Intervention and effect analysis of *Achyranthes bidentata* blume combined with aerobic exercise to interfere with type 2 diabetes

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Abstract: With the continuous progress of traditional Chinese medicine extraction technology in recent years, the active components of traditional Chinese medicine have been continuously extracted and analyzed. In this paper, the authors studied the effect of aerobic exercise combined with the extract of the *Achyranthes bidentata* on the serum indexes of T2DM rats. Through systematic analysis of measurement indexes of Chinese medicine treatment group, we found that all indexes of FPG, INS, NOXs, ROS and SOD all showed a marked improvement, which fully proved the effect of *Achyranthes bidentata* extract on improving the condition of rats with type 2 diabetes mellitus. In this experiment, we can see that aerobic exercise can relieve diabetic patients' condition by comparing and analyzing various indexes of type II diabetes in experimental rats. At the same time, the effect of the combination of aerobic exercise and the extract of *Achyranthes bidentata* is obviously better than that of the extract of pure *Achyranthes bidentata.*

Keywords: Pharmacodynamics analysis, *Achyranthes bidentata*, Type 2 diabetes, Streptozocin, insulin resistance.

INTRODUCTION

With the rapid development of economic and social modernization process, people's lifestyle and eating habits have undergone tremendous changes, excessive high protein, high calorie food intake, resulting in lipid and glucose related disease incidence rate at an alarming rate increased year by year, the serious consequences of diabetes and complications caused by its own to bring great harm human health (Zhang *et al.,* 2007; Yu *et al.,* 2016). Up to now, there is still no drug or method to cure diabetes completely. Western medicine is mainly through oral antidiabetic drug metformin, thiazolidinedione two ketones (TZDs), alpha glucosidase inhibitors, metformin combined with TZDs and orlistat capsules, such as drugs to block the intake of protein and carbohydrate (Udagawa *et al.,* 2012; Paccez *et al.,* 2014), increase body insulin secretion or increased insulin receptor activity and sensitivity the insulin to control blood glucose level of the body (Shi *et al.,* 2015). This treatment can to some extent alleviate the symptoms and control of type II diabetes, but long-term use of Western medicine treatment, the liver and other important organs have side effects and complications of diabetes, so as to increase the suffering of patients, reduce the patient's quality of life and even threaten the patient's life (Ostojic *et al.,* 2015). Therefore, the search for effective treatment of diabetes has always been an urgent problem to be solved in the clinic.

With the continuous progress of traditional Chinese medicine extraction technology in recent years, the active components of traditional Chinese medicine have been extracted and separated. Through the study of active components extracted and separated from traditional Chinese medicine, traditional Chinese medicine theory can also be elaborated through modern knowledge of pharmacology (Nayir *et al.,* 2015; Liu *et al.,* 2017), which makes traditional Chinese medicine more and more widely accepted by clinical practice (Li *et al.,* 2015; Fang *et al.,* 2017). The treatment of diabetes by Chinese medicine and Chinese medicine has gradually become a hot spot in the study of diabetes in clinical medicine, and its clinical application has also gained a qualitative leap (Antonova *et al.,* 2015; Abu, 2017). The antidiabetic effect of multiple target points of traditional Chinese medicine and the concept of overall balance adjustment of the body have been paid more and more attention to and accepted by the medical community. The active components that are found to be hypoglycemic from natural medicines include terpenes, flavonoids, saponins, thioethers, alkaloids, coumarins and unsaturated fatty acids (Chen, 2012; Caziuc *et al.,* 2015). Recently, with the *Achyranthes coumarin* and oxidation of the lipid potent bioactive ingredients hune has attracted more and more attention in medical field. The influence of aerobic exercise on T2DM has been deepened. Aerobic exercise can help increase the body's ability to fight oxidative stress, prevent damage caused by oxidative stress, and delay the aging process of important organs such as liver, kidney and lung. Some research results show that: the effect of aerobic exercise on the T2DM is mainly achieved through enhanced insulin sensitivity. Further studies showed that insulin sensitivity increased ability and muscle glycogen level decreased, exercise can enhance the muscle cell glucose transport and phosphorylation effect, improve blood glucose insulin transport activity (Dindo *et al.,* 2004; Sun *et al.,* 2015).

