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Original Article

Processing method influences the effect of Cassava (*Manihot esculenta*) consumption on blood lipid profile in rats

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ABSTRACT: Cassava is consumed in many tropical countries and is fast becoming the major raw material of many diets, especially in the bakery, brewery and pharmaceutical industries. This study was aimed at determining the effects of various formulations of Cassava feeds on blood lipid profile in rats. Forty adult Wistar rats weighing between 120 and 150 g were divided into 4 groups of 10 rats each. The rats were acclimatized for one week; fed with different formulations of Cassava feeds *ad libitum*, after which the rats were allotted into groups. Group 1 was fed on Garri; group 2 on Cassava flour; group 3 on Tapioca, and the control group (group 4) on normal chow. After 4 weeks, each animal was anaesthetized by exposure to chloroform vapour and blood samples collected by cardiac puncture. Group 1 diet (Garri) significantly increased HDL-cholesterol (HDL-C) concentration and significantly decreased LDL-cholesterol (LDL-C) concentration ($p < 0.05$) compared with the control group. In Group 2 (Cassava flour), there was significant increase in the concentration of HDL-C ($p < 0.05$). Group 3 (Tapioca) had a significant increase in TC, TG, LDL-C concentrations ($p < 0.05$), but an insignificant increase in HDL-C concentration ($p < 0.05$) when compared with the control. In conclusion, our findings suggest that Garri and Cassava flour but not Tapioca enhanced HDL-C in the blood, with Garri proving to be the better of the two.

KEYWORDS: Processed Food; Garri, Cassava flour, Tapioca, Blood Lipid profile.

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INTRODUCTION

Cassava (*Manihot esculenta* Crantz) serves as a staple food in human diets that is consumed in over 80 countries including Nigeria (Gomez *et al.*, 1988). It is one of the most important sources of food energy and industrial raw materials in many tropical and subtropical regions (Santisopasri *et al.*, 2001).

An important issue associated with consumption of Cassava is the presence of toxic compounds, mainly cyanogenic glycosides. This potential toxicity makes it imperative to

process the roots before ingestion. Cassava products that are not adequately processed have been linked to cyanide poisoning (Essers *et al.*, 1996). Cassava products that are not adequately processed contain high levels of cyanogens. Consumption of such poorly processed Cassava products can lead to the formation of hydrocyanic acid in the gut (Miles *et al.* 2011). Cassava contains linamarin, a cyanogenic glycoside that is easily hydrolyzed by the enzyme linamarase (a β -glucosidase) to release hydrogen cyanide (HCN) (Teles, 2002). Cyanide liberated from residual linamarin has been shown to be associated with goitre in iodine-deficient

populations with chronic intake of Cassava-based food products (Taga *et al.*, 2008).

Hyperlipidaemia has been established as a primary risk factor in the development of cardiovascular disease. A high level of plasma cholesterol especially low density lipoprotein cholesterol (LDL-Cholesterol), the “bad cholesterol”, leads to atherosclerosis, a condition in which artery wall narrows as a result of accumulation of cholesterol (Balasubramanian *et al.*, 2012). One of the most commonly recognized complications is “coronary thrombosis” causing myocardial infarction. Similarly, if artery to the brain (carotid artery) is involved, cerebrovascular accident may develop. Different risk factors including dietary lifestyle, age, race, sex, habits etc. have been attributed to the increased incidence of these lipid disorders.

In this study, we used an animal model to explore any possible link between the consumption of Cassava and changes in cardiovascular parameters. The approach we took involved determining the effects of feeding albino rats with different processed forms of Cassava on their blood lipid profiles.

MATERIALS AND METHODS

Experimental rats and treatments:

Forty adult wistar rats (*Rattus norvegicus*) bred at the Animal Holding Unit of the Department of Physiology, University of Ilorin, Ilorin, Nigeria with mean weight of between $138 \pm 1g$ were used for this study. Throughout the experiment, the animals were housed in clean cages placed in well-ventilated housing conditions (under humid tropical conditions). The cages were cleaned twice daily at 12 hours interval. The rats were acclimatized for seven (7) days during which they were fed *ad libitum* with pellet form of grower feed (Vital poultry feed) and had free access to drinking water.

Animal grouping

The rats were randomly grouped into four consisting of ten rats in each group. Prior to the rats being fed with different Cassava formulations, they were given known amount of grower feed and the remaining feed was weighed after 24 hours to ascertain the actual quantity of feed each group took. This was done prior to proper feeding and the average was computed. On the average, it was observed that each group sufficiently ate 300 g of mash feed meaning that each rat can take 30 g of meal per-day. The rats in group A were then fed with 300 g of Garri, rats in group B are fed with 300g of Cassava flour, rats in Group C were fed with 300 g of Tapioca and the rats in group D were fed with 300g of pure Grower’s Marsh.

Collection of blood sample

After four weeks of feeding, the animals were fasted overnight and anaesthetized using chloroform. Blood

samples were collected by cardiac puncture and dispensed into lithium heparin bottle to prevent clotting. The blood was then centrifuged at 5000 rpm at 10 °C for 15 minute (Oyeyemi *et al.*, 2012) to separate the plasma from the cells.

