EVALUATION OF SOME COMMON LEAFY VEGETABLES USED IN GHANA

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ABSTRACT

Twenty different types of exotic and local Ghanaian leafy vegetables were evaluated on the bases of their agronomic and nutritive values. The study showed that availability and consumption of leafy vegetables in Ghana is culture-and region-based. Some of the vegetables indicated good plant morphology and architecture, yield and resistance to pest damage. Nutrient contents of local Ghanaian leafy vegetables were better than the exotic types. Leaves of species like cleome, sweet potato, celosia, and cassava indicated high nutritive values as compared to well-known leafy vegetables like amaranth and cocoyams (taro and tannia). The country is however endowed with large number of under-exploited local leafy vegetable crop plants which need to be harnessed and studied for recommendation in the area of agronomy, crop improvement, recipe formulation and promotion.

INTRODUCTION

Indigenous leafy vegetables play important role in the nutritional system. These vegetables are bulky and have low calorific value, thus when added to the starchy staples they help to reduce problems of obesity by reducing total energy of the food consumed. The high fibre levels have an added advantage of enhancing digestion and preventing constipation (IWES, 1971). Apart from enhancing digestion and preventing constipation, Quaker Oats (2005) has reported that fibre in food like vegetables may reduce the risk of heart disease and certain cancers in man. They therefore recommend several servings of these fibre-rich foods everyday. Leafy vegetables add taste, flavour and supplement for some minerals and vitamins lacking in the starchy staples (Chewya, 1997). According to Norman (1992) tropical leafy vegetables are rich in vitamins A and C. Faber *et. al.* (2002) has also reported that tropical leafy vegetables are rich in vitamins A, B and C, calcium, iron, phosphorus and protein. Shinohara, (1984) stated that tropical leafy vegetables are equally nutritious as the exotic spinach. They are also better placed than their exotic counterparts when it comes to adaptation of the crop to the tropical environment. Their only problem is that they are usually high in anti-nutritional factors like oxalic acids, prussic acids and the like; (Messiaen, 1994. Norman (1992) suggests that systematic breeding could reduce these anti-nutritional factors to accepted levels.

In Ghana, a wide range of leafy vegetables exists. Most of them grow in the wild while some are cultivated in homestead gardens. A great chunk of them are being forgotten because of lack of information on them especially, in the area of documented recipes/usage and research findings on them in publications.

Very little work has been done on the tropical types in terms of germplasm collection and characterization, improvement, agronomy, processing and handling and usage. They are thus largely under exploited. This situation poses a great problem in terms of food security (FAO, 1996) and genetic erosion. Apart from cocoyam *(Xanthosoma sagittifolium* L.*)* which is used across the ethnic groups in Ghana, the others are restricted to specific tribal groups and regions in the country.

This paper is an attempt to bring to highlight some of the indigenous leafy vegetables used in Ghana and their nutritional values thus promoting their usage and research.

MATERIALS AND METHODS

Survey: An informal survey was conducted by interviewing farmers, traders and house-wives in Accra, Ho, Kumasi, Tamale, Bolgatanga and Bawku on their knowledge on leafy vegetables in 1997.

Planting: The vegetables were grown at the Crops Research Institute Experimental Farms, Kwadaso, Kumasi in April, 1997 and 1998 on a sandy loam soil. Propagules of leafy vegetables, i.e., seeds and cuttings (stem, vine or bulbs) were obtained from collections made by the plant Genetic Resources Centre (PGRC), Bunso and also some materials collected from the wild and home-gardens in Accra, Kumasi and Tamale.

Accessions from the PGRC collections that were grown on experimental field in 1997 included, seven accessions of amaranth *(Amaranthus spp.* L.), five accessions of white jute (*Corchorus capsularis* L.), four accessions of gboma (*Solanum macrocarpon* L.), two accessions of celosia each of tossa jute (*Corchorus olitorius* L.), and cleome (*Gynandropsis gynandra*). Three accessions of cowpea (*Vigna unguiculata* (L) Walp.) and one accession of cocoyam (*Xanthosoma sagittifolium* Schoot.) were obtained from Crops Research Institute. Others collected from homestead gardens and the wild included sweet potato (*Ipomoea batatas* (L) Lam.), water spinach (*Talinum triangulare* (Jacq.) Wild.), Indian spinach (*Basella alba* L.), bitterleaf (*Vernonia amygdalina*), taro (*Colocasia antiquorum*), cassava (*Manihot esculenta Crantz.*), pumpkin (*Cucurbita moschata* L.) and okra (*Abelmoschus esculentus (*L.) Molench.). was included in the repeated trial in 1998.

