African Journal of Biomedical Research, Vol. 9 (2006); ***157 - 162***
ISSN 1119 – 5096 © Ibadan Biomedical Communications Group

Full-text available at
http://www.ajbrui.com
http://www.bioline.br/md
http://www.ajol.com

Full Length Research Article

An Assessment of the Dietary Fiber Intake of Selected Students in the University of Ibadan, Ibadan, Nigeria

Adegoke, O.A. Fadupin, G.T. *Ketiku, A.O.

Department of Human Nutrition,
College of Medicine, University Of Ibadan,
Ibadan – Nigeria.

ABSTRACT

It is recognized that adequate intake of dietary fiber tends to reduce the risk of developing chronic diseases such as diabetes, obesity, colon cancer and heart disease. This study was carried out to assess the adequacy of dietary fiber intake of 12 male and 12 female volunteer undergraduates of Ibadan University. Food consumption survey was by the direct weighing method for three days. Representative samples of the diets were analysed for moisture and fiber content using the standard methods of Association of Official Analytical Chemists (AOAC). The study showed that the dietary fiber intake of the students was adequate. Dietary fiber intake of female students (40.5 = 8.5g/day) was significantly lower than the intake (54.2±13.7g/day) of the male students (P<0.05). Cereal based foods contributed the highest (58.2%) while fruits and vegetables contributed the least (9.7%) amount of fiber in the students' diets. Intake of fiber from vegetables and fruits by students should be encouraged.
(Afr. J. Biomed. Res. 9: *157 – 162*)

Keywords: *Dietary Fiber, Cereal Fruits Vegetables, University Students*

Received:
February 2006

Accepted (Revised):
June 2006

Published:
September 2006

**Address for Correspondence (e-mail) : fagtag2000@yahoo.com*

Abstracted by:
African Index Medicus (WHO), CAB Abstracts, Index Copernicus, Global Health Abstracts, Asian Science Index, Index Veterinarius, Bioline International , African Journals online

INTRODUCTION

Dietary fiber is an important part of a health promoting diet. Basically the term dietary fiber refers to some complex carbohydrates and lignin found in plants, which are undigested by human alimentary tract enzymes (Southon, 2000). Although dietary fiber is not digested in the small intestine, and absorbed into the body, it is linked with healthful diet because of its protective role against many chronic diseases (Goldman *et al*, 1999).

Dietary fiber is fermented by bacteria in the large intestine leading to the formation of short-chain fatty acids, which acidify the colonic content resulting in water retention and feacal bulking complex which promotes laxation. It gives a feeling of satiety, slows down the appearance of post prandial glucose levels in the blood leading to a gentle rise in blood sugar, (Wolever and Jenkins 1993). Dietary fiber also enhances stable blood sugar levels which allow less demand on the insulin mechanism, that is needed to convert sugar from the blood into usable energy. It helps weight control by delaying the return of hunger, promotes good intestinal health by increasing viscosity of intestinal contents, bowel motility and decreases transit period through the intestinal tract, which may help in reducing colon and rectal cancers and also diverticulosis (Goldman *et al*, 1999). It binds bile acids and lipid substances such as cholesterol and promotes their excretion thereby lowering the plasma cholesterol and reducing the risk of heart disease (Goldman *et al*, 1999).

The main components of dietary fiber are cellulose, hemicellulose, hexosans, pectin substances, gums, mucilages and lignin. Dietary fiber is present in all foods of plants origin. The best sources are whole fruits, vegetables, cereal grains and legumes (Wagovich, 2000).

There is increasing epidemiological evidence that population groups which consume reasonable amounts of dietary fiber (20 – 35g / day) have lower risk of a number of chronic diet-related diseases such as diverticular disease, coronary heart disease, obesity, type 2 diabetes mellitus, gall stone, colonic carcinoma, hyperlipidaemia, constipation, haemorrhoids and irritable bowel syndrome (Cummings *et al*, 1997). Studies have also shown the important role of dietary fiber in the management of these chronic diseases (Bantle *et al*, 1983, Toma *et al*, 1988, Rimmet *et al*, 1996).

