Indian Journal of Fundamental and Applied Life Sciences ISSN: 2231-6345 (Online)
An Open Access, Online International Journal Available at http://www.cibtech.org/jls.htm
2014 Vol. 4 (4) October-December, pp.338-341/Chardoli and Kahnamoei
Research Article

THE EFFECT OF ARTIFICIAL SWEETENERS ON RENAL FUNCTION IN RATS

Chardoli A [1] and *Rahmani Kahnamoei J [2]
[1]*Department of Veterinary Medicine, Tabriz Branch, Islamic Azad University, Tabriz, Iran*
[2]*Department of Veterinary Clinical Science, Tabriz Branch, Islamic Azad University, Tabriz, Iran*
**Author for Correspondence*

ABSTRACT
Today, artificial sweeteners are used in the production of a variety of foods. One of non-sugar sweeteners is sucralose that was discovered by Lyle and Tate company (1976). In 1998, it was approved by FDA. The rate of sweetening of a commercial pack of Mardinis equal to 2.7 g sugar sweetening. Considering the lack of scientific information about the effect of sucralose on renal function, in this study the effect of commercial artificial sweetener containing sucralose on serum BUN, creatinine, uric acid, total protein and albumin were evaluated. This study was conducted on 18 male Wistar rats weighing 220 ± 20 g that randomly divided into 6 groups of three animals in each: control group, sucralose treatment group and the sugar treatment group. In this study, 15 mg / k dosage of sucralose was administrated by gavage daily for a month in sucralose treatment group. Also regarding that commercial sucralose tablets sweetening is equal to 2.7 grams of sugar according to the company brochure, the amount of sugar for sugar-treatment group was calculated and administered daily for a period of one month by gavage method.At the end of the period, blood samples were taken from rats and serum BUN, creatinine, uric acid, total protein and albumin were evaluated. SPSS software (version 18.0) was used for statistical analysis. No significant changes were proved about understudied factors based on the obtained results from ANOVA test. Considering unchanged serum factors relating to renal function it can be claimed that sucralose containing commercial sweetener, Mardin, has no negative effect on renal function and has no contraindication for healthy, diabetic, and obese people.

Keywords: *Artificial Sweeteners, Renal Function, Mardin, Rats*

INTRODUCTION
Due to a change in life style, there is an increased prevalence of metabolic and nutritional disorders such as diabetes, hypertension, obesity and cardiovascular disease in the world. The challenge led the researchers to find an alternative to some high-energy molecules such as sugars.
Nowadays, artificial sweeteners are used in the production of a variety of foods. Artificial sweeteners have provided the possibility of production the regime soft drinks, chocolate and jam provided for the diabetics and obese people use. Most of these non-sugar sweeteners don't produce a lot of energy in the body and even some of them excreted without making any changes in the metabolic process of the body. One of the non-sugar sweeteners is sucralose that was discovered by Tate and Lyle Company (1976) and was approved by FDA in the 1998.
Sucralose is a non-caloric sweetener derived from sugar that is 600 times sweeter than sugar. Replacement of three chlorine molecules causes sucralose not to be metabolized in the body, unlike the sugar, and pass unchanged and immediately from the body. This material is easily dissolved in water and has a good stability at high temperatures and a taste similar to sugar (Christina, 2008).
According to the studies conducted by the researches it has been found that the sweetener is completely healthy and safe. Furthermore, there is no documented report about its side effects so far. The sweetening amount of a pack of Mardin is equal to 2.7 g of sugar. It also is not contraindicated for pregnant women, lactating mothers and children. The maximum daily consumption of the sweetener is 15 mg / kg (Mezitis, 1996).
Since sucralose has no additive effect on glucose and other carbohydrates, is safe for diabetics (Campose, 2000). In a study conducted by Shastri and colleagues it was showed that the consumption of sugar

sweeteners such as aspartame, A3 sulphame and sucralose in doses of ADI for three weeks has no mutagenic effects on normal and diabetic rats as well as on glucose and serum profiles (Shastry *et al.*, 2012) .

In the evaluation of the effect of sucralose containing commercial tablet, Splenda, on healthy and diabetic rats it was found that the serum glucose of the healthy rats decreased 14% compared with control group. Also, according to the results obtained from diabetic-sucralose group, 150% increase in glucose and 22% decrease in insulin were observed (Helen *et al.*, 2013).

