

Effects of curcumine on antioxidation in diabetic rats

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Abstract: To investigate the effects of curcumin on antioxidation and its mechanism in diabetic rat model. After streptozotocin (STZ) induced diabetic rat model, large, medium and small doses of curcumin group were partly given curcumin solution 200,100,50mg • kg⁻¹, administered once a day, continuously 30 days. In 30th day, determine blood glucose (BG) value, after the last injection, determine the serum superoxide dismutase (SOD), malondialdehyde (MDA), glycosylated serum protein (GSP) and free fatty acid (FFA) levels. Compared with the model group rats, In the 10th, 30th administrate, each dose of curcumin group rats' BG, MDA, GSP, FFA levels were significantly reduced, SOD levels was increased significantly. curcumin can significantly improve the antioxidant capacity of diabetic model, improve the metabolic disorder.

Keywords: Curcumin; diabetes; blood glucose; antioxidant

INTRODUCTION

Epidemiological studies have shown that diabetic patients in China, 60.7% undiagnosed and unable to timely and effective treatment, affecting the quality of patients' life (Tong *et al*, 2014). Diabetes mellitus (DM) is a kind of disease, for genetic and environmental factors in the long-term interaction, and the insulin secretion absolutely insufficient or the relative insufficiency caused by progressive sugar, fat, protein, water and electrolyte metabolism disorder (Qiong *et al*, 2013). Recent studies have found, oxidative stress is closely related to the occurrence and development of diabetes complications (CaoQing *et al*, 2009). Antioxidant treatment can antagonize the oxidative stress occurs, so as to prevent or delay the development of diabetes and its chronic complications. Therefore, explore the safe and effective natural antioxidants has important theoretical significance and clinical application value.

Curcumin is a kind of yellow color of polyphenols extractive from Genus *Curcuma* plants. *Curcuma* in medicinal plants. Curcumin possesses a variety of pharmacological qualities including anti-inflammatory, antioxidant, antiangiogenic and apoptogenic activities (Pinaki *et al*, 2013). But the hypoglycemic effect and mechanism of curcumin was less. This paper is the discussion about effect of curcumin antioxidation and its mechanism on experimental diabetic model rats.

MATERIAL AND METHODS

Experimental animals

Wistar strain, male, body mass (BM) 18~22g, provided by Laboratory Animal Facility in Henan Province, No. 410116 (rat).

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Experimental drug and reagent

Curcumin, provided by Henan Gangye Pigment Co., Ltd, content greater than 90%; Metformin Hydrochloride Tablets, provided by Shanghai Medicine (Group) Co., Ltd Sine Pharmaceutical Station, Batch No.:020602; Streptozotocin (STZ): provided by Sigma company; blood glucose reagent case: provided by Baoding Great Wall Clinical reagents Co., Ltd, Batch No.:030321; SOD reagent case: provided by Nanjing Jiancheng Bioengineering Institute, Batch No: 031205;MDA reagent case: provided by Nanjing Jiancheng Bioengineering Institute, Batch No: 031205; FFA reagent case: provided by Nanjing Jiancheng Bioengineering Institute, Batch No: 031205;GSP reagent case: provided by Nanjing Jiancheng Bioengineering Institute, Batch No: 031205 physiological saline, produced by Zhengzhou Chemical and Medico-Industry Limited Company, Batch No: 030409.

Experimental instrument

752-spectro photometer: produced by Shanghai Third Analytical Instrument Factory; Glass homogenizer: produced by Shanghai Glass Instruments Factory; Homeothermia thermostat-controlled waterbath: produced by Beijing Guangming medical treatment Instrument Factory; Centrifuge: Produced by Beijing medical instrument repair Factory; Homeothermia thermostat-controlled waterbath: Produced by Beijing Guangming medical treatment Instrument Factory; Mechanical transferretor: Produced by Thermo Lab Systems (Shanghai) Co., Ltd.

