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South African Journal of Clinical Nutrition

ISSN: 1607-0658 (Print) 2221-1268 (Online) Journal homepage: https://www.tandfonline.com/loi/ojcn20

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To cite this article: Shirley Isibhakhomen Ejoh, Faustina Dufie Wireko-Manu, David Page & Catherine MGC Renard (2019): Traditional green leafy vegetables as underutilised sources of micronutrients in a rural farming community in south-west Nigeria II: consumption pattern and potential contribution to micronutrient requirements, South African Journal of Clinical Nutrition, DOI: 10.1080/16070658.2019.1652964

To link to this article: https://doi.org/10.1080/16070658.2019.1652964

Published online: 24 Oct 2019.

South African Journal of Clinical Nutrition 2019: 1–6
https://doi.org/10.1080/16070658.2019.1652964

SAJCN
ISSN 1607-0658 EISSN 2221-1268

ARTICLE

Traditional green leafy vegetables as underutilised sources of micronutrients in a rural farming community in south-west Nigeria II: consumption pattern and potential contribution to micronutrient requirements

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Objective: To determine the consumption pattern of selected households consuming traditional green leafy vegetables (TGLVs) during three seasons and potential contribution to recommended nutrient intakes.
Design: Repeated household survey using food frequency questionnaire to obtain consumption pattern of selected TGLVs.
Setting and Subjects: Selected households in a small rural farming community: pre-rainy ($n = 43$), rainy ($n = 36$) and post-rainy seasons ($n = 40$).
Results: *Corchorus olitorius* and *A. hybridus* were the most consumed by > 70% of households across three seasons. *A. esculentus* and *A. viridis* were the least consumed TGLVs through all the seasons. Uncultivated and cultivated TGLVs could contribute between 26–> 100% and 18–96%, respectively, of recommended intake for vitamin A for children and women. For young children, both the cultivated and uncultivated TGLVs could contribute more than 50% of their RDA for iron.
Conclusion: seasonal availability, and preference for certain species, determine the consumption pattern of the TGLVs studied. Uncultivated and less utilised vegetables have the potential to make significant contributions to the micronutrient requirements of women and children, especially vitamin A and iron if frequently used.

Keywords: food system, indigenous vegetables, nutrient contribution, nutrient requirement

Introduction

In Nigeria, apart from under-nutrition and over-nutrition, which currently constitute a double burden of disease, hidden hunger also constitutes a third burden.[1] Vitamin A deficiency (VAD) and iron deficiency remain public health challenges in Nigeria and this is particularly so in rural areas of the country. Some 25% of infant, child and maternal mortality is attributed to vitamin A deficiency.[1] Prevalence of vitamin A deficiency among children aged under five children in Nigeria is between 5.3% and 29.5%,[2,3] depending on the region. Iron deficiency is the cause of prevalent nutritional anaemia (also known as iron deficiency anaemia) in Nigeria; 20–40% in adult females, 20–25% in children and 10% in adult males.[1] High rates of micronutrient deficiency are an indication of low-quality diets, which also contributes to all other forms of malnutrition.[4] The micronutrient quality of poor diets could be improved with readily available and accessible traditional green leafy vegetables (TGLVs), especially among populations who have inadequate access to animal source foods for economic reasons.[5]

Traditional leafy vegetables are an important category in food-based approaches because, apart from fruits, they constitute the major source of micronutrients in the diet, and could contribute significantly to lessen the burden of 'hidden hunger'.[6,7] Furthermore, they can be used to boost dietary diversity and quality to achieve sustainable healthy diets, which benefits everyone within the food system.[8]