In one study, oral administration of sucralose according to ADI dose (15 mg / kg) on a three-phase induction time : 0-3 weeks at a dose of 1 × ADI, 3- 7 weeks at a dose of 2 × ADI, and 7-13 weeks at a dose 4 × ADI, a decrease in serum glucose were reported in all three phases, with the difference that in the phase 1 the decrease was minimal but in phases 2 and 3 the reduction was sensible but not significant. Also, the values of serum lipid profiles in the phase 1 was similar as in control group, while a significant increase of lipid profiles was proved in phases 2 and 3 which was consistent with the findings of the present study (Shastry *et al.*, 2012). In the double-blind study conducted by Grots *et al.*, it has been identified that sucralose at a dose of 7.5 mg / kg / day for a month has not a significant effect on serum glucose and HbA1c levels in humans. According to the manufacturer's brochure, any commercial tablets containing sucralose has also compounds of lactose, L-leucine, Cross, sodium carmulose and PVP and create a low calorie. Due to the lack of reliable scientific information concerning the effect of sucralose on renal function, the effects of artificial sweeteners containing sucralose on serum levels of BUN, creatinine, uric acid, total protein and albumin were evaluated in this study.

MATERIALS AND METHODS

This study was conducted on 18 male Wistar rats weighing 220 ± 20 g that randomly divided into 6 groups of three animals in each: control group, sucralose treatment group and the sugar treatment group. According to the studies conducted by Shastry *et al.*, as well as FDA standards in which the daily acceptable intake of sucralosehas been determined as 15 mg/kg, in this study 15 mg / k dosage of sucralose was administrated by gavage daily for a month in sucralose treatment group. Also regarding that commercial sucralose tablets sweetening is equal to 2.7 grams of sugar according to the company brochure, the amount of sugar for sugar-treatment group was calculated and administered daily for a period of one month by gavage method. The control group had the basal diet and no intervention was conducted on them. At the end of the period, blood samples were taken from rats and serum BUN, creatinine, uric acid, total protein and albumin were evaluated. SPSS software (version 18.0) was used for statistical analysis. The results of the study were analyzed using One-Way ANOVA at the 95% possibility level and $p < 0.05$ significance level. It is worth mentioning that during the period of the study, rats were exposed to 12 hours of light and 12 hours dark and there were no restrictions on access to food and water.

RESULTS AND DISCUSSION

Results

Comparison of mean creatinine(mg/dl) in the study groups: According to data from table (1) and ANOVA test it is observed that the mean creatinine in the control, sugar treatment, and sweetener treatment groups were 0.81 ± 0.075 mg / dl, 0.80 ± 0.063 mg / dl, and 0.88± 0.098 mg / dl respectively which according toF=1.810, significance level of P=0.198, and the reliability level 95%, the differences observed in mean serum creatinine in the three groups were not significant (P>0.05).

Table 1: Comparison of the mean creatinine(mg/dl) in the study groups

Group	number	mean	Intergroups mean	Intragroup mean	F	P
Control	6	0.075±0.81				
Sugar treatment	6	0.063±0.80				
Sweetener treatment	6	0.098±0.88	0.012	0.006	1.810	0.198
total	18	0.08±0.83				

Comparison of meanuric acid(mg/dl) in the study groups: According to data from table (2) and ANOVA test it is observed that the mean creatinine in the control, sugar treatment, and sweetener treatment groups were 1.000 ± 0.15 mg / dl, 1.18 ± 0.36 mg / dl, and 1.06± 0.206 mg / dl respectively which according toF=0.789, significance level of P=0.472, and the reliability level 95%, the differences observed in mean serum uric acid in the three groups were not significant (P>0.05).

Table 2: Comparison of the meanuric acid (mg/dl) in the study groups

Group	number	mean	Intergroups mean	Intragroup mean	F	P
Control	6	0.15±1.000				
Sugar treatment	6	0.36±1.18				
Sweetener treatment	6	0.206±1.06	0.52	0.065	0.789	0.472
total	18	0.25±1.08				

Comparison of mean albumin(g/dl) in the study groups: According to data from table (3) and ANOVA test it is observed that the mean albumin in the control, sugar treatment, and sweetener treatment groups were 4.10 ± 0.43 g / dl, 3.71 ± 0.09 g / dl, and 3.81± 0.19 g / dl respectively which according toF=3.024, significance level of P=0.079, and the reliability level 95%, the differences observed in mean serum albumin in the three groups were not significant (P>0.05).

