African Journal of Food Science Vol. 4(7), pp. 440 - 443, July 2010
Available online http://www.academicjournals.org/ajfs
ISSN 1996-0794 ©2010 Academic Journals

Full Length Research Paper

The health implications of the dietary nutrients detected in the vegetable leaves intercropped with *Raphia hookeri* palms

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Accepted June 28, 2010

Nigerian green vegetables were intercropped with *Raphia hookeri* palms. The leaves of the vegetables and *Raphia* palms were harvested. Proximate composition and mineral contents of the leaves were analyzed by standard methods. The proximate composition result (mean) ranged between: 72.9 - 91.2 (% moisture), 1.3 - 3.0 (% proteins), 0.3 - 3.0 (% lipid), 1.5 - 4.2 (% crude fibre), 1.0 - 4.0 (% ash) and 2.5 - 10.0 (% carbohydrate). The mineral elements detected were in varied concentrations. The health implications of the nutrients detected in human physiology are discussed. On the overall, the nutrients detected were found to play significant roles in humans.

Key words: *Raphia hookeri*, Nigerian green vegetables, proximate composition, mineral content.

INTRODUCTION

The *Raphia* palms are a genus of twenty species of palms native to tropical region of Africa, central and Southern America. Soils supporting the growth of *Raphia hookeri* have been well documented by Obahiagbon (2008); Ndon (2003) and Aghimien et al. (1984). In Nigeria the palms are grown in the south - south geographical zones, particularly along the swampy area of the tropical forest (Moore, 1973; Otedoh, 1974; 1975; Keay et al., 1964). Its growth requires high rainfall, high temperature (22 - 33°C), sunshine of not less than 5 - 7 h and high relative humidity (Ndon, 2003). Every part of the plant is useful economically. The economic products of *R. ho*okeri palm include: the palm sap/wine, gin (distilled from the fermented sap), brooms, bambo, piassava, raffia, oil, roofing mats, baskets etc (Otedoh, 1974; Obahiagbon, 2009).

A great variety of plants and their different parts are eaten as vegetables in Nigeria. In short, green leafy vegetables constitute an indispensable part of human diet. They are consumed generally as cooked compliments to major staples like cassava, cocoyam, based on these staples are considered incomplete without a general serving of cooked green leaves (Oguntona and Oguntona, 1986; Oguntona et al., 1989). They are important food and highly beneficial for the maintenance of health and prevention of diseases. They contain valuable food nutrients which play notable roles in human nutrition, especially in repair and build-up of the body. Besides, they are useful in the maintenance of the alkaline reserve of the body (Oguntona, 1986)?. Greens are especially rich in ascorbic acid and carotene, so closely related to vitamin A. Most of the vitamins of the B group are well represented: thiamine, riboflavin, nicotinic acid among the commonest and in addition pyridoxine, pantothenic acid, folic acid and vitamin K. The percentage of proteins in leaves is low, but what is present is of the highest grade (Rankin et al., 1976). Leafy vegetables are typically low in calories, low in fats, high in dietary fiber, high in iron and calcium and very high in phytochemicals (http://en.wikipedia.org).

Though several authors have reported their findings on vegetable leaves cultivated in Nigeria, there is no report on the green vegetables intercropped with *R. hookeri* palms. Most of the upland growers of this palm in Ovia North-East of Edo State practice the farming system of intercropping. The advantages of growing crops in mixture include higher yield/unit area and increased yield stability (Elemo and Mabbayad, 1980), more efficient use

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of land, maximization of labour use, risk minimization etc (Willey, 1979; Remision, 1980) pest diversion (Onolemhenmhen et al., 1991) and reduction in the levels of insect pests and diseases (Uvah, 1992).

The vegetables intercropped with the *R. hookeri* palms are consumed in large quantities in the upland area where the present study was conducted. The statistics on the production scale of the vegetables are not available. In addition, the nutritional contents and/or benefits of the vegetables grown under the same conditions have not been reported from the present area of study. This study is therefore set to examine the nutritional contents of vegetable leaves intercropped with *R. hookeri* palms and their roles in human health.

MATERALS AND METHODS

Sample collection

The leaves were harvested from a farm land location at Eka-Abetu Village in Ovia North-East of Edo State. The sample leaves for moisture content determination were collected in polyethylene bags to prevent loss of water and labeled accordingly, before conveyance to the laboratory, where the moisture contents were determined (Obahiagbon, 2007). The leaf sample for the other parameters were stored in brown envelops and dried at 55°C for 24 h (Abuye et al., 2003). The dried leaf samples were milled into powder in a milling machine, with 20 mesh sieve.

Proximate composition

The proximate composition of the leaf samples was determined by standard methods (AOAC, 1990).

Minerals assay

Selected mineral elements were assayed for with an atomic absorption spectrophotometer, Model 969 and Unican series (Perkin-Elmer corp., 1968).

