Bioscience Research Communications
Vol. 15, No. 4, August 31, 2003
Printed in Nigeria

0795-8072/2003 $12.00 + 0.00

http://www.klobexpublishers.com

BRC 2002025/15402

Studies on taurocholate binding capacity and water holding capacity of a variety of foodstuffs

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(Received April 30, 2002)

ABSTRACT: Taurocholate binding capacity (TBC) and water holding capacity (WHC) of alcohol insoluble solid of varieties of food stuffs was studied. The taurocholate binding capacity value of the various alcohol insoluble solids varied between 9.9 – 40%. results obtained showed that pectineous vegetables had the highest taurocholate binding capacity value, followed by legumes and cereals. Correlation was observed between water holding capacity and taurocholate binding capacity value. 23 – 34% of the variation in taurocholate binding capacity value was based on the variation in water holding capacity values. Baobab leaf had the highest taurocholate binding capacity value of 35.70mg while millet has the lowest value of 23.60mg.

Key Words: Taurocholate binding capacity; Water holding capacity; Legumes; Cereals; Baobab leaf.

Introduction

Taurocholate, a primary bile acid is an excretory product of cholesterol metabolism. It is excreted from the body through faeces as neutral steroid of bile acids. Several factors play a role in the control of cholesterol metabolism. All of them exert their effects by altering the rate of synthesis or degradation of the steroid. Elevated level of cholesterol in the blood plasma caused hypercholesterolemia which occurs jointly with other disorders associated with lipid metabolism. These include coronary heart disease, obesity and atherosclerosis in humans (Murray *et al*., 1988). These diseases or disorders affect middle age sedentary people and tend to occur in combination of two or three in the same individual.

Excessive deposition of cholesterol in vascular tissue have had undesirable consequences. Efforts have been directed to reduce the levels of blood cholesterol in the hope of reducing the degree of vascular cholesterol deposition. These attempts have utilized a variety of dietary and therapeutic procedures. Drug therapy designed to interfere with endogenous cholesterol biosynthesis has not had practical success. Certain drugs that diminish cholesterol formation lead to an accumulation of intermediates of cholesterol synthesis in the liver and in the intimate of the larger blood vessels.

Cholesterol absorption is interrupted by dietary fibres in the small intestine, thus minimizing the rate of cholesterol absorption thereby decreasing the rate of lipid absorption. The inhibition or interruption of the enterohepatic circulation elicits some beneficial effects in the management of lipid disorder (Spiller and Anen, 1976). Bile salts and acids such as cholic acids, taurocholic acid, lithocholic acid etc. are strongly absorbed by dietary fibre. Bile salts absorbed or bound to dietary fibre through a mechanism of hydrophobioc absorption reduce the plasma cholesterol level which causes diseases associated with lipid metabolism (Eastwood *et al*., 1968). Absorption of bile acid is in turn influenced by the physical and chemical properties of the fibre such as the type of bile acid micelle and osmolecularity of the intestinal Constituent (Kay and Strasberg, 1978).

Studies by Vahomy (1980) showed that pectin enhances stool output of cholesterol and that the hypocholesterolamic effect of pectin is greater when the diet contains cholesterol. Dietary fibre has also been known to play a significant role in the treatment of type II – hypercholesterolemia (McConnel *et al*., 1974). Clinically, this is treated by interrupting the enterohepatic circulation of bile acid by certain drugs. It does this by combining with cholesterol on weight to weight basis and excreted in the faeces (Murray *et al*., 1988). Some of the drugs are also known to block the formation of cholesterol at various stages of the biosynthesis pathway. However, some of these drugs were found to be harmful, hence the need to use fibre.

Materials and Methods

Sundried varieties of food stiffs (Cereals, legumes and vegetables) that are majorfood items of most Nigerian diets were obtained from Maiduguri Monday market.