Method

Absolute diet for 12 hours, single intraperitoneal injection of Pentobarbital at a dose of 25mg•kg⁻¹ to anesthetize, then sublingually intravenous injection of streptozotocin (STZ) into rats at a dose of 55mg•kg⁻¹ (pH=4.5,blend by Citric Acid buffer) to pose a DM mice model. After vena caudalis injection of streptozotocin (STZ) for 72 hours, gain the blood by snipping tail to determine the BG, select

the mice which BG>11.1mmol/L and choose 50 rat and all of them obviously have polydipsia, polyphagia, polyuria symptoms. Then divide them into five groups: Model group, metformin group, large, medium and small doses of curcumin group. Another not molding 10 rats are as blank group. Large, medium and small doses of curcumin group are partly given curcumin solution (200,100,50mg • kg⁻¹, with concentration of solution for 20, 10, 5mg•ml⁻¹, administered volume is 0.01ml • g⁻¹), metformin group are given metformin solution (250mg • kg⁻¹, with concentration of solution for 25mg • ml⁻¹, administered volume is 0.01ml • g⁻¹), model group and blank group are given the same volume of saline perfusion. Administered once a day, continuously 30 days. In 10th, 30th day, take blood (absolute diet for 12 hours), according to the kit method, determine blood glucose (BG) value, observe the urine volume before each determination. 2h after the last administered, take blood and separat serum, according to the kit method, determine the serum superoxide dismutase (SOD), malondialdehyde (MDA), glycosylated serum protein (GSP) and free fatty acid (FFA) levels. The treatment of animal accords with the relevant requirements in The treatment to laboratory animals with good ethics, which is drafted by Ministry of Science and Technology of the People's Republic of China. The experiments are approved by the Animals Ethic Committee, Henan University of Traditional Chinese Medicine, China.

Statistical Treatment

Data analysis used SPSS 13.0 for windows for statistical treatment. measurement data represented by mean ± variance ($\bar{x} \pm s$).

RESULTS

The effect of Curcumin on the BG of DM mice model induced by STZ

The beginning blood glucose values in Blank group, model group, metformin group, large dose of curcumin group, middle dose of curcumin group, small dose of curcumin group partly are 5.30 ± 0.76, 21.83 ± 3.14, 21.60 ± 4.66, 21.49 ± 3.61, 21.19 ± 4.88, 21.97 ± 5.68mmol • L⁻¹, in 10th day, blood glucose values in each group partly are 5.28 ± 0.55, 23.39 ± 4.56, 17.80 ± 3.75, 17.93 ± 5.04, 18.30 ± 4.81mmol • L⁻¹, in 30th day, blood glucose values in each group partly are 5.61 ± 0.91, 19.55 ± 5.87, 16.56 ± 2.69, 9.41 ± 2.67, 11.98 ± 4.53, 14.44 ± 3.82mmol • L⁻¹. The result show that, except blank group, the BG of other groups don't have marked disparity, which demonstrate that the grouping is adqulis. Compared with blank group, the level of BG in 10th, 30th, day is significantly increased, which demonstrated the DM model is doing well. Compared with model group, in 10th day, the large, middle and small dose of curcumin could

obviously degrade the level of BG ($P<0.05$) and Metformin could remarkably degrade the level of BG ($P<0.01$); in 30th day, the large and middle dose of curcumin could remarkably degrade the level of BG ($P<0.01$), the small dose of curcumin and Metformin could obviously degrade the level of BG ($P<0.05$).

The effect of Curcumin on the antioxidation of DM mice model induced by STZ

Table 1 shows that, compared with blank group, the level of SOD in the blood serum of model group rats significantly degraded ($P<0.01$), MDA increased significantly ($P<0.01$), which demonstrated the antioxidation has been degraded; compared with model group, the large and middle dose of curcumin could significantly increase the SOD level ($P<0.01$), Metformin could obviously increase the SOD level ($P<0.05$), small dose of curcumin has the tendency of increasing SOD level; large and middle dose of curcumin could significantly increase the MDA level ($P<0.01$), small dose of curcumin could obviously increase the MDA level ($P<0.05$), which indicated that the curcumin could obviously amendment the antioxidation of DM mice.

The effect of Curcumin on the GSP and FFA of DM mice model induced by STZ

Table 2 shows that, compared with blank group, the level of GSP and FFA in the blood serum of model group rats significantly increased ($P<0.01$) which demonstrate the metabolic disturbance of diabetes has been formed; Compared with model group, the large, middle, small dose of curcumin and Metformin could significantly degrade the GSP level ($P<0.01$); large dose of curcumin could obviously degrade the FFA level ($P<0.05$), middle and small dose of curcumin could significantly degrade the FFA level ($P<0.01$), which indicated that the curcumin could obviously amendment the metabolic disturbance of DM mice.