RESULTS AND DISCUSSION

The results for these studies are presented in Tables 1 and 2. The moisture contents of the leaves analyzed ranged between 72.9 and 91.2%. The water leaf had the highest moisture content while the Okazi leaf had the least water content. The moisture content of the leaves could be reported as high on the overall, since these values were a fraction of the total nutrients contained in each of the leaves. The high water levels of the leaves suggest that the plants had good supply of water and adequate absorption mechanism. The consumption of the leaves under reference would no doubt yield part of the water demand of human subjects, as two thirds of the weight of the body is due to water. Water is present in and around all cells. Water provides fluid basis for the blood, the lymph, glandular secretions and the excretion. Adipose tissue has the lowest water content of 10 percent, followed by bone with 25% and the remaining tissues average 50% (Rankin et al., 1976).

The protein contents of the leaves ranged between 1.3 and 13%. The okazi leaf had the highest protein content while the ewedu leaf had the least content. The health implications of protein consumption include the involvement of its essential and nonessential amino acids as building blocks for protein biosynthesis, not only for the growth of infants and children but also for the constant replacement and turnover of body protein in adult. Again, amino acids, which are the building blocks of protein, are precursors of hormones, porphyrins and many other biomolecules in humans (Lehninger, 1990). Though the protein contents of the vegetable leaves appear not to be high from the nutritional point of view, in animal and human nutrition, the importance of protein in a diet correlate not only with the amount of the protein but also with the essential amino acids profile of the protein. The cumulative (that is, overall sources intake of nutrients from difference sources, may be more important than single and isolated sources in the feeding habits of any people. Accordingly, the small amounts of proteins in most of the vegetables could be regarded as important in being part of the cumulative of protein is human nutrition (Ukhun and Dibie, 1990).

The fats content detected in the vegetable leaves ranged between 0.30 and 6.0%. The okazi leaf had the highest content of fats, while the water leaf had the lowest content. Fats are major energy yielder in human nutrition, ranking close behind carbohydrate. Fats are essential carbon sources for the biosynthesis of cholesterol and other steroids. The provision of essential fatty acids by plant triacylglycerol is also well known and documented (Lehninger, 1990). The low crude fat sources observed in the vegetable leaves make them good for human health (Rumeza et al., 2006).

The range of carbohydrate contents of the leaves was between 2.5 and 10%. Cassava, Amaranths and Okazi leaves had the highest concentrations of carbohydrate, while the least value was in *R. hookeri* leaf. In humans, carbohydrate are utilize as major sources of biological energy through their oxidation in the cells. They also function as organic precursors for the biosynthesis of many cell components.

The crude fibre contents of the vegetable leaves were generally low. Fibre in human diet helps to prevent over-absorption of water and the formation of hard stools which can result in constipation. Besides, fibre lowers the body cholesterol level, thus reducing the risk of cardiovascular diseases (Rankin et al., 1976; Rumeza et al., 2006).

The ash contents ranged between 1 and 4% (Okazi leaf). The mean magnesium contents of the leaves was between 0.5 /100 g and 3.0 /100 g, with Amaranths and water leaves having the highest concentrations,

Table 1. Proximate composition of vegetable leaves intercropped with *R. hookeri* palms.

Leaf samples	Moisture (%)	Protein (%)	Total fat (%)	Crude fibre (%)	Ash (%)	Carbohydrate (%)
Bitter leaf	80.0	3.8	2.0	1.6	1.0	7.40
Ewedu leaf	90.0	1.3	2.9	1.2	2.0	2.6
Cassava	78.5	3.5	0.8	4.2	3.0	10.0
Okazi leaf	72.9	13	3.0	3.0	4.0	10.0
Fluted Pumpkin leaf	82.0	3.0	2.0	3.0	3.0	7.0
Lettuce leaf	90.0	1.5	0.4	3.0	1.5	3.3
Cocoyam leaf	85.0	4.0	1.0	2.0	3.0	5.0
Amaranths	82.2	5.0	1.3	1.5	2.0	10.0
Pepper leaf	89.0	2.5	0.6	1.4	1.0	6.0
Water leaf	91.2	2.0	0.3	2.0	1.5	3.0
R. hookeri leaf	85	3.0	2.5	4.0	3.0	2.5

while the lettuce leaf had the lowest content of magnesium. Magnesium has many diverse physiological functions. It is essential for the integrity of bone and teeth in the intercellular fluids. It is the second most plentiful cation after potassium. Magnesium is an active component of several enzyme systems in which thiamin pyrophosphate (TTP) is a cofactor (McDowell, 1992). Intracellular, magnesium is predominantly associated with the mitochrondria. Its main role in this respect is as an activator of enzymes (Wacker, 1969). Magnesium plays active roles in protein synthesis and in neuromuscular transmission.

