Study on the Effectiveness of Burdock Root in Weight Loss and Fat Reduction

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Abstract: In order to explore the effect of Burdock roots on fat reduction in obese mice, it was randomly to allote the meal 45 mice C57BL/6J into 5 groups, 9 in each group; The intragastric dose of each group was 16g/(kg d), 8g/(kg d, 4g/(kg d). There were basal feed and fat feed for normal contral group and other 4 groups. Established fat model and used Burdock root for 6 weeks and recorded the weight of the mice weekly. After the sixty weeks, extracted mouse fat, emeasured related experimental indicator. The results manifested that the weight, Lee's index and fat coefficient of the model group were more higher than normal control group. The fat mold was created successfully. Triglyceride (TG), cholesterol (TC), low density lipoprotein cholesterol (LDL-C), Alanine transaminase (ALT)and free fatty acid (FFA) levels of serum had the varying degree to decline. Nevertheless, the high density lipoprotein cholesterol (HDL-C) hasn't increased, Aspartate aminotransferase (AST) and lipase (LPS) were not decline, compared with model group. compared with normal control group, adipocytes' diameter of model group were increased fat cells' diameter of administration groups were decreased at different level microscopically. It revealed that Burdock roots had certainly effect on lessen weight and lipid lowering effect.

1. Introduction

With the persistence development of the social economy, the overweight rate of Chinese adults in 2018 reached 34.3%. Obesity has a profound impact on the occurrence and progression of metabolic diseases, circulatory system diseases and many other diseases [1]. For individuals, obesity can hinder job hunting and marriage, and even lead to obesity discrimination, causing physical and mental harm and trauma to patients. According to 2010 data, the major economic burden caused by overweight and obesity nationwide was as high as 90.768 billion yuan [2]. Therefore, finding effective methods to prevent and treat obesity has always been a hot academic issue and social concern. Although commercially available weight loss drugs can effectively control weight and reduce appetite, long-term use of such drugs carries the risk of causing disorders of organ functions and metabolism. Therefore, finding safe and non-toxic weight loss and fat lowering drugs has received widespread attention from the medical community and society.

Burdock root is the underground root of Arctium lappa L. of the Compositae family. It has both medicinal and edible effects. It originated in East Asia and is bred in multiple zones in China. It has

the effects of dispersing wind and heat, reducing swelling and poisoning. It is used for various symptoms of wind and heat, poison, ulcers, sores, swellings, rheumatism, arthralgia, hemorrhoids, and rectal prolapse [3]. Present research has unfold that burdock root has antioxidant [4], anti-hyperglycemic [5], cholesterol lowering, liver protection [6], anti-atherosclerosis [7] and other functions. However, research on weight loss and fat reduction effects is relatively small. By exploring the changes in related indicators of obese mice after intervention with burdock root for 6 weeks, its weight loss and fat reduction effects were analyzed to provide theoretical support for the prevention and treatment of obesity and related diseases with burdock root. It lays the foundation for the mechanism research of burdock root and other weight loss drugs. It provides some insights for the development of herbal medicine products with potential weight loss and lipid-lowering effects.

2. Materials and Methods

2.1 Materials and reagents

Burdock root tablets were purchased from Yunnan Xinglintang Biotechnology Co., Ltd.; SPF grade C57BL/6J male mice, 6-7 weeks old, weighing (20±2g), were purchased from Kunming Medical University and raised in the Experimental Animal Center of Yunnan University of Traditional Chinese Medicine. High-fat feed and control feed were purchased from Jiangsu Synergy Pharmaceutical Bioengineering Co., Ltd. Total cholesterol (TC) assay kit, triglyceride (TG) assay kit, low density lipoprotein cholesterol (LDL-C) assay kit, high density lipoprotein cholesterol (HDL-C) assay kit, free fatty acid (FFA) assay kit, lipoprotein lipase (LPS) assay kit, alanine aminotransferase (ALT) assay kit, and aspartate aminotransferase (AST) reagent kit were all purchased from Mike Technology Co., Ltd..

2.2 Instruments and equipment

SQP electronic balance (Sartorius Scientific Instrument (Beijing) Co., Ltd.); 7100 fully automatic biochemical analyzer (Hitachi Diagnostic Products (Shanghai) Co., Ltd.); ANKETGL-16B centrifuge (Shanghai Anting Scientific Instrument Factory).

