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Effects of Potentilla Anserina Polysaccharide Combined with Aerobic Exercise on Blood Lipid Level and the Liver in Experimental Hyperlipidemia Rats

Fangcheng Li[1,a], Tiande Hou[2,b]

[1]School of Sport, Northwest Minzu University, Lanzhou, China
[2]School of Life Sciences, Northwest Normal University, Lanzhou, China
[a]Fangcheng00336600@163.com, [b]708936432@qq.com

Abstract: Objective: To study the effects of potentilla anserina polysaccharide combined with aerobic exercise on blood lipid level and the liver in experimental hyperlipidemia rats. Methods: 50 healthy male wistar rats were selected after 5 days adaptive feeding. Rats were randomly divided into basic feeding group and high fat feeding group, which were divided into hyperlipidemia group (H group), hyperlipidemia + potentilla anserina polysaccharide group (P group), hyperlipidemia + aerobic group (E group), hyperlipidemia + potentilla anserina polysaccharide + aerobic group (PE group), 10 for each group, and basic feeding group were 10 for normal control group (C group). The feeding method of C group , H group and E group intragastrically treated with normal saline (8ml/kg), P group and PE group with potentilla anserina polysaccharide at the dose of 100mg /(kg d). Once a day, for 10 weeks . Group E and PE for platform sports, 16 m/min, the slope is 0 °, 15 min/d, increased the time every day to 60 min/d for a week at last. 5 ° in the second week, 60 min/d, 18 m/min, with the same running intensity amount to 50% maximum oxygen intake. Fifty healthy male wistar rats were selected after 5 days of adaptive feeding. Rats were randomly divided into basic feed and hyperlipidemia feed feeding, divided into hyperlipidemia (H group), hyperlipidemia + potentilla anserina polysaccharide (P group), hyperlipidemia + aerobic (E group), hyperlipidemia + potentilla anserina polysaccharide + (PE group), 10 each group and basic feed feeding in normal control (C). The feeding method provided C with gastric saline (8 ml/kg) and H, P and PE groups with potentilla anserina polysaccharide (8ml/kg, PAP solution of 100 mg/kg), once a day for 10 weeks. Group E and PE for rat platform training, 16 m/min, 0 °, 15 min/d, per day, 5 ° in the second week, 60 min/d, 18 m/min, with the same running intensity and 50% maximum oxygen intake. Once a day, 6 days a week running as aerobic exercise, and test each indicator after 10 consecutive weeks. Measure the serum triglyceride (TG) , total cholesterol (TC), low density lipoprotein(LDL) , high density lipoprotein (HDL), glutamate pyruvic transaminase (ALT), glutamic oxaloacetic transaminase (AST), The malondialdehyde (MDA) and superoxidase dismutase (SOD), levels of the liver tissue were measured. Results: Compared with the C group, extremely significantly differences in serum TC, LDL, ALT, SOD in H, P, and E groups ($p<0.01$), extremely significantly differences in serum TG, HDL, AST and MDA in H group ($p<0.01$), significant difference in HDL in the P and E groups ($p<0.01$, $p<0.05$). However, there were no significant differences from each item in the PE group compared with C group ($p>0.05$). Compared with the H group, the serum TC, TG, LDL, HDL, ALT, SOD and MDA are very significant difference in C, H, P, E, and PE groups ($p<0.01$). Compared with the PE group, very significant differences in the serum TC, LDL and SOD in H, P, and E group ($p<0.01$). The serum TG, HDL, ALT, AST and MDA associated with the H group also has extremely significant differences compared with the PE group ($p<0.01$). The HDL associated with the E group, the AST in the P group, there were significant differences compared with the PE group ($p <0.05$). Conclusion: PAP, hyperlipidemia in rats with PAP and elevated SOD, has an obvious effect in reducing the symptoms of hyperlipidemia, but gastric PAP combined with aerobic exercise reduced the symptoms most significantly in hyperlipidemia rats, after 10 weeks of gastric PAP and aerobic exercise, hyperlipidemia rats compared with ordinary feed-fed control group, has the best effect $p>0.05$.

Keywords: Hyperlipidemia, potentilla anserina polysaccharide (PAP), aerobic exercise, blood lipid, liver

