Scientific Research and Essay Vol. 3 (2), pp. 057-060, February, 2008
Available online at http://www.academicjournals.org/SRE
ISSN 1992-2248 © 2008 Academic Journals

Full Length Research Paper

Nutritional potential of two leafy vegetables: *Moringa oleifera* and *Ipomoea batatas* leaves

Ibok Oduro, W. O. Ellis and Deborah Owusu*

Department of Biochemistry and Biotechnology, Kwame Nkrumah University of Science and Technology, Kumasi-Ghana.

Accepted 30 January, 2008

Levels of some nutrients in *Moringa oleifera* leaves as well as seven varieties of sweet potato (*Ipomoea batatas*) leaves were determined using standard analytical methods. Crude protein ranged from 16.78 - 25.39%; crude fibre from 9.75 - 12.14%; crude fat from 0.38 - 1.91%; ash content from 8.71 - 11.60%; moisture content (fwb) ranged from 80.16 - 88.20%; carbohydrate values from 53.29 - 59.01%; and calorific values ranged from 1344.00 – 1399.00 kJ/g (316.66-329.76 cal/g) for the sweet potato leaves. For *M. oleifera* leaves, crude protein was 27.51%, crude fibre was 19.25%, crude fat was 2.23%, ash content was 7.13%, moisture content was 76.53%, carbohydrate content was 43.88%, and the calorific value was 1296.00 kJ/g (305.62 cal/g). Elemental analysis of the leaves in mg/100g dry matter (DM) indicates the sweet potato leaves contained appreciable levels of calcium (1310.52-1402.27) and iron (9.62-23.02). Calcium and iron content of *M. oleifera* also in mg/100 g (DM) were 2,009.00 and 28.29, respectively. These results reveal that the leaves contain an appreciable amount of nutrients and can be included in diets to supplement our daily nutrient needs.

Key words: *Moringa oleifera*, *Ipomoea batatas*, nutrition potential.

INTRODUCTION

Recently, researchers have become convinced that nutrients found in fruits and vegetables do more than just prevent deficiency diseases for instance beriberi or rickets. The most publicized finding reveals that certain vitamins or vitamin precursors in produce, notably vitamin C; beta-carotene as well as polyphenols are powerful antioxidants (Consumer Reports on Health, 1998). Antioxidants help prevent molecular damage caused by oxidation in that the protection offered may help fend off many diseases such as cancer, cardiovascular diseases and muscular degeneration (Islam et al., 2002).

Islam et al. (2002) further reported *Ipomoea batatas* leaves as an excellent source of antioxidative polyphenolics compared to other commercial vegetables. Though consumed in Asia and some sub-Saharan countries (Duke, 1983), they have generally been regarded as an underexploited green vegetable. Abbiw (1990) listed *I. batatas* as one of the vegetables consumed by all ethnic groups in Ghana. However, it must be noted that only the storage roots are consumed in large quantities. Yoshimoto et al. (2002) considered sweet potato leaf tougher in terms of texture than other leafy vegetables. This, in addition to the fact that new foods are not easily accepted by the populace, could be one of the reasons why sweet potato leaves are not consumed so much in Ghana.

Moringa oleifera tree has probably been one of the most underutilized tropical crops. Leaves of *M. oleifera* could serve as a valuable source of nutrient for all age groups. In some parts of the world for example Senegal and Haiti, health workers have been treating malnutrition in small children, pregnant and nursing women with Moringa leaf powder (Price, 1985). The leaves are known as great source of vitamins and minerals being served raw, cooked or dried. Fuglie (2005) reported that 8 g serving of dried leaf powder will satisfy a child within ages 1-3 with 14% of the protein, 40% of the calcium, 23% of the iron, and nearly all the vitamin A that the child needs in a day. One 100 g portion of leaves could provide a woman with over a third of her daily need of calcium and give her important quantities of iron, protein, copper, sulphur, and B-vitamins. Introduction of *Moringa* leaves as part of the diet in Senegal has been successful despite the fact that new foods are often very difficult to introduce

*Corresponding author. E-mail: iquomma@yahoo.com. Tel: +233 5160298.

to introduce in West Africa (Price, 1985).

Sweet potato and Moringa leaves have not received needed research-based attention in Ghana in the midst of its well known nutritional properties. The populace unaware of the high nutritional and nutraceutical values of these vegetables, grow sweet potatoes, wait for the storage roots to mature, harvest and discard the leaves or serve them as animal feed with few farmers consum-ing the harvested tops (leaves).

The fact that *Moringa* leaf plays a role in fighting malnutrition in some parts of Africa; it is hardly consumed as a vegetable in the Ghanaian diet except by a few ethnic groups. Based on this, the present study attempts to reveal the nutritional composition of seven varieties of sweet potato leaves relative to *M. oleifera* leaves and their suitability as edible vegetables.