The exotic leafy vegetables included in the trial were lettuce (*Lactuca sativa* L.), cabbage (*Brassica oleracea* var. *capitata* L.), pai-tsai (*Brassica rapa*) and water convolvulus (*Ipomea aquatica* Forsk). Seeds of lettuce and cabbage were obtained from AGLOW Agric Products in Kumasi while Pai-tsai and water convolvulus were also obtained from the Asian Vegetable Research Centre in Taiwan.

The propagules were directly sown (except seeds of leafy eggplant, cabbage and lettuce which were nursed before transplanting) in April, 1997 and 1998 and thinned one week after germination. The seedlings were transplanted at the four true stages. Ten kilograms poultry manure was applied to each of the 3 m^2 experimental plot before transplanting. A standard spacing of 40 cm x 20 cm was adopted for all plants except amaranth which was spaced at 20 cm x 10 cm (Tindall, 1983), as recommended. The experimental design used was randomized complete block with four replications. The plants were largely rainfed but hand-watered as and when needed. Harvesting was done at the edible maturity stage which varied plant species for yield and nutrient value assessment.

Data were collected on number of leaves at harvest, plant height (from soil surface to the shoot apex), leafy length (petiole length of leaf blade) and leaf width (widest portion), stem girth (10cm from the soil surface), marketable yield (yield of edible portion), fresh and oven-dry weights of edible leaves, and pest damage score on a scale of 1-5 (1 = 0- 5%, 2 = 6-15%, 3 = 16-25% 26-50% and 5 = >50%). Other records were percentage contents of iron, calcium, potassium and sodium which were determined by the Flame photometry method described by (Stewart *et al*, 1974).); crude protein contents which were determined by micro-Kjeldhal digestion - distillation method as described by Anderson and Ingram (1989) and crude fibre content using the method described by Van Soest (1963). These were done at the Biochemistry Departments of Crops Research Institute, Kwame Nkrumah University of Science and Technology and University of Cape Coast.

RESULTS AND DISCUSSION

The results of the survey conducted indicated that there are large numbers of wild and cultivated plants in Ghana whose leaves are or can be consumed as

leafy vegetables. As observed by Messiaen (1994) most tropical leafy vegetables plants are largely under-exploited. Table 1 shows some of these leafy vegetables that are most commonly used as pot-herb, added to stew and soup or salads in Ghana. The study indicated that with some of these vegetables, not only the leaves are eaten but the soft stem and the enlarged calyx too (Table1). Plants like okra, cassava, taro, cocoyam, sweet potato and onion are grown not primarily for their leaves, but for fruits, tuber, bulb, corms or cormel. It must be noted however that the leaves of cocoyam are a major leafy vegetable in the middle to southern parts of Ghana and are used in the northern parts when available. Some of these plants are also used as ornamentals, eg., celosia, bitter leaf and some species of amaranths. It was observed that more than 80% of local Ghanaian leafy vegetables are important in the northern parts of the country viz, Northern, Upper East and Upper-West regions, and some 60% in the

