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Vitamin A Content of Southeastern Nigerian Vegetable Dishes, Their Consumption Pattern and Contribution to Vitamin A Requirement of Pregnant Women in Calabar Urban, Nigeria

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Abstract: The frequency of consumption of six dark green leafy vegetables (DGLV), their vitamin A values, and the relative contribution of these vegetables to vitamin A requirement of pregnant women in Calabar urban was assessed. A total of 101 pregnant women attending clinic at the University of Calabar Teaching Hospital (UCTH), Calabar were covered. Using a food-frequency questionnaire, the consumption pattern of the DGLV was assessed. The study revealed that 100% of the women used the six leafy vegetables chiefly in form of soups and pottages. Ikong ubong (*Telfairia occidentalis*), Mon-mon ikong (*Talinum triangulare*) and Afang (*Gnetum africanum*) were extensively consumed by the women with slight variation in their patterns of consumption, while Inyang afia (*Amaranthus hybridus*), Atama (*Heinsia crinita*) and Editan (*Lasianthera africana*) were less frequently consumed. High Performance Liquid Chromatography (HPLC) analysis showed the following values of vitamin A in µg RE/100g for the vegetables: Ikong ubong 860±0.10, Mon-mon ikong 39±0.04, Inyang afia 853±0.19, Afang 44±0.18, Atama 26±0.04 and Editan 36±0.04. Also, Ikong soup with a vitamin A value of 4759.75±672 µg RE/100g per portion size (200g) made the highest contribution (255 %) to the vitamin A requirement of the pregnant women, while Atama as Abak (*Elaeis guinensis* pulp puree) soup (portion size: 150g) with a vitamin A value of 214.33±46 µg RE/100g made the least contribution (12%) to vitamin A requirement in the women. The usual dietary habit of pregnant women in Calabar can sustain their vitamin A status because with the only exception of Atama (Abak soup), a portion size of each of the other green vegetables contain higher levels of vitamin A than the required daily intake of the women.

Key words: Consumption pattern, dark green leafy vegetables (DGLV), vitamin A value, vitamin A requirement, pregnant women

INTRODUCTION

Vitamin A deficiency (VAD) is a major health dilemma in developing countries. In Nigeria, it has been recognized as a major public health problem particularly in pregnant women and children, contributing significantly to the high rate of maternal and infant mortality (UNICEF, 1996; Maziya-Dixon *et al*., 2006). The vitamin A content of human breast milk is strongly affected by maternal nutrition during pregnancy and lactation (Ibrahim *et al*., 1991). Newman (1994) has observed that VAD is often associated with a habitual inadequate dietary intake of vitamin A. The joint FAO/WHO expert consultation on human vitamin and mineral requirements recommends a daily intake of 800 µg retinol equivalents (RE) as safe level of vitamin A for pregnant women, 19 years and above (WHO/FAO, 2004). This level represents an increased requirement of 60 percent over the non-pregnant state (500 µg RE/day) and can be adequately provided from maternal reserves of women eating at concentrations above recommended dietary allowances (Underwood, 1994). For women who habitually consume diets containing vitamin A near the basal requirement (370 µg RE/day), such an increment becomes very crucial to meet up with the need for rapid foetal growth and maternal storage for lactation.

Of the strategies to prevent or control VAD during pregnancy, food-based approach is increasingly being emphasized because the dietary approach is sustainable, provides nutrients other than vitamin A, adds variety to the diet and is less risky when considering the teratogenicity that may arise from excessive intake of the vitamin (Rosa, 1984; SCN, 1993). Retinol-rich foods are most effective in improving vitamin A status (De Pee and West, 1996) but ironically, except for mother's milk, they are expensive and often beyond the reach of most families in developing countries. A number of studies have shown that provitamin A from much cheaper easily accessible plant sources can effectively combat VAD (Rukmini, 1994; Wadhwa *et al*., 1994; Jalal *et al*., 1998).