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1. Introduction

Hyperlipemia is a condition with higher lipid levels than normal in plasma due to fat metabolism disorders, generally with hypercholesterol, hypertriglyceride, high and low density lipoprotein, low high density lipoprotein and hybrid hyperlipidemia forms of[1]. Hyperlipidemia is closely related to the occurrence of a variety of diseases of the human body, which can cause atherosclerosis, coronary heart disease, damage cardiovascular and cerebrovascular, leading to the occurrence of a series of diseases. The population of hyperlipidemia is increasing year by year, and the harm of its complications is also increasing. At present, the treatment of hyperlipidemia in western medicine may cause patients with abnormal liver function, body intolerance and other adverse reaction symptoms[2-3]. Traditional medicine has advantages in the treatment of hyperlipidemia. At present, the main effective components of the research include: flavonoids, saponins, phenol, polysaccharides, etc., mainly American ginseng, ginseng, Schisandra, wolfberry, tea, notoginseng and other[4]. It mainly reduces by antioxidant, inhibiting exogenous lipid absorption and reducing lipid deposition in vascular endothelium[5]. It can be used both as a drug and as a food, and has a high utilization value. potentilla anserina L. contains tannins, sugars, proteins, fatty acids and meins. The pharmacological experimental results suggest that the drug improves its immunity, fatigue resistance, hypoxia resistance and antibacteriostasis[6-7]. The potentilla anserina L. is rich in the polysaccharide content, and the polysaccharide has the extensive physiological and pharmacological effects, so it is speculated that the potentilla anserina polysaccharide (PAP) should be one of the active components of the potentilla anserina L. A large number of studies have shown that aerobic exercise can reduce blood lipid levels and relieve hyperlipidemia. This paper used PAP and aerobic exercise to observe their lipid effect and protective effect on liver, and provide reference for the treatment of hyperlipidemia.

2. Materials and Methods

2.1. Preparation of PAP

After crushing the Potentilla anserina. L., water lift, alcohol sink, centrifugal, and then washed with anhydrous ethanol, propylene ethanol, ether precipitation after centrifugal, coarse and polysaccharide. Tricloroacetate deprotein, get potentilla anserina polysaccharide. Polyaccharide content was measured by phenol sulfate[8].

2.2. Chemicals and Equipment

Triglyceride(TG), total cholesterol (TC), Malondialdehyde (MDA), superoxidase dismutase (SOD), low density lipoprotein, (LDL) , high density lipoprotein (HDL) glutamate pyruvic transaminase (ALT), glutamic oxaloacetic transaminase (AST) were obtained from Institute of Nanjing Jian Cheng Bioengineering (Nanjing, PR China). All other chemicals used were ultrapure or analytic grade. Sports animal platform (sa101) is purchased in Huaibei Zheng Hua, fully automatic biochemical analyzer (7600-020) in Hitachi, Japan.

2.3. Animal Modeling Grouping and Intervention

Eight week old healthy male wistar rats (purchased from Lanzhou University Experimental Animal Center, Class SPF, scxk (Gan) 2018-0001] 50, body quality 180 ~ 220 Class g , SPF. Maintain feed feeding, free diet, animal room temperature 22℃~23℃, relative humidity 38%~42%, natural ventilation, natural light, ultraviolet disinfection of feeding room and utensils once a week, 5 days after adaptive feeding. Rats were randomly divided into basic feed feeding group and high-fat feed feeding group. The high-fat feed formula was: 1% cholesterol, 0.5% sodium cholate, 0.2% propypyriacil, 2% lard, 5% soybean powder, 1% fish powder, 2% egg yolk, and basic feed 88.3%[9].hyperlipidemia feed fed rats were divided into hyperlipidemia group (H group), hyperlipidemia+ PAP group (P group), hyperlipidemia + aerobic group (E group), hyperlipidemia +PAP+ aerobic group (PE group), 10 each, and 10 basic feed fed group were normal control group (C group). The feeding method was performed with normal control and hyperlipidemia gastric saline (8ml/kg); hyperlipidemia+ PAP (P), hyperlipidemia+ PAP+ aerobic group (PE), gastric fern PAP (8ml/kg, fern polysaccharide solution at 100mg/kg)[10-11]. Once a day, for 10 weeks. Group E and Group PE had a 16 m/min, gradient at 0, 15 min/d, 18 m/min, at 5 ° in the second week and 60 min/d, rats for about 50% of the maximum oxygen intake. Once a day, 6 days a week, break for 10 consecutive weeks[13-14].

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2.4. Serum TC, TG, HDL, LDL, ALT, AST Determination

After the last exercise and injection, 12h, was forbidden to use gastric ether for anesthesia, abdominal aortic blood collection, put into the centrifuge, centrifuge to take serum, separate serum, and measure serum TC, TG, HDL, LDL, ALT and AST values according to the kit instructions.

2.5. Liver SOD and MDA Determination

Take liver tissue, homogen, centrifuge, and test liver SOD and MDA. according to the kit instructions.

2.6. Statistical Analysis

Processing by SPSS 21.0, represented by x ± s, and variance analysis. All statistical comparisons were carried out by means of one-way ANOVA test. P-values less than 0.05 were considered statistically significant while P-values less than 0.01 were considered extremely significant.