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Achyranthes bidentata Blume has a high medicinal value. With the deepening of research on *Achyranthes bidentata* in recent years, more and more effective components have been isolated, such as steroids, three terpenoid saponins, carbohydrates, alkaloids, coumarins and amino acids (Chen *et al.,* 2009; Sheng *et al.,* 2015). Modern pharmacological studies show that *Achyranthes* has anti-inflammatory and analgesic, antibacterial, antiviral, antitumor, anti-aging, enhance immunity, diuresis, promoting blood circulation, protecting liver, reducing enzyme activity (Tang *et al.,* 2017). Study on chemical composition of *Achyranthes* has made great progress, has been successfully isolated from: saponins, plant phytosterone, polysaccharides, amino acid and protein, flavonoids etc. Aerobic exercise is the appropriate physical exercise, including walking, jogging, swimming, and so on, when the supply of oxygen is sufficient. Many studies have shown that appropriate aerobic exercise can enhance the body's consumption of blood sugar and fat (Vekov *et al.,* 2015), improve the function of the heart and lungs, and improve the immunity of the body. Research shows that exercise or lack of exercise can lead to diabetes. Exercise as a basic way to prevent diabetes plays a decisive role in the prevention, treatment and rehabilitation of diabetes (Takahashi, 2017). The use of exercise methods to treat diabetes can improve the sensitivity of the insulin in the patient's body and improve the metabolism of blood lipids, as well as to avoid complications. Based on the above facts, in order to study the effects of aerobic exercise combined with the extract of *Achyranthes bidentata* extract on diabetic rats, we selected some biochemical indicators that could reflect the situation of diabetes in rats, so as to study the effect of aerobic exercise combined with the extract of *Achyranthes bidentata* extract on the serum indexes of T2DM rats.

MATERIALS AND METHODS

Experimental object

70 SPF male rats of 6 week age were used as the subjects of the study. Feeding environment: indoor temperature (25±1)°C, relative humidity (40±15)%, under the standard conditions of natural lighting, free feeding of drinking water. It is kept in cages, with 2 cages per cage. The basal diet purchased from experimental animal center, the total energy of 11.7 kJ/g (feed protein: fat: carbohydrate =27:20:53). The animal experiment program has been approved by the experimental animal ethics committee, which conforms to the principles of animal protection, animal welfare and ethics, and conforms to the relevant provisions of the national laboratory animal welfare ethics, No.FTKZPF/13FT.

Extraction of effective components of Achyranthes bidentata

1000 grams of *Achyranthes bidentata*, processed into powdery. Extraction steps: In the 2000 milliliter distilled bottle, add the coarse powder 500g, and the distilled water was added to 600 ml for 2 hours. Then 75% ethanol was added to 1000 milliliters, and the heat was reflued for 3 hours, and the extraction solution was leaning out. Again, 75% ethanol was added to 1000 ml and continued to be reflued for 3 hours. The distilled water was combined with distilled water 800ml and decompressed distillation. Repeated 2 times steaming to achieve no alcohol taste. Repeat the above operation, combine 2 extraction liquid, and finally add distilled water to 2000ml. Made of concentrated liquid containing *Achyranthes bidentata* extract 0.5g crude drug /ml.

Rat model of diabetes mellitus

First of all, 60 SPF grade SD male rats were fed with high fat and high sugar for 4 weeks, so that they were obese. The Streptozocin (STZ) induction method was used to make the model of T2DM. The specific steps are as follows: first of all, 50 rats were fasted for 12 hours; weigh the weight, and then press the 40mg dose per kg of body weight, abdominal fast injection concentration of STZ drugs 1%, one hour after the fed high-fat food protein. The changes of fasting GLU and INS value after 3 days of injection of azothromycin were detected, and the homeostasis model insulin resistance index was obtained, and the success of modeling was confirmed. In order to avoid the problem of increased mortality caused by reduced resistance in T2DM rats, a clean and dry feeding environment has been kept in the experiment: 2 cages, keeping good ventilation. As the urine volume of the rats increased obviously, the paving was changed every day to keep the environment dry and sanitary. In the experiment, normal control rats were fed with ordinary feed and the rest were still fed with high fat and high sugar diet. After a two week experiment, the blood glucose level of the rats was at a high level, higher than 16.7mmol/l and the insulin resistance index was higher than that of the normal control group. Results 40 rats were in accordance with the standard of diabetes model.

Experimental grouping

40 T2DM rats were randomly divided into 4 groups. The normal control group was divided into one group. The specific grouping situation was shown in table 1.

Blood extraction after test

The next day at the end of the experiment, the rats were the last time after weighing, sealing glass containers will be placed in the tampon containing ether, which was removed after anesthesia, supine fixed on the foam board, 10ml syringe holding 7 gauge needle by rat xiphoid margin at the center (touch clear heart needle), oblique puncture needle piercing into the chest, heart, blood due to cardiac natural influx of syringes, syringe needle core slow twitch, desirable blood 5-8 mL

Table 1: Experimental grouping

Group	N	Mode of intervention
Group A (normal control group)	10	Gavage of physiological saline
Group B (diabetic control group)	10	Gavage of physiological saline
Group C (diabetic exercise group)	10	Swimming: 1 hours per day, 5 days / week, 8 weeks in total, saline irrigation
Group D (diabetic Chinese medicine group)	10	Gavage of Chinese herbal extracts: 1 times per day, 5 days per week, 8 weeks in total
Group E (diabetic exercise + Chinese medicine group)	10	10 exercise and C group, traditional Chinese medicine extract gavage with D group

