Original Article

Effect of High Carbohydrate Diet on Biochemical Parameters in Iraqi Volunteers

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Abstract

High carbohydrate diet was incorporated into typical Iraqi food and was given for 35 days to 27 healthy volunteers (males and females). The biochemical parameters including glucose, insulin, urea, creatinine, lipid profile, cortisol and HOMA-IR were analyzed before and after the experiment period. The results depicted significant rise in levels of triglycerides, total cholesterol, low density lipoprotein, and very low-density lipoprotein and significant decline in high density lipoprotein due to high carbohydrate diet ($P \leq 0.05$). Furthermore, the plasma insulin, fasting blood sugar, cortisol, HOMA-IR, creatinine, and urea were significantly increased. These findings show that high carbohydrate diets alter insulin, triglycerides, and high density lipoprotein cholesterol levels, which have been linked to an increase in the prevalence of coronary artery disease.

Keywords: High carbohydrate diet, insulin resistance, lipid profile

Introduction

Along with fats and proteins, carbohydrates are one of the 3 macro-nutrients found in human diet and are made of hydrogen, oxygen and carbon atoms.[1] In addition to serving as an energy source, carbohydrates are also engaged in the metabolism of triglycerides, cholesterol, insulin and blood glucose. Upon intake, digestive system converts carbohydrates to glucose and utilize it as energy source. The muscle tissue and liver store any extra blood glucose until more energy is needed. Fruits, sugar, fibers, legumes and vegetables are all included under general term of "carbohydrates".[2,3]

Complex carbohydrates are among the healthiest options because of their little impact on the levels of blood glucose. Unprocessed whole grains, vegetables, legumes and fruits are some of the examples. Simple carbohydrates can be consumed in moderation, but sodas, pastries, white bread, and other heavily processed meals can significantly increase blood glucose levels. A healthy adult's daily diet should have approximately 45% to 65% or 200g - 300g of carbohydrates. One gram of carbohydrates has about 4000 calories in it. Another crucial carbohydrate is fiber which a healthy person must take around 30g per day because it is known to reduce the risks of strokes, digestive problems and coronary heart disease. High glycemic foods can increase the risk of heart disease, type 2 diabetes mellitus (T2DM), ovulatory infertility, and obesity. These foods include corn flakes, white bread, pretzels, popcorns, rice cakes and white potatoes.[4] An increase in simple carbohydrates could be a factor in obesity, which increases people's risk for other illnesses like cardiovascular disease (CVD). T2DM, which is not insulin-dependent, can be caused by the consumption of carbohydrates. On the other hand, low-glycemic and non-starch polysaccharide-rich meals can help guard against this disease.[5]

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With time, changes in body composition and anthropometric measurements are comparable to those caused by diet higher in carbohydrates.[6] In terms of comparing the efficacy of diet depending on various carbohydrates and fats, the increased protein in a hypocaloric diet can positively effects fat-free body mass maintenance.[7] The same study reported that individuals who followed high protein diet lost more body mass than those who followed a low-carb diet with less proteins. It is important to highlight and answer the question of which diet is best for losing body mass and having the least negative effects on muscle mass. A study demonstrated no differences in effects of the low-carb, high-fat (LCHF) and low-fat, high-carb (LFHC) diets on body composition between groups that followed them for a specific time.[8] Additionally, it is uncertain how differing dietary fat and carbohydrate intake affect the body composition of athletes who participate in strength sports. Therefore, the purpose of this study is to determine the effect of LCHF and LFHC on the body composition of males and females who participate in strength training and have a healthy body mass while still keeping the recommended protein and diet intake.

Material and Methods

Study design

In the present study, data from 27 healthy Iraqi males and females, aged 22–40 years, were recruited. The participants had been following a high carbohydrate diet daily for about 30-35 days.

Laboratory analyses

Blood samples for routine biochemical assessment were collected at the pre-study medical screen, both prior to the start of each dietary regimen and at follow-up. These tests included routine fasting blood sugar (FBS), urea, creatinine, lipid profile,[9] serum insulin, cortisol and HOMA-IR.[10] Their results were reviewed by a physician before including the participants in the study. Blood samples were collected after 16hrs of fasting in the chemical laboratory at Department of biotechnology, College of Science, University of Baghdad. The tests were run according to the instructions provided by the manufacturer.

Statistical analyses

The SPSS for Windows, version 22 was used for data analyses. The mean and standard deviation (SD) of the data were used to compare the percentages (0.05 and 0.01 probability).[11] P-value < 0.05 was considered statistically significant.

Results and Discussion

Effect of high carbohydrate diet on biochemical parameters

As shown in table 1, significant differences were found with respect to the levels of FBS, insulin, HOMA-IR and cortisol after 35 days of high carbohydrate diet (HC) as compared to the levels before experiment (P≤0.05).

Table 1: Effect of high carbohydrate diet on biochemical parameters.