In Nigeria, TGLVs are a prominent food group in the diet with great diversity across the different regions of the country. In the past they were consumed more frequently and diets of especially rural Nigerians contained considerable amounts of different green leafy vegetables.[9] In recent times, however, there has been a narrowing of the diversity of TGLVs consumed, reflected in the overdependence on a few, mostly cultivated green leafy vegetables species, which account for the number in people's diets. Several traditional leafy vegetables are being neglected, especially the uncultivated and wild species, many of which unfortunately are regarded as weeds.[10] They continue to fall into disuse because to date they have received less attention than cultivated ones. The implication is that the food basket from which micronutrients can be obtained gets smaller. Few of them, particularly uncultivated and wild TGLVs, become important during periods when cultivated commonly consumed vegetables are not in season and are expensive in the markets; this especially holds true for people in the rural communities.[11]

Furthermore, uncultivated TGLVs usually compare well in terms of their micronutrient contents with more commonly consumed and cultivated vegetables. Findings by Ejoh *et al.*[13] highlighted the nutritional relevance of uncultivated TGLVs when compared with cultivated TGLVs; uncultivated and less utilised TGLVs were as nutrient-dense as the conventional and commonly consumed leafy vegetable species, especially in β-carotene and lutein. In view of this and given that TGLVs are part of the dietary structure of Nigerian local diets, it is important to examine the consumption pattern, both to ascertain the potential contribution they could make to micronutrient requirements and to better understand the overall nutrient intake of vulnerable groups. In article I[13] we presented the micronutrient content of selected

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cultivated and uncultivated TGLVs. In this article, we have evaluated the consumption pattern of TGLVs in selected households in a rural community in south-west Nigeria during three different seasons and estimated the potential contribution of these underexploited plant foods to micronutrient requirements in terms of the TGLVs analysed from the study site for their micronutrient content in article I.[13]

Methods

Sampling and participants

The study was conducted in Eleruwa community, a rural farming community made up of seven small villages and situated in Orire LGA, about 21 km from Ogbomoso, a major town in Oyo state, Nigeria. The major occupation of the community members was farming but also to regularly carry out off-farm activities, which included trading of their farm produce and agro-processing activities (additional details of the study community have been published elsewhere [Ejoh and Samuel[11]]).

Participants were women of reproductive age (18–49 years) who had young children (2–5 years). Household listing was conducted in the community by assigning a number to each housing unit and a sub-number to the households in each house (because a housing unit comprised at least two households) and to enable the researcher to locate participants easily during the survey period. Households with the target group were identified and participants were included if they had lived in the community for ≥ 1year and were willing to be interviewed.

Data collection

A combination of qualitative techniques (focus-group discussions, key informant interviews and other informal interviews with community members) and quantitative methods were used for data collection. On the basis of qualitative results (methodology and outcome published elsewhere [Ejoh and Samuel[11]]), the food frequency questionnaire was developed with foods available in the study location and used to obtain data on frequency of consumption of TGLVs.

Frequency of TGLV consumption

In each household face-to-face interviews were conducted with the woman of reproductive age responsible for food procurement and preparation, at home during the survey period. A repeated household dietary survey conducted during three seasons: $n = 43$ (pre-rainy season—March/April), $n = 36$ (rainy season—June/July) and $n = 40$ (post-rainy season—November) with the same households. The three seasons correspond to the pre-planting, planting and harvest seasons respectively. A one-month adapted food frequency questionnaire for biodiversity (adapted from the Nutrition Indicators for Biodiversity 2. Consumption [FAO, 2010])[12] was used. The questionnaire gave a qualitative assessment of foods eaten at least once in the last 24 hours, last 7 days or in the last month for the target household. Sociodemographic data were obtained from the male household head (if present at the time of interview) or from the adult female participant selected for the study. Interviews were conducted in the local language, *Yoruba*, by the researcher and trained student research assistants from the Department of Human Nutrition, University of Ibadan, Nigeria. In this article, data on the frequency of consumption of cultivated and uncultivated TGLVs are examined and the potential contribution to micronutrient requirements is discussed.

Data analysis

Frequency of consumption of cultivated and uncultivated TGLVs were entered on Microsoft Excel spreadsheet (Microsoft Corp, Redmond, WA, USA) and summarised using frequencies and percentages. Means (SD) were calculated for age, number of children and household size.