Table 2: Changes of fasting blood glucose in rats after intervention

Group	GLU (mmol/L)
A group	7.84±0.36
B group	17.24±0.84
C group	13.68±0.55
D group	12.03±0.51
E group	10.54±0.95

Table 3: Changes of fasting abdominal insulin in rats after intervention

Group	INS (μiu/ml)
A group	16.25±1.05
B group	21.35±1.27
C group	18.42±1.84
D group	16.17±2.43
E group	14.68±1.85

Table 4: Changes of NOXs activity in blood leukocytes of rats after intervention

Group	NOXs (pmol NADPH/min per mg protein)
A group	3.24±0.14
B group	157.03±6.71
C group	115.26±7.45
D group	92.03±6.31
E group	61.27±6.95

Table 5: Changes of ROS formation in blood leukocytes of rats after intervention

Group	ROS (RLU)
A group	3.62±0.12
B group	140.75±9.34
C group	106.12±7.86
D group	94.53±7.31
E group	78.39±6.47

Table 6: Changes of SOD activity in rats after intervention

Group	SOD (U/mL)
A group	9.13±1.45
B group	7.42±2.38
C group	8.37±2.56
D group	8.15±1.31
E group	7.48±1.15

Data processing

The experimental results were processed using the SPSS13.1 software, the results of measurement data using the mean ± standard deviation (x ± SD) said that the first ANOVA test, Kamo Sai, analysis of the differences between groups with one-way ANOVA, $P<0.05$ results in significant difference, $P<0.01$ difference is very significant, $P>0.05$ was no significant difference.

RESULTS

Changes of fasting blood glucose in rats after intervention

Effect of 8 week intervention on blood glucose in T2DM rats, compared with A group, diabetic control group B rats blood glucose levels were significantly elevated in diabetic rats without timely treatment, the high blood sugar caused by the fact that; C group and D group rats compared with B rats blood glucose decreased significantly, but not to throw the health level compared with the control group, A group, the single aerobic exercise group or single treatment group can slightly alleviate diabetes, but can not really achieve the most effective results; E rats and diabetic rats compared with abnormal glucose decreased significantly, while the normal control group and blood glucose levels of rats in the A group there are still obvious differences, but the blood glucose has reached the ideal level of aerobic exercise and traditional Chinese medicine *Achyranthes* gavage to effectively control blood sugar levels in rats, and the rats in group E blood glucose level was significantly lower than that of C Group and D group rats blood glucose levels, that aerobic exercise combined with

traditional Chinese medicine treatment group, the diabetic rats condition has been significantly improved, which reflects the effectiveness of two interventions in alleviating and treating diabetes, that combination can effectively control blood glucose levels in rats.

Changes of insulin in rats after intervention

Effect of 8 weeks of intervention on the level of INS in T2DM rats, compared with A rats, the rat insulin level of B group increased significantly, indicating more severe diabetes, insulin level is higher; compared with C group and D group rats and diabetic rats in the control group, C group and D group rats insulin levels decreased, that single aerobic exercise group or single treatment group can slightly alleviate diabetes, health and normal control group rat insulin compared to no difference, which shows that the combination of aerobic exercise in diabetic rats after intragastric administration of *Achyranthes bidentata* insulin secretion has returned to normal; insulin level of E group was lower than that of C group and D group insulin the level that aerobic exercise combined with *Achyranthes* gavage group reached the ideal level. As shown in table 3.

Changes of NOXs activity in blood leukocytes of rats after intervention

Analysis of 8 week intervention on NOXs activity of white blood cells in T2DM rats, C group and D group rat leukocyte NOXs activity was significantly lower than that of E in white blood cells of rats in the NOXs group activity, but still with NOXs white blood cells of rats in the A group activity are significantly different, indicating that the single sport or drug treatment effect for lipid the adjustment disorder caused by diabetes is not ideal; while the rats in the E group, the pathological disorders of oxidative stress can be corrected. As shown in table 4.

Changes of ROS in blood leukocytes of rats after intervention

Analysis of the 8 week intervention found on T2DM rats generated by ROS, C, ROS group of white blood cells of rats in D group were significantly lower than the generation of white blood cell ROS rats of group E generation, but still with white blood cells ROS A rats produced significant differences, indicating that the single sport or drug treatment effects on lipid regulation disorder because diabetes is still not very ideal. As shown in table 5.

Changes of SOD in rats after intervention

Effect of 8 weeks of intervention in T2DM SOD rats, and normal compared to the control, SOD level of the observation group B group rats decreased significantly, with statistical significance, C group and D group rats SOD levels compared with E group rats significantly increased significantly, but compared with the rats in the normal control group, the difference is still the rats in group E significantly; the level of SOD compared with B group rats decreased significantly, but compared with the normal control group rats still significantly difference, and E in SOD group was significantly lower than that of C group and D group rats SOD level, significant difference. As shown in table 6.