MATERIALS AND METHODS

Source and preparation of sample

Leaves of seven (7) varieties of *I. batatas* were collected from the Crops Research Institute (CRI) at Fumesua, Kumasi. The one specie from the Moringaceae family common in Ghana, *M. oleifera* leaves used for this project were obtained from the Horticulture Department of the Faculty of Agriculture, KNUST, Kumasi. Both species of leaves were grown in the wet semi-equatorial climate of Ghana with temperatures between 26 - 30°C and relative humidity between 70 - 80%. Soil in the area is of the forest ochrosol type which is less leaching and contains greater nutrients (Dickson and Benneh, 1980). The *I. batatas* leaves were harvested during the rainy season at the phase of rapid growth of vines and hence large increase in leaf area. Leaves for *M.* oleifera were harvested during the same period as the *I. batatas* leaves, when new branches and pinnae were being formed. The *I. batatas* tops obtained were harvested were 15 cm apical tip of the vine, including the stem, petioles and tender leaves of the plant. The *M.* oleifera leaves were also harvested at 15 cm from the tip of the pinnae. The young tips were harvested because they are tender and not as tough as the older leaves (Fuglie, 2001; Woolfe, 1992). Leaves were steam blanched, 100 g at a time for 5 min and air dried for six days. After drying, they were ground onto powder and stored in well labeled polypropylene films placed in a clean well-dried black container.

Nutritional composition

Chemical analysis to determine proximate composition of sample was carried out using standard procedure. Moisture content was determined by air drying, fat by Soxhlet extraction, carbohydrate calculated by difference, ash content by incineration, crude fibre by incineration after acid and base digestion, mineral element composition using the AAS after acid digestion of the samples and protein by the Kjedahl method (AOAC, 1990). The caloric value was determined based on the Atwater factor (FAO, 2006a).

Statistical analysis

Data for all determinations were subjected to analysis of variance (ANOVA). Fisher's least significant difference (LSD) test was used to identify significant differences among treatment means ($p<0.05$).

RESULTS AND DISCUSSION

Table 1 reveals results of proximate composition of sweet potato (*I. batatas*) and *M. oleifera* leaves. The values for moisture content showed Otoo having highest value (88.20%) maintaining Otoo more prone to deterioration since foods with high moisture content are more prone to perishability (Fennema and Tannenbaum, 1996). Values of moisture for both sweet potato leaves and *M. oleifera* leaves corroborated with standard references for sweet potato: 82.21-87.48% (Antia et al., 2006; FAO, 2006b; Woolfe, 1992) and for *M. oleifera*: 75.00% (Fuglie, 2001; Nutritional Value of Malunggay Pods/Leaves, 2006).

The ash content of *M. oleifera* leaves was lower than that of the sweet potato leaves. The high ash content of the sweet potato leaves is a reflection of the mineral contents preserved in the food materials. The results therefore suggest a high deposit of mineral elements in the leaves. Of all the leaf samples, Sauti and Hi Starch have relatively high ash content. The ash was subjected to acid digestion and analyzed for Iron and Calcium (Table 2).

Crude fat content of sweet potato leaves (0.38-1.91%) were lower when compared to that of the moringa leaf (2.23%). A diet including *M. oleifera* should be more palatable than that with sweet potato leaves because dietary fats function to increase food palatability by absorbing and retaining flavours (Lindsay, 1996). A diet providing 1 - 2% of its caloric energy as fat is said to be sufficient to human beings, as excess fat consumption yields to certain cardiovascular disorders such as atherosclerosis, cancer and aging (Davidson et al., 1975; Kris-Etherton et al., 2002).

With the exception of Sauti and Okumkom leaves, all leaf samples had protein levels above 20%. Comparatively, Moringa leaves had a higher protein content than all the sweet potato leaves. Protein content of the sweet potato leaves compared favourably with cassava (24.88%) and other leaves (Akindahunsi and Salawu, 2005) but quite low when compared to *M. oleifera* leaves (27.51%). This makes these leaves a good source of protein when compared to other vegetables such as amaranth, taro leaves, pumpkin leaves and okra leaves (FAO, 2006b).

The crude fibre content of Moringa leaves was higher than that of sweet potato, and this makes it a more favourable vegetable since high fibre content of foods help in digestion and prevention of colon cancer (Saldanha, 1995; UICC/WHO, 2005). Non-starchy vegetables are the richest sources of dietary fibre (Agostoni et al., 1995) and are according to Saldanha (1995) employed in the treatment of diseases such as obesity, diabetes and gastrointestinal disorders.

