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Protein and Vitamin B_6 Content of Foods Consumed by Nigerian Adolescents

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ABSTRACT

The moisture, protein and vitamin B_6 contents of foods commonly consumed in Nigeria were determined. Subsequently, dietary protein and vitamin B_6 consumption of 41 adolescents resident in a post primary Institution were assessed over a 7-day period. The vitamin B_6 content of the foods as estimated by chemical method correlated strongly ($r = 0{\cdot}8562$, $P < 0{\cdot}001$) with values obtained from microbiological assay (using Saccharomyces uvarum *as test organism). Likewise, a strong and positive correlation existed between protein and vitamin B_6 content as determined by chemical assay ($r = 0{\cdot}3927$, $P < 0{\cdot}02$) or by microbiological assay ($r = 0{\cdot}7161$, $P < 0{\cdot}002$). Vitamin B_6 intake of the adolescents also correlated significantly ($r = 0{\cdot}8741$, $P < 0{\cdot}001$) with protein intake. The daily mean vitamin B_6 and protein intake was $1{\cdot}5 \pm 0{\cdot}34$ mg and $62{\cdot}1 \pm 13{\cdot}1$ g, respectively. The findings indicate that population groups that consume staple diets based on roots and tubers or those who do not meet their needs for protein would have poor vitamin B_6 status. Since institutional diets are often better than diets consumed in many homes, an extensive study of vitamin B_6 consumption patterns of other population groups is suggested.*

INTRODUCTION

Vitamin B_6 is an important nutrient in intermediary metabolism; it functions in protein metabolism, central nervous system (CNS) control and haemoglobin synthesis (Ink & Henderson, 1984). Vitamin B_6 inadequacy has been linked to mental retardation in children, depression in pregnant

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women or in women who use oral contraceptives. Vitamin B_6 deficiency is also implicated in a host of disorders including *diabetes melitus* and protein energy malnutrition (Hollenbeck *et al.*, 1983; Wilson & Davis, 1983). The scarcity of information on the vitamin B_6 content of foods commonly consumed in Nigeria explains why very little attention has been directed to vitamin B_6 nourishment of Nigerians. This report therefore attempts to provide information on vitamin B_6 content of some foods consumed in Nigeria. The authors also use the information provided to assess the vitamin B_6 intake of an adolescent population resident in a post-primary Institution.

MATERIALS AND METHODS

Subject

Dietary information was obtained for forty-one (20 males and 21 females) adolescents aged 10–18 years who resided in a post-primary Institution (Federal Government College, Ijanikin, Lagos). They weighed $46{\cdot}2 \pm 8{\cdot}4$ kg and were $153{\cdot}2 \pm 15{\cdot}4$ cm in height.

Food sample collection

All foods and snacks consumed by each student were weighed and recorded daily for 7 days. A portion of each food item as well as the snacks consumed by the adolescents for seven consecutive days was collected into wide mouth jars with screw-cap tops. The jars were sealed with tape and protected from light by wrapping with black cellophane. All samples were kept frozen until collection was completed.

Sample preparation

Similar food items were thawed, combined and homogenised in a Waring blender. The homogenate from each food was spread out on clean dry metal trays and dried to constant weight at 55°C in a vacuum oven. The dried samples were pulverised and stored in coloured bottles with tight fitting covers and protected from light until assayed for vitamin and protein content.

Analysis

Crude protein and moisture determinations were made on triplicate samples according to standard procedures (AOAC, 1970).

Vitamin B_6 estimation

Vitamin B_6 was assayed by microbiological assay (AOAC, 1970) using *Saccharomyces uvarum* ATCC 9080 as the test organism. The chemical measurement was made on pyridoxine extracts according to Hochberg *et al.* (1944).

Preparation of pyridoxine extract

An aliquot (1 g) of each food sample was hydrolysed with 10 ml 4N HCl in a boiling water bath for 1 h. The hydrolysate was cooled and adjusted to pH 3 with 12N NaOH. Phosphate–citric acid buffer (3 ml) was added followed by 2·5 g Lloyd's reagent. The resulting suspension was stoppered, left for 5 min, centrifuged and the supernatant discarded. The pyridoxine-bound absorbent was washed with 15 ml of 0·991N HCl 3 consecutive times. The bound pyridoxine was eluted from Fuller's earth with 5 ml of 2N NaOH, diluted to 20 ml with distilled water and centrifuged. The supernatant (10 ml) was dispensed into 60 ml of isopropanol in a centrifuge tube. The mixture was centrifuged; the pyridoxine extract was collected and adjusted to pH 5·7 with 12N HCl.