DISCUSSION

With the continuous development of the level of science and technology and the level of medicine, great progress has been made in the recent twenty years to study the active ingredients and dosage of hypoglycemic agents in Chinese and foreign countries (Tural *et al.,* 2015). By summarizing and analyzing the literature in recent ten years, the research on Hypoglycemic Active Ingredients of traditional Chinese medicine is mainly focused on the form of mixture formed by active ingredients of traditional Chinese medicine, while the data of single component in active ingredients of traditional Chinese medicine are still lacking (Udagawa *et al.,* 2012; Paccez *et al.,* 2014). The Chinese medicine active ingredient is complex, its hypoglycemic mechanism is a link, not only contains trypsin hormone like activity components, repair of pancreatic beta cells, promote the active ingredients of pancreatic hormone secretion, has increased the number of active ingredients and pancreatic hormone receptor to improve pancreatic hormone receptor sensitivity, with increased hepatic glycogen synthesis, active ingredients in regulating glucose metabolism also, anti-inflammatory, antioxidant, anti oxygen free radicals and other active ingredients. It is difficult to realize the current medical level if the effective components of a variety of drugs in one group are studied and observed (Zhang *et al.,* 2007; Yu *et al.,* 2016). The hypoglycemic effect of one or two kinds of active ingredients in traditional Chinese medicine was observed, and the mechanism of reducing sugar was discussed. It should be a more practical and feasible research direction of traditional Chinese medicine (Nayir *et al.,* 2015; Liu *et al.,* 2017). It can provide a theoretical basis for further research on the hypoglycemic effect and prevention of diabetic complications in Chinese medicine, and provide effective data for the compatibility and dose adjustment of various Chinese herbs in the prescription and prescription.

Through the systematic analysis of Chinese medicine treatment group rats measurement index: FPG (fasting plasma glucose), INS(Insulin), NOXs(NADPH oxidases), ROS (Reactive Oxygen Species), SOD (Superoxide Dismutase), all indexes improved obviously, fully proved that *Achyranthes* extract on experimental rats with type 2 diabetes condition improvement; therefore, we can try to use and to alleviate the *Achyranthes bidentata* extract and the treatment of patients with diabetes in the future for the treatment of diabetes, the more ideal treatment effect.

Many studies have reported that proper aerobic exercise

can enhance the body's consumption of blood sugar and fat, improve heart and lung function, improve glucose metabolism and improve immunity (Ostojic *et al.,* 2015). For the rapid demand for energy and the energy consumption speed of the muscle to meet the movement, three glycerol ester stored in the skeletal muscle cells, must improve the decomposition rate; at the same time, adipose tissue decomposition three acyl glyceride released into the blood and liver fatty acid decomposition of glucose released into the blood glucose is still for oxidation can. In order to maintain the normal operation of the central nervous system during exercise, the glucose in the blood must be kept at a considerable concentration (Li *et al.,* 2015; Fang *et al.,* 2017. Research shows that: lack of exercise or no exercise will lead to the development of diabetes, as a basic method for the prevention of diabetes mellitus, mainly by improving glucose metabolism activity, including glycogen phosphorylase, hexokinase, phosphofructokinase and pyruvate kinase activity increased rate of glucose metabolism during exercise to meet the capability of supply. Aerobic exercise significantly helps to increase the body sensitive to insulin to suppress the symptoms of high blood sugar, blood glucose and help T2DM patients to return to normal.

CONCLUSION

At present, the research on diabetes is mainly focused on the diagnosis, treatment and complications of diabetes. It has important guiding value for us to further understand the pathological characteristics of diabetes and to prevent, alleviate and treat diabetes. However, in-depth analysis found that the treatment of diabetes is mainly from the perspective of Western medicine to the research of Chinese medicine part only discusses the effect of terpenoids, saponins, flavonoids, alkaloid drugs in the treatment of diabetes. Based on this, this article from the perspective of Chinese medicine to explore the system of aerobic exercise and *Achyranthes bidentata* extract for the effect of relieving and treating diabetes, so as to provide the necessary in value for prevention, mitigation and treatment of diabetes activities.

In this experiment, through the in-depth study and comparative analysis of the test indexes of type II diabetes in rats, it was found that aerobic exercise only alleviated the patient's condition of diabetes to a certain extent. But it can't achieve the effect of treating diabetes. The effect of aerobic exercise combined with extract of *Achyranthes bidentata* was better than that of the extract of *Achyranthes bidentata*. This also proves the importance of daily exercise for the masses, and for those who have diabetes, divided into drug therapy, proper aerobic exercise can effectively improve the therapeutic effect of diabetes.

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