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RESEARCH ARTICLE

Mineral Iron Content of *Commelina benghalensis, Paspalum vaginatum, Ipomoea pes-caprae* and *Philoxerus vermiculeris* found along Ibeno Coastline, Nigeria

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Abstract

This study evaluated mineral iron content in stem, leaf and root of *Commelina benghalensis*, *Paspalum vaginatum, Ipomoea pes-caprae* and *Philoxerus vermiculeris* during dry and wet seasons. The study showed that *C. benghalensis* exhibited 16% of the total mineral iron concentration in dry season, followed by *P. vermiculeris* (root; 13%), *I. pes-caprae* (stem; 11%), *P. vermiculeris* (leaf; 9%), *I. pes-caprae* (root; 8%), *P. vermiculeris* (stem; 7%), *P. vaginatum* (root; 6%), *I. pes-caprae* (leaf; 5%), *C. benghalensis* (stem; 4%), *P. vaginatum* (stem; 4%) and *P. vaginatum* (leaf; 4%). Unlike dry season, *P. vaginatum* (root) had highest total mineral iron concentration of 14% followed by *C. benghalensis* (stem; 13%), *P. vermiculeris* (root; 13%), *P. vaginatum* (stem; 10%), *P. vermiculeris* (stem; 9%), *C. benghalensis* (root; 8%), *I. pes-caprae* (stem; 8%), *I. pes-caprae* (leaf; 7%), *P. vaginatum* (leaf; 6%), *C. benghalensis* (leaf; 4%), *I. pes-caprae* (root; 4%) and *P. vermiculeris* (leaf; 4%). Increase in iron concentration in dry season follow the trend, *C. benghalensis* (33%)>*P. vermiculeris* (29%)>*I.pes-caprae* (24%)>*P. vaginatum* (14%). Increase in iron concentration during wet season in the present study follow the trend *P. vaginatum* (30%)> *P. vermiculeris* (26%)>*C. benghalensis* (25%)>*I. pes-caprae*. This study concluded that the evaluated species of plants are the best source of minerals in a form that is easy for our body to use.

Keywords: Anemia, mineral iron, *Commelina benghalensis*, *Paspalum vaginatum, Ipomoea pes-caprae, Philoxerus vermiculeris*.

Introduction

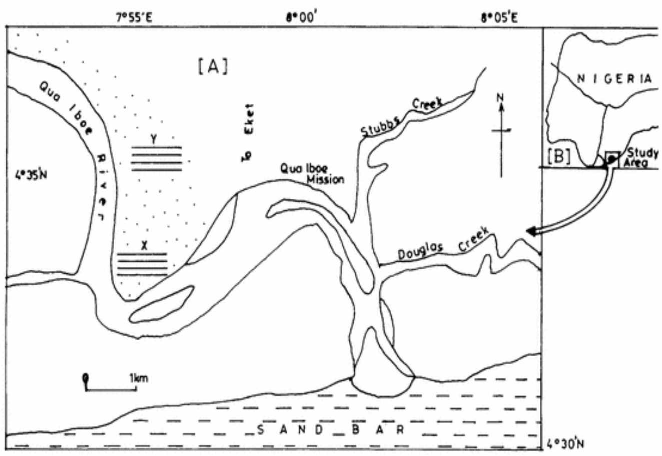
Our blood has almost the same composition as sea water. About 65-70% of the iron in the body is referred as 'transport iron' that is the iron as part of the haemoglobin (the pigment of the red blood cells), 25% is stored within the liver, spleen, bone-marrow and muscles (storage iron) and approximately 4% is used within myoglobin and iron-containing enzymes (functional iron). Haemoglobin is crucial for the supply of oxygen throughout the body and iron is the essential element needed by the body to produce sufficient amounts of haemoglobin. Furthermore, iron is part of haemoglobin itself and binds to oxygen which enables its transportation. If iron stores are low, normal haemoglobin production slows down, which means that the lungs receive less oxygen, resulting in symptoms such as fatigue, dizziness, lowered immunity or reduced performance and stamina in athletes. Since our body can't produce iron itself, we need to make sure we consume sufficient amounts of iron in our diet (Nelson, 2014). Anemia occurs when a person has lower-than-normal levels of red blood cells (RBCs) in the blood. According to the American Society of Hematology, there are many factors that can contribute to lower-than-normal RBC counts, including age, viral infections, and certain chronic diseases (ASH, 2010). Iron-deficiency anemia is the most common type of anemia, which occurs when our body does not have enough of the mineral iron. Our body needs iron to produce a protein called hemoglobin, which is responsible for carrying oxygen to your body's tissues. Our tissues and muscles need oxygen to function effectively. In women of child-bearing age, the most common cause of iron-deficiency anemia is loss of iron in blood due to heavy menstruation or pregnancy. Iron-deficiency anemia can also be caused by a poor diet or by certain intestinal diseases that affect how the body absorbs iron. According to the Centers for Disease Control and Prevention (CDC), iron deficiency is the most common nutritional deficiency in the United States. It is also the most common cause of anemia (CDC, 2011). Plants contain minerals and abundance of vitamins and other nutrients. Plants can be used for developing adaptive responses including the synthesis of several bioactive molecules. Currently, an increasing interest is granted to plant species because of their high content in bioactive compounds (primary and secondary metabolites) such as polyunsaturated fatty acids, carotenoids, vitamins, sterols, essential oils (terpenes), polysaccharides, glycosides, and phenolic compounds. These bioactive substances display potent antioxidant, antimicrobial, anti-inflammatory, and anti-tumoral activities, and therefore represent key-compounds in preventing various diseases (e.g. cancer, chronic inflammation, atherosclerosis and cardiovascular disorder) and ageing processes (Ksouri *et al.,* 2011).

