COMPARATIVE ANALYSIS OF THE NUTRITIONAL AND MINERAL VALUES OF LAND FERN (PTERIDIUM AQUILINUM) AND WATER FERN (NEPHOLEPSIS BISERRATA) CONSUMED IN OKWALE COMMUNITY, NIGERIA

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Abstract

This work was on the comparative analysis of the nutritional and mineral values of land fern (Pteridium aquilinum) and water fern (Nephrolepsis biserrata) consumed in Okwale Community, Nigeria. The parameters were analyzed using standard methods of the Association of Official Analytical Chemists (AOAC, 2006), flame Spectrophotometer and atomic absorption Spectrophotometer. In this study, the moisture (83.33%), protein (7.00), and carbohydrate (6.25%) contents of Pteridium aquilinum was higher than the moisture (66.41%), protein (6.56%) and carbohydrate (5.208%) contents of Nephrolepsis biserrata. However, the fibre (10.002%), lipid (9.60%) and ash (2.20%) contents of Nephrolepsis biserrata was higher than fibre (0.62%), lipid (1.30%) and ash (1.50%) contents of Pteridium aquilinum. The mineral values of Pteridium aquilinum and Hephrolepsis biserrata also showed that the potassium (4318.950 mg/kg), iron (689.70 mg/kg), magnesium (465.15 mg/kg), calcium 361.10 mg/kg), sulphate (229.950 mg/kg), sodium (163.65 mg/kg), zinc (107.70 mg/kg), manganese (51.95 mg/kg), phosphorus (36.33 mg/kg), and copper (4.15 mg/kg) contents of Pteridium aquilinum were higher than potassium (78.672 mg/kg), iron (337.40 mg/kg), magnesium (436.20 mg/kg), calcium (135.15 mg/kg), sulphate (114.975 mg/kg), sodium (128.00 mg/kg), zinc (87.70 mg/kg), manganese (43.85 mg/kg), phosphorus (35.82 mg/kg), and copper (1.90 mg/kg) contents of Nephrolepsis biserrata. Chromium was not detected in both ferns. However, the calculated mean value of the minerals of Ptgeridium aquilinum (642.863 mg/kg) is higher than that of Nephrolepsis biserrata (39.967 mg/kg). This is a clear indication that Pteridium aquilinum is more nutritious than Nephrolepsis biserrata. This study therefore recommends that both ferns should be consumed with more preference on Pteridium aquilinum (land fern).

Keywords: Nutritional values, minerals values, comparatives analysis, land and water ferns' Okwale Community.

Introduction

Kebe (ferns) are used worldwide as food. In Europe and America, a few fern, such as ostrich fern, were used for food. However, in Oceania and Asia, there are so many fern used as foods as main or side dishes and traded in market place. Especially in Korea, the dried and steamed fiddle head of brackens are important as ancestral service food for Thanksgiving Day, New Year's Day and home ceremony for ancestors every year. In Ghana, fern together with other leafy plants are used in making palm-nut soup and given to lactating mothers. The protein in the fern is believed to enrich the blood of lactating mothers (Shin, 2010; Wei, 2010).

In Nigeria, a variety of unprocessed foodstuffs are eaten by different communities regardless of the nutritive value, mineral value and potential toxic hazards posed to health by some of the constituents. However, many people are aware of the benefits of regular consumption of leafy plants and vegetables which serves as sources of both minerals and nutrients that refresh and nourish the body (Enechi and Odonwodo, 2008).

Attention on minerals and nutritive constituent has been focused mainly on commonly used leafy vegetable species in Nigeria such as dandelion greens, bitter leaves, African spinach, Malabar spinach, Lagos spinach, African egg plant leaf, African basil (scent leaves), African jointfir (afang or okazi leaves), fluted pumpkin leaves, atama leaves, uziza leaves, moringa leaves and garden egg leaves. This has led to the neglect, less cultivation, underutilization and un-recognition of other equally important edible leafy vegetable like fern.

Meanwhile, it is used in most part of Africa especially in Ghana and Nigeria in combination with other leaves to improve the quality and quantity of breast milk in lactating mothers. The leaves (fronds), spores, fiddle heads, rhizomes, and roots of ferns have infinite potential for improving the quality of human life because of their biological activities (Fashakin, 2014). Moreover, very little is known in literature about the nutritional values and mineral values of land fern (*Pteridium aquilinum*) and water fern (*Nephrolepsis biserrata*) in Okwale Community in Ogoni. Hence, the comparative study of the nutritional and mineral composition of land fern (*Pteridium aquilinum*) and water fern (*Nephrolepsis biserrata*) in Okwale Community in Ogoni, Nigeria is of paramount importance.