The study of Mbofung and Atinmo (1984) indicates high dietary fiber consumption by urban and rural Yoruba Nigerian women. Other reports also indicate that older adults are often plagued with chronic diseases that have nutrition origin which are associated with inadequate intake of dietary fiber (Cumming *et al*, 1997; Williams, 1999). Good food habits and lifestyles that can prevent or reduce the occurrence of diet related chronic diseases need to be established early in life as it may become more difficult to change such habits later in life.

The objective of the study was to analyze the dietary fiber content of students' diets, determine their dietary fiber intake and establish the adequacy of their dietary fiber intake.

MATERIALS AND METHODS

The study was carried out in the Department of Human Nutrition, University of Ibadan. Out of a total student population of 120 students, only twenty–four students made up of 12 males and 12 females, aged 19 to 30 years volunteered to take part in the study after the implication had been explained to them.

Food Consumption Survey

The direct weighing (recipe) method was used for the survey. The food consumption survey of each student was measured for two week days and one weekend day with the use of a sensitive 5.0kg salter scale calibrated at intervals of 20g. The investigators visited the subjects before each meal was served to record the weight of the empty plate and of each food item served separately. The weight of each food consumed was recorded and the leftover was subtracted from the weight of food served to obtain the actual food intake of the subjects. Before each weight was taken, the scale was always zeroed. The reading of the scale was read with the investigator right in front of the scale to avoid error due to parallax. Similar sizes of snacks consumed by the subjects between meals were weighed and recorded. A known weight of the duplicate sample of each

food item consumed was taken and analysed for moisture using AOAC method (1984) and total dietary fiber content determined as neutral detergent fibre using the method of Reinhold and Garcia (1979). The dietary fibre intake of each subject was calculated from the food intake data and the dietary fibre percentage of each of the diet components. The data obtained was analysed using means with its standard deviation and percentages by SPSS computer version 6.1.

RESULTS

The foods eaten by the students consisted of cereal, legumes and nuts, roots and tubers as well as vegetable and fruits based foods. The fiber content of the foods ranged from 0.9 ± 0.3g/100g in 'eba' to 10.5 ± 1.0g/100g in fresh cooked maize while the moisture content ranged from 2.4 ± 0.3/ 100g in roasted groundnut to 95.1 ± 0.1g/100g in okro soup. The major sources of fiber from the cereal based foods eaten by the students were fresh cooked maize (10.5 ± 1.0g/100g), white bread (9.3g ± 0.7g/100g), noodles (6.0 ± 0.2g/100g) and spaghetti (5.7g ± 0.2g/100g). Within the rice based foods, Jollof rice had higher moisture (74.9 ± 2.1/100g) and lower fiber content of 2.6 ± 0.3/100g than cooked white rice or fried rice which had moisture content of 66.4 ± 1.5g/100g and 63.9 ± 1.8g/100g and fiber content of 2.8 ± 0.2g/100g and 3.2 ± 0.6g/100g respectively. Jollof rice also had the least fiber and the highest moisture content among the cereal based foods (Table 1).

The legume foods eaten by the subjects were cooked cowpea and steamed seasoned cowpea pudding called 'moinmoin'. Cooked cowpea had higher fiber (5.2 ± 0.4g/100g) and moisture (71.0 ± 1.6/100g) content than the steamed seasoned cowpea pudding 'moinmoin' which had 4.0 ± 0.5g/100g fiber and 69.5 ± 2.0g/100g moisture respectively.
Varieties of cassava products were eaten more than other roots and tubers based foods by the subjects (Table 3). Among the cassava products, cassava 'fufu' had higher fiber content (2.8 ± 0.5g/100g) than cassava 'amala' (2.1 ± 0.3/100g) or cassava 'eba' (0.9 ± 0.3/100g).