Statistical Analysis

Data obtained from blood samples were analysed and presented as mean \pm standard error of the mean (mean \pm SEM). Means were compared by the analysis of variance, followed by the LSD *post-hoc* test. $P < 0.05$ was accepted as significant.

RESULTS

The effect of the different processed forms of Cassava diet on Total Cholesterol (TC) levels in the blood of the animals in the different treatment groups are shown in Figure 1. Total cholesterol was elevated in animals fed with Tapioca (312.0 ± 89.8 mg/dl) compared to the control group (167.0 ± 53.9 mg/dl) that received only the Grower’s Marsh feed, while groups fed with Garri (195.0 ± 14.9 mg/dl) and Cassava flour (217.7 ± 31.7 mg/dl) had no significant variation when compared with the control group (167.0 ± 53.9 mg/dl) ($p < 0.05$).

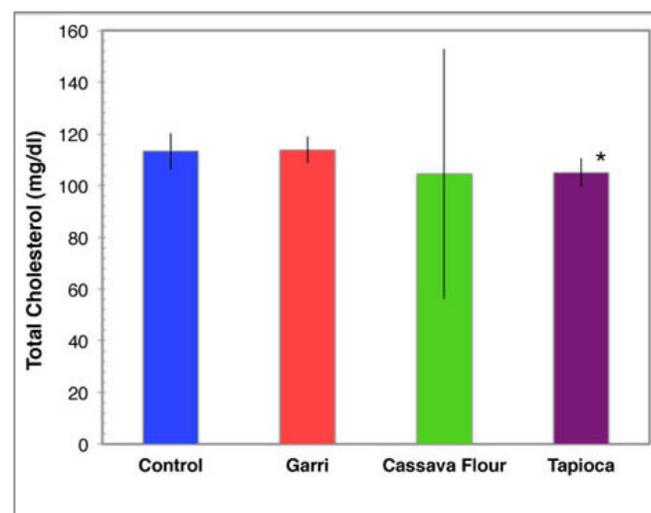


Figure 1: Effect of garri, cassava flour and tapioca on total cholesterol (TC) * $p < 0.05$ vs control

Figure 2 shows the Triglyceride (TG) levels in the different groups. Animals fed Tapioca had significantly reduced triglyceride level (105.0 ± 5.5 mg/dl) when compared with those in the control group (113.3 ± 7.1 mg/dl) ($p < 0.05$). There were no significant differences in the TG concentrations in the groups fed with Garri (113.8 ± 5.1 mg/dl) and Cassava flour (104.5 ± 48.3 mg/dl) when compared with the control group (113.3 ± 7.1 mg/dl) ($p < 0.05$).

Figure 3 shows the high density lipoprotein cholesterol (HDL-C) levels in the different treatment groups. There was a significant increase in High Density Lipoprotein-cholesterol in animals fed with Garri (71.0 ± 4.4 mg/dl) and Cassava flour

(63.2 ± 14.1 mg/dl) compared to the control animals (41.5 ± 11.1 mg/dl) ($p < 0.05$). There was no significant change observed in HDL-C in the group given Tapioca diet (43.5.0 ± 4.9 mg/dl) and the control group (41.5 ± 11.1 mg/dl) ($p < 0.05$).

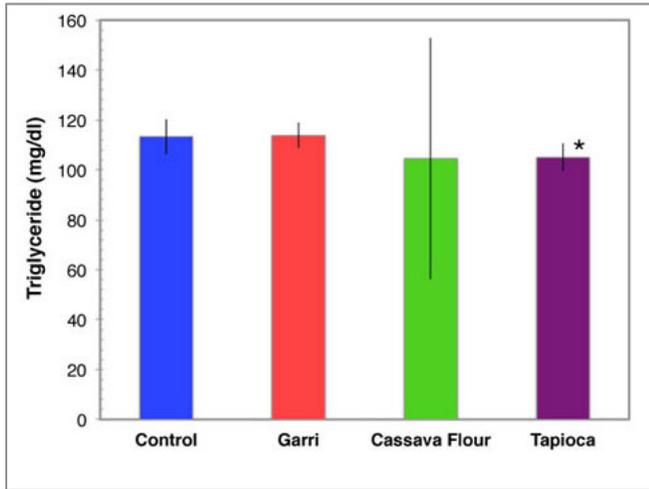


Figure 2: Effect of garri, cassava flour and tapioca on triglycerides (TG) * $p < 0.05$ vs control

