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Dietary Incorporation of Boiled Fluted Pumpkin (*Telfairia occidentalis* Hook F.) Seeds 2: Alterations in Serum Lipid Profile and Blood Glucose Concentration of Rats

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Abstract: Oil-seeds are said to be useful in supplementing nutritional requirements, especially in resource-poor countries. Fluted pumpkin (*Telfairia occidentalis*), an oil-seed is known to be a good source of protein and energy but the effect of its consumption on the lipid profile and blood glucose concentration is not known. Twenty four adult male albino rats were divided into 4 Groups I, II, III and IV. Group I served as the control group while Group II, III and IV received 5, 15 and 45% boiled *T. occidentalis* supplemented diets for 21 days. The fasting blood glucose concentration of all rats was assayed by the glucose oxidase method while the lipid profile (total cholesterol, triglycerides and High Density Lipoprotein (HDL) cholesterol concentrations) in their sera was assayed by enzymatic colorimetric methods. Low Density Lipoprotein (LDL) and Very Low Density Lipoprotein (VLDL) cholesterols were estimated using standard formulae. Serum total cholesterol increased from 2.31±0.18 mmol L^{-1} in Group I to 3.27±0.52 mmol L^{-1} in Group IV while serum HDL-cholesterol increased from 1.33±0.20 mmol L^{-1} in Group I to 1.88±0.25 mmol L^{-1} in Group IV. The results show a progressive increase in the level of hyperlipidemias with increasing doses of *T. occidentalis*, though rats in Group II had similar values on all counts with the control group. Only rats in Group IV became significantly ($p<0.05$) hyperglycaemic, relative to the control. Very high consumption of the seeds of *T. occidentalis* may result in derangements in lipid and glucose metabolism and is therefore discouraged.

Key words: Blood glucose concentration, fluted pumpkin, oil-seeds, serum lipid profile, rats, Nigeria

INTRODUCTION

The quest for alternative sources of energy and protein to be used in augmenting the declining food supply in developing countries, especially in sub-Saharan Africa has inspired research into locally available seeds in the region (Enujiugha and Ayodele-Oni, 2003). Attention has been turned particularly to hitherto under utilized oil-seeds such as fluted pumpkin (*Telfairia occidentalis* Hook F.) (Giami and Wachuku, 1997). The seeds of fluted pumpkin are said to contain as much as 54% fat and 27% protein (Nafisa *et al*., 2008). The oil contains high levels of unsaturated fatty acids (63.22%) and lower levels of saturated fatty acids (36.78%) (Ajayi *et al*., 2004). Studies have shown that the feeding regimen of an animal influences the level of serum lipoproteins, triglycerides and other lipids (Bokman *et al*., 1991; Abraham *et al*., 1994; Truswell, 1994). Also, lipid structure composition and configuration in addition to excessive fat and cholesterol consumption, affect the lipid profile in plasma (Kritchevsky, 1995).

Data from experimental and epidemiological studies show that elevated levels of LDL-cholesterol and triglycerides and low levels of HDL-cholesterol are major risk factors for Coronary Heart Disease (CHD) (Watts *et al*., 1994). Nicolosi *et al*. (1990) have shown that these alterations may be due to impaired catabolism rather than increased synthesis. It has also been shown that glucose and fatty acids appear to interact in health and disease (McGarry, 1998). Since fluted pumpkin, a tropical vine with large lobed leaves and long twisting tendrils (Okoli and Mgbeogu, 1983) is widely available in Nigeria but grossly underutilized (Fagbemi *et al*., 2005), this study investigated the effect of its consumption on the blood glucose level and serum lipid profiles of rats fed graded doses of the boiled seeds. The researchers hope this would provide information that would guide its recommendation or not as a good dietary supplement.

MATERIALS AND METHODS

Preparation of fluted pumpkin seeds: Fluted pumpkin fruits were bought from a local market in Umudike, Nigeria.

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The fruits were sliced open and the pulp and seeds removed. The seeds were cleaned and freed from unwanted materials before they were shelled manually. Bad seeds were promptly removed. The good seeds were washed thoroughly and boiled for 1 h. Thereafter, the seeds were dried in an oven at 40°C until a constant weight was achieved. The boiled and oven-dried seeds were then milled in a laboratory miller and used for the study.

