Available online at http://www.journalijdr.com

IJDR

ISSN: 2230-9926

International Journal of Development Research
Vol. 08, Issue, 02, pp.18969-18972, February, 2018

ORIGINAL RESEARCH ARTICLE OPEN ACCESS

BRAZILIAN TYPICAL FOOD WITH POTENTIAL TO IMPROVE LIPID PROFILE

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ARTICLE INFO

Article History:
Received 14th November, 2017
Received in revised form
20th December, 2017
Accepted 23rd January, 2018
Published online 28th February, 2018

Key Words:
Manihotesculenta Crantz, Cholesterol, Glycaemia, Body Weight.

ABSTRACT

Tapioca is a food produced from the cassava roots and is commonly used in Brazil to prepare many products. The aim of this study was to evaluate the effects of tapioca on the metabolic profile of Wistar rats. Twenty female rats were divided in G1: control group (n=10) and G2: treated group (n=10). The treated group received tapioca flour mixed to the rat food for 45 days, and the control group received commercial rat food. Body weight was evaluatedthree times a week. Blood samples were collected to evaluate glycemia, total cholesterol (TC), LDL-c, HDL-c, and triglycerides (TG). Anthropometric parameters were also evaluatedas well as atherogenic indices. A significant reduction was observed in the levels of TC, LDL-c, and abdominal circumference in the treated group although the food intake was significantly higher in this group. The intake of tapioca positively interferes with the lipid levels.

Citation: Patrícia Cincotto dos Santos Bueno, Sandra Maria Barbalho, Isabela Ramos Araújo de Medeiros, Isabella Vasconcelos Zattiti, Claudemir Gregório Mendes, ElenLandgraf Guiguer, Maricelma Silva Soares De Souza, Adriano Cressoni de Araújo and Raul J. S. Girio, 2018. "Brazilian typical food with potential to improve lipid profile", *International Journal of Development Research*, 8, (02), 18969-18972.

INTRODUCTION

The ingestion of many different kinds of foods has been postulated to improve risk factors of chronic degenerative diseases such as diabetes, obesity, metabolic syndrome, and hypertension, which are related to cardiovascular diseases, cancer, and death. Many of these foods have shown effects against insulin resistance, dyslipidemia, overweight and obesity (Telle-Hansen *et al.*, 2017;Santos *et al.*, 2017; Noumi*et al.*, 2017; Costa *et al.*, 2017; Seo, Kim, 2017; Castellano-Castillo *et al.*, 2017). Tapioca has been considered in popular medicine as also having effects under these conditions. However, few studies are observed in the literature. Tapioca is an edible starch, produced from the roots of cassava (*Manihotesculenta* Crantz), which is used in the preparation of sweet and savory dishes.

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It is a plant widely cultivated in several tropical countries and often consumed as a staple food. The roots provide a cheap source of carbohydrate and a low content of proteins (Kanmani*et al.*, 2018; Silva *et al.*, 2013; Wang *et al.*, 2014; Maier *et al.*, 2017). The cassava belongs to the family Euphorbiaceae and is produced in Brazil under the system of subsistence agriculture. Nowadays tapioca can be considered one of the most traditional symbols of the cuisine of the North and Northeast of the country and is used in different dishes appreciated by the populations of all the income ranges (Oso *et al.*, 2014; Queiroz*et al.*, 2009; Dias, Leonel, 2006). Tapioca is a very common food for Brazilians, has low cost, and popularly is associated with the reduction of some cardiovascular risk factors. For these reasons,the aim of this study was to evaluate its effects on the metabolic profile of Wistar rats.