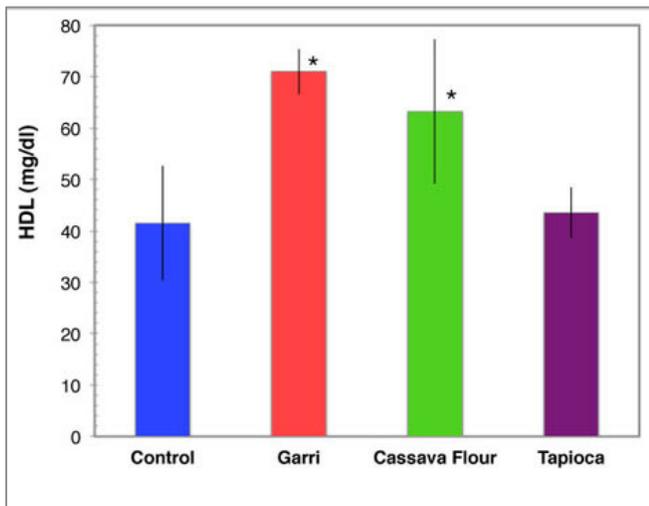


Figure 3: Effect of garri, cassava flour and tapioca high density lipoprotein cholesterol (HDL-C) * $p < 0.05$ vs control

The effect of the different processed forms of Cassava diet on Low Density Lipoprotein cholesterol (LDL-C) levels in the blood of the animals in the different treatment groups are shown in Figure 4. Low Density Lipoprotein-cholesterol was significantly decreased in the group fed with Garri (39.2 ± 1.7 mg/dl) and significantly increased in the group fed with Tapioca (64.5.0 ± 2.7 mg/dl) when compared with the control group (55.8 ± 8.2 mg/dl) ($p < 0.05$). There was no significant difference in the LDL-C of animals fed with Cassava flour (50.5 ± 10.1 mg/dl) and the control group (55.8 ± 8.2 mg/dl) ($p < 0.05$).

DISCUSSION

Studies in the past have linked Cassava dietary intake with a decrease in blood cholesterol level and this was said to be due to the presence of high dietary fibre in Cassava (Anderson *et al.* 2010). The hypolipidemic effects of dietary fibre generally are mediated by the action of soluble fibre in binding bile acids, thereby increasing the faecal excretion and interrupting the enterohepatic circulation of bile salts (Anderson *et al.* 2010). The increased dietary fibre often results in reduction in availability of cholesterol for incorporation into lipoproteins (Story and Furumoto, 1990). This is also similar to earlier report of Anderson *et al.* (2010) in which high dietary fibre was found to increase excretion of cholesterol and thereby lowering blood cholesterol level.

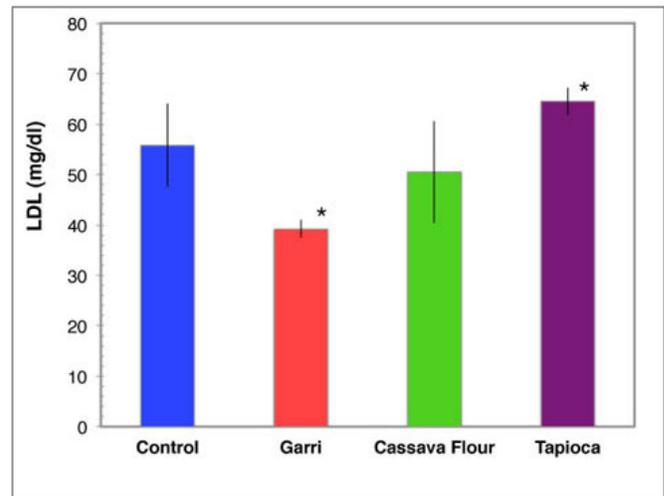


Figure 4: Effect of garri, cassava flour and tapioca low density lipoprotein cholesterol (LDL-C) * $p < 0.05$ vs control

In the group fed with Cassava flour, there was no significant increase in total cholesterol, triglyceride and low density lipoprotein cholesterol but there was a significant increase in high density lipoprotein at $p < 0.05$. In the group fed with Tapioca, there was a significant increase in total cholesterol, triglyceride, and low density lipoprotein but there was no significant increase in high density lipoprotein at $p < 0.05$. The increase in cholesterol level is in contrast to what was reported by Oladunjoye *et al.* (2010) where a low cholesterol level was observed in lye treated Cassava peel meal. Cassava peel contains hydrocyanic acid and the presence of hydrocyanic acid in Cassava peel can also exert hypocholesteronic influence as glycosides have ability to interfere with the intestinal absorption of the dietary cholesterol and lipid (Brown *et al.*, 1999) but during Cassava processing the Cassava peel has been removed and the level of hydrocyanic acid is reduced, thus, can lead to an increase in cholesterol level. This was similar to an increase in the level of triglyceride observed by Dhas *et al.* (2011) in a study that investigated the effects of hydrogen cyanide

exposure in Cassava workers. Triglycerides may also increase in impaired thyroid function since hydrogen cyanide increases thyroid stimulating hormone (TSH) and decreases thyroxine (T₄) and triiodothyronine (T₃) resulting in abnormal thyroid function. Thus the increase in triglyceride can also be due to impaired thyroid function (Blance *et al.*, 1985)

In conclusion, Garri and Cassava flour increase the level of high density lipoprotein and decrease the level of low density lipoprotein significantly which shows a possible cardio-protective ability of this diets while Tapioca showed a significant increase in total cholesterol, triglyceride, and low density lipoprotein cholesterol which has cardio-lethal properties.

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