Table 1: Some green leafy vegetables commonly used in Ghana

Scientific Name	English Name	Family	Edible Portion Commonly Used	Area of consumptioin	Propagule
Amaranthus hybridus	Amaranth	Amaranthaceae	Leaves/Shoot	All	Seed
Celosia argentea	Celosia	Amaranthaceae	Leaves	Eastern	Seed
Colocasia antiquorum	Taro	Araceae	Leaves/Corm	Southern Parts	Corm
Xanthosoma sagitifolium	Cocoyam	Araceae	Leaves/Corm	Southern, Parts of Northern Parts Volta	Corm
Gynandropsis gynandra	Cleome	Capparidaceae	Leaves	Volta	Seed
Corchorus olitorius	Tossa	Tiliaceae	Leaves	Northern Parts Volta	Seed
Corchorus capsularis	White Jute	Tiliaceae	Leaves	- Do-	Seed
Ipomoea batatas	Sweet Potato	Convolvulaceae	Leaves, Tuber	Northern Parts	Vine
Solanum macrocarpon	Leafy Egg-Plant	Solanaceae	Leaves, Fruits	Northern Parts Volta, Eastern	Seed
Cucurbita moschata	Pumpkin	Cucurbitaceae	Leaves	Northern Parts	Seed
Vigna unguiculata	Cowpea	Fabaceae	Leaves, Grains, Young Pods	Northern Parts	Seed
Hibiscus cannabinus	Roselle	Malvaceae	Leaves, Calyx	Northern Parts	Seed
Abelmoschus esculentus	Okra	Malvaceae	Young Leaves, fruits	Northern Parts	Seed
Basella alba	Indian Spinach	Basellaceae	Leaves	Southern Parts	Seed, Vine
Talinum triangulare	African Spinach	Polygaceae	Leaves	Southern Parts	Seed
Manihot esculenta	Cassava	Euphorbaceae	Leaves, Tuber	Northern Parts	Stem
Brassica oleraceae var. capitata	Cabbage	Cruciferae	Leaves	All	Seed
Vernonia amygdalina	Bitter Leaf	Asteraceae	Leaves	Northern Parts	Seed, Stem
Lactuca sativa	Lettuce	Asteraceae	Leaves	All	Seed

*Northern Parts: = Northern, Upper West and Upper East regions

*Southern Parts: = Brong Ahafo, Ashanti, Eastern, Western, Central, Greater Accra regions

Table 2. Range of yield and yield parameters of accessions of local Ghanaian green leafy vegetables

Vegetable	Plant Height (cm)	Stem Girth (cm)	Leaf Width (cm)	Leaf Length (cm)	Petiole Length (cm)	No of Leaves/ Plant	Yield (g/Plant)	Damage Score*
Amaranth	26.9-36.3	2.8-3.7	8.8-10.1	20.1-22.0	8.7-12.7	12-15	103.0-221.0	2.0-4.7
Gboma	35.2-21.3	1.1-1.9	10.8-13.9	16.6-25.0	2.1-3.8	7-11	55.0-92.0	2-3.5
White Jute	14.0-21.3	1.1-1.4	4.9-7.9	8.4-14.0	5.1-6.7	11-14	32.0-40.0	5
Tossa Jute	21.3	1.1	4.9	12.1	6	11	39 5	
Roselle	42.2-54.1	2.5	13.6-14.9	16.5-16.8	16.2-16.5	16	168.0-200.0	5
Cleome	59.6	1.8	4.6	9.4	11.6	13	102 5	
Cowpea	26.5-30.3	1.0-1.4	8.4-7.9	13.4-14.0	21.3-22.6	10	92.0-145.0	3
Celosia	9.7-10.3	1.7-7-1.9	4.5-6.0	21.8-22.2	4.2-4.8	15	75.0-82.0	2.0-3.3

Damage Score :- (1 = 0- 5%, 2 = 6-15%, 3 = 16-25% 26-50% and 5 = >50%).

Volta region in the south (Table 1). The more expensive exotic leafy vegetables are produced by subsistence growers in and around cities and big towns as market-gardens. This confirms earlier wok reported by Narteh (1981).

Agronomic evaluation of nine of the leafy vegetables revealed varying performance levels within accessions. Differences in growth parameters (Table 2) suggest the possibility for selecting plants with suitable architecture when considering integration of leafy vegetables into cropping systems.

The differences observed in the plant height within accessions suggests like amaranths, white jute, and roselle suggest that section can easily be made to obtain materials that are shorter and less prone to lodging

Yield variations within accessions were 54% for amaranth, 40% for leaf eggplant, 37% for cowpea and 26 for roselle (Table 2). Among the leafy vegetables studied roselle, cleome, vegetable jutes (tossa and white jutes) were those severely attacked and damaged by pests.

Within the amaranth accessions pest damage score ranged between 2.0-4.7 (Table 2). The high yielding ones were those mostly attacked. This therefore suggests the possibility for their improvement through hybridization with the pest resistant types.