Pyridoxine assay

Triplicate tubes, each containing 6 ml of pyridoxine extract and 2 ml of ammonia/ammonium chloride are set up for each sample. Equal volumes (1 ml) of boric acid, water and pyridoxine (10 μg/ml) were added into tubes, 1, 2 and 3, respectively. The absorbance of each tube content was read at 620 nm, 60 s after the addition of 2, 6 dichloroquinone chloroimide reagent (1 ml). The vitamin B_6 content of each sample was calculated thus:

$$\mu\text{g pyridoxine/g sample} = \frac{\text{OD tube 2}}{\text{OD tube 3-2}} \times \frac{10}{\text{g}(W)} \times \frac{18{\cdot}5}{10} \times \frac{60}{10}$$

where OD tube 3-tube 2 = increment in spectrophotometric absorbance due to added pyridoxine.

W = weight of test sample—in grams

18·5 is the correction made in calculating for the volume of 1·5 ml occupied by 2·5 g Fuller's earth in a total volume of 20 ml.

Reliability of procedure

Recovery of known amounts of pyridoxine added to food samples was $94 \pm 4{\cdot}9\%$ and $97 \pm 3{\cdot}1\%$ for chemical and microbiological assays, respectively.

RESULTS AND DISCUSSION

The moisture, protein and vitamin B_6 contents of foods and snacks consumed are presented in Table 1. The vitamin B_6 content of the foods varied greatly. It is observed that a higher vitamin B_6 content was obtained for some plant foods by chemical than by microbiological assay. Likewise, animal foods yield a higher vitamin B_6 content by the microbiological than by the chemical method. Further classification of the foods into common food groups revealed that root- and tuber-based foods had considerably lower protein and vitamin B_6 contents. For example, *amala* (from yam), *fufu* (from cassava) and cooked yam had little or no protein or vitamin B_6 (Table 1).

The vitamin B_6 contents (of foods), as determined by both chemical and microbiological methods, were similar for roots and tubers, cereals, and dairy products. However, vitamin B_6 values obtained by both methods differed significantly ($P < 0{\cdot}05$) for fish, meat and their products. For individual foods analysed, the vitamin B_6 content obtained by the chemical method correlated strongly ($r = 0{\cdot}8562$, $P < 0{\cdot}001$) with values obtained by the microbiological assay.

The regression analysis showed that a significant and positive correlation existed between protein and vitamin B_6 contents of the foods. The correlation between protein and vitamin B_6 content analysed by microbiological methods was $r = 0{\cdot}7161$, $P < 0{\cdot}002$; the regression equation being vitamin B_6 (mg) $= 0{\cdot}2390 + 0{\cdot}0180$ (protein). Also, a lower but significant correlation existed between protein and vitamin B_6 content obtained by the chemical method ($r = 0{\cdot}3927$, $P < 0{\cdot}05$); the regression equation being vitamin B_6 (mg) $= 0{\cdot}2888 + 0{\cdot}0090$ (protein).

The vitamin B_6 intake of adolescent males ($1{\cdot}63 \pm 0{\cdot}3$ mg) was slightly higher ($P < 0{\cdot}05$) than values obtained for females ($1{\cdot}39 \pm 0{\cdot}25$ mg). The vitamin B_6 intake of the adolescents correlated significantly with protein intake ($r = 0{\cdot}8741$, $P < 0{\cdot}001$). The regression equation for vitamin B_6 intake (mg/day) $= 0{\cdot}1152 + 0{\cdot}0225$ (protein). The mean vitamin B_6 intake of the subjects in relation to protein was 0·02 mg/g protein with a high proportion (65%) of the total vitamin B_6 intake being derived from plant sources.

