

Risk assessment of antinutrient consumption of plant foods of south eastern Nigeria.

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Abstract

The risk assessment of anti-nutrient of consumed plant food of South Eastern Nigeria were estimated from actual quantity of plant food diet and the values compared with known risks levels from existing biological studies. The foods studied were yam, rice, garri, cassava fufu, tapioca and cowpea. Using the proportion of anti-nutrient composition of the plant food by weight, the anti-nutrients consumed were calculated from the weight of consumed food. The anti-nutrients were measures in mg/kg of food. The results show that the levels of lectin (0.05 mg/kg), cyanide (0.21-5.78 mg/kg) acceptable by existing studies while levels of phytate (23.5-130.65 mg/kg), oxalate (4.7-95.6 mg/kg) and tannin (108.3 mg/kg) are high enough to be associated with health risk and further studies should be carried out to authenticate Maximum Residual Limits (MRL) of these ante nutrients in human to determine whether the levels on the foods consumed should be reduced or allow them as they are.

Keywords: Dietary intake, Plant Foods, Southern Eastern Nigeria.

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Introduction

Much work exists on the anti-nutrients content of Nigerian plant foods. Hardly is there a proximate analysis of individual plant foods in local and international Journals without information on the antinutrient value of these plant foods [1-4]. Very few attempts have been made to estimate the actual quality of these toxicants and anti-nutrients consumed from plant food in Nigerian diet and yet it is the actual quantity of these anti-nutrients consumed that really matter, in terms of disease causation. The common anti-nutrients of interest in South Eastern Nigeria diet are lectin, saponin, cyanide, phytate, tannin and oxalate. Though South Eastern Nigerian plant foods have a long history of use, yet most of the toxicological base indices are not available as required by the Codex Alimentarius Commission. Their indices include the Acceptable Daily intake (ADI), the Maximum Residual Limit (MRLs) No Observed Adverse Effect level (NOAEL) and the Lowest Observed Adverse Effect level (LOAEL).

The management of risk arising from foods with anti-nutrients has been a major issue among the people and the government. Nutritional risks are reported in news media and Science Journals and such reports heighten public anxiety. The public demands disclosure of information on risk so that they can chose the appropriate direction to follow also want to participate in the regulatory decision making process itself [5,6].

The risk identification involves the recognition that a well-defined hazard exists. This is followed by determining the magnitude of the hazard involved. These risks may then be evaluated in terms of their significance and acceptability, severity of the hazard involved as well as any associated benefits. Finally, suitable strategies for intervention may be developed in order to control or manage know risks to the extent feasible desirable [7,8]. This study is aimed at establishing the nutritional antinutrient intake and risks (if any) associated with antinutrient of plant food of South Eastern Nigerian diet.

Materials and Methods

A survey research design was used to estimate the amount of anti-nutrients consumed from plant foods of South Eastern Nigerian Diet. Diet intake of each antinutrient was determined from total food intake measured gravimetrically.

The food intake study was done using the method described by [9,10]. The oxalate content of the foods were determined by colorimetric methods (AOAC 1990), the Tannin content was determined using [11]. The phytic acid was determined using spectrophotometric method as described [12,13]. While lectin was determined using the method described [2]. The saponin and cyanide content were determined as described [2,10].

The amount of anti-nutrients consumed from the plant foods were estimated from the food intake putting into consideration plant food combination diet. The results were compared to results of levels of various anti-nutrients which have been associated with pathology in animal and human studies.

Statistical analysis

The data collected were analysed statistically by means of Analysis of variance (ANOVA) and comparison of means of intake data by the method of Steel and Torrie using SPSS computer package [14].

Results

The total anti-nutrient consumption and risk evaluation of the anti-nutrient in plants food in South Eastern Nigeria are shown in Tables 1 and 2.

The results show that cassava products still provide the highest cyanide in the south-eastern state diet. Garri/ugu diet provides the highest level of cyanide (5.78 mg/kg). Tapioca/beans provide the highest level of phytate (130.65 mg/kg) followed by garri/bean (117.2 mg/kg). A close observation

Table 1. Total Anti-nutrient Consumption of South Eastern Nigerian Diets (mg/kg food).

Food Combination	Cyanide	Phytate	Saponin	Tannin	Oxalate	Lectin
Yam/rice	1.39	35.8	0.33	1.35	10.76	0.062
Yam/green	0.85	23.58	3.1	60.23	12.05	0.06
Amaranth	-	-	-	-	-	-
Yam/ora	0.78	25.65	0.67	82.03	59.05	0.06
Yam/ugu	1.12	23.95	1.44	98.43	27.43	0.08
Yam/beans	1.03	77.25	0.35	1.37	7.73	0.11
Rice/green	0.34	46.88	2.83	0.06	4.39	0.052
Amaranth	-	-	-	-	-	-
Garri/ogbono	5.27	63.9	0.3	58.92	12.05	0.022
Garri/ora	5.44	75.6	0.3	0.77	58.5	0.01
Garri/ugu	5.78	63.9	1.17	80.76	66.9	Nil
Garri/bitter leave	5.48	69.4	20.88	97.16	35.28	0.02
Garri/beans	5.69	117.2	0.08	108.36	29.08	Nil
Cassava	2.23	39.33	20.85	0.1	15.58	0.05
Fufu/bitter leave	-	-	-	-	-	-
Cassava/fufu/ugu	2.53	31.85	1.14	108.3	21.68	Nil
Cassava	2.19	45.53	1.14	97.1	27.91	0.02
Fufu/ora	-	-	-	-	-	-
Cassava	0.22	33.83	0.3	0.71	59.53	Nil
Fufu/ogbono	-	-	-	-	-	-
Tapioca/beans	3.29	130.6	0.05	0.04	51.13	0.01
Beans/green	0.7	88.33	2.85	58.94	9.48	0.07
Amaranth	-	-	-	-	-	-
Bitter	0.25	40.9	21.15	108.371	5.68	0.01
Leave/ogbono	-	-	-	-	-	-
Ugu/ogbono	0.55	35.4	1.44	97.81	63.98	0.03
Ora/ogbono	0.21	47.1	0.67	81.41	95.6	0.01

