Original Article

Total Protein and Albumins Concentrations in Albino Rats (*Rattus norvegicus*) Fed Granulated Sugar and Gari

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ABSTRACT

To determine the effect of feeding sugar and gari on total protein and albumins in rats, seven groups of five albino rats per group in a treatment were fed normal rat diet mixed with sugar (Granulated) and gari (a dried cassava product) as treatments respectively at concentrations of 10%, 20%, 40%, 60%, 80% and 100% while the last groups were fed normal rat diet and distilled water to serve as control. The Total proteins and albumin were monitored in the animals.There were variations in albumin and total protein in sugar and gari treated albino rats compared with their respective controls. The study showed that protein and albumin decrease as concentration of sugar and gari increased. Therefore feeding sugar and gari can repress protein synthesis in the liver as shown in the differences between the controls and the rats fed gari and sugar diets.

Keywords: Albumin, Protein, Hepatic, gari, Sugar

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INTRODUCTION

The sucrose is a natural sweetener, traditionally, used in human nourishment due to its pleasant taste, nutritious value and low cost production. The sugar cane is one of the most important sucrose sources, containing 20% w sucrose (Glazer and Nikaido, 1995). Sucrose hydrolysis produces a fructose and glucose equimolar mixture named inverted sugar. The inverted sugar is incorporated more easily in industrial preparations and has more added value than sucrose (Chou and Jasovsky, 1993). However, due to the sucrose low market value, the research on methods to produce inverted sugar from sugarcane, sucrose has increased in interest. Acid and enzymatic hydrolysis has been identified as chemical and biochemical ways to sucrose conversion (disaccharide) into glucose and fructose (soluble monosaccharide).

The conversion of dietary carbohydrate to fat is well-established. All carbohydrates, however, do not exert the same effect on fat metabolism (Hodges, and Krehl 1965; Anonymous 1966). Refined sugar has had its salts, fibres, proteins, vitamins and minerals removed to leave a white, crystalline substance. Sucrose is labelled as 'a carbohydrate' that most generic of a term which describes a compound comprising of carbon coupled with hydrogen and oxygen. Excess sugar is initially stored in the liver in the form of glycogen. When the liver can no longer cope with the load, it pours the accumulated sucrose toxins back into the bloodstream in the form of fatty acids, which are then taken to storage areas of the body, namely the belly, thighs, hips, breasts and the back of our upper arms. Once the storage areas are filled, the body begins to distribute the metabolite acids into the active organs, such as the heart and kidneys (Glinsman *et al* 1986). This in turn causes hormonal imbalances, abnormal blood pressure as the circulatory and lymphatic systems are invaded, threatening the cardiovascular system.

Cassava was transplanted from Brazil to Africa by the Portuguese nearly three centuries ago (Bourdoux*et al* 1980). Gari processing consisted of peeling, shredding, fermenting and dehydrating (light roasting) in sacks for 3-4 days, sifting, gelatinizing and roasting. Gari is made by grating cassava (*Mannihotutilisima*) and then dehydrating the fibre in sacks for 3 days after which the residue is roasted.Gari a starchy food prepared from cassava (*Manihotutilisima*)tubers is one of the most popular staple foods of the people of the rain forest belt of West Africa and contains mainly starch-20% amylase and 70% amylopectin having lost the soluble carbohydrates (i.e. glucose and sugar) during processing. Long-term consumption of cassava containing high levels of cynogenicglycocides has been associated with tropical ataxic neuropathy, spastic paraparesis and in areas with low iodine intake, development of hypothyroidism, goitre and cretinism (Osuntokun, 1981; Delang and Ermaus, 1971; Delang*et al*., 1971; JECFA, 1993; Abiye*et al*., 1998). Acute cassava poisoning-sometimes leading to the death of whole families has been reported after the consumption of inadequately processed cassava (Osuntokun, 1981; Cliff and Coutinho, 1995). Continual dependence on gari (and other cassava related foods) as staple food may lead to protein and vitamin deficiencies (Grace, 1977).Gari is rich in starch. It also has very high fibre content and also contains proteins and some essential vitamins. Gari diet has been shown to reduce enzymes induced by petroleum hydrocarbon (Braide, *et al.,* 2011a) and reversed haematoxicity (Braide, *et al.,* 2011b).

This study is aimed at comparing the effect of feeding various concentrations of sugar and gari on albumin (Alb) and Total Protein (TProt) concentrations in albino rats.