2.3 Methods

2.3.1 Animal experiment

45 SPF grade C57BL/6J male mice were adaptively fed for 1 week and allocated into different group randomly, 9 mice in each group. Basic feed for blank control group, and the other groups were fed high-fat feed, 9 mice in each group, namely model group, burdock root high dose group (0.8g/ml/d), burdock root medium dose group (0.4g/ml/d), and burdock root low dose group (0.2g/ml/d). High-fat feeding and gavage of burdock root aqueous extract were carried out simultaneously. Weigh mice and record weekly. After 6 weeks of administration, the mice were forbidden food for 12 h, except water. Blood was drawn from the retro-orbital plexus, and the mice were sacrificed by dislocation of the cervical spine. The blood was centrifuged at 10 min and 3000 r/min. The supernatant was frozen for backup. After blood collection, the lower abdomen, perineum and perirenal fat of mice were quickly separated. After rinsing, the moisture was absorbed with filter paper, weighed and recorded, and stored in a -80 ℃ freezer for backup.

2.3.2 Body weight and fat coefficient

According to the body weight and body length of mice, Lee's index was calculated by formula (1)

and fat coefficient of visceral fat and body weight was calculated by formula (2).

2.3.3 Detection of serum biochemical indicators

According to the kit instructions, the content of LDL-C, FFA, HDL-C, TC, AST, ALT, TG and LPS in serum were measured.

2.3.4 Data statistics and analysis

The data results were expressed as mean ± standard deviation (Mean±SD) and statistically analyzed using SPSS 25.0 software.

3. Results and Analysis

3.1 Effect of burdock root aqueous extract on body weight of obese mice

Significant weight gain is one of the external manifestations that distinguishes obese mice from normal mice. Lee's index was used as the standard to judge whether obese mice model was established. Calculate Lee's index[8].

$$\text{Lee's index} = \sqrt[3]{\text{Body weight} \times 1000/\text{Body length}} \tag{1}$$

$$\text{Fat coefficient} = \frac{\text{Fat mass}}{\text{Body mass}} \tag{2}$$

According to Table 1, the average body weight of the blank control group mice was lower than that of the model group obviously, P<0.01; the body weight of the burdock root high, medium and low dose groups was all less than the model group. Comtrasted to the model group, the discrepancy were P<0.01 in the high and medium dose groups, and P<0.05 in the low dose group. From the statistics in Table 1, model group mice has raeched to paek in the fat coefficient data beside the blank group P<0.01; the administration groups was lower than that of the model group, P<0.01 in the high and medium dose groups, and P<0.05 in the low dose group in correspondence. indicate that burdock root has an obvious effect on reducing fat and body weight in mice.

Table 1: Effect of high-fat diet induced obesity model formation in mice

Group	Body weight	Lee's index	Fat coefficient
Blank control group	24.89±1.52	13.75±0.24	0.009±0.003
Model group	29.56±2.50[##]	14.45±0.38[##]	0.041±0.021[##]
High dose group	26.67±0.90[**]	14.01±0.13[**]	0.018±0.004[**]
Medium dose group	25.89±1.92[**]	13.91±0.31[*]	0.019±0.019[**]
Low dose group	27.08±1.98[*]	14.09±0.30[*]	0.025±0.006[*]

Compared with blank control group ##(P<0.01); compared with model group **(P<0.01), * (P<0.05)

3.2 Effect of burdock root aqueous extract on TC and TG of obese mice

The content of TC and TG is positively correlated with the probability of suffering from cardiovascular diseases. Studies have found that for every 1mmol/L increase in TG level, the incidence of cardiovascular disease increases by 12% to 37%, and the incidence of diabetes and kidney disease also increases [9]. According to Table 2, the TC standard of the obese group has higher concentration among the normal group, P<0.01; the serum TC of the burdock root high, medium and low dose groups was 30.5%, 23.1% and 16.3% lower than that of the obese model group, respectively.

TG was lower in the high, medium and low dose groups than in the model group. P<0.01 in the high and medium dose groups, and P<0.05 in the low dose group. By comparison to the control group, TG in the model group was 28.8% higher than that in the control group, with statistically significant difference of P<0.01; compared with the model group, TG levels in the burdock root high, medium and low dose groups were 25.6%, 23.2% and 25.6% lower than those in the model group, respectively, and P values were all <0.01, indicating that burdock root aqueous extract had a positive effect in down-regulating serum TC and TG levels in obese mice.