DISCUSSION

Recent estimates indicate that there were 171million people in the world with diabetes in the year 2000 and this is projected to increase to360 million in the year 2030 (Amjad *et al*, 2013). STZ is a broad spectrum antibiotic, has the properties of antibacterial, antitumor and side effects on diabetes, with highly selective toxicity on β cell of the animal, is now widely used STZ prepared diabetic animal model (YuanYuan *et al*, 2013). Glucose metabolism is the most important and basic pathological changes in diabetes. Therefore the determination of blood glucose is the main index of the evaluation of the success of the model of diabetes mellitus and the drug effective. GSP is glycated albumin that albumin in high glucose environment occurring non-enzymatic glycosylation and can cause a series of pathological changes, is one of the key links in the chronic complications of diabetes

Table 1: The effect of Curcumin on the antioxidation of DM mice model induced by STZ ($\bar{x} \pm s$)

Groups	N	Dosage (mg·kg ⁻¹)	SOD (u/ml)	MDA (mmol/ml)
Normal control group	10	—	190.1±29.2**	9.581±1.435**
Untreated diabetes group	10	—	153.5±22.5	12.24±2.247
Metformin group	10	250	172.3±15.3*	10.629±1.920
Large dose of curcumin group	10	200	187.7±23.4**	9.162±1.776**
Middle dose of curcumin group	10	100	178.6±19.8**	9.274±1.544**
Small dose of curcumin group	10	50	167.0±21.0	9.480±1.398*

Table 2: The effect of Curcumin on the GSP and FFA of DM mice model induced by STZ ($\bar{x} \pm s$)

Groups	N	Dosage (mg·kg ⁻¹)	GSP (mmol·L ⁻¹)	FFA (mmol·L ⁻¹)
Normal control group	10	—	1.496±0.143*	426.2±148.2*
Untreated diabetes group	10	—	3.242±0.186	586.5±175.7
Metformin group	10	250	2.920±0.130**	409.8±249.7
Large dose of curcumin group	10	200	2.474±0.181**	350.1±212.7*
Middle dose of curcumin group	10	100	2.519±0.177**	294.7±140.7**
Small dose of curcumin group	10	50	2.737±0.236**	355.2±124.1**

Note: compared with model group: * $P < 0.05$. ** $P < 0.01$

development. FFA is an intermediate in fatty metabolism, is the body main supply source of energy. SOD is the oxygen free radical scavenger synthesizing *in vivo*, its activity can reflect the ability of antioxidation. The change of the content of MDA reflects the speed and extent of lipid oxidation, and represents the free radical activity (Peng *et al*, 2013). Therefore, in order to better reflect the antioxidant effects of curcumin on diabetes, observation on the index could exactly react the status of oxidative stress in the body, can be used as an important index to evaluate the effect of diabetes mellitus; The oxidative stress, as an important target in the development and the treatment of diabetes, is the key to the treatment of diabetes. This experiment provides the data support for the treatment of diabetes mechanism, it also provides new ideas and more direction of curcumin study.

Through the result we can suggest the following factors for the curcumin hypoglycemic effect: firstly the hypoglycemic effect of it continued stability and this effect may be related to decreasing blood lipids, improving insulin resistance and the pancreas function. Moreover it can significantly improve the diabetic model antioxidant capacity, reduce the oxidative injury of DM rats. Further study in these factors could be considered.

REFERENCES

Amjad AK, Mohammad A, Alzohairy and Abdelmarouf H (2013). Mohieldein antidiabetic effects of camel milk in streptozotocin-induced diabetic rats. *American Journal of Biochemistry and Molecular Biology*, **3**(1): 151-158.

- Cui P, Tian CY and Zhang YP (2013). Experimental Study of the effect of Shuang-yi Prescription on SOD, MDA and FFA in Type 2 Diabetic Rats. *Lishizhen Medicine and Materia Medica Research*, **24**(8): 1840-1842.
- Guo CQ, Wang C and Miao MS (2009). Analysis of oxidative stress and diabetes. *Journal of Traditional Chinese Medicine*, **24**(6): 24-26.
- Liu T, Li YH and Li L (2014). Analysis on diabetes prevention and control knowledge and its influencing factors among diabetics in six provinces of China. *Chinese Journal of Health Education*, **30**(1): 11-15.
- Lu Q and Zhou YG (2013). Rational use of drugs for diabetes. *Zhongnan pharmacy*, **11**(10): 781-792.
- Pinaki B Patel and Vasudev Thakkar (2013). Cell proliferation and DNA damage study by SCGE in fission yeast exposed to curcumin and 5-fluorouracil. *Asian Journal of Cell Biology*, **8**(1): 22-32.
- Zhan YY, Zhang R and Ren WJ (2013). Study on the expression of islet MHC-1 cells in diabetic rats induced by STZ. *Shandong Medical*, **53**(42): 31-32.