Table 2. Risk Assessment of Consumed Antinutrient from plant Food of South Eastern Diet.

Anti-nutrient	Mean consumption	Stipulated residual limit mg/k of food	Study animal
Lectin	0.05	5A	rat
Phytate	23.5-130.7 mg/Kg	26.4-150B	human
Oxalate	4.7-95.6 mg/kg	50C	human
Saponin	0.03-0.2 mg/kg	5-10D	rat
Tannin	108.37	120E	rat

of the result show that beans products provides the highest level of phytate in the South Eastern Nigeria diet. The results shows that bitter leave/ogbono provide the highest level of saponin (21.15 mg/kg). The highest level of tannin exposure come from Garri/bitter leave, cassava/fufu/bitter leave and bitter leave/ogbono combination (108.3 mg/kg), these are followed by yam/beans (98.4 mg/kg), while the least exposure was from tapioca/beans (0.4 mg/kg). The highest oxalate exposure comes from ora/ogbono (66.9 mg/kg) and the results show that lectin exposure is very low.

Discussion

Risk assessment of consumed anti-nutrients

Animal studies show that the adverse effect of high lectin oral consumption (5 mg/kg) affects absorption of protein and glucose [15]. The level found in this study is very low (0.05 mg/kg) and it is concluded that dietary lectin consumption do not pose any risk to south eastern Nigeria population. The low content may be due to the fact that lectin is heat labile.

Animal studies indicated that dietary phytate bind with zinc, iron and other deficiencies occur in population that subsists on unleavened whole grain bread containing 26.4 – 150 mg/

kg of phytate. The level of phytate found in Southern Eastern Nigeria diet is relatively high (23.5-130.65 mg/kg). It may be stated that dietary phytate in South Eastern Nigerian diet is a risk factor of micronutrient deficiency in the area. This needs further investigations.

Animal studies has shown that insoluble oxalates (calcium and Magnesium oxalates) are not absorbed and do not pose health risk unlike the soluble oxalates that reduce the bioavailability of calcium and help in the formation of kidney stones [16]. Nooman and Savage stated that diet with soluble oxalate of 50 mg/kg are excreted from urine and predispose the individual to kidney stones [17]. The results of his study indicated that the oxalate consumption from South Eastern Plant food is moderately high (4.7-95.6 mg/kg) and may constitute to some extent nutritional risk of calcium deficiencies and kidney stone formation.

It has been reported that oral intake of saponin of 5-10 mg/kg produces local effect of corrosion and paralytic ileus [18]. From this study saponin content of south Eastern Nigeria diet is relatively low (0.03-0.2 mg/kg) and may not pose any health risk to the populace.

Osagie reported that high level of dietary Tannin (120 mg/kg) reduces absorption of protein and damages the intestinal walls and Butler associated 200 mg/kg to damage to intestinal wall [19,20]. The result of this study show that tannin intake from South Eastern Nigerian Plant food is moderate high (108.37 mg/kg) and can affect the protein utilization in area with low protein intake.

Absorption of cyanide after ingestion with the food occurs across the mucosa membrane [21]. B-glucosidase enzyme is activated in the alkaline environment of the gut to hydrolyse the cyanide glucoside to release hydrogen cyanide that is responsible for the toxic effect [22]. ACGIH reported that 80% of the absorbed cyanide is detoxified in the liver by the enzyme rhodanase and it is excreted from the urine [23-26]. According to Okofor the observed adverse effect level (OAEL) for cyanide in human diet is 9 mg/kg body weight. From this study the cyanide intake from the diet is relatively low (21-5.78 mg/kg). It is included from the study that cyanide consumption from south Eastern Nigerian met poses low health risk.

Though the level of phytate (2.5-0.65 mg/kg), oxalate (47.95.6 mg/kg) and tannin (108.37 mg/kg) are high enough to be associated with health risk, yet their ability depend on their excretion and the frequency of consumption. There is a need to establish the excretion and consumption frequency of each to determine whether the levels in the food consumed should be reduced or left at it.

Conclusion and Recommendation

It was concluded from this study that the level of consumption of lectin cyanide and saponin are within the limit acceptable existing studies while that of phytate, malate and tannin are high enough to be associated with health risks going by visiting studies. It is recommended that further studies be carried out to authenticate maximum residual limits of these anti-nutrients in humans.

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