MATERIALS AND METHODS

Test Animals

Seventy Wistar albino rats of 0.195kg average body weight on normal rat diet were obtained from the animal house of the department of Pharmacology and Toxicology, University of Port Harcourt. These rats were fed adlibitum with normal rat pellet and water and acclimatized to laboratory conditions for a period of 14days prior to commencement of study. The granulated sugar (produced by Dangote Sugar Nigeria PLC) and the Gari used in this study were purchased from Mile 3 Market, Port Harcourt.

Determination of Effect Concentration

Seventy (70) albino rats averaging 0.195kg in body weight were used for the determination of effect of sugar and gari concentrations. The test animals were divided into thirty five (35) rats each for sugar and for gari. The rats were further divided into seven groups of five test animals per group each and fed with rat diet mixed with sugar and gari respectively at concentrations of 10%, 20%, 40%, 60%, 80% and 100% w/w. The last group was fed normal rat diet with distilled water to serve as control (0.00g/kg) for 3 weeks. The animals were sacrificed, blood collected and taken to the laboratory for analysis.

Biochemical Studies

Total Protein concentration was carried out using Biuret method. 5.0ml of Biuret reagent was pipetted into tubes labelled blank, standard, test, and control. 0.1ml of distilled water, standard, sample and control were pipetted into their respective tubes, mixed and incubated for 30minutes at 25ºC. The absorbances were measured against the reagent blank at wavelength of 546nm. The concentration of total protein was calculated by dividing the absorbance of sample against absorbance of standard multiplied by concentration of standard (Henry*et al.,* 1974).

Bromocresol green (BCG) method by Doumas*et al.*(1971) was usedfor albumin estimation. 3ml of Bromocresol green reagent was pipetted into tubes labeled blank, standard, sample and control. 0.01ml of distilled water, standard, sample and control was pipetted into their respective tubes, mixed and incubated at 25 ºC for 5minutes. The absorbances were measured at 578nm against the reagent blank. The concentration of Albumin was determined by dividing the absorbance of sample against absorbance of standard multiplied by concentration of standard.

Statistical Analysis

The biochemical data were subjected to some statistical analysis. Values were reported as Mean $\pm$ SEM while student's t-test was used to test for differences between treatment groups using Statistical Package for Social Sciences (SPSS) version 16.A value of $P<0.05$ was accepted as significant.

RESULTS

The Total protein (g/L) concentration of 68.00 $\pm$ 1.87 of the control rats were decreased to 65.60 $\pm$ 2.48 when fed sugar diet at 10% concentration. The concentration of 71.00 + 1.58 at 20% were then increased to 74.00 ± 1.70 at 40%while it reduced to71.00 ± 2.60, 63.00 ± 1.73 and 61.00 ± 3.49 at concentrations of 60%,80% and 100% respectively. The Total protein (g/L) concentration in the control was 68.00 ± 1.87 which decreased in albino rats fed gari diet to 66.00 ± 4.20 at 10% concentration but increased to 68.00 ± 3.45 at 20%.The concentrations now reduced to 67.20 ± 2.58, 64.80 ± 2.06,63.00 ± 0.89, and 62.80 ± 1.02 at 40%,60%,80% and 100% respectively (Table 1).

There was dose dependent decrease in albumin concentration (g/l) of both sugar and gari fed rats. The albumin (g/L) concentration of 36.00 ± 1.76 of the control rats were decreased to 34.60 ± 1.53 when fed sugar diet at 10% concentration which was increased to 38.00 ± 0.84 at 20% then decreased to 37.00 ± 1.10,37.00 ± 1.05, 36.00 ± 1.30 and 32.00 ± 1.30 at concentrations of 40%, 60%,80% and 100% respectively. The albumin (g/L) concentration of the control in gari fed albino rats was 36.00 ± 1.76 which decreased in albino rats fed gari diet to 35.20 ± 1.02 at 10% concentration but increased to 37.60 ± 1.72 at 20%.The concentrations now reduced to 36.80 ± 1.25, 36.20 ± 1.69,34.80 ± 1.36, and 35.20 ± 1.02 at 40%,60%,80% and 100% respectively (Table 1).