Estimation of contribution of TGLVs to micronutrient requirements

Micronutrient contribution based on 100 g portion of boiled TGLVs (reported in Ejoh *et al.*[13]) to micronutrient intake recommendations of individuals was calculated. The calculation was done using the highest and lowest values of selected micronutrients (vitamin C, vitamin A, iron, zinc, calcium) obtained from cultivated and uncultivated TGLVs as groups. The result was expressed as percentage (range) of recommended nutrient intake/recommended dietary allowance (RNI/RDA) for females (18–49-year-old pre-menopausal women, not pregnant or lactating) and children (2–5 years).[21]

Ethical approval for the study was obtained from the UI/UCH institutional review board (IRB) Institute of Advanced Medical Research and Training (IAMRAT), University of Ibadan, Nigeria (UI/EC/16/0136).

Results

Characteristics of respondents in the household dietary survey are presented in Table 1. The mean age of the women was 32.5 years. The mean number of children was 2.8 and average household size 5.6. Most of the women either had no formal education or were educated only up to primary school level (36%, respectively). The majority of the women (64%) were primarily involved in farming. Most of the household heads (75%) also engaged in farming as their primary occupation.

Proportion of households consuming TGLVs

More than 50% of the households surveyed consumed *Corchorus olitriou* (95%), *Amaranthus hybridus* (84%), *Cerathoteca sesamoids* (72%), *Launaea taraxacifolia* (58%), *Adansonia digitata* (58%), and *Vernonia amygdalina* (51%) during the pre-rainy season (Table 2). During the rainy season only *Corchourus olitorius* (86%), *Amaranthus hybridus* (78%), and *Launaea taraxacifolia* (53%) were consumed by more than half of the households surveyed. In the post-rainy season, more than half of the target households consumed *Corchorus olitrious* (83%), *Amaranthus hybridus* (83%), *C. argentea* (70%) and *S. macrocarpon* (55%).

Consumption pattern of traditional green leafy vegetables by target households

Ewedu (*Corchorus olitorius*) was the most frequently consumed leafy vegetable by participants in the 24 hours preceding the interview, in all three seasons (Table 3). In the pre-planting season, *efo tete* (*Amaranthus hybridus*) and *eku petere* (*Ceratotheca sesamoides*) were the leafy vegetables most frequently consumed by participants, within seven days preceding the interviews. In the planting and harvest seasons, respectively, *efo tete* (*Amaranthus hybridus*) was the most frequently consumed leafy vegetable in the seven days preceding the interviews.

The proportion of participants who consumed *eku* petere was higher in the pre-planting season than in the planting and harvest seasons, respectively.

There was an increase in the proportion of households that consumed *Celosia argentea* and *Crassocephalum crepididiodes*

Table 1: Sociodemographic characteristics of household participants

Characteristics ($n = 43$)	%	Mean (SD)
Age		32.5 ± 8.8
Number of children		2.8 ± 1.8
Household size		5.6 ± 2.1
Education:		
No formal education	36.4	
Primary level	36.4	
Secondary level	25.0	
Tertiary level	2.3	
Main occupation of household heads (males):		
Farming	75.0	
Trading	2.3	
Artisan	9.1	
Civil servant	4.5	
Driver	4.5	
Main occupation of respondents (females):		
Farming	63.6	
Trading	25.0	
Agro-processor	2.3	
Artisan	6.8	
Civil servant	2.3	
Main source of cooking fuel:		
Firewood	79.2	
Charcoal	12.5	
Firewood and charcoal	8.3	
Main source of water:		
Well	11.4	
Hand-pumped borehole	70.5	
Stream	11.4	
Well and borehole	4.5	
Stream and borehole	2.3	
Type of toilet:		
Bush/short put	100	
Source of waste disposal		
Bush	100	

during the post-rainy season compared with the pre-rainy and rainy seasons, respectively (see Table 3).