The world over, dark green leafy vegetables (DGLV) are rich in provitamin A carotenoids especially β-carotene and in southeastern Nigeria, these vegetables and red palm oil (RPO) are the major sources of provitamin A, and indeed vitamin A, available to the people. In Calabar, DGLV are mainly consumed as soups in combination

with local staples such as garri (cassava farina), foo-foo (fermented cassava meal) and pounded yam. However, the consumption pattern of DGLV dishes in Calabar has not been documented. Also, the provitamin A content or vitamin A value of each serving of these vital dietary components is largely unknown. This study therefore sought to assess the consumption pattern, provitamin A content and vitamin A value of DGLV dishes commonly consumed by pregnant women in Calabar. The study also assessed the relative contribution of the portion sizes of the DGLV dishes to the total vitamin A requirement of the pregnant women. Several DGLVs are found in Calabar. Of these, six were selected for the study based on relative availability and consumption. They are Ikong ubong (*Telfairia occidentalis*), Mon-mon ikong (*Talinum triangulare*), Inyang afia (*Amaranthus hybridus*), Afang (*Gnetum africanum*), Atama (*Heinsia crinita*) and Editan (*Lasianthera africana*).

MATERIALS AND METHODS

Consumption pattern: This was obtained by use of food-frequency questionnaire administered to 101 pregnant women attending clinic in the University of Calabar Teaching Hospital (UCTH), Calabar.

Collection and preparation of vegetables for extraction: The six DGLV were obtained from Watt market in Calabar and were properly identified. Each vegetable type was washed, handpicked and chopped into very small pieces. It was then steamed in a clean pot for three minutes using a gas cooker. About 5g of the vegetable sample was transferred into a sterile sample bottle, sealed, labeled and stored in a refrigerator at -20°C for High Performance Liquid Chromatography (HPLC) analysis within one week.

Extraction and quantification of β-carotene from the vegetable samples: Each frozen sample was left to thaw at room temperature. The methods used in extraction and quantitation of β-carotene in the vegetable samples were similar to those developed by Hart and Scott (1995) with minor modifications: ethyl β-apo-8'-carotenoate was used as internal standard instead of echinenone; mobile phase consisted of methanol, acetonitrile, chloroform (MeOH: ACN: CHCL3; 47: 47: 6v/v/v) instead of acetonitrile, methanol, dichloromethane (ACN: MeOH: DCM; 75: 20: 5v/v/v) (Thurnham *et al*., 1988). All manipulations were carried out under gold fluorescent lighting. In principle, a given quantity of vegetable sample is treated with magnesium carbonate, which neutralizes any organic acids in the sample and the carotenoids are extracted from the vegetable matrix using a mixture of suitable organic solvents. An aliquot of the organic phase is dried, diluted with the mobile phase to a suitable concentration and injected onto an HPLC column. A sensitive UV/Vis detector set at 450nm detects β-carotene, which is eluted as a sharp peak within 19-22 minutes. β-carotene is then quantified by use of peak height ratios or peak area ratios relative to an internal standard and the results expressed in µg/100g edible portion (EP).

Preparation of vegetable dishes: Each soup was prepared using the customary/ traditional method. The mean portion sizes as consumed by the women were obtained by interview. The ingredient compositions of the various soups and portion sizes were computed using the procedures outlined by Olusanya (1977).

Estimation of vitamin A activity in the dishes: The vitamin A value (retinol equivalent or RE) of the soups as consumed was computed using the value obtained by direct chemical analysis in the present study and from Food Composition Table (FAO, 1968). The vitamin A value of portion sizes was obtained based on the revised operational equivalence 14 µg of dietary β-carotene yields 1µg of vitamin A activity or 1 µg of dietary β-carotene equals 0.071µg RE (Van Het Hof *et al*., 1999; WHO/ FAO, 2004). The amount of vitamin A in the portion sizes were expressed as percentage of total vitamin A content and daily recommended intakes.

Statistical analysis: Where appropriate, percentages (%) were used. The mean±standard deviation for the measured variables was also determined.