3. Results

3.1. Effect of the Experiment Sample on Serum TC, TG, HDL, LDL Content in Rats

From Table 1, compared with C group, very significant difference in serum TC and LDL in H , P and E groups ($p<0.01$),very significant differences in serum TG, HDL from the H group ($p<0.01$), extremely significant differences from HDL in the E and P group ($p< 0.01$, $p<0.05$), no significant difference in serum TC, TG, LDL, HDL from the PE group ($p>0.05$). Compared with the H group, the C, P, E, and PE groups all differ significantly from the H group at the TC, TG, HDL, LDL level ($P< 0.01$). Compared with the PE group, very significant differences in serum TC and LDL in the H, P and E groups ($p<0.01$), very significant differences in serum TG and HDL from the H group ($p<0.01$), significant differences from the HDL in the E group ($p<0.05$), No significant difference between the PE group and the C group values ($p<0.05$). It is shown that both PAP and aerobic exercise reduced blood lipid and reduced symptoms in hyperlipidemia rats. PAP outperformed the aerobic exercise group in reducing serum TC, TG and LDL, but there was no significant difference. PAP combined with aerobic exercise had the best effect of reducing blood lipid. After 10 weeks of aerobic exercise combined with gastric perfusion PAP had no significant difference in serum TC, TG and LDL, HDL levels compared with the blank normal group(C group), which had a good effect on lowering blood lipid.

Table 1: Effect of the experiment sample on serum TC, TG, HDL, LDL content in rats(mmol L-1, n=10).

Group	TC	TG	LDL	HDL
C	2.61±0.41**	0.69±0.23**	1.22±0.12**	1.59±0.27**
H	14.82±3.9△△▲▲	1.97±0.51△△▲▲	7.33±0.93△△▲▲	0.91±0.19△△▲▲
P	8.2±4.32△△**▲▲	0.81±0.22**	4.93±0.79△△**▲▲	1.31±0.42△**
E	8.92±4.45△△**▲▲	0.91±0.29**	5.06±0.62△△**▲▲	1.26±0.39△△**▲
PE	3.12±5.04**	0.73±0.26**	1.52±0.36**	1.52±0.51**

△△P<0.01 vs C group, **P<0.01 vs H group, ▲▲P<0.01 vs PE group,
△P<0.05 vs C group, *P<0.05 vs H group, ▲P<0.05 vs PE group.

3.2. Effect of the Experiment Sample on ALT, AST Content in Rats

Table 2: Effect of the experiment sample on ALT, AST content in rats (U L-1, n=10)

Group	ALT	AST
C	35.31±3.98**	25.86±4.15**
H	63.91±6.28△△▲▲	38.77±6.57△△▲▲
P	43.16±3.12△△**▲	26.67±5.19**
E	48.27±6.82△△**▲▲	27.49±6.13**
(PE)	37.37±6.56**	24.04±5.02**

△△P<0.01 vs C group, **P<0.01 vs H group, ▲▲P<0.01 vs PE group,
△P<0.05 vs C group, *P<0.05 vs H group, ▲P<0.05 vs PE group.

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From Table 2, Compared with the C group there are very significant differences in the ALT values in the H and E groups ($p<0.01$), extremely significant difference in AST in the H group ($p<0.01$).

Compared with the H group, very significant differences in ALT and AST in the C, P , E and F groups ($p<0.01$). Compared with the PE group, very significant differences in the ALT and AST in the H group ($p< 0.01$), very significant differences in ALT in the E group ($p< 0.01$), significant differences in the ALT in the E group ($p<0.05$), no significant differences (observed) from the control group. Both PAP and aerobic exercise were well in reducing AST, with no significant differences from C and PE groups ($P >0.05$). PAP combine with aerobic exercise for lower ALT and AST. It can well protect liver damage due to a high-fat diet.

3.3. Effects on Liver SOD and MDA in Experimental Rats

From Table 3, Compared with the C group there are very significant differences in the SOD values in the H, P, E groups ($p< 0.01$), extremely reduced, very significant differences in MDA in the H group ($p<0.01$), no significant difference in the PE group. Compared with the H group, very significant differences in the MDA and SOD in the C, P, E and PE groups ($p<0.01$). Compared with the PE group, very significant differences in the SOD in the H, P and E groups ($p< 0.01$), very significant differences in MDA in the H group ($p <0.01$). Liver SOD content in high blood lipid rats decrease, elevated MDA content, aerobic exercise, gastric pap or aerobic exercise combined gastric pap can increase liver SOD content, reduce MDA content, eliminate free radicals, improve the antioxidant ability, aerobic exercise combined with gastric pap can better reduce the liver DAM, increase SOD, and remove free radicals.

Table 3: Effects on liver SOD and MDA in experimental rats. (mmol mg-1, n=10).