Estimated contribution of 100 g boiled TGLVs to micronutrient requirements for women 18–49 years and children 1–6 years

The calculated estimates in Table 4 show that uncultivated TGLVs (UTGLVs) as a group could contribute up to 130% of the vitamin C requirement for women compared with 21% from cultivated TGLVs (CTGLVs)— between 75 and 855 µg RAE. For iron content, UTGLVs' contribution is estimated to be as high as 41.1% per 100 g portion compared with the cultivated species contribution of about 25%, for women of reproductive age (assuming a bioavailability of 10% and a moderate consumption of vitamin C-rich fruits/vegetables). For young children (1–6 years), both the cultivated and uncultivated TGLVs could contribute more than 50% of their RDA for iron.

Discussion

This study assessed the consumption pattern of TGLVs in households of women of reproductive age in a rural farming

Table 2: Uncultivated/and cultivated TGLVs studied and number of target households consuming them across three seasons

Scientific name	Family	English name	Local/common name	Status	Number of households consuming		
					pre-rainy season: $n = 43$(%)	rainy season: $n = 36$(%)	post-rainy season: $n = 40$(%)
Cultivated:							
Corchorus olitorius L.	Malvaceae	Jute mallow	*Ewedu*	Cultivated	41 (95)	31 (86)	33 (83)
Amaranthus hybridus L.	Amaranthaceae	Pig weed	*Efo tete/green*	Cultivated	36 (84)	28 (78)	33 (83)
Celosia argentea L. (red)	Amaranthaceae	Cock's comb	*Soko*	Cultivated	5 (12)	12 (33)	28 (70)
Uncultivated:							
Launaea taraxacifolia (Willd.) Amin, ex C. Jeffrey	Asteraceae	African lettuce/wild lettuce	*Yanrin*	Uncultivated	25 (58)	19 (53)	19 (48)
Amaranthus viridis L.	Amaranthaceae	Slender amaranth	*Tete Ibile*	Uncultivated	2 (5)	5 (14)	7 (18)
Crassocephalum crepidioides (Benth.) S. Moore	Asteraceae		*Ebolo*	Uncultivated	3 (7)	11 (31)	16 (40)
Vernonia amygdalina Delile.	Asteraceae	Bitter leaf	*Ewuro*	Uncultivated	22 (51)	16 (44)	19 (48)
Adansonia digitata[d]	Malvaceae	Baobab leaves	*Luru/kuka*	Uncultivated	25 (58)	13 (36)	17 (43)
Ceratotheca sesamoides (Endl.)	Pedaliaceae	False sesame	*Eku petere*	Uncultivated	31 (72)	9 (25)	13 (33)
Talinum triangulare (Jacq.) Willd.	Talinaceae	Water leaf	*Gbure*	Uncultivated	8 (19)	10 (28)	5 (13)
Solanum macrocarpon L.	Solanacea		*Efo igbagba*	Cultivated/wild	14 (33)	12 (33)	22 (55)
Abelmoscus manihot (L.) Medikus (leaves and tender shoots)	Malvaceae	Okro leaves	*Ilasa*		14 (33)	8 (22)	11 (28)

Table 3: Households' frequency and consumption pattern of cultivated and uncultivated traditional leafy vegetables during three different seasons