The findings from the present study indicate that vitamin B_6 content is closely related to the protein content of the foods. This association is also reflected in the dietary protein and while vitamin B_6 intake of the subjects appeared adequate, the bioavailability may be questioned because of the great dependence on protein from plant sources. Since roots and tubers are low in both protein and vitamin B_6, population groups consuming root- and tuber-based staples may have poor vitamin B_6 status. Nevertheless, it is possible to maintain adequate vitamin B_6 status from only plant sources by

TABLE 1
Moisture, Protein and Vitamin B_6 Content of Food Items Commonly Consumed in Some Parts of Nigeria (100 g Edible Portion)

Food item	*Moisture* (%)	*Protein* (g)	*Vitamin B_6 (μg/100 g)*	
			Chemical method	*Microbiological assay*
Cooked rice	72·2	1·77	8·2	10·2
Jollof (Spanish) rice	72·0	2·40	303	284
Bread	26·3	4·80	431	259
Eko	88·7	0·13	Trace[a]	Trace[a]
Eba	72·9	0·06	88·7	68·2
Amala (from Yam flour)	75·4	1·24	Trace[a]	Trace[a]
Fufu (from fermented cassava)	75·1	Trace[b]	62·3	42·8
Cooked Yam	68·9	Trace[b]	Trace[a]	Trace[a]
Fried Yam	65·6	4·25	52·5	63·8
Gari	15·9	2·08	308	287
Pottage (Yam)	76·2	3·60	202	235
Cooked Beans	54·7	18·4	544	498
Moin-Moin	74·4	10·4	656	526
Akara (fried beans)	32·4	20·4	1 086	976
Okro soup (*Hibiscus esculentus*)	92·9	0·45	Trace[a]	Trace[a]
Fish stew	85·8	5·14	79·0	125
Ewedu soup (*Conchorus olitorus*)	94·3	Trace[b]	Trace[a]	Trace[a]
Chicken/Chicken stew	82·9	6·03	586	727
Meat stew	85·0	2·27	121	162
Vegetable soup (Amaranthus soup)	81·6	1·45	64·5	108
Smoked Fish	48·1	26·8	586·1	862
Fried Fish	50·2	27·1	533	854
Meat (cooked)	42·7	48·0	354	805
Tomato (ripe whole)	94·1	0·14	162	184
Guava	81·7	Trace[b]	463	251
Cooked groundnut	49·8	2·32	109	118
Roasted groundnut	2·7	3·31	326	269
Plantain chips	8·9	0·12	462	330
Puff-puff	39·3	15·6	271	364
Biscuit	5·6	8·89	Trace[a]	Trace[a]
Cake	24·3	5·69	467	524
Roasted corn	38·8	0·03	226	176
Vitalo (Cocoa product)	5·1	6·23	503	620
Tea (with milk)	98·6	2·30	702	656
Bournvita (Cocoa product)	5·3	5·70	596	439

[a] Trace less than 1 μg vitamin B_6/100 g sample.
[b] Trace less than 5 mg nitrogen %.

wise combinations of legumes, fruits, cereal grains, vegetables and oil seeds. The association between vitamin B_6 values obtained by chemical and microbiological assay suggests that either method would give a reliable estimation of vitamin B_6 content of foods. It is, however, noted that microbiological assay may be a more reliable method for determining vitamin B_6 especially in foods from animal sources.

In America where nutritional status is apparently better than in developing countries, the daily intake of vitamin B_6 of adolescent girls ranged between 1·19 and 1·24 mg (Kirksey *et al.*, 1978; Driskell & Moak, 1986). In the present study, a high daily mean intake of $1{\cdot}50 \pm 0{\cdot}33$ mg obtained for the adolescents may be attributed in part to better diets provided in boarding institutions as a consequence of the subsidisation of the feeding of students in Unity Schools by the Federal Government. Food consumption records from another institution (Ajayi & James, 1984) confirm that diets in Government Institutions are better than diets consumed in many homes (Ajayi, 1984). It is therefore desirable that vitamin B_6 status of population groups in Nigeria be assessed and that effective measures be suggested in meeting the physiological needs.

At present, there has been no documented information on the vitamin B_6 content of African foods. Available reports (FAO, 1968) indicate that similar food items are consumed by vast population groups in Africa. The results obtained from this study may therefore be useful in the assessment of the vitamin B_6 status of population groups with similar dietary patterns.

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