Experimental design: Twenty four adult male wistar rats were obtained from the Animal Breeding Unit of the Faculty of Biological Sciences, University of Nigeria, Nsukka. They were housed in four cages and acclimatized to the animal house for 1 week. After 1 week, the rats weighing approximately 154 g each were randomly (while controlling for weight differences) assigned to four Groups: I, II, III and IV. Rats in Group I served as the control and received semi-purified rat chow (Bendel Feed and Flour Mills Ltd., Nigeria). Those in Group II, III and IV received the semi-purified rat chow supplemented with 5, 15 and 45% boiled *T. occidentalis* seeds, respectively. The supplemented diets were thoroughly homogenized, manually palletized and oven dried at 40°C to a constant weight and stored in air-tight containers from where they were dispensed to the rats daily.

The study lasted for 21 days. During this period, each animal received 25 g of feed daily and had unrestricted access to water. The animal house was airy under tropical conditions and had 12 h light and dark cycles. After 21 days, the rats were fasted overnight dazed by a cervical blow and bled by cardiac puncture. The blood was transferred into clean sample containers and a drop each was used for fasting blood glucose assay. The other portion of blood was allowed to stand at ambient temperature and immediately after clotting, centrifuged for 5 min at 2000 g. The sera were carefully removed, thereafter and placed into clean and appropriately labeled sample containers. They were kept in the refrigerator at 4°C and analyzed within 24 h.

Assays: Fasting blood glucose concentrations were measured by using the glucose oxidase method with an automated glucose analyzer (Accu-Check Advantage, Roche Diagnostics GmbH, Mannheim, Germany).

Serum total cholesterol, High Density Lipoprotein (HDL) cholesterol and triglycerides were assayed for by standard enzymatic colorimetric techniques using test kits procured from Randox Laboratories, Ltd, Crumlin, UK. Very Low Density Lipoprotein (VLDL) cholesterol was estimated using the formula: VLDL cholesterol = Triglycerides (mmol L^{-1})/2.2 while low density lipoprotein cholesterol was estimated by difference (Friedewald *et al*., 1972). Means and standard deviations for all groups per parameter were calculated and differences between means separated by the one way ANOVA test with the least significant difference fixed at 0.05. All data analyses were done using the statistical software SPSS for windows version 11.0 (SPSS Inc. Chicago IL). Data are presented in bar charts.

RESULTS AND DISCUSSION

Mean serum total cholesterol level was highest in rats fed 45% *T. occidentalis* supplemented diets and lowest in the control rats. The mean values for the three test groups compared to the control were statistically similar ($p>0.05$). Conversely, serum triglycerides were highest in the control group and lowest in Group III. Mean triglyceride levels were significantly ($p<0.05$) lower in Group III and IV but not Group II, compared to the control group (Fig. 1).

Serum HDL-cholesterol was lowest in the control group and highest in rats in Group IV. The mean HDL-cholesterol value of the rats in Group IV was significantly ($p<0.05$) higher than that of the control group while that of rats in Group II and III were similar to the control group (Fig. 2).

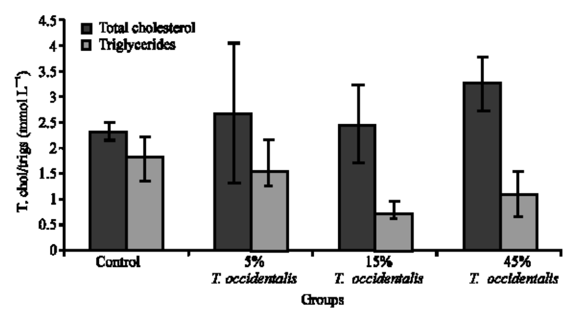

Fig. 1: Serum total cholesterol and triglycerides concentration in control and test rats