Table 1:
Dietary Fiber and moisture content of cooked cereal based foods eaten by the Subjects

Cereal based foods	Dietary fiber content of edible portion (g/100g)	Moisture content (g/100g)
White rice *(Oryza sativa)*	2.8 ± 0.2	66.4 ± 1.5
Jollof rice *(Oryza sativa)*	2.6 ± 0.3	74.9 ± 2.1
Fried rice *(Oryza sativa)*	3.2 ± 0.6	63.9 ± 1.8
Spaghetti "Dangote"	5.7 ± 0.2	66.1 ± 1.6
Noodles "Indomie"	6.0 ± 0.2	66.9 ± 2.0
White bread *(Triticum aestivum)*	9.3 ± 0.7	29.2 ± 1.2
Fresh–Cooked maize *(Zea mays)*	10.5 ± 1.0	50.4 ± 2.0
Doughnut *(Triticum aestivum)*	4.7 ± 0.3	33.3 ± 1.4

Table 2:
Dietary fiber and moisture content of cooked legumes, and nuts based foods eaten by the Subjects

Legumes and nuts based foods	Dietary fiber content of edible portion (g/100g)	Moisture content (g/100g)
Cowpeas *(Vigna unguiculata)*	5.2 ± 0.1	71.0 ± 1.6
Steamed seasoned bean pudding "moinmoin" *(Vigna unguiculata)*	4.0 ± 0.5	69.5 ± 2.0
Roasted groundnut *(Hypogea spp)*	3.0 ± 0.9	2.4 ± 0.3

Among the soups eaten by the subjects, melon soup had the least moisture (36.4 ± 1.1%) while the highest fiber content of 9.9 ± 0.2% was from the bitter leaf in melon stew. The only fruit taken by some of the subjects was apple (Table 4).
In Table 5 the cereal based foods contributed the highest dietary fiber (47.8% for males and 58.2% for females) while fruits and vegetables contributed the least amount of 10.6% and 9.7% to the dietary fiber intake of the male and female students respectively.

Table 3:
The Moisture and Dietary Fiber Content of Cassava, Yam and Plantain Product eaten by the Subjects

Roots and tubers based foods	Dietary fiber content of edible portion (g/100g)	Moisture content (g/100g)
Fermented cassava 'Fufu' *(Mannihot esculenta)*	2.8 ± 0.5	71.5 ± 2.0
Cassava meal 'Eba' *(Mannihot esculenta)*	0.9 ± 0.3	77.1 ± 1.8
Cassava flour (white 'amala') *(Mannihot esculenta)*	2.1 ± 0.3	72.7 ± 1.5
Yam boiled *(Dioscorea rotundata)*	2.6 ± 0.3	70.1 ± 2.3
Fried ripe plantain *(Musa sinensis)*	5.2 ± 0.4	38.4 ± 0.8

Table 4:
The Moisture and Dietary Fiber Content of Fruits and Vegetable based Foods eaten by the Subjects

Fruits and vegetable based foods	Dietary Fiber content of edible portion (g/100g)	Moisture content (g/100g)
Apple (*Malus sp*)	2.0 ± 0.2	79.7 ± 1.6
'Ewedu soup' (*Cochorus sp*)	1.9 ± 0.3	93.3 ± 1.4
Okro soup (*Hibiscus esculentus*)	1.4 ±0.6	95.1 ± 1.0
Pumpkin leaf soup (*Curcubita sp*)	6.2 ± 0.4	74.9 ± 1.5
Bitter-leaf *(Veronia amygdalina) in* melon stew	9.9 ± 0.2	74.3 ± 1.5
Melon soup (*Citrullis sp*)	3.0 ± 0.5	36.4 ± 1.1

The dietary fiber intake of the subjects according to their sex (Table 6) indicates an average fiber intake of 54.2g/day by the male and 40.5g/day by the female. The difference was statistically significant ($p<0.05$). Such intakes satisfied 180% and 135% of the recommended dietary allowance of 30g for the fiber intake of adult male and female respectively (Cummings *et al*, 1992).