METHODS

Ethical Principle and Group of Animals: This study had the approval by the Animal Research Ethics Committee of the

Medical School of Marilia (UNIMAR) – Marilia – São Paulo, Brazil. Twenty female Wistar rats (*Rattusnorvegicus*), weighing 180g to 200g, were obtained from the Animal Experimentation Center - University of Marilia (UNIMAR), Marilia – São Paulo, Brazil. Seven days before the beginning of the experimental protocol the female were separated into 2 groups andwas acclimated to the laboratory conditions and housed in plastic boxes at controlled room temperature (20°C to 25°C) and light/dark cycle of 12 hours. After acclimation, female rats were divided in G1: control group (n=10) and G2: treated group (n=10). The treated group received tapioca flour during 45 days, and the control group received commercial rat food. Both groups received water and food *ad libitum.*

The treated group received the commercial rat food mixed with the tapioca flour in a ratio of 80:20 (commercial rat food:tapioca). This mixture was moistened, and the pellets were reconstituted and dried for later use. Body weight was evaluatedthree times a week. At the end of the experimental protocol,the rats were anesthetized with thiopental (200mg/kg). After death, blood samples were collected to evaluate the biochemical profile: glycemia, total cholesterol (TC), HDL-c, and triglycerides (TG). Anthropometric parameters were also evaluated (Lee Index, body weight, thoracic circumference; abdominal circumference and visceral fat weight).

Atherogenic Index (AI), Atherogenic Coefficient (AC), and Cardiac Risk Ratio 1 (CRR1) were evaluated after Ahmadvand *et al.*, 2016; Munshi, Joshi and Rane, 2015); Ikewuchi, 2012): non-HDL-c = Total cholesterol – HDL-c; AI = log (TG/HDL-c); AC = (TC – HDL-c)/HDL-c; CCR1 = TC/HDL-c, and CCR2 = LDL-c/HDL-c.

Statistical analysis

All data were expressed as mean ± standard deviation. The analysis was performed initially by the unpaired T-test for the variables with distribution or the Man-Whitney test when they did not present normality. The results were analyzed using the software BioEstat5.3, and the level of significance was 5%.

RESULTS

In Table 1 it is observed that the animals of the two groups started the experiment with similar mean body weight. At the end of the study, no significant difference was observed in the mean weight gain, Lee index, Body Mass Index, thoracic circumference, and visceral fat. A significantincrease in food intake was observed in the treated group but no modifications were observed in body weight and a reduction was seen in the abdominal circumference.

Table 1. Food and water intake, nthropometric and biochemical parameters for G1 and G2

Parameters (mg/dL)	G1	G2	*p*-value*
Weight [1]	137.8±20.68	148.5±30.52	p = 0.185
Weight [2]	224.5±16.54	233.4±15.83	p =0.117
Food intake (g)	82.06±20.15	105.24±17.05	p < 0.000‡
Water intake (mL)	140.17±29.03	133.15±28.56	p = 0.148
Lee Index	296.67±7.52	294.98±8.46	p =0.321
Body mass index	0.54±0.035	0.52±0.038	p =0.492
Weight gain (%)	67.40±35.84	62.38±31.144	p =0.452
T. Circumference	9.25±1.11	8.75±0.35	p = 0.153
A. Circumference	10.6±0.61	10.2±0.35	p = 0.045‡
Visceral fat	1.318±0.42	1.236±0.36	p = 0.323

[1]Weight at the beginning of the experimental protocol; [2]Weight at the end of the experimental protocol;T. Circumference: Thoracic circumference; A. Circumference: Abdominal circumference; ‡ significant difference.

Table 2. Biochemical parameters of G1 and G2 after the treatment with tapioca

Parameters (mg/dL)	G1	G2	*p*-value*
Glycaemia	155.7±22.52	165.8±20.88	p= 0.156
Triglycerides	129.3±19.00	118.75±24.42	p= 0.158
Cholesterol	164.75±5.59	158.7±5.23	p= 0.0151‡
HDL-c	52.0±5.361	50.4±5.361	p=0.495
LDL-c	98.1±24.735	82.4±4.850	p=0.032‡

‡Significant difference; HDL-c: High-Density Lipoprotein; LDL-c: Low-Density Lipoprotein

Table 3. Atherogenic indices in the experimental protocol for G1 and G2

Parameters (mg/dL)	G1	G2	*p*-value*
Non-HDL-c	119.0±23,317	108.3±5.510	p=0.081
AC	1.23±0.630	1.57±0.413	p=0.095
AI	2.233±0.633	2.579±0.413	p=0.919
CCR1	3.17±0.439	3.170±0.230	p=0.490
CCR2	1.389±0.896	1.652±0.203	p=0.336

AC: Atherogenic Coefficient; AI: Atherogenic Index; CRR1: Cardiac Risk Ratio 1; CRR2: Cardiac Risk Ratio 2.