Materials and Methods

Sample Collection and Preparation

Fresh leaves of selected fern were collected from uncultivated farm land and streams in Okwale Community. Both were packaged differently in polyethylene bags and taken to the Department of Forestry, Wildlife and Biodiversity for Identification by Experts. The authenticity of the fern samples

were validated and certified to be *Pteridium aquilinum* (Land fern) and *Nephrolepsis biserrata* (Water fern).

Fresh samples of *Pteridium aquilinum* and *Nephrolepsis biserrata* were collected at random not according to their anatomy or their morphological stage of growth. They were sorted to remove unwanted materials, washed, grinded and used immediately for the analysis.

Determination of Nutritional Value

Fresh samples of *Pteridium aquilinum* and *Nephrolepsis biserrata* were analyzed for their moisture, ash, protein, lipid, carbohydrate and fibre contents using standard methods of the Association of Official Analytical Chemists (AOAC, 2006).

Sample Preparation for Determination of Values

1 gram of the fresh sample of ferns was weighed respectively into two porcelain crucibles. Each of the crucibles was inserted into a muffle furnace and regulated to a temperature of 630^0C for three hours and allowed to cool to room temperature. The ash content was dissolved in 10ml of concentrated hydrochloric acid and was heated on a hotplate till color change was observed and was allowed to cool. The respective solutions of ash were diluted to 50mls with distilled water and used for analysis.

Fresh samples of *Pteridium aquilinum* and *Nephrolepsis biserrata* were analyzed for sulphur, phosphorus, calcium, magnesium, sodium, potassium, chromium, copper manganese, iron and zinc using different instrumentation technique as shown in Table 1 below.

Table 1: The Methods used for the Analysis of Minerals

Parameters	Abbreviation	Units	Method/Instrumentation Technique
Sulphur	SO_4^{2-}	Mg/Kg	AOAC, (2006)/Flame Spectrometer
Phosphorus	P	Mg/Kg	AOAC, (2006)/Flame Spectrometer
Calcium	Ca	Mg/Kg	AOAC, (2006)/Atomic Absorption Spectrometer
Magnesium	Mg	Mg/Kg	AOAC, (2006)/Atomic Absorption Spectrometer
Sodium	Na	Mg/Kg	AOAC, (2006)/Atomic Absorption Spectrometer
Potassium	K	Mg/Kg	AOAC, (2006)/Atomic Absorption Spectrometer
Chromium	Cr	Mg/Kg	AOAC, (2006)/Atomic Absorption Spectrometer
Copper	Cu	Mg/Kg	AOAC, (2006)/Atomic Absorption Spectrometer
Manganese	Mn	Mg/Kg	AOAC, (2006)/Atomic Absorption Spectrometer
Iron	Fe	Mg/Kg	AOAC, (2006)/Atomic Absorption Spectrometer
Zinc	Zn	Mg/Kg	AOAC, (2006)/Atomic Absorption Spectrometer

Results and Discussion

Nutritional Values of the Samples

The result of the nutritional values of *Pteridium acquilinum* (land fern) and *Nephrolepsis biserrata* (water fern) is presented in Table 2 below.

Table 2: Nutritional Values of *Pteridium aquilinum* and *Nephrolepsis biserrata*

	Sample	
Parameters	***Pteridium aquilinum***	***Nephrolepsis biserrata***
Moisture	83.33%	66.41%
Ash	1.50%	2.20%
Carbohydrate	6.25%	5.208%
Protein	7.00%	6.56%
Lipid	1.30%	9.20%
Fibre	0.62%	10.022%
Mean	16.67%	16.67%

Mineral Values of the Sample

The result of the mineral values of *Pteridium aquilinum* (land fern) and *Nephrolepsis biserrata* (water fern) is presented in table 3 below.