Parameters	Before experiment	After 35 days of HCdiet	P-value
FBS (mg/dl)	88±4.9	137±11.2	≤0.05
Insulin (μIU/ml)	11.8±1.9	13.8±2.3	≤0.05
HOMA-IR	2.56±0.4	4.6±0.8	≤0.05
Cortisol (ng/ml)	8.1±1.9	8.9±2.2	≤0.05

These results are consistent with other studies which reported worsening of blood glucose levels with sucrose, in spite of its dietary content. Moreover, when combined with HC diet, resistant starch and dietary fiber were found to enhance T2DM characteristics. Majority of studies on carbohydrate intake are conducted in Japan, US, and China. Foods rich in sugar and/or convenience foods are frequently available in various forms in the US, which lead to bad dietary practices. Additionally, the size of the portions, which are typically served in restaurants, raises questions about extra calories being consumed.[12] For a number of years, it was widely acknowledged that a "low-carbohydrate diet" is one that includes less than 130g of the carbohydrates per day.[12] However, it might not be practical for patients to regularly check grams of carbohydrates when receiving routine therapy. The present study found elevated cortisol levels in individuals who were taking HC diet. These results are both consistent and inconsistent with some studies. A study proposed that diets rich in protein might enhance mood because, contrary to HC foods, they might not cause the concentrations of the salivary cortisol to rise under stress.[13] A study has reported an increase in the release of the stress hormone cortisol especially when the food is taken around lunch.[14] In contrast, no discernible salivary cortisol response to meal intake was observed in a research by Bray *et al*.[15]. Another study found no meal-induced salivary cortisol response with respect to mental stress, however, they did find a meal-induced response of the cortisol with respect to physical stress. Moreover, women responded more strongly to physical stress and lesser to mental stress as compared to men.[16]

Effects of high carbohydrate diet on the lipid profile

Table (2) shows significant differences in lipid profile of participants after 35 days of taking HC After the experimental period, total cholesterol (T.ch), triglycerides (T.G), very low density lipoprotein (VLDL-C) and low density lipoprotein (LDL-C) were found to be increased significantly in study participants (p≤0.05). Whereas, levels of high density lipoprotein (HDL.C) significantly decreased after 35 days of HC diet (p≤0.05).

Table 2: Effects of high carbohydrate diet on the lipid profile.

Parameters	Before experiment	After 35 days of HC diet	P-value
T.ch (mg/dl)	147±6.9	191±11.1	≤0.05
T.G (mg/dl)	97±4.1	123±12.5	≤0.05
HDL-C (mg/dl)	43±2.3	38±6.5	≤0.05
VLDL-C (mg/dl)	19.4±2.1	24.6±4.3	≤0.05
LDL-C (mg/dl)	84.6±4.5	128.4±9.4	≤0.05

Similar to these results, a study reported association of unfavorable lipid profile with larger intake of added sugar and carbohydrates.[17] The long-term effects of reducing total carbohydrate intake remain unclear, although it is well-known that carbohydrates have a significant impact on both pre- and postprandial glucose excursions, which is crucial for controlling blood glucose levels, glycaemia, and even weight. Some metanalysis and systematic reviews of randomized controlled trials have looked into such issues.[18] The current study found increased levels of LDL-C in the HC group. This finding is consistent with studies that revealed additional sugar to be associated with elevated LDL-C in T2D patients. This emphasizes how crucial it is to concentrate on carbohydrate quality and stay away from "simple" carbohydrates. Moreover, decrease in the levels of HDL-C in present study is also consistent with another study which also observed its decline in people with T1D who consumed a diet high in carbohydrates and fibers than those who consumed a diet low in fiber and carbohydrates.[19]

Effects of high carbohydrate diet on kidney functions

Table (3) shows significant differences in kidney function after 35 days of HC diet. When compared with levels before taking HC diet, the levels of urea and creatinine were found significantly increased (p≤0.05) after 35 days of HC diet.

Table 3: Effect of high carbohydrate diet on kidney functions

Parameters	Before experiment	After 35 days of HC diet	P-value
Urea (mg/dl)	14.7±6,4	21.1±4.9	≤0.050
Creatinine (mg/dl)	0.89±0.10	1.1±0.2	≤0.050

These results are in agreement with a previous study which reported improvement in glomerular filtration rates by reducing glucose intake. Increasing the percentage of protein/fat intake and decreasing percentage of carbohydrate intake can improve kidney function. These alterations are unrelated to markers of inflammation, endothelial function, or plasma glucose homeostasis, suggesting that dietary carbohydrates may directly affect glomerular filtration.[20] Reducing glucose intake results in short-term increase in glomerular filtration which, is a sign of hyperfiltration, an untoward reaction to abnormal renal hemodynamics, and the advancement of kidney damage and diseases.[21] Future studies might use novel kidney injury urine markers[22] to further explore the advantages or disadvantages of dietary carbohydrates.

Conclusion

From this study we conclude that increase in the level of blood sugar by HC diet increase insulin which prevents lipids to burn in the body causing obesity. Furthermore, HC diet effects kidney function, increases level of lipids and decreases HDL-C.

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