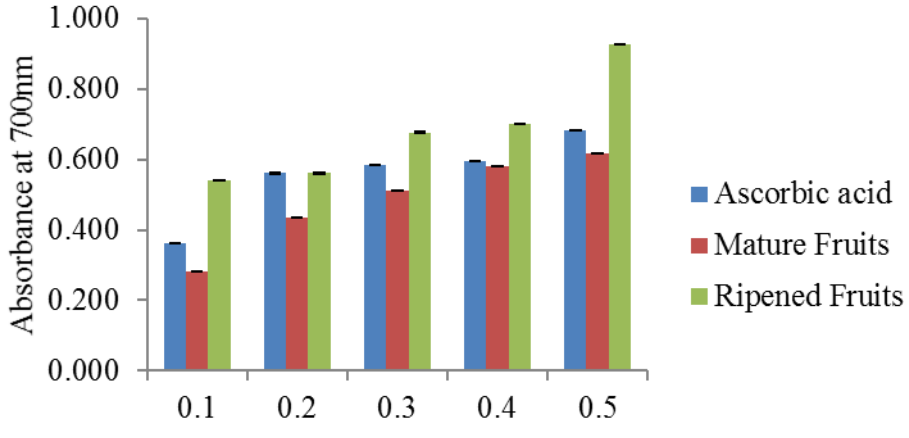
Graph 6: Ferric reducing antioxidant power (FRAP) in *Antidesma acidum*



Graph 7:Ferrous ion chelating ability in Antidesma acidum



Graph 8: Reducing power assay in *Antidesma acidum*



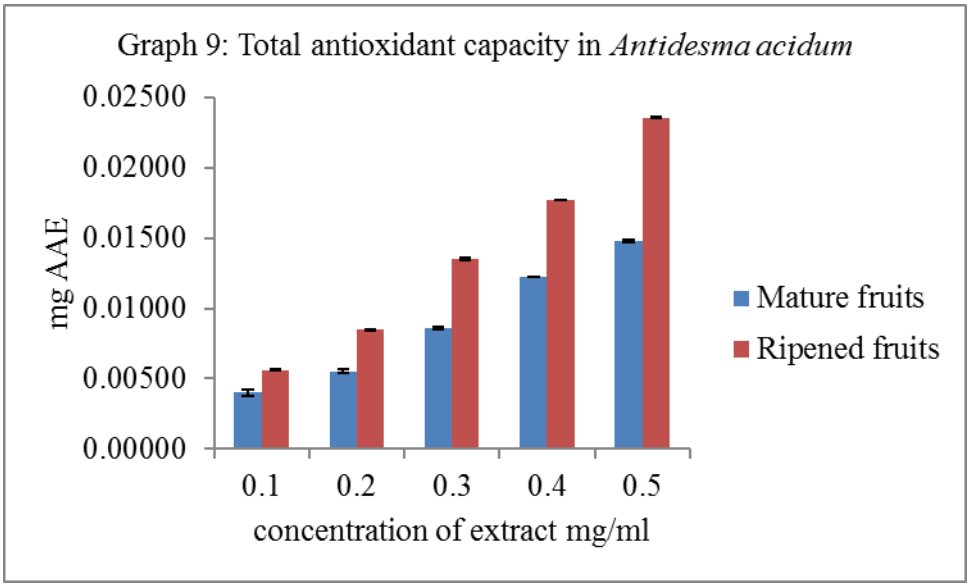


Table No. 1: Total phenolic content and Total Flavonoid content.

Antidesma acidum	**Total phenolic content (TPC) mg GAE/mg of extract**	**Total Flavonoid content (TFC) g/100g DW**
Mature fruits	0.0041 ± 0.0000	0.803 ± 0.000
Ripened fruits	0.0043 ± 0.0000	0.944 ± 0.004

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