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Human Serum Vitamin A and β-Carotene Contents in Relation to Locally Consumed Foods, Social Status and Gender in Kano Metropolis

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ABSTRACT

Determination of the levels of vitamin A (as retinol) and β-carotene in locally consumed foods in relationship to their occurrence in the serum of individuals grouped according to different social groups and sexes was carried out in Kano metropolis. Both raw and prepared foods (meals/snacks) investigated showed the presence of β-carotene while vitamin A was only present in the latter. The levels of β-carotene in foods/snacks ranged from 2.00 – 3.40 and 88 – 1120 iu/kg in raw foods while that of vitamin A in the former was 13.00 – 23.50 iu/kg. Food/snacks derived from animal products and those made from vitamin A fortified foods showed marginally higher vitamin contents. The mean serum β-carotene and retinol concentrations of the individual grouped according to sex and social class showed significant differences between the three social groups ($P < 0.05$). The higher the income class, the higher the value of vitamin A and its precursor. There was no significant difference in the β-carotene and retinol concentration between males and females of low income and high income class ($P > 0.05$). However, there was significant difference between males and females of the medium income class ($P < 0.05$). These results are discussed in terms of an apparent relationship between income and serum vitamin A content.

Keywords: Human serum, retinol, β-carotene, income, sex, social class.

Introduction

Vitamin A is a fat soluble vitamin widely distributed in natural foods. In plants, which is the source of the vitamin to most animals including man, it exists as the precursors, the carotenoids, while in animals, especially higher animals, it is in the form of retinol, retinaldehyde, retinylester and/or retinoic acid (Olson *et al.,* 2000; Lean, 2006). In the higher animals, the body makes most of its vitamin from dietary carotenoids and the rest as preformed vitamin A (mainly from diets of animal origin) and store substantial amounts of both mainly in the liver (Bender, 1992).

Vitamin A is very important for maintaining good vision, contributes to the maintenance of healthy skin and mucous membranes that line the nose, sinuses and mouth (Akanya, 2004). It is also necessary for proper immune system function, growth, bone formation, reproduction and wound healing (Roberts and Sporn, 1984). There is little information on the vitamin A status of individuals in many locations in Nigeria on the basis of age, sex or income and that in their diets. This work aimed at determining the β-carotene and vitamin A (as retinol) concentrations in human serum, in Kano, Nigeria, based on income group and gender as well as in raw and prepared local foods.

Materials and Method

The raw food samples used in this study for β-carotene levels were selected based on their wide and regular consumption by the local populace and obtained from markets within Kano metropolis. The raw food materials used were dry baobab leaves, fresh amaranths, okra and carrots, dry okra and dry maize grains. The extraction and determination of

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carotenes involve three stages, namely maceration of sample, pigment extraction and spectrophotometric measurement of absorbance according to the method of the Association of Official Analytical Chemists (AOAC, 1980).

On the other hand the food samples in form of snacks (consumed informally between meals or at ceremonial occasions) and diets were selected based on their popularity and were obtained within the Kano metropolis. The estimation of β-carotene and retinol was carried out in three stages, namely homogenization, extraction using hexane and diethyl ether and colorimetric estimation after developing a colour using triflouroacetic acid (TFA) at 450 nm and 620 nm, according to the modified method of Adamu (1979).

In the study of the vitamin A levels in human sera, apparently healthy 120 subjects were randomly selected within Kano metropolis and their blood samples collected. A questionnaire was also administered to each subject to obtain information on age, income and dietary habits. The classification of income group was carried out based on Central Bank of Nigeria Statistical Bulletin (2004). The subjects were classified into 3 groups (low income, medium income and high income). The estimation of retinol and β-carotene in serum was carried out according to the method of Carr and Price (1926). The method involves the extraction of β-carotene from serum with ethanol to precipitate the proteins, then further extraction of the β-carotene from the supernatant with light petroleum ether and measurement of the absorbance at 450 nm. While for retinol the light petroleum ether extract was evaporated at 40°C, and then dissolved in chloroform with acetic anhydride to remove excess moisture and the absorbance measured at 620 nm.

Result and Discussion

The β-carotene contents of the raw foods analyzed are presented in Table 1 and ranged from 88 to 1120 iu/kg. The results showed that dry baobab leaves had the highest content, while dry okra had the least. The low concentration in dry okra could be due to oxidation of the carotenes during drying in sunlight as the β-carotene content of fresh okra is much higher than that of dry okra despite the high percentage of moisture. The results suggest that vegetables and fruits with high β-carotene content could be encouraged as a component of regular diets to minimize the risk of vitamin A deficiency associated health abnormalities.