Therefore, the main aim of this study is to evaluate *Commelina benghalensis*, *Paspalum vaginatum, Ipomoea pes-caprae* and *Philoxerus vermiculeris* as potential sources of preventing and treatments of iron deficiency anemia in human.

Materials and methods

Study area: Ibeno coastline (Fig. 1) is a sandy beach located in Akwa Ibom State that attracts thousands of tourists worldwide annually. The major river in the study area is Qua Iboe River which empties into the Atlantic Ocean. The study area is in a tropically humid climatic region characterized by distinct dry and wet seasons. The wet season, which sometimes begins in March or April to October, is always characterized by heavy storms of short duration. The dry season which normally lasts 3-5 months is comparatively short beginning in November and extending to February. The mean annual rainfall ranges from 2,000 to 3,200 mm for the study area. The mean annual temperature in the study area is fairly constant and averages about 28°C. Relative humidity is comparatively uniform over the area with mean value of 80% for October and 60% for dry season. It varies depending on the heaviness of the rains (Udosen *et al*., 2012). The main activities of the people are boat construction, fishing and sand mining (Uwah *et al.,* 2013).

Fig. 1. Map of the study area.



Plant collection: All plants were collected at low tide in two seasons (dry and wet) from Ibeno Atlantic Coastline Akwa Ibom State-Nigeria. Samples of *C. benghalensis, P. vaginatum, I. pes-caprae* and *P. vermiculeris* were generally found growing over sandy substrates near the intertidal offshore. Collected whole plants (50-100 g, fresh weight) were placed in polyethylene bags rinsed with doubled distilled water to eliminate salts and foreign particles. All samples were preserved in a cooler immediately after sampling at temperature of 4°C and were transported to the laboratory prior to further treatments and analysis.

Sample treatment and preparation: Prior to treatment, samples were identified in the Dept. of Botany, University of Calabar. Tissues samples for iron analysis were obtained from the leaves, stem and roots of the species, since these parts are essentials to analysis. Samples were dried overnight in an oven at a constant temperature of 60°C. Dried samples were ground and stored in plastics bags prior to digestion process.

Sample digestion: About 2 g of dried samples were poured into digestion flask and 20 mL conc. H_2SO_4, 10 mL conc. HNO_3, 16 g Na_2SO_3 and anti-bombing granules were added and mixed. The mixture was heated until a clear solution was observed. The beaker was then removed from the hot plate, cooled and transferred into 100 mL volumetric flask. The content of the flask was then diluted and made up to the mark with distilled water. This was then stored in sample bottles until required.

Iron analysis: For the determination of iron, 10 mL aliquot from the stock samples was taken and volume was adjusted to 100 cm^3 with distilled water. The treated samples were taken for the analysis of iron using atomic absorption spectroscopy.