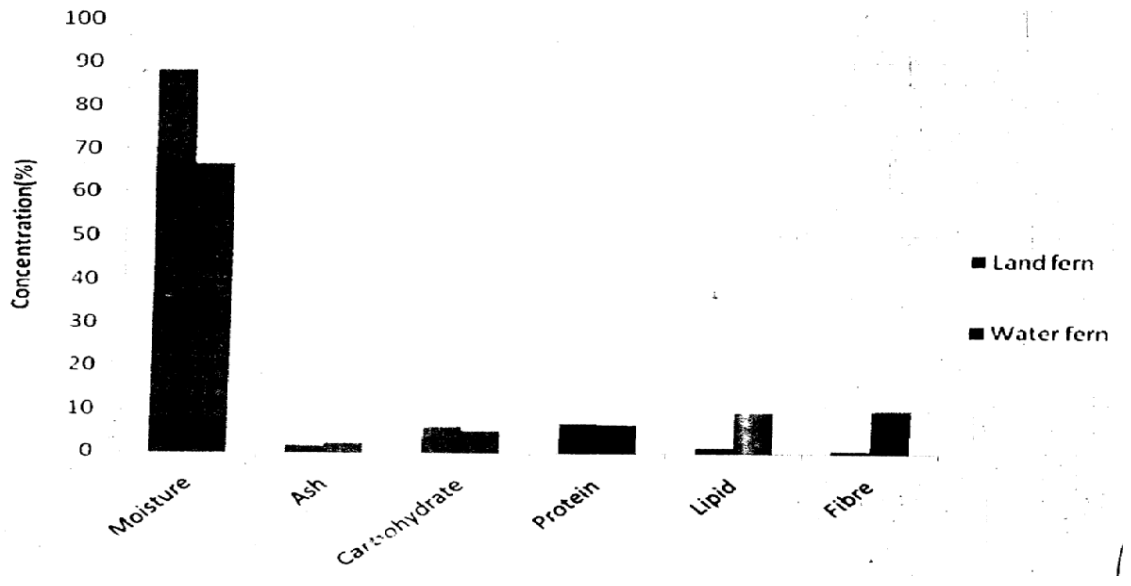

Fig. 1: Bars of Nutritional Values of land fern and water fern

Table 3: Mineral Values of *Pteridium aquilinum* and *Nephrolepsis biserrata*

	Sample	
Parameters	***Pteridium aquilinum***	***Nephrolepsis biserrata***
Sulphate	229.950 mg/kg	114.975 mg/kg
Phosphorus	36.33 mg/kg	35.82 mg/kg
Calcium	361.10 mg/kg	135.15 mg/kg
Magnesium	465.15 mg/kg	436.20 mg/kg
Sodium	163.65 mg/kg	128.00 mg/kg
Potassium	4318.950 mg/kg	78.672 mg/kg
Copper	4.15 mg/kg	1.90 mg/kg
Magnessium	51.95 mg/kg	43.85 mg/kg
Iron	689.70 mg/kg	337.40 mg/kg
Zinc	107.70 mg/kg	87.70 mg/kg
Chromium	Not detected	Not detected
Mean	642.863 mg/kg	139.967 mg/kg

