Advance Journal of Food Science and Technology 12(12): 663-666, 2016
DOI:10.19026/ajfst.12.3326
ISSN: 2042-4868; e-ISSN: 2042-4876

Submitted: August 3, 2015 Accepted: October 11, 2015 Published: December 25, 2016

Research Article

Effect of Total Flavonoids of Flos Sophorae on Glucose Levels, Serum Lipid and Antioxidation Ability in Diabetic Rats Model

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Abstract: Objective: To investigate the effect of Total Flavonoids of Sophorae Flos (TFSF) on Glucose Levels, Serum Lipid and antioxidation ability in diabetic rats model which was established by streptozotocin. Method: The diabete rat model was established by injected with streptozotocin, which were fed with high dosage TFSF, medium dosage TFSF, low dosage TFSF, metformin and Physiological saline, another healthy rats were divided into blank group. All the rats were administrated once a day for 30 days. Blood Glucose (BG) in the limosis were measured on the tenth and twentieth day. On the thirtieth day the levels of BG, serum total cholesterol, triglyceride, low-density lipoprotein, high-density lipoprotein, MDA and SOD were measured. Results: Has obvious effect of reducing blood glucose of different doses of TFSF on streptozotocin-induced hyperglycemic rats, which can reduce the levels of serum total cholesterol, triglycerides, low-density lipoprotein, significantly higher the levels of serum high density lipoprotein and MDA, increased SOD antioxidation ability. Conclusion: The TFSF can lower blood sugar and blood lipid efficacy might be related with the increased antioxidant capacity.

Keywords: Antioxidation ability, Blood Glucose (BG), diabetic, serum lipid, streptozotocin, Total Flavonoids of Flos Sophorae (TFSF)

INTRODUCTION

Flos Sophorae for leguminous plants locust (*Sophora japonica L.*) dry flower and bud, the former known as "Sophora japonica", the latter is called "Huaimi" (National Pharmacopoeia Committee, 2010). Numerous studies indicated that Flavonoids could reduce the blood glucose, blood lipid and blood pressure, anti tumor, anti inflammation, treatment of cardiovascular disease and so on (Wang *et al*., 2011). The TFSF is the main component of Sophorae Flos. Previous results showed that TFSF has good hypoglycemic effect on the diabete rats established by injection of streptozotocin (Xiaojing *et al*., 2012). It can decrease the level of blood sugar and leptin and increase the level of insulin and C-peptide significantly (Mingsan *et al*., 2011). On this basis, this study further observed the the effect of TFSF on Glucose Levels, Serum Lipid and antioxidation ability in diabetic rats model.

MATERIALS AND METHODS

Animals: Wistar rats, male, whose weight were 180-200 g, were supplied by the Experimental Animal Center of Hebei Province. The Animal permit number is 701022.

The experimental reagents and drugs: The TFSF provided by the Henan Engineering Research Center for Chinese medicine development and the content more than 60%; Streptozotocin (STZ) was from sigma company; Metformin Hydrochloride Tablets was from Shanghai Pharmaceutical Group Co., Ltd. Xinyi Pharmaceutical Factory; SOD kit (measuring total), Malondialdehyde (MDA) test kit, Nanjing Jiancheng Bioengineering Institute of production; Glucose kits, Low-Density Lipoprotein Cholesterol assay Kit (LDL-C), High-Density Lipoprotein Cholesterol assay kit (HDL-C), glycerin Three Greases determination kit (TG), Total Cholesterol assay kit (TCH), Zhejiang Dongou Biological Engineering Co., Ltd production; Physiological saline, zhengzhou yonghe pharmaceutical Co., Ltd production.

The experimental instrument: UV-2000 UV-visible spectrophotometer, UNICO (Shanghai) Instrument Co., Ltd; FA (N) /JA (N) series electronic balance, Shanghai Minqiao Precision Instrument Co., Ltd; Adjustable liquid shifter, Shanghai Leibo Analysis Instrument Co., Ltd.

Methods: 100Wistar male rats, after fasting 12 h, Random take 90 rats tail vein injection 60 mg/kg STZ (with citrate buffer formulated at pH 4.2) after fasting

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12 h and the 10 rats remained as the blank group, tail vein injection of an equal volume of citrate buffer (Huang *et al*., 2012). On the tenth day, tail blood test blood sugars, select 50 rats which BG>11.1 mmol/L and obviously drinking, eating, urining, then were fed with high, medium and low dosage TFSF suspension (600, 300, 150 mg/kg, respectively), metformin suspension (208 mg/kg), model group and blank control group were given the same volume physiological saline. Once a day, treated for 30 days. Fasting blood glucose levels were measured on the tenth, twentieth and thirtieth days of administration, In the last fasting blood sugar test one day before 12 h, drenching 2 h after blood serum was separated, according to kit instructions mearsured glucose levels, Serum Lipid and antioxidation ability.

