



## **Antioxidant Activities of Extracts from Celery Leaves (*Apium Graveolens L*) Grown in Jos, Nigeria**

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### **Authors' contributions**

*This work was carried out in collaboration among all authors. Authors MSS, EAA, JHK and MMG designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors MSS, EAA, JHK and MMG managed the analyses of the study and the literature searches. All authors read and approved the final manuscript.*

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### **ABSTRACT**

The presence of natural antioxidant in plants is well known. Plant phenolics constitute one of the major groups of components that act as antioxidant and free radical terminator. Hence, this study focused on investigating the antioxidant activity of Celery plant (*Apium graveolens L*). The fresh leaves were collected, crushed and extracted with ethanol and acetone by maceration. The radical scavenging properties of the extracts were determined by measuring changes in absorbance of DPPH radical at a wave length of 517 nm by UV and ascorbic acid is used as the standard. It showed that the crude ethanolic extract has higher antioxidant activity compared to ascorbic acid and acetone extract with less scavenging activity. The values were (IC<sub>50</sub> 114.6 µg/mL) for ascorbic acid, (IC<sub>50</sub> 112 µg/mL) for the crude ethanolic extract and (IC<sub>50</sub> 172 µg/mL) for crude acetone extract. The result shows that Celery plant grown in Jos possess good antioxidant properties which may be linked to the presence of phenolics and flavonoids in the plant, which justifies its use as a medicinal plant. This can be further investigated for the isolation and identification of active compounds of medicinal utilities.

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## 1. INTRODUCTION

Plants produce a vast and diverse assortment of organic compounds, organic chemists, however, have long been interested in the study of phytochemicals and their chemical properties extensively since the 1850s [1]. Most developing countries including Nigeria are endowed with vast resources of medicinal and aromatic plants that have been used over the millennia for human welfare [2]. Medicinal plants represent a rich source from which antimicrobial agents may be obtained. Plant are used medicinally in different countries, plant are a source of many potent and powerful therapeutic agents. The active components of many drugs found in plant are secondary metabolites [3]. Traditional medicine practices in Nigeria have continued to provide remedies for various diseases and most rural dwellers depend on it for health care needs [4,5].

Flavonoids and other phenolic compounds spread widely in plants and their diverse biological activities such as antioxidants effects have been investigated in many studies such as coronary heart disease [6,7] diabetes [8] and cancer [9].

Celery is a member of the *Apiaceae* family. *Apiaceae* is large family of mostly aromatic flowering plants named after the type of genus *Apium*. Celery (*Apium graveolens* L) is a native of Spain, grown mainly in coastal regions. Celery is widely cultivated in the temperate zones as an important garden crop. The leave stalks are relished as a popular vegetable [10]. The Celery (*Apium graveolens* L) is not a native plant in Nigeria there for it doesn't have a local name but is now grown in Jos because of the favourable soil and climatic conditions which are suitable for growing such plant.

The plant genus has had a long history of its medicinal uses. *Apium graveolens* contains variety of bioactive components such as terpenoids, phenolic acids, alkaloids, tannins and flavonoids which have numerous biological and pharmacological properties such as hyperglycemic, analgesic, anti-inflammatory, anti-hypertensive, anticancer, anti-neurogenesis, anti-platelet, weight lost, natural diuretic, menstrual pain reduction and aid in digestion [11]. The plant can also be liquidized and be taken as a juice for joint and urinary tract inflammations, rheumatoid arthritis, cystitis, or

urethritis, for weak conditions and nervous exhaustion [12].

Celery (*Apium graveolens* L) is a medicinal herb used as food, and also in traditional medicine. It contains aromatic substance in the roots, stem and leaves. The healing properties of celery are due to the essential oils and flavonoids mostly apeginin and apiin [13]. The main objective of the present study is to determine the antioxidant properties of the plant extract using different extracting solvents.

## 2. MATERIALS AND METHODS

All reagents and solvents used were of analytical grade, the equipment used were thoroughly washed with HPLC graded hexane and acetone and oven dried at appropriate temperatures. Ethanol (99%) acetone (HPLC grade), ascorbic acid, 2, 2-Diphenyl-1-picrylhydrazyl (DPPH) and other reagents, all analytical grade (HPLC grade) were provided by JuNeng Nigeria Limited.

### 2.1 Collection and Identification of the Celery Plant

The fresh leaves of *Apium graveolens* L were collected from Yelwa ward (Jos North local government area of Plateau State, Nigeria) in the month of June, 2018. The Celery plant was identified and authenticated at the department of Horticulture, Federal College of Forestry Jos, Plateau State, Nigeria, and voucher specimen number (FHJ/18/012) was deposited in the Herbarium of the same department.

### 2.2 Sample Preparation and Extraction

The freshly collected leave samples were washed of dirt, pounded into smaller particle sizes using agate mortar and pestle. The properly crushed samples were immediately transferred into a stoppered container that had been previously washed with n-hexane and acetone and oven dried. This was extracted using HPLC graded ethanol and acetone by maceration at room temperature for 2 days (48 hours) with frequent agitation. The mixture was then strained into a beaker using muslin cloth and filtered with Whatman no.1 filter paper. The filtrate was then concentrated using Rotary Evaporator (R-205) at 60°C to obtain a crude extracts of the leaves, which was properly transferred and kept in an air-tight round bottom flask for further use [14,15].