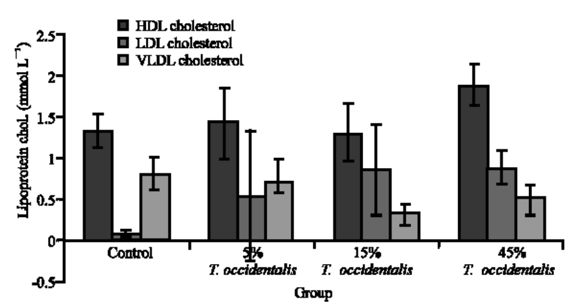

Fig. 2: Serum lipoprotein cholesterol concentrations in control and test rats

Serum LDL-cholesterol was lowest in the control group and highest in Group IV. The difference in the mean values for rats in Group III and IV but not Group II were statistically significant ($p<0.05$) compared to the control group. Conversely, serum VLDL-cholesterol was highest in the control group and lowest in Group III. While the mean VLDL-cholesterol levels were similar between Group I and II, the other two test groups had values that were significantly ($p<0.05$) lower than that of the control group (Fig. 2).

Figure 3 shows the fasting blood glucose levels of rats in both the control and test groups. Only rats in Group IV became significantly ($p<0.05$) hyperglycaemic with respect to the control group. Rats in Group II and III had comparable fasting blood glucose levels to those in Group I. Nutrition plays an undisputed role in the aetiology of hyperlipidemias and associated disorders. Studies have shown that saturated fats have the capacity to increase total cholesterol and alter lipoprotein patterns (Dwyer, 1995; Caggiula and Mustad, 1997). The data show a progressive increase in the level of lipidemia with increasing doses of the *T. occidentalis* supplement. For example while rats in Group II compared with those in the control group on all the serum lipids, those in Group III had favorable serum triglycerides, VLDL-cholesterol and HDL-cholesterol but a significantly high LDL-cholesterol; and rats in Group IV had a clearly undesirable serum lipid profile. The case of high total cholesterol level, accompanied by a significant decrease in triglycerides and VLDL-cholesterol and a significant increase in both HDL- and LDL-cholesterol levels in the sera of rats in Group IV, resembles a typical case of hyperlipidemia in humans (Tholstrup *et al*., 1995). The observed effect may be due to the saturated fats in the seeds of *T. occidentalis*. Ajayi *et al*. (2004) had shown that the seeds contain 36.78% saturated fats, which was almost entirely palmitic acid. Watts *et al*. (1994) had shown that a high level of saturated fats was required to induce elevated serum or

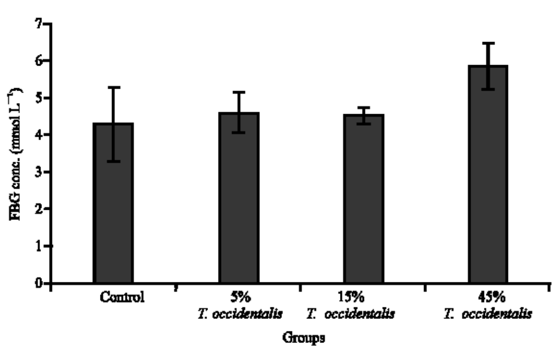

Fig. 3: Fasting blood glucose concentrations in control and test rats

tissue cholesterol levels and other hypercholesterolemia-related metabolic disturbances. This view is supported by some other researchers (Khosla and Sundram, 1996; Jeffery *et al*., 1997).

Significant hyperglycaemia relative to the control was seen only in rats in Group IV which also had an undesirable serum lipid profile. Though dietary fat, cholesterol and individual fatty acids affect glucose tolerance differently (Schwab *et al*., 1995) the interaction of high fat diets on glucose metabolism is still not clear (Holmgren and Brown, 1993; Zulet *et al*., 1999). It is known, however that saturated fats and polyunsaturated fatty acids may work together to regulate the expression of several enzymes involved in carbohydrate metabolism (Jump *et al*., 1994; Zulet *et al*., 1999) and hence, affect blood glucose levels.

CONCLUSION

In this study, the data discourages excessive consumption of the seeds of fluted pumpkin as it could result in hyperlipidemias and hyperglycaemia conditions that are not desirable as they could result in morbidity and mortality from their sequelae.

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