Methods statistical analysis: Data analysis used SPSS 10.0 for windows for statistical treatment. The differences of measurement data between groups were analyzed using ANOVA, ranked data used Ridit test.

RESULTS AND DISCUSSION

Impact on blood sugar in the STZ rat model: From Table 1, compared with the blank group, the level of BG in tenth, twentieth and thirtieth day was significantly increased (p<0.01), showed that the model successfully. Significantly higher blood sugar before administration of each group were compared with the blank group, the BG of other groups don`t have marked disparity, which demonstrate that the grouping is uniform. Compared with the model group, on the 10th day, each treatment group had a tendency to lower blood sugar level, but not obvious. On twentieth day, the high dosage TFSF group and metformin group could remarkably reduce the level of BG (p<0.01); the medium dosage TFSF group could obviously reduce the level of BG(p<0.05); On thirtieth day, the high, medium dosage TFSF group and metformin group could remarkably reduce the level of BG(p<0.01); the low dosage TFSF group could obviously reduce the level of BG(p<0.05). It showed that the TFSF has a good effect to reduce the BG and the high dosage effect is the best.

Impact on serum lipid in the STZ rat model: From Table 2, compared with the blank group, the levels of serum total cholesterol, triglyceride, low-density lipoprotein in the model group were significantly higher (p<0.01); the level of high-density lipoprotein were significantly lower (p<0.01); It suggests that the model copied successfully. Compared with the model group, On thirtieth day, the high, medium dosage TFSF group and metformin group could remarkably reduce the levels of serum total cholestero and triglyceride (p<0.01); the low dosage TFSF group could obviously reduce the level of serum total cholestero (p<0.05); the high, medium, low dosage TFSF group and metformin group could remarkably reduce the level of low-density lipoprotein (p<0.01); the high, medium, low dosage TFSF group and metformin group could remarkably increase the level of high-density lipoprotein (p<0.01). It shows that the TFSF can effectively regulate the disorder of lipid metabolism in diabetic rats.

Impact on antioxidation ability in the STZ rat model: From Table 3, compared with the blank group, the level of MDA in the model group were significantly higher (p<0.01) and the activity of SOD were significantly lower (p<0.01), It shows that diabetic rats in the model appeared significant dyslipidemia. Compared with the model group, On thirtieth day, the medium dosage TFSF group and metformin group could remarkably increase the activity of SOD (p<0.01); the high, low dosage TFSF group could obviously increase the activity of SOD (p<0.05). The high, medium dosage TFSF group and metformin group could remarkably reduce the level of MDA (p<0.01), the low dosage TFSF group could obviously reduce the

Table 1: Effect of TFSF on the level of blood glucose in diabetic rat model injected with streptozotocin ($\bar{x}$ ±s, mmol/L, n = 10)

		The level of BG (mmol/L)			
Group	Dose (mg/kg)	Began to glucose	10 days	20 days	30 days
Blank group		4. 832±0.858**	4.982±0.766**	4.735±1.094**	4.862±0.718**
Model group		15.473±2.600	17.755±2.492	18.484±2.355	19.766±2.754
Metformin group	208	15.870±2.936	15.663±2.090	13.585±2.061**	11.548±1.992**
High dosage TFSF group	600	15.97±2.980	16.619±2.692	14.852±3.186**	13.130±2.937**
Medium dosage TFSF group	300	15.933±2.813	17.477±2.640	15.429±3.126*	13.744±2.832**
Low dosage TFSF group	150	16.057±2.685	17.828±2.442	17.549±1.974	17.113±1.919*

Compared with the model group, *p<0.05, **p<0.01

Table 2: Effect of TFSF on the level of serum lipid in diabetic rat model injected with streptozotocin ($\bar{x}$ ±s, mmol/L, n = 10)

Group	Dose (mg/kg)	Serum Total Cholesterol (TC)	Triglyceride (TG)	High-Density Lipoprotein (DL-C)	Low-Density Lipoprotein (LDL-C)
Blank group		4.108±0.790**	0.487±0.035**	1.288±0.137**	2.869±0.502**
Model group		7.148±1.027	1.287±0.302	0.830±0.076	5.070±0.832
Metformin group	208	5.310±1.198**	0.895±0.110**	1.232±0.052**	2.943±0.709**
High dosage TFSF group	600	5.080±0.806**	0.943±0.142**	1.177±0.171**	2.869±0.502**
Medium dosage TFSF group	300	5.468±1.089**	0.928±0.139**	1.213±0.120**	3.158±0.833**
Low dosage TFSF group	150	5.965±1.300*	1.078±0.185	1.069±0.054**	3.685±0.794**