The mean concentration of potassium in the leaves under reference was between 1.0 /100 g and 6.5 /100 g. Physiologically, potassium functions as an electrolyte in body fluids alongside with sodium and chlorine. They help to maintain osmotic pressure and regulate acid-base equilibrium. Potassium is the principal intracellular cation. Potassium functions as a cofactor in several enzyme systems involved in the transmission of nerve impulses and in the regulation of heart beat (Thompson, 1978).

The calcium contents in the leaves were in varied concentrations. The fluted pumpkin leaf had the highest concentration of calcium, (2.0 /100 g), while the lettuce leaf had the least concentration of 0.09 g/100 g. Calcium like phosphorus forms the major part of the mineral content of bone. Calcium is very abundant in the human body. Non-skeletal calcium plays important roles in a wide variety of essential functions in body metabolism (Bronner, 1964).

The mean sodium concentration of the leaves ranged between 0.04 /100 g and 1.0 /100 g. The bitter leaf, fluted pumpkin leaf and Amaranths leaf had the highest concentration. Like potassium and chlorine, sodium helps to maintain osmotic pressure and regulate acid-base equilibrium in body fluids. Sodium plays a major role in the transmission of nerve impulse and in maintaining proper muscles and heart contraction. Sodium plays essential roles in the control of the passage of nutrients into the cells and waste products out. Sodium ions must be present in the lumen of the small intestine for absorption of sugars and amino acids (Grim, 1980).

The concentrations of zinc in the leaves were very low. The highest concentration was in Amaranths leaf (0.06 /100 g). Zinc plays important role in enzymes, both as part of the molecule and as an activator. In its structural role, zinc usually stabilizes the quaternary structure of the enzymes. Large quantities of firmly bound zinc stabilize the structure of RNA, DNA and ribosome (Prask and Plocke, 1971).

The range of the concentrations (mean) of iron in the leaves was between 0.02 /100 g and 0.09 /100 g. The Amaranths leaf had the highest concentration of iron, followed closely by cocoyam leaf. Iron plays key roles in many biological reactions. It is present in several enzymes (cytochromes) responsible for electron transport. Iron plays an essential role in the tricarboxylic acid (Krebs) cycle, as all the 24 enzymes in this cycle contain iron either at their active centre or as essential cofactors (Dowell, 1992). Cadmium and lead were not detected in any of the ten leaves studied. The concentrations of Cd in the leaves were therefore within the human tolerance limit. The health implications of Cd toxicity include kidney dysfunction, hepatic damage and hypertension. The toxic effects of lead are associated with encephalopathy, seizures and mental retardation.

Conclusion

The proximate compositions of the vegetables and *Raphia* palm leaves (intercropped) have shown that they contain the nutrients required in humans, for energy and essential molecules that either cannot be synthesized by the tissues or cannot be synthesized at a rate sufficient to meet the needs for growth and maintenance. Though, the dietary fibre does not provide energy per se, but it has several beneficial effects in human health, in reducing the risk of constipation and hemorrhoid formation, soften stools, lowers blood cholesterol, increases bowel motility

Table 2. Mineral compositions of intercropped vegetables with *R. hookeri* palms (g/100 g).

Leaf samples	Mg	K	Ca	Na	Zn	Fe	Cd	ND
Bitter leaf	2.0	4.0	1.5	1.0	0.02	0.04	ND	ND
Ewedu leaf	1.2	3.5	1.0	0.9	0.03	0.05	ND	ND
Cassava leaf	1.0	1.9	0.5	0.04	0.01	0.03	ND	ND
Okazi leaf	0.9	1.0	0.5	0.09	0.02	0.03	ND	ND
Fluted pumpkin leaf	1.9	2.5	2.0	1.0	0.03	0.05	ND	ND
Lettuce leaf	0.5	1.0	0.09	0.04	0.01	0.02	ND	ND
Cocoyam leaf	1.2	1.5	0.9	0.08	0.03	0.07	ND	ND
Amaranths	3.0	5.0	1.5	1.0	0.06	0.09	ND	ND
Pepper leaf	1.0	3.0	0.5	0.09	0.01	0.02	ND	ND
Water leaf	3.0	6.5	1.2	0.9	0.02	0.04	ND	ND
R. hookeri leaf	2.5	5	1.7	1.0	0.09	1.0	ND	ND

ND = Not detectable.

and reduces the exposure of gut to carcinogens. On the other hand, the mineral constituents of the leaves play a number of roles in metabolism, where they function as cofactors in enzyme-catalyzed reactions blood (Pamela et al., 1994). The intercropping of annuals like vegetable leaves with *Raphia* palm cultivation at an early stage of its growth (before the frond canopies are formed) should be encouraged in an upland area based on this report. The consumption of vegetable leaves provides several essential health implications, particularly their low fats content which may help to lower the plasma cholesterol and thus reducing the incidence of coronary heart diseases.

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