Group	SOD	MDA
C	181.66±8.25**	0.71±0.19**
H	111.57±7.31△△▲▲	1.56±0.68△△▲▲
P	156.89±8.16△△**▲▲	0.96±0.34**
E	145.29±7.75△△**▲▲	0.83±0.17**
(PE)	177.19±6.71**	0.72±0.15**

△△P<0.01 vs C group, **P<0.01 vs H group, ▲▲P<0.01 vs PE group,
△P<0.05 vs C group, *P<0.05 vs H group, ▲P<0.05 vs PE group.

4. Discussion

4.1. Treatment of Hyperlipidemia Drugs

The drugs for blood lipid reduction mainly include chemical drugs, such as statin lipid lowering drugs, beta blood lipid lowering drugs and other[15]. In recent years, a variety of polysaccharides have blood lipid reduction. Polygonum oligosaccharides has a good lipid reduction effect, which can prevent cholesterol accumulation in the liver and relieve the formation of atherosclerosis. Polygonum multiflorum polysaccharide can significantly reduce TC, TG, in hyperlipidemia model mouse serum and increase HDL-C[16]. Hawthorn polysaccharide has a good inhibition effect on pancreatic lipase and α-glucosidase, and hawthorn polysaccharide can also reduce the effect of cholesterol in[17]. Guo Xiaona and other research has proved that Mulberry polysaccharide have significantly reduced blood lipid, regulate the viscosity of blood state and improve the anti-lipid peroxide effect of for experimental hyperlipidemia model rats[18].

4.2. Research of PAP

Chen Jioran and other[6] through chemical simulation in vitro tests, found that PAP can effectively remove hydrogen peroxide. Zhang Yonghui and other[19] have established a model of cerebral ischemia-reperfusion injury in rats. Gastropap can increase the SOD activity and GSH-Px content of brain tissue in rats with ischemia-reperfusion injury, reduce the MDA content of lipid peroxide product, and proves that PAP has a certain protective effect on cerebral ischemia-reperfusion injury. PAP can decrease liver MDA in mice with chemical liver injury and enhance liver GSH-Px vitality.[20] studies such as Min guangning showed that PAP could significantly reduce the activity of ALT, AST in the serum of liver injury mice.

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4.3. Exercise and Hyperlipidemia

Studies have shown that moderate-intensity, long-time periodic aerobic exercise is a very effective non-drug therapy. The treatment of hyperlipidemia was significant with 40% to 40% -60% maximum oxygen intake or 60% -70% maximum heart rate exercise. The effect of exercise on serum triglycerides is related to exercise intensity, exercise amount and exercise time, which makes serum triglycerides decrease and maintain it for a long time. Long-term aerobic exercise can significantly reduce the total plasma cholesterol and triglyceride content, improve the activity of lipoprotein lipase, promote the hydrolysis of plasma triglycerides, cause the increase in the surface area of skeletal muscle capillary endothelial cells, accelerate the skeletal muscle intake of oxygen and fatty acids, promote the transport of triglycerides from the liver, therefore, medium and low intensity aerobic exercise is conducive to the reduction of plasma triglycerides and the transport of triglycerides in the liver, and has a good role in the prevention and treatment of fatty liver[1]. Nor the longer the exercise time the better, the experiments proved that 60min significantly improved blood lipid, and more than 60min could not continue to improve blood lipid levels. Extensive experiments have shown that exercise improves both the HHD lipoprotein content and reduces the LDL content. It may be long-term aerobic exercise to improve lipoprotein metabolism key enzyme lipase activity, conducive to lipid degradation.

4.4. PAP, Aerobic Exercise and Hyperlipidemia in Rats

In this experiment, the effects of potentilla anserina polysaccharide combined with aerobic exercise on blood lipid level and the liver in experimental hyperlipidemia rats. Compared with the C group, extremely significantly differences in serum TC, LDL, ALT and SOD in H, P, and E groups ($p<0.01$), extremely significantly differences in serum TG, HDL, AST, MDA in H group ($p<0.01$). Significant difference in HDL in the P and E groups ($p<0.01$, $p<0.05$). However, there were no significant differences from each item in the PE group compared with C group ($p > 0.05$). Compared with the H group, the serum TC, TG, LDL, HDL, ALT, SOD, MDA are very significant difference in C, H, P, E, and PE groups ($p <0.01$). Compared with the PE group, very significant differences in the serum TC, LDL and SOD in H, P, and E group ($p<0.01$). The serum TG, HDL, ALT, AST and MDA associated with the H group also has extremely significant differences compared with the PE group ($p <0.01$). The HDL associated with the E group, the AST in the P group, there were significant differences compared with the PE group ($p<0.05$). PAP, hyperlipidemia in rats with PAP and elevated SOD, has an obvious effect in reducing the symptoms of hyperlipidemia, but gastric PAP combined with aerobic exercise reduced the symptoms most significantly in hyperlipidemia rats, after 10 weeks of gastric PAP and aerobic exercise, hyperlipidemia rats compared with ordinary feed-fed control group, has the best effect $p>0.05$.

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