Results and discussion

Iron concentration ranged from 1.63-7.25 mg/g in *Commelina benghalensis* with maximum concentration recorded in leaf tissues and the minimum concentration found in stem with a mean value of 4.88±2.91 (Table 1) in dry season. Meanwhile, in wet season, the iron concentration ranged from 2.08-5.93 mg/g maximizing at the stem and minimizing in leaf tissues with a mean value of 3.93±1.93 in *C. benghalensis*. A remarkable concentration of 5.75 and 3.8 mg/g during dry and wet seasons was also observed in roots of *C. benghalensis* proposing the major source of this nutrient element to be from the organic matter of the sediment. In the case of *Paspalum vaginatum,* the concentration of iron ranged from 1.75-2.58 mg/g maximizing in roots and minimizing in stem tissue with a mean value of 2.04±0.46 during dry season. Similar variation was recorded in wet season with concentration of iron ranging from 2.98 mg/g in leaf tissue to 6.85 mg/g in roots of the *P. vaginatum* with a mean value of 4.88±1.94 (Table 1). The marked value of iron in root tissue of *P. vaginatum* confirmed that the major source of this mineral iron to be the sediment of the study area. Iron concentration in *I. pes-caprae* was found ranging from 2.35 mg/g in leaf tissues to 5.13 mg/g in stem during dry season with a mean value of 3.71±1.39 (Table 1). In wet season, iron concentration ranged from 1.98 mg/g in roots to 3.73 mg/g in stem with a mean value 3.03±0.93. The concentration of iron in *P. vermiculeris* ranged from 3.35 mg/g in stem tissue to 6.18 mg/g in roots with a mean value of 4.58±1.45 during dry season while in wet season the concentration ranged from 1.68 mg/g in leaf tissue to 6.28 mg/g in roots tissue with a mean value of 4.03±2.3 in the present study.

Table 1. Concentration of iron in various plant parts (mg g^{-1} dw).

Sample	Fe conc. (mg/g)	Mean	Std. deviation	Variance
Dry season				
Ipomoea pes-caprae leaf	2.35			
Ipomoea pes-caprae stem	5.13	3.71	1.39	1.93
Ipomoea pes-caprae root	3.65			
Commelina benghalensis leaf	7.25			
Commelina benghalensis stem	1.63	4.88	2.91	8.48
Commelina benghalensis root	5.75			
Paspalum vaginatum leaf	1.8			
Paspalum vaginatum stem	1.75	2.04	0.46	0.21
Paspalum vaginatum root	2.58			
Philoxerus vermiculeris leaf	4.2			
Philoxerus vermiculeris stem	3.35	4.58	1.45	2.10
Philoxerus vermiculeris root	6.18			
Wet season				
Ipomoea pes-caprae leaf	3.4			
Ipomoea pes-caprae stem	3.73	3.03	0.93	0.87
Ipomoea pes-caprae root	1.98			
Commelina benghalensis leaf	2.08			
Commelina benghalensis stem	5.93	3.93	1.93	3.72
Commelina benghalensis root	3.8			
Paspalum vaginatum leaf	2.98			
Paspalum vaginatum stem	4.83	4.88	1.94	3.76
Paspalum vaginatum root	6.85			
Philoxerus vermiculeris leaf	1.68			
*Philoxerus vermiculeris*stem	4.13	4.03	2.30	5.30
Philoxerus vermiculeris root	6.28			