RESULTS

Table 1 shows the relative frequency of consumption of the six DGLV used in the study. One hundred percent (100%) of the women consumed each of the leafy vegetables. Mon-mon ikong (*T. triangulare*) was the most frequently consumed vegetable as 73.3% of the women consumed it at least 4 times per week. Ikong ubong (*T. occidentalis*) consumed by 66.3% of the women at least 4 times per week and Afang *(Gnetum africanum)* consumed 2-3 times per week by 91.9% of them were also extensively utilized. Inyang afia (*A. hybridus*), Atama (*H. crinita*) and Editan (*L. africana*) were less utilized as most of the women consumed them only once a week or occasionally.

HPLC analysis of the leafy vegetables showed that Ikong ubong had the highest β-carotene concentration (12,038±1.53 µg/100g) and vitamin A value (860±0.10 µg RE/100g). Inyang afia also recorded a comparatively high β-carotene content (11,938±2.65 µg/100g) and vitamin A value (853± 0.19 µg RE/100g). Atama leaves had the least vitamin A quality. Its β-carotene content and vitamin A value were respectively 2,213±0.58 µg/100g and 26±0.04 µg RE/100g. (Table 2). The total vitamin A value per portion size of the various dishes commonly consumed by the pregnant women covered in the study are presented in Table 3. The results showed that the

Table 1: Frequency of consumption of the DGLV by the pregnant women

	Frequency (weekly)			
	Proportion of pregnant women (%)			
Vegetable type (name)	≥ 4 times	2-3 times	once	occasionally
Ikong ubong (*Telfairia occidentalis*)	66.3	33.7	-	-
Mon-mon ikong (*Talinum triangulare*)	73.3	26.7	-	-
Inyang afia (*Amaranthus hybridus*)	-	3.0	57.4	39.6
Afang (*Gnetum africanum*)	5.9	91.9	-	3.0
Atama (*Heinsia crinita*)	-	-	53.5	46.5
Editan (*Lasianthera africana*)	-	2.0	56.4	41.6

Table 2: b-carotene content and vitamin A value of various boiled green leafy vegetables consumed by respondents

Vegetable Type (Name)	β - carotene concentration (µg/100g *EP)	Vitamin A value (µg RE/100g *EP)
Ikong ubong (*Telfairia occidentalis*)	12, 038±1.53	860±0.10
Mon-mon ikong (*Talinum triangulare*)	3, 238±0.58	39±0.04
Inyang afia (*Amaranthus hybridus*)	11, 938±2.65	853±0.19
Afang (*Gnetum africanum*)	3, 695±2.52	44±0.18
Atama (*Heinsia crinita*)	2, 213±0.58	26±0.04
Editan (*Lasianthera africana*)	2, 982±0.58	36±0.04

*EP = Edible Portion

Table 3: Total vitamin A content of portion sizes of various dishes commonly consumed by the pregnant women

Dish/ Soup	Portion size (g)	Provitamin A (µg RE)	Preformed vitamin A (µg RE)	Total vitamin A (µg RE)	% Contribution to vitamin A requirement
Abak atama[a]	150	213.46 ±46	0.87 ±0.20	214.33 ±46	12
Afang[b]	200	3122.74 ±186	2.89 ±1.43	3125.63 ±188	168
Afia efere[c]	130	4.18 ±0.83	2.52 ±0.41	6.70 ±0.49	1
Iwuk edesi[d]	350	903.49±183	3.79 ±1.60	907.29 ±184	49
Iwuk edesi[e]	350	4.61 ±0.92	3.79±1.60	8.40 ±1.19	1
Editan[f]	200	3268.13 ±467	2.48 ±0.05	3529.00±189	175
Ekpang nkukwo[g]	500	3238.05±743	4.02±0.71	2838.00±350	174
Etighi[h]	150	2007.41±297	3.11±0.21	2010.52±297	108
Ikon[i]	180	1722.63±261	3.66 ±0.36	1726.28 ±262	93
Ikong[j]	200	4754.70±671	5.05 ±0.54	4759.75 ±672	255
Okoti[k]	300	2138.61±425	-	2138.61±425	115
Otong[l]	150	1786.31±158	0.73 ±0.13	1872.76±76	96
Stew[m]	60	48.74±16	-	48.74±16	3

