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ORIGINAL ARTICLE

Effects of fructose consumption on food intake and biochemical and body parameters in Wistar rats☆

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KEYWORDS
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Abstract
Introduction and Objective: Increased fructose consumption is associated with various metabolic changes that favor the onset of obesity and related comorbidities. The objective of this study was to assess the effects of chronic fructose consumption on body weight and adipose tissue, as well as on serum glucose and triglyceride levels.
Methods: Thirty-day-old Wistar rats were divided into two groups: fructose (F) and control (C), which had free access to commercial chow and either water or a 20% fructose solution. Body mass was measured weekly and food consumption at 30, 60 and 90 days. At 90 days, the animals were killed by decapitation and fat deposits (mesenteric, epididymal and retroperitoneal) were removed and blood collected for measurement of glucose and triglyceride levels.
Results: There was no significant difference in body weight gain, but the percentage of body fat was higher in group F. This group also consumed less feed at 60 and 90 days and had higher consumption of fructose solution than water in group C at 30 and 60 days. This meant higher calorie intake in group F and lower feed efficiency. Retroperitoneal and epididymal fat deposits and triglycerides were higher in group F than in group C.
Conclusion: Consumption of fructose solution for eight weeks, while not directly reflected in body weight gain, did increase abdominal fat in group F compared to group C, as well as changing triglyceride levels. These two factors increase risk of cardiovascular disease.

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PALAVRAS-CHAVE
Frutose;
Tecido adiposo;
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Triglicerídeo

Efeitos do consumo de frutose sobre ingestão alimentar, parâmetros bioquímicos e corporais em ratos *Wistar*

Resumo
Introdução e objetivos: O aumento do consumo de frutose pela população vem sendo associado às diversas alterações metabólicas, que favorecem ao aparecimento da obesidade e suas comorbidades. O objetivo deste trabalho foi avaliar os efeitos do consumo crônico de frutose sobre o consumo alimentar, ganho de massa corporal e de tecido adiposo, além de níveis séricos de glicose e triglicerídeos.
Métodos: Ratos *Wistar* com 30 dias de vida foram divididas em dois grupos: frutose (F) e controle (C), os quais receberam um tratamento com livre acesso a ração comercial, água ou solução a 20% de frutose. A massa corporal foi avaliada semanalmente e o consumo alimentar aos 30, 60 e 90 dias. Aos 90 dias de vida, os animais foram eutanasiados por decapitação e retirados os depósitos de gordura (mesentérico, retroperitoneal e epididimal), e coletado o sangue para dosagem da glicose e triglicerídeos.
Resultados: Não houve diferença significativa entre o ganho de massa corporal, todavia os percentuais de gordura corporal foram maiores nos grupos que consumiram bebidas adoçadas. O grupo F consumiu menor quantidade de ração aos 60 e 90 dias e maior consumo de solução de frutose comparado ao controle hídrico nos períodos de 30 e 60 dias, e isso significou maior consumo calórico do grupo F e menor eficiência alimentar. Os depósitos de gordura retroperitoneal e epididimal, bem como a trigliceridemia apresentaram-se elevados no grupo F quando comparado ao grupo C.
Conclusão: O tratamento por 60 dias com solução de frutose, apesar de não ter influenciado diretamente no ganho de massa corporal, foi capaz de aumentar a gordura corporal na região abdominal neste grupo, quando comparado com o grupo C, além de alterar níveis de triglicerídeos. E estes dois fatores implicam risco de doenças cardiovasculares.

Introduction

Diet plays an important role in the development of cardiovascular disease (CVD), and sugar intake appears to be linked to its risk factors.[1] Studies have shown the health risks associated with fructose consumption, in both humans[2] and rodents,[3] whether consumed in pure form or in combinations of carbohydrates, and at different concentrations and durations of ingestion.

Fructose, or levulose, is a monosaccharide, composed of six carbon atoms in simple covalent bonds, with a carbonyl group at the end of the chain (molecular formula $C_6H_{12}O_6$), and is a ketohexose. It is found in the diet in corn syrup, sucrose, soft drinks, and fruit and fruit-derived products. Its consumption in the form of soft drinks is a public health concern.[4,5]

Although fructose has the same molecular formula and mass as glucose, physiologically they are processed differently. Fructose does not require insulin for cellular internalization. Phosphorylation of fructose into fructose-1-phosphate occurs through the action of fructokinase, leading to the formation of two pentoses, dihydroxyacetone and glyceraldehyde. This enzyme is not regulatory and can thus stimulate lipogenesis. Similarly, glucose is phosphorylated twice before entering the fructose pathway, in which it is also broken down into dihydroxyacetone and glyceraldehyde, but its metabolism depends on a limiting enzyme, phosphofructokinase, which is inhibited by ATP and citrate, which limits the accumulation of carbon-rich intermediaries entering the Krebs cycle.[6]

Among the metabolic disorders associated with fructose are hypertriglyceridemia, hyperuricemia, hyperinsulinemia, hepatic steatosis, vascular compromise, peripheral insulin resistance and increased visceral adiposity, and there may also be increased food intake and body mass and obesity.[5]

These effects have sparked interest in the role of fructose consumption in the development of the metabolic syndrome and CVD, and it is thus important to understand the mechanisms involved in fructose metabolism. The objective of this study was to assess the effects of chronic fructose consumption on food intake, body weight and adipose tissue, as well as on serum glucose and triglyceride levels.

Methods

Study design

All experimental procedures were approved by the research ethics committee of the Federal University of Rio de Janeiro. Thirty-day-old male Wistar rats weighing around 85 g from a local laboratory animal supplier, were divided into a control group (C) (n=10) and a fructose group (F) (n=10), and had free access to commercial chow and water (group C) or 20% fructose solution (group F) for 60 days, under a 12-h light cycle (6 am to 6 pm) at a constant temperature (24±1 °C).