Legumes: Red beans (*Vigna unguiculata*), white beans (*Vigna unguiculata*, Soybeans (*Glycine max*) and bambara nut (*Voanzeia*).
Cereals: Corn (*Zea mays*), Sorghum (*Sorghum vulgare*), Millet (*Pennistetum typhoiderm*), Wheat (*Triticum aestivum*) and rice (Oryza sativa).
Vegetables: Okro (*Hibiscus esculentus*), false sesame (*Ceratethaca sesamoide*), baobab leaves (*Adansonia digilata*) and Ogbono (*Irvinga gabonensis*).

Procedure: Taurocholate determination: 100g of each of the dried samples were weighed, ground finely into powdered form and sifted through sieve (No. 4) filter paper. Different weight of the samples (2.0g, 1.0g and 0.5g) was used for the analysis.
To the different weights (2.0g, 1.0g and 0.5g) of the finely sieved powder, 10ml of water was added and allowed to boil for 5 minutes. The suspension was then filtered through Whatman (No. 1) filter paper. Samples were then washed thrice with 10ml ethanol each time followed by centrifugation at 2400 rpm, the supernatant was discarded and the residue air dried for subsequent experiment.

Samples were then put into a dialyzing tube and kept in a refrigerator at 4°C over night. Sixteen test tubes were then used for the test. To the blank, 1ml of water, 0.5ml of sucrose solution and 1ml conc. H_2SO_4 was then added drop wise from the biuret. Optical density readings for each was taken after development of the characteristic purple colour at 580nm were length.

Determination of water holding capacity of the alcohol insoluble solid.

Procedure: Different weight (2.0g, 1.0g and 0.5g) of the powdered samples was soaked in water for 24 hours. It was then centrifuged at 2,400 RPM to remove the intestitial water. The water holding capacity (WHC) was calculated from the difference in weight of material before and after centrifugation.

Results and Discussion

Results presented in Tables 1 and 2 show that all the food samples analysed have the ability to bind taurocholate in-vitro and the capacity partially depends on the tendency to imbibe water. Results also showed that taurocholate binding increased positively with increased food sample in the order 2.0g>1.0g>0.5g. The alcohol insoluble solids band more at acidic pH 5.8 than at pH 8.0. This suggests that hydrogen bonds and hydrophobic interaction mediated in the binding of taurocholate to alcohol insoluble solids. Variation in taurocholate binding capacity values are based on the variation in water holding capacity values. However, other physiochemical factors other than water holding capacity may be responsible for the variation in taurocholate binding capacity value. The taurocholate binding capacity of alcohol insoluble solids when compared to the value obtained in pectin (36.10mg/g which was used as a reference standard) varied between (40 – 90%).

The results obtained shows that 342g of baobab leaves served for the period of 2 months based on the average consumption of 5g/day/individual will be able to extract 12g of taurocholate from the enterohepatic circulation in addition to 13.60g that would be extracted under normal condition. This means that a total of 25.60g will be excreted in 2 months resulting in cholesterol clearance from blood to the liver leading to a hypocholesterolemic effect. If intended as drug, the naturally in take of 5g could be doubled to 10g and duration of application in turn reduced.

Table 1: Taurocholate binding capacity of alcohol insoluble solids of varieties of food stuffs at pH 5.8.

Sample	**Taurocholate binding capacity (mg/g)**		
	2.0	**1.0**	**0.5**
Cereals	23.61 ± 0.41	21.72 ± 0.10	20 94 ± 0.06
Millet	35.61 ± 0.39	34.74 ± 0.01	32.65 ± 0.60
Rice	29.32 ± 1.09	16.40 ± 0.19	14.11 ± 0.11
Guinea corn	29.34 ± 1.34	19.26 ± 1.48	19.73 ± 0.40
Wheat	28.89 ± 3.11	25.78 ± 2.50	23.56 ± 0.40
Legumes			
Red beans	28.63 ± 1.50	18.21 ± 0.10	15.56 ± 1.76
White beans	30.00 ± 0.18	24.26 ± 0.30	22.52 ± 0.20
Soya beans	31.45 ± 1.08	26.21 ± 01	24.00 ± 227
Bambara nuts	29.31 ± 1.74	26.01 ± 0.27	18.10 ± 0.01
Vegetables			
Baobab leaf	31.26 ± 0.68	30.20 ± 0.10	29.65 ± 0.20
Okro	30.25 ± 1.31	28.28 ± 0.40	23.55 ± 1.67
Fals sesemal	28.44 ± 0.50	25.01 ± 3.01	16.42 ± 0.04
Bush okro	30.27 ± 1.08	24.10 ± 1.31	18.42 ± 0.40
Ogbono	29.87 ± 0.70	26.24 ± 1.21	20.02± 0.92
Standard			
Pectin	32.08 ± 0.12	31.30 ± 0.01	31.20 ± 0.08

All values are means ± S.D. for triplicate determination.