Table 3: Comparison of the mean albumin(g/dl) in the study groups

Group	number	mean	Intergroup mean	Intragroup mean	F	P
Control	6	0.43±4.10				
Sugar treatment	6	0.09±3.71				
Sweetener treatment	6	0.19±3.81	0.237	0.078	3.024	0.079
total	18	0.31±3.78				

Comparison of mean total protein(g/dl) in the study groups: According to data from table (4) and ANOVA test it is observed that the mean total protein in the control, sugar treatment, and sweetener treatment groups were 8.06 ± 1.25 g / dl, 8.58 ± 1.01 g / dl, and 8.21± 1.43 g / dl respectively which according toF=0.273, significance level of P=0.765, and the reliability level 95%, the differences observed in mean serum total protein inthe three groupswere notsignificant (P>0.05).

Table 4: Comparison of the meantotal protein (g/dl) in the study groups

Group	number	mean	Intergroup mean	Intragroup mean	F	P
Control	6	1.25±8.06	0.424	1.55	0.273	0.765
Sugar treatment	6	1.01±8.58				
Sweetener treatment	6	1.43±8.21				
total	18	1.19±8.28				

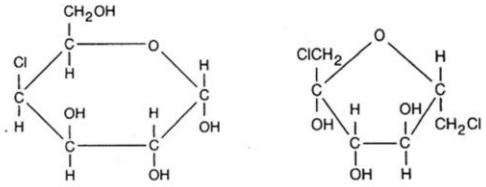
Comparison of mean BUN(mg/dl) in the study groups: According to data from table (5) and ANOVA test it is observed that the mean BUN in the control, sugar treatment, and sweetener treatment groups were 21.16 ± 2.92 mg / dl, 19.83 ± 3.65 mg / dl, and 21.83± 2.401 mg / dl respectively which according toF=0.674, significance level of P=0.524, and the reliability level 95%, the differences observed in mean serum BUN in the three groups were not significant (P>0.05).

Table 5: Comparison of the mean BUN in the study groups

Group	number	mean	Inter groups mean	Intra group mean	F	P
Control	6	2.92±21.16				
Sugar treatment	6	3.65±19.83				
Sweetener treatment	6	2.401±21.83	6.222	9.233	0.67	0.524
total	18	2.97±20.94			4	

Discussion

Non-sugar sweetener sucralose changes to 4CG and 1,6 DCF as a result of hydrolysis. These metabolites are resistant to more hydrolysis and completed composition, because sucrose chlorination and changing into sucralose causes molecule conformation, and strengthen it against glycoside enzymes of digestive tract, that normally causes in turn the carbohydrate decomposition.



4-CG 1,6-DCF

In this study, serum levels of biochemical factors, creatinine and protein, did not show significant changes in the study groups, that consistent with the results obtained by Jun (2013).

Since according to the studies conducted by Simes *et al.*, (2000) sucralose reabsorption in renal tubules was very low and its rate was under 5% during 24 hours, there is no significant change in serum biochemical factors in relation to the renal function, which is consistent with the results of this study. Due to the lack ofchange inserum factorsrelated torenal functionit can be claimed that the commercial sweetener sucralose containing, Mardin, has no negative impact on renal function and it is not contraindicated for healthy, diabetic's and obese people. It is recommended that the effect of high doses of sucralose on serum biochemical factors administration of to be studied in the future studies.

REFERENCES

Campos MB (2000). Sucralose. *Food Ingredients* **17** 18-21.

Christina R Whitehouse BSN, Joseph Boullata RN, PharmD RPh BCNSP and Linda A McCauley (2008). The Potential Toxicity of Artificial Sweeteners. *AAOHN Journal* **56**(6) 251–259.

Grotz VL and Munro IC (2009). An overview of the safety of sucralose. *Regul. Toxicol.Pharmacol*. **55** 1-5.

Helen N Saada, Nefissa H Mekky, Hassan A Eldawy and Abeer F Abdelaal (2013). Biological Effect of Sucralose in Diabetic Rats. *Food and Nutrition Sciences* **4** 82.

Jun Sung NAH, KyeongJu LEE and Sang Min CHOI (2013). Environmental accumulation of artificial suger (sweeteninig) and effect on organism. *APEC Youth Scientist Journal* **6**(2) 156-169.

Mezitis NH, Maggio CA, Koch P, Quddoos A, Allison DB and Pi-Sunyer FX (1996). Glycemic effect of a single high oral dose of the novel sweetener sucralose in patients with diabetes. *Diabetes Care* **19** 1004–1005.

Shastry CS, Yatheesh CK and Aswathanarayana BJ Comparative (2012). Evaluation of Diabetogenic and Mutagenic Potential of Artificial Sweeteners Aspartame, Acesulfame-K and Sucralose. *NUJHS* **2**(3) 80-84.

Sims J, Roberts A, Daniel JW and Renwick AG (2000). The Metabolic Fate of Sucralose in Rats. *Food and Chemical Toxicology* **38**(2) 115-121.