DISCUSSION

Tapioca is the starch product extracted from the cassava roots that are peeled, crushed, disintegrated, concentrated, dehydrated and dried. It is a natural polysaccharide, consisting of linear chains (amylose) and branched chains (amylopectin) and obtained through roots of manioc roots. The result is a product with a high carbohydrate content, low in protein, lipids, and minerals. The tapioca flour presents 6.14% of resistant starch, which does not undergo enzymatic digestionin humans (Queiroz*et al.*, 2009). In Brazil, thepopulationhas been using tapioca as an alternative to reduce weight. Also, our results show areduction in the abdominal circumference and in the food intake, although we did not observe significant differences in the body weight of the animals. Ble-Castillo*et al.* (2017) evaluated the effects of banana starch on the appetite and found no associated effect on the subjective appetite ratings or gut hormones but helped to reduce meal size. Resistant starch supplementation is also related to the reduction of body weight by some authors (Si *et al.*, 2017; Barczynska *et al.*, 2016). Diet may interfere in the composition of the human microbiome that displays several systemic actions. Resistant starch may exhibit a plethora of health benefits, including the increase in the ratio of *Firmicutes*: *Bacteroidetes* (Maier *et al.*, 2017). Furthermore, the fermentation of resistant starch in the colon leads to the production of acids and derivatives of organic acids with short chain as acetate, butyrate, and propionate.

These compounds act in the reduction of hypercholesterolemia. Our results also showed areductionon the cholesterol and LDL-c levels. By reducing serum cholesterol levels, resistant starch acts in the prevention of diseases such as constipation, type 2 diabetes, andcoronary heart disease. Some studies report a decrease in postprandial blood glucose or insulin levels associated with ingestion of resistant starch compared to the consumption of digestible starch. Similarly to our results, other researchers found no modification in the glycaemia (Reshmi, Sudha and Shashirekha, 2017; Koh and Rowling, 2017; Matsuda *et al.*, 2016).

Liu *et al.* (2006) studied the effects of retrograded tapioca starch on the ovarian hormone deficiency-induced hypercholesterolemia in rats and showed that tapioca leads to a hypocholesterolemic effect in ovariectomized rats but not in sham-operated animals. Okafor *et al.* (2016) studied the effects of four different blends of cassava-wheat bread samples with 0, 10, 15, and 20% of cassava flour. These samples were included individually to groups of healthy human volunteers that were studied in the morning after a 10-12-hr overnight fast. Glycaemia was evaluated after 30 minutesand after 2 hours and observed that the increase in cassava incorporation resulted insignificantly less glycemic index. We did not find studies that showed the effects of tapioca on the abdominal circumference. Our animals showed areduction of this parameter, but the visceral fat weight did not show asignificant reduction. The flour of other plants may reduce visceral weight, such as *Morindaoleifera* flour (Guiguer*et al.*, 2016) and *Pereskia aculeate* flour (Barbalho *et al..*, 2016).Visceral fat is known as an endocrine organ associated with the maintenance of homeostasis. On the other hand, it plays an important role in the development of several comorbidities such as insulin resistance, diabetes, inflammation and cardiovascular diseases. This association is due to the release of pro-inflammatory cytokines such as resistin, leptin, Tumor Necrosis Factor, Interleukin 6, and many othersbiomarkers (Edrisi *et al..*, 2017; Shirkawa *et al.*, 2017). The evaluation of the atherogenic indices is capable of indicating the increase of the risks for development of cardiovascular diseases and may be considered in the clinical practice as a potential way of stratification of these diseases(Choi *et al.*, 2017; Mopuri*et al.*, 2017;Ikewuchi, 2012). The intake of tapioca did not interfere in these indices. Tapioca may bring positive effects on the metabolic profile of Wistarrats. Nevertheless, we suggest more studies using this product to establish the amounts that should be usedin order to improve cardiovascular risks.

Conflict of interests

Authors declare no conflict of interests.

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