Compared with the model group, *p<0.05, **p<0.01

Table 3: Effect of TFSF on the level of MDA and SOD in diabetic rat model injected with streptozotocin ($\bar{x}$ ±s, n = 10)

Group	Dose (mg/kg)	MDA (nmol/L)	SOD (U/mL)
Blank group		5.563±0.701**	77.51±13.885**
Model group		9.298±0.686	49.561±7.042
Metformin group	208	6.503±0.944**	69.569±6.176**
High dosage TFSF group	600	7.086±1.105**	61.321±12.843*
Medium dosage TFSF group	300	7.126±1.110**	65.587±7.311**
Low dosage TFSF group	150	8.225±1.328*	59.860±9.647*

Compared with the model group, *p<0.05, **p<0.01

level of MDA (p<0.05). It shows that the TFSF has better effect to improve the antioxidant capacity.

Diabetes in traditional Chinese medicine belong to the category of "excessive" and obviously drinking, eating, urining, thin body, or turbid urine, urine has a sweet taste; Modern medicine that diabetes is a chronic metabolic disease caused by a variety of causes, its basic pathology for the absolute or relative lack of insulin secretion and peripheral tissue is not sensitive to insulin, or cause is given priority to with sugar metabolic disorders, including fat and protein metabolism disorder of a systemic disease (Fan *et al*., 2013). Diabetes is a chronic metabolic disease, although metformin has hypoglycemic effect, but the long-term use is easy to appear lactic acidosis, gastrointestinal reaction and side effect, also exist a certain degree of resistance (Miao *et al*., 2014). So in the new understanding of the drawbacks in the background, to seek a more safe and effective treatment method is very necessary and urgent to find more and more attention from traditional Chinese medicine.

This experiment using tail vein injection of streptozotocin diabetic rats model made. Because streptozotocin as a broad-spectrum antibiotic, which will selective destruction of pancreatic β cell of experimental animal, resulting in the synthesis of insulin to reduce animal glucose, elevated blood lipids significantly, tissue toxicity is relatively low and the animal survival rate is high (Yongxin and Jinbin, 2013), similar to the mechanism of human diabetes and could well reflect the effects of various types of antidiabetic drugs, which is one of many animal models of diabetes induction methods currently used (Jun-wei *et al*., 2014). Flavonoids have been reported, such as corn silk flavonoids can effectively reduce the blood sugar and blood lipid levels in diabetes and hyperlipidemia rats, improve the antioxidant ability (Yi *et al*., 2011). In order to better judge curative effect of Flos Sophorae on diabetes, this experiment to evaluate BG, blood lipid, serum MDA level and SOD activity in the rats. Glucose metabolic disorder of diabetes changed is the most important and basic pathology, the determination of blood glucose is to evaluate whether the model is successful and the main index of drug is effective. After lipid metabolism secondary to diabetes glucose metabolism disorders, high blood sugar is hypertriglyceridemia and hypercholesterolemia direct cause of the presence of hyperlipidemia is accelerated atherosclerosis in diabetes and its vascular complications, such as the main factor and therefore in the control of blood glucose while reducing the blood lipid levels is another goal of delaying diabetic complications (Dequan *et al*., 2012). MDA is the major metabolite of reactive oxygen species, when suffered from diabetes, glycosylation reaction can cause increased production of oxygen free radicals in diabetic patients in long-term hyperglycemia, when glycosylation reaction enhanced, thereby significantly increased its concentration in the blood MDA. To prevent free radical damage to the body, the body can remove normal oxygen free radicals, the process of Superoxide Dismutase (SOD) is more important, its main role is to be converted into superoxide anion into hydrogen peroxide (Wei *et al*., 2010).

CONCLUSION

The results of the study indicate the TFSF could remarkably or obviously reduce the level of BG in the rats which were established by streptozotocin; could remarkably or obviously reduce the levels of serum total cholesterol, triglyceride, low-density lipoprotein, increase the level of high-density lipoprotein, could remarkably or obviously reduce the level of MDA and increase the activity of SOD. It suggests that the TFSF can fight free radical damage caused by streptozotocin to protect islet cell secretory function, lower blood sugar and blood lipids, increase the body's antioxidant capacity. And Flos Sophorae as medicinal and edible plan which has high medicinal value in-depth study of the Sophora deepen further as a medicinal resource development has broad application prospects. This study provides experimental basis for TFSF treatment of diabetes and laid the foundation for the clinical treatment of diabetes mellitus.

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