Table 5:

Mean dietary fiber Intake of subjects from different food groups

Food Source	Fiber Intake	
	Male (g/day)	Female (g/day)
Cereals	25.9 ± 10.8	23.6 ± 8.10
Roots, tubers and plantain	13.4 ± 6.8	8.3 ± 3.5
Legumes and nuts	9.2 ± 4.3	4.7 ± 2.7
Vegetables and fruits	5.7 ± 2.9	3.9 ± 2.1
Total	54.2 ± 13.7	40.5 ± 8.5

Table 6:
Mean daily fiber intake of the male and female subjects in comparison with RDA

Sex	Mean fiber intake (g/day)	RDA (g/day)	% RDA met
Male n = 12	54.2 ± 13.7^a	30	180
Female n = 12	40.5 ± 8.5^b	30	135

RDA= Recommended dietary allowance. (Cummings et al 1992)
Fiber intake values with different superscripts are significantly different ($P<0.05$).

DISCUSSION

The study showed that cereal based foods were the major sources of fiber in the students diets. Rice in form of jollof rice had higher moisture content and less fiber than cooked plain white rice. The less fiber and more moisture in jollof rice than cooked plain white rice and fried rice could be due to the fact that jollof rice was cooked softer than plain white rice or fried rice. Also cooked cowpea had higher moisture content and more fiber than 'moinmoin' which was prepared from hulled cowpea but with similar ingredients. Cassava meal (eba) had more moisture content and less fiber than cassava 'amala' or 'cassava' 'fufu'. The consistency of

'eba' usually depends on the preference of the consumer.

Although the male subjects took more dietary fiber (54.2 ± 13.7g) in their diets than the females, (40.5 ± 8.5g), the fiber intake of all the subjects was high. These findings confirm the previous reports that fiber intake among populations in developing countries is high and much more than in the developed countries (Bingham *et al*, 1979, Mbofung and Atinmo, 1984; Kasper and Rasbat, 1986). The quantity of fiber consumed by the subjects was more than 200% of the 13.4g/day reported by Marlett and Bokram (1981) for a group of American undergraduates and 100% more than the 20 – 22g/day reported by Bingham *et al* (1979) and Kasper and Rasbast (1986) for the British population and the 15.0g by Alaimo *et al* (1994) for the American adult population.

The high fiber intake of the students could be because cereals, roots and tubers are the main staple foods in Nigeria. They are grown in large quantity, and are more accessible and cheaper than refined foods. The high levels of fiber intake observed in this study has further provided another evidence for claims hitherto made that Nigerian diets are high in fiber (Mbofung and Atinmo 1984). Another point of note is that cereal based foods contributed the highest while fruits and vegetables contributed the lowest amounts of fiber in the diet of the students. This was because cereals in form of maize was consumed in large amount because fresh maize was in season during the study while, fruits and vegetables were not regularly eaten. Also very little amounts of vegetable in soup was served with the starchy staples of the students. The high fiber intake of these subjects is expected to confer on them some protection against chronic diseases such as coronary heart disease, diabetes, diverticular diseases, colon cancer, obesity and hypertension.

It is necessary to draw the attention of the subjects to the need to include more fresh fruits and vegetables in their diets in order to have maximum health benefits of adequate fiber intake.

REFERENCES

Alaimo, K. McDowell, M.A. Briefel, R.R. Bischof, A.M. Caughman, C.R. Loria, C.M. , Johnson C.L., (1994) Dietary Intake of Vitamins, Minerals and Fiber of Persons Ages 2 months and over in the United States. Third National Health and Nutrition Examination Survey Phase 1, 1988-91. Haysville Md.