Season	Pre-rainy season *n* = 43				Rainy season *n* = 36				Post-rainy season *n* = 40			
TGLVs	Last 24 hrs	Last 7 days	Last 1 month	Total *n* (%)	Last 24 hrs	Last 7 days	Last 1 month	Total *n* (%)	Last 24 hrs	Last 7 days	Last 1 month	Total *n* (%)
Cultivated:												
Corchorus olitorius	24	14	3	41 (95)	19	11	1	31 (86)	11	18	4	33 (83)
Amaranthus hybridus	6	16	14	36 (84)	5	22	1	28 (78)	7	22	4	33 (83)
Celosia argentia	–	2	3	5 (12)	–	5	7	12 (33)	3	4	11	28 (70)
Uncultivated:												
Launaea taraxacifolia	3	13	9	25 (58)	6	8	5	19 (53)	1	8	10	19 (48)
Amaranthus viridis	–	1	1	2 (5)	–	4	1	5 (14)	–	6	1	7 (18)
Crassocephalum crepidioides	–	2	1	3 (7)	1	6	4	11 (31)		5	11	16 (40)
Vernonia amygdalina	3	12	7	22 (51)	2	12	2	16 (44)	3	7	9	19 (48)
Eku petere	10	17	4	31 (72)	1	4	4	9 (25)	4	3	6	13 (33)
Talinum triangulare	–	6	2	8 (19)	1	4	5	10 (28)	–	2	3	5 (13)
Adansonia digitata	1	13	11	25 (58)	1	9	3	13 (36)	3	9	5	17 (43)
Solanum macrocarpon	2	2	10	14 (33)	2	8	2	12 (33)	1	12	9	22 (55)
Abelmoscus esculentus (leaves)	4	5	5	14 (33)	1	3	4	8 (22)	1	7	3	11 (28)

*Dropout in rainy season (which corresponds to planting season) was due to farming activities of households during this period.

Table 4: Potential contribution of cultivated and uncultivated traditional green leafy vegetables to reference nutrient intake of vitamin C, vitamin A and selected mineral intakes for premenopausal women (18–49 years) and young children (1–6 years)

Nutrient	RNI	% contribution from CTGLVs[a] (nutrient per 100 g)	% contribution from UTGLVs[b] (nutrient per 100 g)
Vitamin C			
Women (premenopausal 18–49)[c]	45 mg/day	2.0–21	1.4–130
Young children (1–6 years)[c]	30 mg/day	3.0–31	2.0–196
Vitamin A			
Women (premenopausal 18–49)	500 µgRE/day	18–87	26–200
Young children (1–6 years)	400–450 µgRE/day	20–96	29–222
Iron (10% bioavailability)			
Women (premenopausal 18–49)	29.4 mg/day	19.3–25.4	4.0–41.1
Young children (1–6 years)	6.3 mg/day	89.8–118.4	18.7–190.6
Zinc* (low bioavailability)			
Women (premenopausal 18–49)	9.8 mg/day	2.2–7.0	3.6–13.6
Young children (1–6 years)	9 mg/day	2.4–7.7	3.9–14.6
Calcium			
Women (premenopausal 18–49)	1000 mg/day	6.4–29.7	6.4–38.3
Young children (1–6 years)	500–600 mg/day	10.7–49.5	10.7–63.8

[a]CTGLV: cultivated traditional green leafy vegetables.
[b]UTGLV: uncultivated (wild) traditional green leafy vegetables.
[c]RNI, which meets the nutrient requirements of almost all apparently healthy individuals in an age- and sex-specific population group. It is equivalent to RDA as used by the Food and Nutrition Board of the United States National Academy of Sciences.[21]

community vis-à-vis the potential contribution of the TGLVs to their micronutrient requirements.

Frequency and consumption pattern of TGLV varieties consumed by households

Six varieties of traditional green leafy vegetables were consumed by more than half of the target households in the pre-raining season compared with only three and four varieties consumed by half of the target households in the rainy and post-rainy seasons, respectively. This is an indication that consumption of some traditional leafy vegetables in the target households, particularly the uncultivated TGLVs, may depend on seasonal availability.[11]

However, *C. olitorious* and *A. hybridus* were most commonly consumed by a majority of the households, irrespective of seasons. These two TGLVs are widely cultivated in the south-west of Nigeria all year round, thus accounting for their availability in the community through different channels all year and, particularly in seasons when they are less cultivated, they could be purchased from the market.[11]