Table 1 Effects of sugar and gari on total protein and albumin concentrations

	TOTAL PROTEIN (g/l)			ALBUMIN (g/l)		
CONCENTRATION (%)	SUGAR TREATED	GARI TREATED	P VALUE	SUGAR TREATED	GARI TREATED	P VALUE
0.00	68.00 ± 1.87	68.00 ± 1.87	1.000	36.00 ± 1.76	36.00 ± 1.76	1.000
10	65.60±2.48	66.00 ± 4.20	0.926	34.60 ± 1.53	35.20 ± 1.02	0.818
20	71.00 ± 1.58	68.00 ± 3.45	0.208	38.00 ± 0.84	37.60 ± 1.72	0.836
40	74.00 ± 1.70	67.20 ± 2.58	0.056	37.00 ± 1.10	36.80 ± 1.25	0.002
60	71.00 ± 2.67	64.80 ± 2.06	0.061	37.00 ± 1.05	36.20 ± 1.69	0.456
80	63.00 ± 1.73	63.00 ± 0.89	1.000	36.00 ± 1.30	34.80 ± 1.36	0.547
100	61.00 ± 3.49	62.80 ±1.02	0.647	32.00 ± 1.30	35.20 ± 1.02	0.030

Overall there was significant difference in total protein (g/l) of 67.60±2.10 obtained in sugar fed and 65.3 ± 0.88 in gari fed rats. There was also significant difference in 67.60±2.10 and 65.3 ± 0.88 obtained in sugar fed and gari respectively compared with 68.12 ± 0.16 of the control rats.

Also there was significant difference in albumin (g/l) of 35.77 ± 0.89 and 35.97 ± 0.45 obtained in sugar and gari respectively compared with 36.60 ± 0.50

obtained in the controls while there was no difference in albumin concentration of sugar and gari (Table 2).

Table 2. Overall effects of sugar and gari on protein concentrations

PARAMETER	SUGAR	GARI	P VALUE	SUGAR	CONTROL	P VALUE	GARI	CONTROL	P VALUE
TOTAL PROTEIN(g/l)	67.60± 2.10	65.30± 0.88	0.180	67.60± 2.10	68.12 ± 0.16	0.813	65.30± 0.88	68.12 ± 0.16	0.029
ALBUMIN(g/l)	35.77 ± 0.89	35.97 ± 0.45	0.770	35.77 ± 0.89	36.60 ± 0.50	0.433	35.97 ± 0.45	36.60 ± 0.50	0.481

DISCUSSION

The result of this study showed that protein and albumin decreased as concentrations of sugar and gari increased. This is similar to the studies by Lakshmanan, *et al.* (1967), Coles and Macdonald (1963), Chang and Varnell (1966),Oboh*et al.* (2007) and Braide*et al.* (2011c). Coles and Macdonald (1963) and Chang and Varnell (1966) observed that the chief variation in serum proteins due to type of dietary carbohydrate was in albumin concentration. Also previous studies by Lakshmanan, and Adams (1965) have shown that both type and level of dietary fat produce significant changes in the concentrations of most of the serum protein components of the BHE-strain rat. The study has shown that synthesis of proteins and albumin decreasedas concentration of sugar and gari increased.Braide*et al* (2011c) reported dose dependent decrease in albumin and protein in rats fed gari and sugar.

In a study on effect of sucrose intake on performance time and biochemical changes, the total serum protein levels were noted to rise significantly after each race, irrespective of diet (McKechnie*et al.,* 1970). This was associated with an increase in serum albumin levels and confirms previous observations (McKechnie, *et al.*, 1967) from which it had been suggested that athletic performance induced albumin mobilization from the liver.

The differences observed in the protein and albumin concentrations of sugar and gari fed albino rats may be due to presence of cyanogens present in gari and differences in rate of absorption. Grace (1977) had reported that continual dependence on gari (and other cassava related foods) as staple food may lead to protein and vitamin deficiencies. The presence of cyanogens in the gariand the differences in rate of absorption between gari and sugar might be the cause of slight reduction seen in proteins and albumins concentrations in gari fed compared with sugar fed albino rats.Cohen *et al.* (1966) found significantly lower glucose tolerance curves with a bread diet than with a high sucrose diet suggesting that the more slowly digested starch of the bread gives a less rapid flow of glucose into the circulatory system than does sucrose.

The feeding on carbohydrates as typified by granulated sugar and gari lowered the total protein and albumin concentrations in this study compared with the controls.Total protein, albumin and globulin levels were significantly lowered in rabbits fedhigh carbohydrate low protein diet (Oboh*et al.,* 2007) suggesting that the rabbits were protein malnourished. Similar low albumin and globulin values have been observed in earlier studies when rabbits were fed protein deficient diet (Mayne, 2001). Low concentration of plasma protein and albumin is a clear indication of a low protein diet. The typical Nigerian diet consists of high carbohydrate and low protein. This is consumed from early childhood into adulthood.

CONCLUSION

This study has shown that feeding on certain concentrations of granulated sugar and gari will repress the synthesis of proteins. These repressions depend on the concentration of carbohydrate.

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