Table 2: Effect of burdock root aqueous extract on TC and TG of obese mice

Group	TC	TG
Blank control group	2.67 ± 0.35	0.97 ± 0.13
Model group	$3.80 \pm 0.41^{\#\#}$	$1.25 \pm 0.22^{\#\#}$
High dose group	$2.64 \pm 0.32^{**}$	$0.93 \pm 0.13^{**}$
Medium dose group	$2.92 \pm 0.44^{**}$	$0.96 \pm 0.19^{**}$
Low dose group	$3.18 \pm 0.27^{*}$	$0.93 \pm 0.14^{**}$

Compared with blank control group ##(P<0.01); compared with model group **(P<0.01), * (P<0.05)

3.3 Effect of burdock root aqueous extract on HDL-C and LDL-C in obese mice

HDL-C and LDL-C are lipoproteins in cholesterol metabolism. HDL-C can transport cholesterol from other tissues to the liver for decomposition and then excrete it out of the body. When excess cholesterol carried by LDL deposits in the arterial wall for a long time, the risk of atherosclerosis increases [10]. According to Table 3, HDL-C did not increase significantly in the treatment groups. Compared with the control group, LDL in the model group increased significantly, P<0.01. LDL levels in the burdock root high, medium and low dose groups were significantly lower than those in the obese model group, P<0.01 (high and medium dose groups) and P<0.05 (low dose group), indicating that burdock root aqueous extract can significantly reduce LDL levels in obese mice.

Table 3: Effect of burdock root aqueous extract on HDL-C and LDL-C in obese mice

Group	HDL-C	LDL-C
Blank control group	1.49 ± 0.22	0.35 ± 0.06
Model group	1.92 ± 0.24##	0.47 ± 0.07##
High dose group	1.40 ± 0.12**	0.32 ± 0.06**
Medium dose group	1.57 ± 0.20**	0.35 ± 0.06**
Low dose group	1.64 ± 0.11*	0.39 ± 0.07*

Compared with blank control group ##(P<0.01); compared with model group **(P<0.01), * (P<0.05)

3.4 Effect of burdock root aqueous extract on ALT and AST in obese mice

ALT is distributed in all organs, the most densely in the liver. Elevated ALT in the blood can be detected when the liver is damaged. ALT elevation is usually a signal of liver cell damage [11]. AST is mainly present in the cytoplasm and mitochondria of liver cells. When liver cells are damaged for a long time, such as drug hepatitis, fatty liver, alcoholic hepatitis, etc., AST in the blood also increases synchronously [12]. According to Table 4, compared with the blank group, ALT increased in the model group, but there was no statistical difference. Compared with the model group, burdock root high, medium and low dose groups significantly reduced ALT levels in obese mice, P<0.01 (high and medium dose groups), and P<0.05 (low dose group). While refering to the blank group, AST increased in the model group, regardlessly, yet no statistical significance. The burdock root high dose

group reduced AST levels in obese mice to some extent, no statistical significance. AST was not reduced in the medium and low dose groups.

Table 4: Effect of burdock root aqueous extract on ALT and AST in obese mice

Group	ALT	AST
Blank control group	30.44±7.14	81.78±24.34
Model group	35.89±6.85	99.11±33.80
High dose group	25.67±2.87**	97.33±17.03
Medium dose group	26.33±3.60**	115.66±31.42
Low dose group	28.00±5.45*	152.22±25.58*

Compared with model group **($P<0.01$), * ($P<0.05$)

3.5 Effect of burdock root aqueous extract on FFA and LPS in obese mice

FFA is as an energy material yielded by the decomposition of adipose tissue, usually combined with serum albumin in the blood. When the FFA level exceeds the binding capacity of albumin, the blood FFA level will risen. Obese patients have higher FFA levels than normal people, because there's adipose tissue releases high concentrations of FFA, and the body's ability to clear FFA is reduced [13-15]. LPS belongs to the class of carboxylic acid hydrolase, which exists mostly in pancreas, stomach and other tissues [16]. After eating fat-containing food, glycerides are hydrolyzed into monoglycerides, glycerides and free fatty acids under the catalysis of enzymes. Gastric lipase and pancreatic lipase continue to hydrolyze into free fatty acids and monoacylglycerol, and remain in the body in the form of cholesterol and lipoproteins [17-18]. According to Table 5, compared with the blank group, FFA increased significantly in the model group, $P<0.01$; compared with the model group, the FFA levels decreased to some extent in the treatment groups, but without statistical significance. Compared with the blank group, LPS decreased significantly in the model group, $P<0.01$; compared with the model group, LPS increased in each treatment group, without statistical difference. It shows that burdock root can reduce the content of FFA in plasma to some extent, increase the level of LPS, reduce lipid accumulation and slow down the speed of obesity.

