Husni Muhammed Hasan  
Suad Yusif Yousif Alkass  
Daniele Suzete Persike de Oliveira  
College of Pharmacy, Department of Medicinal Chemistry, University of Duhok, Duhok 1006 AJ, Iraq

**Introduction:**

Previous studies conducted on saccharin and cyclamate were either limited to experimental animals or lacking evaluation of their long term consumption effects in humans. With increased consumer interest in reducing sugar intake, food products made with sweeteners rather than sugar have become more common. Obese and diabetic patients, in addition to individuals concerned about their diet, are more likely to use sugar-free and low-calorie products. Low-calorie synthetic sweeteners have recently emerged in the pharmaceutical and food industries, but their health risks due to their side effects restrict their use. Several previous studies have shown that the use of artificial sweeteners can be hazardous to human health.

**Objectives:**

The present results indicate that saccharin and cyclamate mixtures cannot be considered as healthy sugar substitutes and their use should not be recommended.

**Subjects and Methods:**

This cross-sectional study was carried out between July 2015 to October 2016 at the Diabetic Center in Duhok, Kurdistan Regional Government - Iraq. Healthy participants were classified into 2 groups based on whether they consumed sweeteners or not. Similar classification was done to the diabetic patients. The volunteers were also classified according to the amount of sweetener consumed per day (<5, 5-10, and >10 tablets) and according to the duration of sweetener consumption (<5, 5-10 and >10 years). The Diabetic groups included 181 type 2 diabetic patients of which 88 consumed sweeteners and 93 who did not consume sweeteners. The groups of healthy people included 107 individuals of which 14 consumed sweetener and 93 did not consume sweeteners. Venous blood samples were treated with EDTA for the estimation of HbA1c, while serum was used for measuring all other parameters. The categories of parameters measured were antioxidant parameters - serum catalase activity and serum peroxynitrite, as well as, pro-oxidant parameters - serum ceruloplasmin (CP) and the oxidation product - malondialdehyde (MDA). In addition, glycated haemoglobin (HbA1c), fasting serum glucose (FSG), serum creatinine, alanine transaminase activity (ALT) and lipid profile were also evaluated.

**Results:**

- **Figure 1:** Percentage of change in (A) WC, BMI, Blood pressure, ALT activity and creatinine level, (B) FSG and HbA1C, (C) Lipid profile parameters and (D) Oxidative stress parameters among healthy individuals (H), diabetic (D) and diabetic using sweetener (DS). *P<0.05 (independent t-test).

- **Table 1:** Percentage of change in healthy groups for demographic and biochemical parameters.

**Conclusion:**

Consumption of the saccharin and cyclamate tablets mixture affected biochemical parameters related to metabolic function in a time and dose dependent manner and appear to increase oxidative stress in healthy and diabetic type 2 patients. The present results add further evidence of an atherosclerotic effect caused by artificial sweeteners in healthy individuals and diabetic patients. Furthermore, the artificial sweetener mixture showed harmful effects on kidney and liver functions. The amount of sweetener taken was positively associated with FSG and creatinine, while being negatively associated with catalase, peroxynitrite and ceruloplasmin. The period of consumption was positively associated with FSG and TG levels in diabetic patients. The present results indicate that saccharin and cyclamate mixtures cannot be considered as healthy sugar substitutes and their use should not be recommended.