The caloric value obtained showed *M. oleifera* as having the lowest value (305.62 cal/g). Among the sweet potato specie, Sauti has the lowest value whiles Santom Pona has the highest value. The caloric value of these leaves make them a good source of energy for all people

Table 1. Proximate and energy composition of *Ipomoea batatas* and *Moringa oleifera* leaves*.

Sample	Moisture content (%)	Ash content (%)	Crude fat (%)	Crude protein (%)	Crude fibre (%)	Carbohydrate (%)	Caloric value
Apomuden	83.17±0.03[a]	8.71±0.03[a]	1.91±0.09[a]	23.39±0.05[a]	11.62±0.09[a]	54.38±0.03[a]	1392.58±2.86kJ/g[a] 328.23±0.70 cal/g
Hi Starch	80.16±0.08[b]	11.37±0.06[b]	0.83±0.02[b]	21.89±0.00[b]	10.10±0.06[b]	55.81±0.01[b]	1351.64±0.37kJ/g[b] 318.28±0.09 cal/g
Moringa oleifera	76.53±0.02[c]	7.13±0.03[c]	2.23±0.03[c]	27.51±0.00[c]	19.25±0.07[c]	43.88±0.01[c]	1296.09±1.31kJ/g[c] 305.62±0.32 cal/g
Ogyefo	85.15±0.07[d]	9.75±0.03[d]	0.38±0.01[d]	22.69±0.00[d]	9.39±0.04[d]	57.79±0.00[d]	1382.40±0.28kJ/g[d] 325.38±0.07 cal/g
Okumkom	85.15±0.06[d]	9.56±0.07[e]	1.46±0.03[e]	19.41±0.00[e]	12.14±0.00[e]	57.42±0.11[e]	1360.25±0.53kJ/g[e] 320.49±0.11 cal/g
Otoo	88.20±0.09[e]	9.31±0.09[f]	1.61±0.02[f]	21.85±0.05[b]	10.66±0.18[f]	56.57±0.19[f]	1392.87±5.01kJ/g[a] 328.21±1.19 cal/g
Santom Pona	83.39±0.09[f]	9.90±0.09[g]	1.67±0.02[f]	25.39±0.00[f]	9.75±0.04[g]	53.29±0.03[g]	1399.41±1.13kJ/g[f] 329.76±0.27 cal/g
Sauti	84.33±0.07[g]	11.60±0.03[h]	1.50±0.02[e]	16.78±0.00[g]	11.11±0.00[h]	59.01±0.05[h]	1343.96±0.27kJ/g[g] 316.67±0.06 cal/g

*Mean values ± Standard deviation values. [a-h] means in same column but with different superscripts differ significantly ($p < 0.05$).

Table 2. Mineral composition of *Ipomoea batatas* and *Moringa oleifera* leaves*.

Sample	Iron (mg/100 g)	Calcium (mg/100 g)
Apomuden	16.57±0.001[a]	1402.27±0.03[a]
Hi Starch	23.02±0.002[b]	1334.78±0.05[b]
Moringa oleifera	28.29±0.047[c]	2009.79±0.02[c]
Ogyefo	12.27±0.021[d]	1310.52±0.002[d]
Okumkom	20.73±0.039[e]	1326.19±0.06[e]
Otoo	9.62±0.074[f]	1352.27±0.03[f]
Santom Pona	13.52±0.0003[g]	1316.45±0.02[g]
Sauti	12.39±0.012[h]	1315.70±0.03[h]

* Mean values± Standard deviation values.
[a=h] means in same column but with different superscripts differ significantly ($p < 0.05$).

compared to some vegetables such as pumpkin leaves, taro leaves, mushrooms, tomatoes (FAO, 2006b). The, low caloric value of *Moringa* makes it a good addition in the diet of the obese and those who don't want to gain too much weight

The mineral composition of the leaves (Table 2) unravels a high concentration of iron and calcium. Children, women of reproductive age and pregnant women are most vulnerable to micronutrient deficiency and anemia (GDHS, 2004). Hence, they need food with high iron content. Of all the leaf samples, the *M. oleifera* leaves had a very high iron and calcium content with the Otoo sample having relatively lower iron content and the Ogyefo samples relatively lower calcium content. The high value of iron in these leaves makes them an additional source of iron for the people especially the *M. oleifera* leaves. Calcium helps to build up strong bones and teeth so the consumption of sweet potato and moringa leaves can add to daily calcium requirements of each individual. A comparison between sweet potato and *Moringa* leaves shows that the latter are superior in calcium than the sweet potato leaves.