AOAC (1984) Official Methods of Analysis of the Association of Official Analytical Chemists. Washington, DC.

Auradha, V. & Praskash, J. (1989) Dietary fiber Content of selected vegetable and fruits. J. Ed. Sci. Tech. 26: 6: 354-256.

Bantle, J. P. Laine D.C. Castle, G.W. Thomas, J.W. I toogwerf, B.J. and Goetz, F.C. 1983 Post pandnal glucose and insulin responses to meals containing different carbohydrales in normal and diabetic subjects N. Eng J. Med. 309: 7-12.

Bingham, S. Cummings, J.H. & McNeil, N.I. (1979): Intakes and sources of dietary fiber in the British Population. Am. J. Clin. Nutr. 32: 1313 – 1319.

Cummings J.H; Bingham S.A, Heaton K.W, Eastwood M.A (1992): Feacal weight colon cancer risk and dietary intake of non-starch polysaccharides (dietary fiber). Gastroenterology 103:1783 - 1789.

Cummings, J.H., Roberfroid, M.B., & Anderson, H. (1997) A new look at dietary carbohydrates: Chemistry, Physiology and Health. Eur. J. Clin. Nut. 51: 417-423.

Gold, S.P Man, I.L Kader, A. A and Keintz C. (1999): Influence of production, handling and storage on phyto nutrient content of foods. Nutrition Reviews 1999; 57 (9) S46 – S52.

Hyson, D. (2002) The health benefits of fruits and vegetables. A scientific overview for professionals. Produce for Better Health Foundation, Wilmington DE, pp 20 - 37.

Kalt W. (2000): Health functional phytochemicals of fruits. Hort. Rev. 2000. 27: 269-315.

Kasper, K. and Rasbast, U. (1986) Studies on the extent of dietary fiber Intake in the West Germany. J. clin. Epidemiol 47: 525 – 536.

Marlett, J.A. & Bokram, R.L. (1981): Relationship between Calculated dietary and Crude Fiber intakes of two hundred college students. Am. J. Clin. Nut. 355-342.

Mbofung, C.M.F. Atinmo, T. (1981) Neutral Detergent Fiber (NDF) and Crude Fiber (CF).

Content of Selected Nigerian Foods. Nig J. Nut 2: 71-79.

Mbofung, C.M.F. Atinmo, T. (1984) Dietary Fiber in the diets of urban and rural Yoruba Nigerian Women Nutrition Research 4:225-235.

Raymond, W.F. (1969) The Nutritive value of Forage Crops. Agron 21:2 – 6.

Reinhold, J.G. Garcia, JL (1979) Fiber of the Maize Tortilla. Amer. Clin. Nutr.32: 1326-1329

Rimmet S.P, E.B. Ascherio, A. Giovannucci, E. Speigelman, D. Stampfer, M.J. Willet, W.C. (1996) Vegetable fruits and cereal Fiber intake and risk of coronary heart diseases among men JAMA 275: 447-451.

Southon S (2000): Increased fruit and vegetable consumption within EU: Potential health benefits; food Res Int. 2000; 33: 211-217.

Toma, E.D. Clement, A. Marcelli, M. Cappelloni, M. and Lintas C (1988):. food fiber sources for diabetes A.M. J. clin Nutr. 1988; 47: 243-246.

Trowell. H. (1987) Marabou Symposium on Food and Fiber Nutr. Rev. 35:6.

Wargo, S.P. Vich, M.J. (2000) Anticancer properties of fruits and vegetables. Hort Science, 35:5-7.

Willians S.R. (1999) Nutrition for adults: Early, middle and later year. In Nutrition and Diet therapy, Seventh ed. 273-287 Mosby. Inc, USA.

Wolever T.M.J, Jenkins DJA (1993) Effects of fiber and foods on carbohydrate metabolism. In Spiller GA (ed), Dietary fiber in human nutrition, 2nd ed, CRC Press, Boca Raton, FL, PP 111-152.