It is widely reported that leafy vegetables are nutritious and have medicinal properties (Berinyuy *et.al.* 1997, CIGAR, 2001), and as a result have been recommended to pregnant and nursing mothers, weaning babies and the sick. The study recorded high percentage dry matter (DM) of about 63% and 55% for vegetable jute and tossa respectively and at least of about 12% and 14% for pai-tsai and cabbage respectively (Table 3).

Most of the indigenous leafy vegetables had quite high DM yield. Crude protein (CP) levels were between 11% and 32%. Very high CP levels were recorded for bitter leaf (32%),sweet potato (31%) and celeome (31%). With the exception of taro and Indian spinach which had CP levels of 12% and 19% respectively, the rest of the indigenous vegetables had levels over 20% (Table 3). These levels are comparable with CP levels of cowpea, pigeon pea, lentil and adzuki bean (Kay, 1979) which is highly recommended as substitute for animal protein. The study thus confirms earlier work done by Berinyuy *et al.* (1997). Crude fibre (CF) content of the vegetables observed were generally high. Inclusion of them therefore in cereal and other starchy based diets will enhance digestion; help prevent

Table 3. Percentage dry matter (DM), moisture, crude protein (CP), crude fibre (CF) and mineral nutrients in some green leafy vegetables used in Ghana

Vegetable	% DM	% CP	% CF	% Ca	% K	% Na	% Fe
Amaranth	16.2-21.3	23.5-27.0	2.6-7.6	4.8-6.4	5.8-6.9	0.04-0.05	0.02-0.03
Taro	28.7	11.9	ND	2.9	4.5	0.02	0.02
Cocoyam	24.9	26.3	9.3	2.63	5.2	0.07	0.02
Cleome	26.62	30.8	11.6	2.13	5.38	0.07	0.03
Tossa	55	24.6	ND	2.63	5.69	0.023	0.03
White jute	37.42-62.79	23.9-27.7	7.94	2.13-2.5	4.5-5.69	0.02-0.025	ND
Celosia	27.47-27.62	20.0-28.3	3.9	3.63-3.88	7.88	0.025-0.06	0.03-0.04
Sweet potato	36.14	31.1	12.1	2.13	5	0.08	0.02
Gboma	30.0-38.1	23.4-27.3	8.1-9.1	2.63-4.68	6.38-6.37	0.03-0.055	0.03-0.04
Cowpea	27.1-28.94	26.4-32.9	3.9-6.9	2.88-5.32	3.25-4.07	0.026-0.039	0.02-0.03
Roselle	20.58-23.51	12.6-25	9.9	2.5-2.63	3.19-3.25	0.03-0.05	0.02-0.03
Bitter leaf	39.67	31.5	8.5	2.13	5.5	0.02	0.03
Indian Spinach	26.35	18.5	11.6	3.73	7.88	0.11	0.09
Water leaf	15.49	23.7	ND	4.75	11.5	0.18	.0.05
Okra	48.36	23.4	9.4	4.54	1.7	0.152	0.03
Cassava	45.9	28	12.5	1.63	2.63	0.01	0.03
Cabbage	13.9	10.7	8.5	1.25	3.13	0.04	0.03
Water convolvulus	37	30.2	6.7	2.13	5.75	0.19	ND
Pai-tsai	12.1	9.6	11.9	4.5	9.25	0.22	0.04
Lettuce	27.85	17.1	7.1	2.84	6.7	0.12	ND

ND = Not determined

constipation and colon cancer (IWES 1971, CIGAR,2001, Quaker Oats (2005). Leaves of amaranth accessions gave the highest Ca content, while water spinach recorded high percentages of K and Na. Generally, values of percentage Fe content were similar raging between 0.02% and 0.05% with most of them recording 0.03%. The only exception was Indian spinach, which recorded the highest Fe level of 0.09 (Table 3).

A general comparison between the exotic leafy vegetables (i.e., lettuce, cabbage, Pai-tsai and water convolvulus) and the local ones, revealed that the local vegetables had higher levels of nutrients than their exotic counterparts. This observation agrees with work done by Toohey and Rollin (1962), Darko (1981), Shinohara (1984) and Mnzava (1997) who have indicated that tropical leafy vegetables are nutritionally superior to their temperate counterparts except for the nutrient inhibitors which they usually carry. These others have suggested could be corrected through breeding.

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