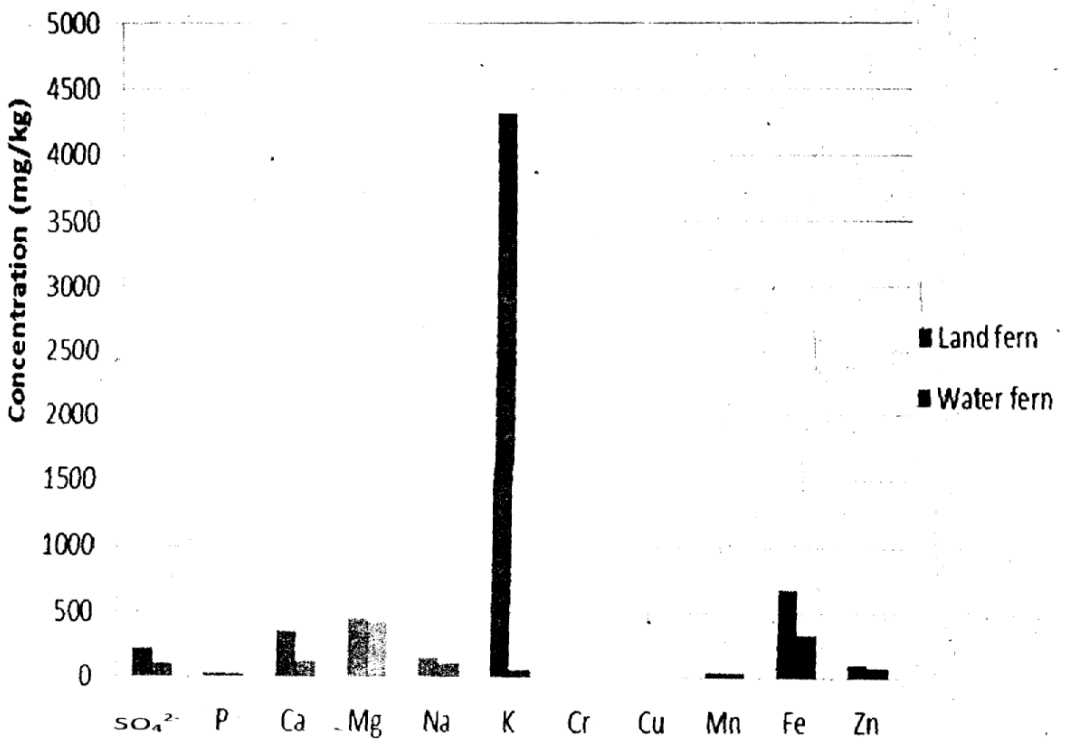

Fig. 2: Bars of Mineral values of land fern and water fern.

Discussion of the Result

The moisture content of *Pteridium aquilinum* was found to be 83.33% compared to *Nephrolepsis biserrata* which was 66.41% (Table 2). The trend in moisture content of the two fern types in this study were close with those obtained from *Palisota hirsute* (84.00%). *Rauvoltfia vomitoria* (76.50%), *Spondias mombin* (64.00%). Oha (83.75%), Nturukpa (80.75%) and Okazi (83.75%) as reported by Bassey *et al.,* (2014). However the results of both ferns are much higher than 9.26% and 22.23% reported by Awe and Amobi (2015) and Babyemi *et al.,* (2006) who worked on same *Pteridium aquilinum* and *Nephrolepsis biserrata* same *Pteridium aquilinum* and *Nephrolepsis biserrata* respectively. The high moisture content of *Pteridium aquilinum* is due to its high water requirement for survival and its extensive root system which has many fine roots in the soil surface which enables the fern to compete effectively with pasture species for moisture and nutrients. High amount of moisture in plants makes them vulnerable to microbial attack, hence spoilage (Desai and Salunkhe, 2008). The moisture content of any food is

an index of its water activity and is used as a measure of stability and susceptibility to microbial contamination (Davey, 2012). The high moisture content also means that dehydration would increase the relative concentration of other food nutrients and thereby increase the shell-life of the ferns. The proportion of ash content is a reflection of the total amount of minerals present within a food. The ash content of *Nephrolepsis biserrata* 2.20% was higher that *Pteridium aquailinum* 1.50% (Table 2). These results could suggest a high deposit of mineral elements in *Pteridiu aquilinum* than in *Nephrolepsis biserrata.*

There was a notable increase in protein and carbohydrate content of both ferns. However, the protein and carbohydrate contents of *Pteridium aquilinum* 7.00% and 6.25% were higher than *Nephrolepsis beserrata* 6.56% and 5.208 respectively as shown in Table 3. This observation could be explained by the fact that when fat is removed from a food sample, the ingredients available to replace it are protein, carbohydrates, minerals or air.

These items increase automatically and proportionally even if nothing new is added to the food sample (Vaclavik and Christian, 2008). This phenomenon was consistent with observations reported by Oloyede et al., (2008) and Awe and Amobi (2015) who also recorded increased in protein and carbohydrate contents in same species of fern; *Nephrolepsis biserrata* and *Pteridium aquilinum* respectively. The high protein content of the fern leaves suggest that it can supplement cereal and tuber flours which are not only deficient in amino acids but low in protein. However, carbohydrate is the main source of energy for man and animals as a result these ferns are necessary for them.

Lipids are a measure of energy values as it yields high amount of energy. The lipid content of *Nephrolepsis biserrata* 9.60% was far much higher than *Pteridium aquilinum* 1.30% as shown in Table 2. The decrease in the lipid content of *Pteridium aquilinum* might be due to degradation of the fern during regular visit of ants, birds and perhaps microorganisms.

The fibre content of *Nephrolepsis biserrata* 10.022% was evidently higher than the fibre content of *Pteridium aquilinum* 0.62% (Table 2). The value obtained for both fern were lower when compared to vegetables like Okazi (24.6%), and Nturukpa (24.6%) as reported by Najeeb et al., (2014). Fibre is the part of the food that is not digested by human but the functioning of the intestinal tracts depends upon the presence of

adequate fibre. It decreases the time that waste materials spend in the gastrointestinal tract. Fibre helps in the maintenance of human health and has been known to reduce cholesterol level of the body. Thus *Nephrolepsis biserrata* can be preferred as a veritable fibre source in diet over *Pteridium aquilinum* as a result of its relatively high fibre content.