### 2.3 Antioxidant Activity

The antioxidant activities of the crude extracts were determined on the basis of their scavenging activity of stable 2, 2-diphenyl-1-picrylhydrazyl (DPPH) free radical. A range of concentrations (0, 5, 10, 50, 100, 200, 300 and 500 µg/ml) of the extracts were prepared using serial dilution and to 1.0 ml each of the different concentrations prepared, 3 ml of 0.004% DPPH free radical solution was added and kept for 30 minutes for complete reaction [15,16]. The absorbance of the mixtures was then determined at the wavelength of 517 nm using UV-Vis spectrophotometer, where absolute ethanol was used as a control. This was compared with the corresponding absorbance of standard ascorbic acid concentrations (0-500 µg/ml). The % inhibition was calculated by the following equation.

$$\% \text{ percentage inhibition} = \frac{(\text{absorbance of blank} - \text{absorbance of sample})}{\text{absorbance of blank}} \times 100$$

From the standard curves of the different concentrations of the extracts, the inhibitory concentration (IC<sub>50</sub>) was determined using statistical analysis. IC<sub>50</sub> value denotes the concentration of sample required to scavenge 50% of the DPPH free radicals [14,17].

### 3. RESULTS AND DISCUSSIONS

The antioxidant activities of the crude ethanolic extract and crude acetone extract using DPPH were determined and compared to that of ascorbic acid (standard).

Tables 1 and 2 shows the results of the absorbance of standard ascorbic acid at 517 nm and those of crude ethanolic extract and acetone extract at the same wavelength. The IC<sub>50</sub> values for the ethanolic extract, ascorbic acid and acetone extracts were found to be 112 µg/ mL, 114.6 µg/mL and 171.73 µg/mL respectively. This IC<sub>50</sub> values indicates the scavenging activity of each crude extracts tested, compared to that of ascorbic acid, showing that the ethanolic extracts has higher antioxidant activity as lower IC<sub>50</sub> indicates a higher antioxidant activity [18]. The IC<sub>50</sub> values of the different extracts and ascorbic acid are shown in Table 3. Figure 1 shows the picture of the Celery Leaves (*Apium tablegraveolens L.*) Grown in Jos, Nigeria.

The antioxidant activity observed may be linked to the presence of phenolics, flavonoids and pigments in the celery plant. This study reveals that the celery leaves exhibit strong antioxidant property comparable to that of Ascorbic acid. Flavonoid and phenolic compounds may have

**Table 1. Crude ethanol extracts (Antioxidant activity using DPPH)**

Concentration (ug/mL)	Absorbance of standard ascorbic acid	Absorbance of ethanolic extract	Standard ascorbic acid % inhibition	Ethanolic extract % inhibition
0	0.672	0.644	0.9	5.0
5	0.649	0.501	4.3	26.1
10	0.531	0.452	21.7	33.3
50	0.277	0.311	59.1	54.1
100	0.101	0.275	85.1	59.4
200	0.083	0.098	87.8	85.5
300	0.055	0.082	91.9	87.9
500	0.055	0.083	91.8	87.8
<b>Blank = 0.678</b>				

**Table 2. Crude Acetone Extract (Antioxidant activity using DPPH)**

Concentration (ug/mL)	Absorbance of standard ascorbic acid	Absorbance of acetone extract	Standard ascorbic acid % inhibition	Acetone extract % inhibition
0	0.672	0.674	0.9	0.6
5	0.649	0.607	4.3	10.5
10	0.531	0.517	21.7	23.7
50	0.277	0.358	59.1	47.2
100	0.101	0.321	85.1	52.7
200	0.083	0.233	87.8	65.6
300	0.055	0.125	91.9	81.6
500	0.055	0.098	92.0	85.5
<b>Blank = 0.678</b>				

important role in the antioxidant and free radical scavenging ability of the *Apium graveolens* leaves. Yao et al. in (2010), analyzed the structure of phenolic compounds and phenolic activities of 11 antioxidant celery cultivars. The major phenolic acids in extracts included caffeic acid, p-coumaric acid and ferulic acid, while the identified flavonoids included apigenin, luteolin and kaempferol [19]. Apigenin was the main flavonoid in this sample and the most abundant phenolic acid was p-coumaric acid. Studied plants had high levels of phenolics and antioxidant capacity [19,20]. In another study conducted in 2012 by Nagella et al. Chemical compounds and antioxidant activity of essential oils isolated from celery leaves were investigated and the results showed that the isolated oil from celery has natural antioxidant capacity [21]. The above information shows that the major compounds of celery can have a key role as a natural antioxidant [21]. A study was carried out by Shanmugapriya and Ushadevi in (2014) on *Apium graveolens* seed extract, the antioxidant activity of the seeds was analyzed using the DPPH assay method. Among the various extracts under assessment, methanol extract had the highest antioxidant activity [20]. In the density of 80 mg/mL of extracts, methanol extract had the maximum antioxidant activity with 63.28%. In the entire concentration of methanol extract of the plant, the seed had highest antioxidant activity [22].

**Table 3. 50% inhibitory concentration (IC<sub>50</sub>) Values of DPPH scavenging activity of different *Apium graveolens* leave extracts and standard ascorbic acid**

Sample	IC <sub>50</sub> value (ug/mL)
Ethanol extract	112.0
Acetone extracts	171.75
Standard ascorbic acid	114.6



**Figure 1. Celery leaves (*Apium graveolens* L.) Grown in Jos, Nigeria**

#### 4. CONCLUSION

The celery plant extracts showed strong antioxidant capacity. The extracts can be considered as a good source of natural antioxidants and antimicrobials. Based on the result of free radical scavenging activity observed, the crude ethanolic extract exhibit stronger antioxidant activity as compared to standard ascorbic acid. The presence of flavonoids, terpenoids, anthocyanins and carotenoid among other secondary metabolites may be responsible for its antioxidant property and its medicinal application. Furthermore, these compounds can be isolated, screened and identified for different kind of therapeutic uses, further research will be needed to find out the structural analysis of flavonoids by use of different analytical method such as NMR and Mass Spectrophotometer. This would be useful in providing more scientific evidence in support of its therapeutic uses.

#### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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