Table 5: Effect of burdock root aqueous extract on FFA and LPS in obese mice

Group	FFA	LPS
Blank control group	0.45±0.05	77.91±15.18
Model group	0.75±0.17##	30.81±3.84##
High dose group	0.64±0.20	38.08±9.02
Medium dose group	0.70±0.16	31.10±4.00
Low dose group	0.52±0.08**	36.52±21.52

Compared with blank control group ##($P<0.01$); compared with model group**($P<0.05$)

3.6 Effect of burdock root aqueous extract on adipocytes in obese mice

Compared with the blank control group, the diameter of adipocytes in the model group mice was significantly increased under the same field of view, the number of cells was small, and the cells formed mutual squeezing in the limited space of the abdominal cavity. The adipocytes in the model group were no longer round or oval, but polygonal. Comtrasted to the model group, the diameter of adipocytes in the burdock root high, medium and low dose groups was reduced to different degrees under the same field of view after intervention, and the number of cells increased. The adipocytes in the high dose group mice were mostly restored to the original type or oval. It shows that burdock root

can greatly or significantly slow down the trend of obesity in mice, reduce lipid droplet accumulation in adipocytes, and help obese mice lose weight.
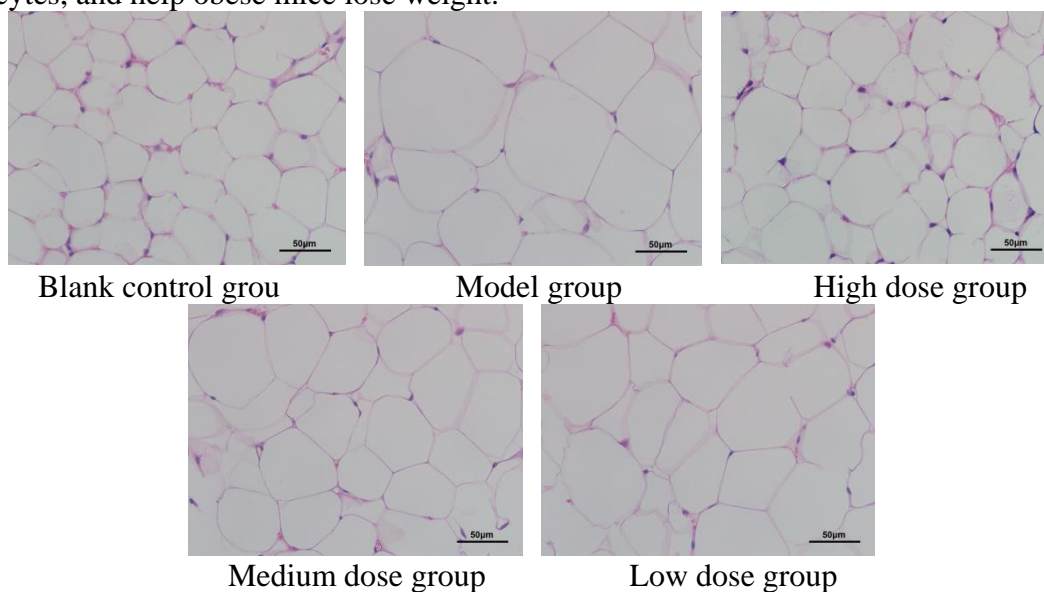

| Blank control grou | Model group | High dose group |

Medium dose group   Low dose group

Figure 1: Five groups microscopic image of adipase tissue

3.7 Conclusions and Discussion

Obese mice were induced by feeding high-fat diet. Mice were given burdock root extract at different doses of high, medium and low to explore whether burdock root extract has the efficacy of weight loss and lipid lowering in obese mice and the intervention degree of different doses of drugs on obesity trend in mice. After 6 weeks of modeling and drug intervention, and detection of various related indicators, it was found that burdock root extract at doses of 1.6 g/(kg d), 0.8 g/(kg d) and 0.4 g/(kg d)   could reduce body weight, decrease visceral fat generation and lipid droplet accumulation in adipocytes, lower TC, TG, LDL-C and ALT levels in the serum of obese mice, have a trend to reduce FFA concentration in plasma, reduce lipid deposition in blood, prevent obesity, cardiovascular diseases and other diseases caused by lipid deposition, but could not increase HDL-C level. Based on the above results, burdock root extract has a positive intervention effect on obese mice. This result is of important reference significance for the prevention and treatment of obesity from laboratory to clinical path, which can expand the efficacy of traditional Chinese medicines with a long history of use, such as burdock root, from treating exogenous diseases, late febrile diseases, surgical carbuncles and swelling pain, to discovering that it able treat cardiovascular diseases and diabetes, and feedback to clinical medication, broaden diagnosis and treatment ideas and medication methods. At the same time, it provides some scientific data support for the development of herbal medicines and health products.

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