[a]Atama, APP, fish, crayfish, [b]Afang, Mon-mon ikong, RPO, fish, crayfish, [c]Pounded yam, fish, crayfish, [d]Rice, RPO, fish, crayfish [e]Rice, REO, fish, crayfish, [f]Editan, Mon-mon ikong, RPO, fish, crayfish, [g]Grated cocoyam, Inyang afia, RPO, fish, crayfish, [h]Okro, Ikong, RPO, fish, crayfish, [i]Melon, Ikong, RPO, fish, crayfish, [j]Ikong, Mon-mon ikong, RPO, fish, crayfish, [k]Beans, RPO, [l]Pounded bush mango seeds, Ikong, RPO, fish, crayfish, [m]Fresh tomatoes, REO, Abbreviations: APP = African-oil palm puree, RPO = Red palm oil, REO = Refined edible oil

dark green-leafy vegetable-based dishes which include Ikong, Afang, Editan, Ekpang nkukwo and Etighi, had the highest vitamin A values ranging from 2010.52±297 µg RE/100g in Etighi to 4759.75±672 µg RE/100g in Ikong. Consequently, they made the highest contribution (108% and 255% respectively) to the vitamin A requirement in the women. Dishes prepared with little or no green leafy vegetables such as Abak Atama, Afia efere, Iwuk edesi, and stew or tomato sauce had much lower vitamin A values. The only exception to this is Okoti (bean pottage) which had a high vitamin A value (2138.61±425µg RE/100g) and also made a significant (115%) contribution to the vitamin A requirement in the women.

DISCUSSION

Over half of the women sampled consumed Mon-mon ikong (*T. triangulare*) and Ikong ubong (*T. occidentalis*) at least four times per week. According to Hart *et al.* (2005), the consumption of a food item more than four times per week shows that the food is consumed almost every day in a week. Therefore it could be said that the women in this study consumed these two vegetables daily. Overall, Mon-mon ikong had the highest frequency of consumption. This is understandable since traditionally, the vegetable is cooked and consumed together with ikong ubong (*T. occidentalis*) in ikong soup, afang (*G. africanum*) in afang soup and editan (*L. africana*) in editan soup and with porridges. Regarding the high frequency of Ikong ubong consumption recorded in this study, it is possible that the women were affected by the health benefits usually attributed to this vegetable. Use of this vegetable in the prevention and treatment of many life-threatening ailments have been reported including constipation,

appendicitis, atherosclerotic cardiovascular disease and stroke, infection, liver problems, anaemia, convulsion, high blood pressure, hypercholesterolemia, diabetes mellitus, arthritis, impotency and loss of libido in men (Ajayi *et al*., 2000; Alada, 2000; Eseyin *et al*., 2006; Nworgu *et al*., 2007). In fact, it is common to observe people from the Efik/ Ibibio tribes of Southeastern Nigeria drinking the raw extract of this vegetable as preventive measure against anaemia and other diseases.

The vitamin A value of the DGLV ranged from 26±0.04µgRE/100g in atama (*H. crinita*) to 860±0.10µgRE/100g in ikong ubong (*T. occidentalis*). These values are generally lower than the values reported in earlier studies (Polacchi *et al*., 1982; IVACG, 1989; Rahman *et al*., 1990). Such variations could be due to differences in handling. A number of studies have shown that boiling results in reduction of vitamin A activity of leafy vegetables (Sweeney and Marsh, 1971; Leung *et al*., 1972). Another potential source of variation is the recent changes in the vitamin A equivalency of provitamin A carotenoids because of the lower bioavailability of carotenoids than earlier assumed (Wardlaw and Kessel, 2002; WHO/FAO, 2004). However, the vitamin A value obtained in the present study for inyang afia (*A. hybridus*) (853±0.19µgRE/100g) is slightly higher than that reported in earlier studies (Polacchi *et al*., 1982; Rahman *et al*., 1990).

In conclusion, this study reveals that all things being equal, exception of atama (abak soup) which had low values, all other DGLV dishes usually consumed by pregnant women in Calabar are adequate to meet their daily vitamin A needs. They are in the order ikong, editan, ekpang nkukwo, afang and ogbono soups. Exception of atama, the consumption of these green leafy vegetables should be encouraged.

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