Minerals are considered to be essential in human nutrition and generally minerals from plant sources are less-bioavailable than those from animal sources (Soetan et al., 2010). Table .3 shows the mineral values of *Pteridium aquilinum* and *Nephrolepsis biserrata* in mg/kg. Although, the mineral values of *Pteridiurn aquilinum* were quantitatively higher than *Nephrolepsis biserrata* except for chromium which was not detected in both species. Although the mineral values of both species were high, copper and phosphorus show very low values of 4.15 and 1.90; and 36.33 and 35.82 of *Pteridium aquilinum* and *Nephrolepsis biserrata* in mg/kg respectively. These minerals are vital for the overall mental and physical wellbeing, and are important constituent of bones, teeths, tissues, muscles, blood and nerves cells (Batra and Seth, 2002).

They generally help in maintenance of acid-base balance, response of nerves to physiological stimulation and blood clotting. Calcium and Phosphorus are associated with each other for growth and maintenance of bones, teeth and muscles. Magnesium is a component of the chlorophyll and it is an important content in connection with ischemic heart disease and calcium metabolism in bone. Zinc is involved in normal functioning of immune system and is associated with protein metabolism. Iron is an essential trace element for haemoglobin formation, normal functioning of central nervous system and in the oxidation of carbohydrate, protein and fat (Tejada-jimemez, 2009). Deficiencies of these minerals are known to affect the performance and health of animals. In animals a Ca/P ratio above 2.0 helps to increase the absorption of calcium in the small intestine. Food is considered “good” if the ratio Ca/P > 1 and “poor” if <0.05 (Asagba, 2007). The Ca/P ratio of *Pteridium aquilinurn* is 9.94. And *Nephrolepsis biserrata* is 3.77. Therefore, *Pteridium aquilinum* is more preferable in calcium absorption. The differences in the values obtained could be due to the level of minerals in the soil, climate and. stage of growth.

Conclusion

This study was conducted to comparatively analyze the nutritional and mineral values of *Pteridium aquilinum* and *Nephrolepsis biserrata* consumed in Okwale community. In this study, the moisture (83.33%), protein (7.00), and carbohydrate (6.25%) contents of Pteridium aquilinum was higher than the moisture (66.41%), protein (6.56%) and carbohydrate (5.208%) contents of *Nephrolepsis biserrata*. However, the fibre (10.002%), lipid (9.60%) and ash (2.20%) content of *Nephrolepsis biserrata* was higher than fibre (0.62%), lipid (1.30) and ash (1.50%) contents of *Pteridiurn aquilinum.* The mineral values of *Pteridium aquilinum* and *Nephrolepsis biserrata* also showed that the potassium (4318.950mg/kg), iron (689.70mg/kg), magnesiurn (465.15rhg/kg), calcium (361.10mg/kg), sulphate (229.950mg/kg), sodium (163.65mg/kg), zinc (107.70mg/kg), manganese (51.95mg/kg), phosphorus (36.33mg/kg) and copper (4.15mg/kg) contents of *Pteridium aquilinum* were higher than the potassium (78.672mg/kg), iron (337.40mg/kg) magnesium (436.20mg/kg),calcium (135.15mg/kg), sulphate (114.975mg/kg), sodium (128.00mg/kg), zinc (87.70mg/kg), manganese (43.85mg/kg), phosphorus(35.82mg/kg), and copper (1 .90mg/kg) contents of *Nephrolepsis biserrata.* Chromium was not detected in both ferns. However, the calculated mean results of the nutritional and mineral value of *Pteridium aquilinum* (16.67% and 642.863mg/kg) is higher than that of *Nephrolepsis hiserrata* (16.67% and 39.967mg/kg) respectively. This is a clear indication that *Pteridium aquilirium* is more nutritious than *Nephrolepsis biserrata* consumed in Okwale community, Nigeria.

The following are further recommended based on the findings of the study:

1. *Pteridium aquilirium* should be consumed more than *Nephrolepsis biserrata* because it's more nutritious.
2. Further studies should be conducted to ascertain the potential toxicity of *Pteridium aquilinum* and *Nephrolepsis biserrata*, as this will enlighten the people of Okwale community and Nigeria of its effect if any, when consumed by humans or animals in excess.
3. Further studies should be encourage to ascertain the nutritiona1 and mineral value of ferns found in Nigeria, this will help reduce over dependence on commonly used vegetables.

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