Despite availability of a variety of TGLVs in this community, especially uncultivated species, the target households did not use them frequently. Some studies have reported that infrequent use of uncultivated plant food species may be due to several factors such as scarcity in the vicinity, e.g. far from agricultural land or commonly visited spaces, and required time-consuming trips to gather, difficulty/ease of gathering them and palatability, among others.[11,14–16] Seasonality, preference and location are therefore possible reasons for this observation. Similar findings have been reported in the literature.[17,18] Hart *et al.*[19] reported that season had a strong influence on leafy vegetable consumption in some parts of old Rivers state, south-south Nigeria, as observed here. A higher proportion of households (60.2% and 65.4%) in two of the communities surveyed consumed leafy vegetables during the peak of the rains in May–June, when these vegetables were most abundant. In the south-south region of Nigeria, however, *Vernonia amygdalina* (bitterleaf) was the most consumed leafy vegetable by most households irrespective of the season of abundance; > 70% of households surveyed consumed it more than four times a week.[19] The difference in the type of leafy vegetables mostly consumed underscores the cultural diversity in TGLVs consumed in different regions of Nigeria. While *A. hydribus* was consumed by > 70% of households in our study, only 4% of households were reported by Hart *et al.*[19] to have consumed it. Other studies have also made similar observations regarding the variation in seasonal availability and daily use of cultivated and uncultivated TGLVs and wild gathered foods in rural and urban areas in Africa.[20] However, diversity is important if individuals are to meet their nutritional requirements and also be protected against factors that may affect availability of cultivated vegetables.[10] Hence, in seasons when a greater number of TGLVs are used, households would likely benefit from the array of TGLVs that are rich in several micronutrients.

Potential contribution of cultivated and uncultivated traditional green leafy vegetables to selected micronutrient requirements

Uncultivated TGLVs have as much potential to contribute to intakes of the selected micronutrients as cultivated TGLVs. For example, 100 g of the boiled TGLVs could contribute a significant proportion (> 18%) of RDA for vitamin A.[21] What cannot be inferred from our study is adequacy of consumption i.e. quantity of TGLVs consumed, to substantially contribute to micronutrient intake. Studies have also demonstrated the importance and contribution of cultivated and uncultivated leafy vegetables to micronutrients like vitamin A, vitamin C and iron.[5,22,23] Micronutrient deficiency, especially vitamin A deficiency and iron deficiency, are still of public health concern in Nigeria. Promoting consumption of TGLVs through food-to-food fortification as suggested by Icard-Vernière *et al.*[5] should be part of food-based strategies to mitigate the problem.

The potential contribution of TGLVs to RDA for iron is appreciable; however, the bioavailability/bioaccessibility of iron from TGLVs is questionable given the level of antinutrients such as phytates and polyphenols that inhibit iron absorption[5,24,25] or enhancers of iron absorption such as vitamin C and β-carotene.

TGLVs remain an underutilised resource for meeting micronutrient needs. The findings of our study therefore justify the need for continuous identification, analysis (using updated methods), compilation and promotion of underutilised TGLVs that could contribute to micronutrient intakes of individuals and groups.[26]

Conclusion

There is a diversity of traditional green leafy vegetables available in the rural farming community studied. Only a few of them are domesticated and consumed frequently. The uncultivated and less utilised vegetables have the potential to make significant contributions to the micronutrient requirements of women and children, especially vitamin A and iron provided they are consumed frequently and in adequate amounts. The use of traditional leafy vegetables to improve intake of certain nutrients of public health importance could be a less expensive and more sustainable dietary strategy in the long term because of their availability and affordability. However, seasonal availability, and preference for certain species, are important considerations. There is a need for further studies to directly evaluate the quantity of TGLVs consumed so that actual contribution of TGLVs within the overall diet to micronutrient intakes of vulnerable groups in the community can be known.

Disclosure statement – No potential conflict of interest was reported by the authors.

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Received: 18-01-2019 Accepted: 4-08-2019