Remarkable value of 3.4 and 4.2 mg/g were recorded in leaf tissues of *I. pes-caprae* (wet season) and *P. vermiculeris* (dry season) respectively indicating the controlling factor of transpiration within the species. Generally as shown in Fig. 2, leaf tissue of *Commelina benghalensis* exhibited 16% of the total iron concentration in dry season, followed by *P. vermiculeris* (root; 13%), *C. benghalensis* (root; 13%), *I. pescaprae* (stem; 11%), *P. vermiculeris* (leaf; 9%), *I. pes-caprae* (root; 8%), *P. vermiculeris* (stem; 7%), *P. vaginatum* (root; 6%), *I. pescaprae* (leaf; 5%), *C. benghalensis* (stem; 4%), *P. vaginatum* (stem; 4%) and *P. vaginatum* (leaf; 4%). This result showed that *P. vaginatum* was found with the lowest concentration of iron in dry season while *C. benghalensis* was found with the highest concentration. *Philoxerus vermiculeris* also exhibited a remarkable concentration. Increase in iron concentration in dry season follow the trend, *C. benghalensis* (33%)>*P. vermiculeris* (29%) >*I. pes-caprae* (24%)>*P. vaginatum* (14%). In wet season, there was variation in total percentages of iron in the present study as shown in Fig. 3. Unlike dry season, *P. vaginatum* (root) was found with highest conc. of 14% followed by *C. benghalensis* (stem; 13%), *P. vermiculeris* (root; 13%), *P. vaginatum* (stem; 10%), *P. vermiculeris* (stem; 9%), *C. benghalensis* (root; 8%), *I. pes-caprae* (stem; 8%), *I. pes-caprae* (leaf; 7%), *P. vaginatum* (leaf; 6%), *C. benghalensis* (leaf; 4%), *I. pes-caprae* (root; 4%) and *P. vermiculeris* (leaf; 4%). Increase in iron conc. during wet season follow the trend *P. vaginatum* (30%) >*P. vermiculeris* (26%)> *C. benghalensis* (25%)>*I. pes-caprae*.

Fig. 2. Distribution of iron in root, stem and leaf of plants in dry season.

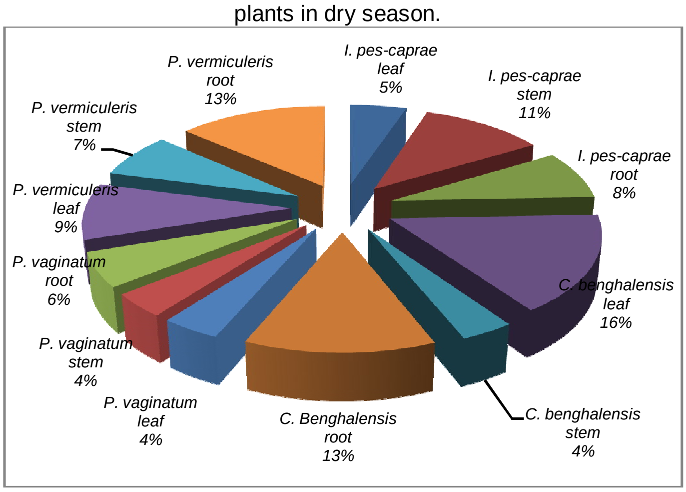
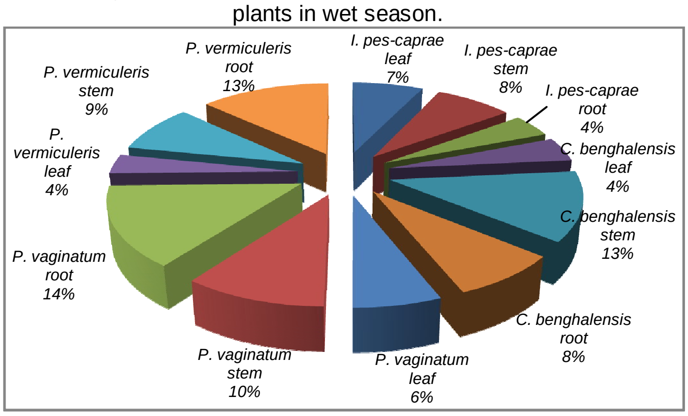


Fig. 3. Distribution of iron in root, stem and leaf of plants in wet season.



It was also observed that, iron availability was low generally during wet season in leaf tissues, which means that transpiration have little or no effect in mineral iron distribution within tissues of plants. It's worth to note that stem and roots of plants contain more mineral iron for preventing and treating iron-deficiency anemia in human when compared to leaf.

Conclusion

From the result obtained for mineral iron concentration in root, stem and leaf along Ibeno coastline, *Commelina benghalensis*, *Paspalum vaginatum, Ipomoea pes-caprae* and *Philoxerus vermiculeris* are potential sources of preventing and treating iron deficiency anemia in human when compared to other sources of iron such as meats which contains high level of cholesterol and fat that can cause cardiovascular diseases and are very dangerous to hypertensive patients.

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