This study indicates that the leaves of *I. batatas* and *M. oleifera* are very nutritious when compared to vegetables such as cassava leaves, amaranth, mushrooms, taro leaves and pumpkin leaves. Relatively, *Moringa* leaves contain higher levels of calcium, iron and proteins making it a very rich source of dietary nutrient compared to the *I. batatas* leaves. However both leaves can contribute significantly to the nutrient requirements of humans and

should be strongly recommended in Ghana.

REFERENCES

Abbiw DK (1990). Traditional vegetables in Ghana. Department of Botany, University of Ghana, Legon, Ghana.

Agostoni C, Riva R, Giovannini M (1995). Dietary Fiber in Waning Foods of Young Children. Pediat. (96):1000-1005.

Akindahunsi AA, Salawu SO (2005). Phytochemical Screening and nutrient/antinutrient composition of selected tropical green leafy vegetables. Afr. J. Biotech. (4):497-501.

Antia BS, Akpan, EJ, Okon, PA, Umoren, IU (2006). Nutritive and Anti-Nutritive Evaluation of Sweet Potatoes *(Ipomoea batatas*) Leaves. Pak. J. Nutr. 5 (2):166-168.

AOAC (1990). Official Methods of Analysis of the Association of Official Analytical Chemists (15th edition), Washington DC, pp 992 – 995.

Consumer Reports on Health (1998). Consumers Union of U.S., Inc., Yonkers, NY. 10703-10705.

Davidson SP, Brock JF, Truswel ASI (1975). Human Nutrition and Dietetics. 6th ed. Churchill Livingstone / Longman Group Ltd. pp. 107-119, 221-224.

Dickson KB, Benneh G (1980). A New Geography of Ghana, Longman Group Ltd. London.

Duke J A (1983). *Ipomoea batatas*. Handbook of Energy Crops. Unpublished. [http://www.hort.purdue.edu/newcrop/default.html].

FAO Corporate Document Repository (2006 a). Calculation Of The Energy Content Of Foods- Energy Conversion Factors. [http:/www.fao.org/ag].

FAO Corporate Document Repository (2006 b). PROXIMATE COMPOSITION OF FAOODS. [http:/www.fao.org/ag].

Fennema RO, Tannenbaum S R (1996). Introduction to Food Chemistry. In: Fennema RO, Karel M, Sanderson GW, Tannenbaum SR, Walstra P, Witaker JR (eds). Food Chemistry, Marcel Dekker Inc. New York. pp. 1-64.

Fuglie LJ (2001). The Miracle Tree. *Moringa oleifera*: Natural Nutrition For The Tropics. CWS, Dakar, Senegal p.115.

Fuglie LJ (2005). The Moringa Tree: a local solution to malnutrition? Church World Service in Senegal.

Ghana Demographic and Health Survey *(GDHS) 2003* (2004). Ghana Statistical Service (GSS), Noguchi Memorial Institute for Medical Research (NMIMR), and ORC Macro. Calverton, Maryland:GSS, NMIMR, and ORC Macro.

Islam SM, Yoshimoto M, Yahara S, Okuno S, Ishiguro K, Yamakawa O (2002). Identification and Characterization of Foliar Polyphenolic Composition in Sweetpotato (*Ipomoea batatas* L.) Genotypes. J. Agric. Food Chem. Vol. 50. American Chemical Society. pp. 3718-3722.

Kris-Etherton PM , Hecker KD, Bonanome A, Coval SM, Binkoski AE, Hilpert KF, Griel AE, Etherton TD (2002). Bioactive compounds in foods: their role in the prevention of cardiovascular disease and cancer. PubMed, 113 Suppl 9B:71S-88S.

Lindsay RC (1996). Flavours. In: Fennema RO, Karel M, Sanderson GW, Tannenbaum SR, Walstra P, Witaker JR (eds). Food Chemistry, Marcel Dekker Inc. New York. pp. 611-612.

Nutritional Value of Malunggay Pods/Leaves (2006). [http://malunggayherbatea.multiply.com/journal/item/2].

Price ML (1985). The Moringa Tree, ECHO Technical Note (revised 2000 by Kristin Davis).

Saldanha LG (1995). Fibre in the diet of U. S. Children: results of national surveys. Pediat. (96):994-996.

UICC/WHO (2005). Global Action Against Cancer NOW. Geneva: UICC and WHO Publications Department.

Woolfe JA (1992). Sweet Potato: an untapped food resource. Cambridge University Press. Cambridge. 9(92):165-168.

Yoshimoto M, Yahara S, Okuno S, Islam S, Ishiguro K, Yamakawa O (2002). Antimutagenicity of Mono- Di-, and Tricaffeoylquinic Acid Derivatives Isolated from Sweetpotato (*Ipomoea batatas* L.) Leaf. Biosci. Biotechnol. Biochem. 66 (11): 2336-2341.