Table 1: Concentration of β-carotene in some raw foods sold in Kano metropolis

Sample	Concentration (iu/kg)
Dry baobab leaves	1120 ± 25.23
Fresh carrot	880 ± 18.72
Fresh amaranth	640 ± 19.65
Dry maize	440 ± 11.83
Fresh okra	192 ± 18.17
Dry okra	88 ± 6.55

The concentration of β-carotene and retinol in foods showed that those of animal origin were expectedly richer in the vitamin than those of plant origin. Roasted liver had the highest concentrations of retinol and β-carotene: 3.40 and 23.50 μg/g; while *masa* had 2.00 and 13.00 μg/g and fried yam 2.30 and 13.00 μg/g. Thus foods based on cereals and tubers had the least. Liver is the major organ for the storage of both vitamin and its precursor; this is responsible for the significantly high values observed. Also, some of the processed foods were prepared from a selection of ingredients such as flour, vegetable oil and sugar which were already fortified with vitamin A (Akunyili, 2001), and this could have been responsible for the high to moderate vitamin A concentration in them. The results suggest that consumption of foods of animal origin in combination with processed foods or diets compounded from vitamin A fortified ingredients could be more beneficial, and would help to diminish vitamin A associated health anomalies.

Table 2: Concentration of β-Carotene and retinol in selected foods and diets in Kano metropolis

Sample	Beta-carotene (ug/g)	Retinol (ug/g)
Roasted liver (cow)	3.40	23.50
Roasted lung (cow)	2.80	15.50
Fried meat (cow)	3.00	20.50
"Alkaki"	3.40	22.00
Wheat flour Cake	2.90	19.50
Bread	2.80	17.50
Pound cake	3.10	19.00
Spaghetti meal	2.30	15.00
"Masa"	2.00	13.00
Beans cake *(akara)*	2.40	17.50
"Alale *(moinmoin)*"	2.80	15.50
Fried yam	2.30	13.00
Fried potatoes	2.60	15.00
Rice + beans + oil + pepper	2.50	18.00
"Tuwon dawa" and dry baobab leaves soup	3.20	17.00

The β-carotene and retinol levels in human sera are presented in Tables 3 and 4. The serum β-carotene and retinol concentration (mg/dl) in the subjects studied ranged from 0.2 – 4.6 and 0.12 – 2.09, while the mean was found to be 2.41 ± 1.41 and 1.20 ± 0.61 respectively. There was a direct correlation between income and serum vitamin A content. Those with high income were vitamin A sufficient, while the low income group was low in vitamin A but not deficient. There was no significant difference in the β-carotene and retinol levels between males and females of low income and high income classes respectively ($P > 0.05$). But there was significant difference between males and females of the medium income class ($P < 0.05$). Apparently this observation could not be scientifically attributed to any phenomenon. In all the cases studied no hypervitaminosis A and hypovitaminosis A were observed, but the low level may suggest risk to especially women of child-bearing age.

Table 3: Serum β-carotene concentration according to Sex and Social Groups of some selected people in Kano metropolis

Subjects	Low income (mg/dl)	Medium income (mg/dl)	High income (mg/dl)
Mean ± S.D.	0.765 ± 0.328	2.240 ± 0.490	4.02 ± 0.308
Males Range	0.2 – 1.1 * n = 20	1.6 -3.1 * n = 20	3.4 -4.5 * n = 20
Mean ± S.D. Females	0.785 ± 0.404	2.540 ± 0.520	4.085 ± 0.337
Range	0.2 – 1.5 n = 20	1.7 – 3.4 n = 20	3.5 – 4.6 n = 20

Table 4: Serum Retinol concentration according to sex and social groups of some selected people in Kano metropolis

Subjects	Low income (mg/dl)	Medium income (mg/dl)	High income (mg/dl)
Mean ± S.D.	0.4575 ± 0.1748	1.2085± 0.1702	1.8710 ± 0.1050
Males			
Range	0.12 – 0.69 * n =20	1.00 – 1.55 * n =20	1.72 – 2.04 * n =20
Mean ± S.D.	0.4915 ± 0.2531	2.540 ± 0.520	4.085 ± 0.337
Females			
Range	0.13 – 0.87 n = 20	1.10 – 1.71 n = 20	1.72 – 2.09 n = 20

Results are presented as mean ± standard deviation and range respectively. Also, n refers to the number of subjects and * indicates significant difference.

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