Table 2: Taurocholate binding capacity of alcohol insoluble solids of varieties of food stuffs at pH 8.0.

Sample	Taurocholate binding capacity (mg/g)		
	2.0	**1.0**	**0.5**
Cereals			
Millet	19.61 ± 0.37	17.32 ± 0.06	15.54 ± 0.02
Maize	31.51 ± 0.35	30.34 ± 0.01	28.25 ± 0.01
Rice	25.32 ± 1.05	21.41 ± 3.05	10.11 ± 0.10
Guinea corn	25.30 ± 1.30	15.22 ± 1.48	15.71 ± 0.40
Wheat	24.85 ± 3.09	21.38 ± 2.10	18.56 ± 0.20
Legumes			
Red beans	28.63 ± 1.50	18.21 ± 0.10	15.56 ± 1.76
White beans	30.00 ± 0.18	24.26 ± 0.30	22.52 ± 0.20
Soya beans	31.45 ± 1.08	26.21 ± 0.01	24.00 ± 2.27
Bambara nuts	29.31 ± 1.74	26.01 ± 0.27	18.10 ± 0.01
Vegetables			
Baobab leaf	31.26 ± 0.68	30.20 ± 0.10	29.65 ± 0.20
Okro	30.25 ± 1.31	28.28 ± 0.40	23.55 ± 1.62
Fals sesemal	28.44 ± 0.50	25.01 ± 3.01	16.42 ± 0.04
Bush okro	30.27 ± 1.08	24.10 ± 1.31	18.42 ± 0.40
Ogbono	29.87 ± 0.70	26.24 ± 1.21	20.02 ± 0.92
Standard Pectin	32.08 ± 0.12	31.30 ± 0.01	31.20 ± 0.08

All values are means ± S.D. for triplicate determination.

Table 3: Water holding capacity (WHC) of alcohol insoluble solids of varieties of food stuffs.

Sample	Water holding	capacity	(mg/g)
	2.0	**1.0**	**0.5**
Cereals			
Millet	1.39 ± 0.01	1.01 ± 0.02	0.55 ± 0.21
Maize	1.50 ± 0.01	1.51 ± 0.01	0.55 ± 0.05
Rice	1.43 ± 0.05	1.05 ± 0.06	0.90 ± 0.01
Guinea corn	1.14 ± 0.01	1.31 ± 0.01	0.70 ± 0.10
Wheat	1.96 ± 0.01	1.618 ± 0.04	0.61 ± 0.08
Legumes			
Red beans	1.11 ± 0.01	0.65 ± 0.05	0.45 ± 0.05
White beans	0.56 ± 0.06	0.45 ± 0.05	0.25 ± 0.06
Soya beans	1.86 ± 0.06	0.05 ± 05	0.95 ± 0.05
Bambara nuts	1.15 ± 0.05	0.80 ± 0.01	0.70 ± 0.01
Vegetables			
Baobab leaf	1.96 ± 0.01	1.67 ± 0.05	0.50 ± 0.01
Okro	1.93 ± 0.04	1.35 ± 0.05	0.70 ± 0.05
False sesemal	1.92 ± 0.01	1.0 ± 0.02	0.51 ± 0.01
Bush okro	1.70 ± 0.05	0.75 ± 0.15	0.41 ± 0.01
Ogbono	1.45 ± 0.05	0.6 ± 0.05	0.45 ± 0.05
Standard Pectin	1.98 ± 0.04	1.89 ± 0.02	0.92 ± 0.01

All values are means ± S.D. triplicate determination.

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