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Original Article

Effects of Leek Extract on Rats with Hyperlipidemia

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ABSTRACT

Background and Aim: Hyperlipidemia is one of the major risk factors for atherosclerosis. The aim of this study is to investigate the effect of leek extract on hyperlipidaemia in rats. **Methods:** Rats were fed a modified diet containing 0.5% cholesterol and 0.25% cholic acid to induce hyperlipidaemia as previously described. Leek extracts were administrated at daily doses of 100 mg/kg and 200 g/kg for 8 weeks. **Results:** There were significantly increased in all tested parameters including body weight, liver weight index and liver lipid profile in hyperlipidemic model rats compared to control rats. However, the administration of leek extracts in dose-dependently led to reduction these parameters compared to hyperlipidemic model rats. During the experiment, leek extract with 100mg/kg did not exert antihyperlipidaemic effect. **Conclusion:** Our data provide that leek extract may be useful for management of hyperlipidemia.

Keywords: Leek (*Allium porrum*), Hyperlipidaemia, Experimental, Lipid profile, Liver weight index.

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INTRODUCTION

Lifestyle changes accompanying industrialization have a significant impact on the health of the people. The modernization of societies appears to result in a dietary pattern that is high in saturated fats and refined sugars and is low in fibre content. Analyses of available aggregate data sources indicate that a shift towards "western diets" high in saturated fat and sugar and low in fibre is occurring.[1] These changes in dietary pattern coupled with changes in physical activity patterns, increased use of tobacco products and alcohol are possible causes of hyperlipidaemia and obesity which are becoming important factors in the pathogenesis of chronic degenerative diseases such as cardiovascular disease, diabetes and cancer. It has been postulated that in many individuals excess weight gives rise to cardiovascular disease, type 2 diabetes mellitus, hypertension, stroke, dyslipidaemia, osteoarthritis, and some cancers.[2-4] It is also known that fatty liver disease is associated with hyperlipidaemia and obesity.[5] On the order hand, over the last years, attention to health care and quality of life has been progressively increasing. Many people are always looking for a correct lifestyle that may help preventing the onset of the principal pathologies including cardiovascular diseases, diabetes and relative comorbidities. Now they prefer to use plants rather than to take chemical drugs for the prevention and treatment of diseases, because plants are the major source of materials which combat various ailments and preserve health. At present, a number of botanicals are still being used in folk-medicine for treatment of different diseases. Korea has long cultivation history of several Allium plants. Leek (*Allium porrum*) is also cultivated for several benefits such cooking and traditional medicine in DPR of Korea. Leek is added in the traditional dumplings in most areas of DPR of Korea. It is one of the sources of nitrates as well as a rich source of sulphur volatiles like thiopropanal S-oxide, thiosulphinates and related compounds (zwiebelanes, capaenes) in minor quantities, which participate in the rich flavour.[6,7] Furthermore, some secondary metabolites are endowed with interesting biological activities. Flavonol glycosides have inhibitory activity on human platelet aggregation and prevent atherosclerosis and also, they have an antioxidant activity.[8] Allium plants also possess antifungal activity due to the chitinaces[9] and they have high contents of inulin-type fructans with good effects on serum lipids, blood glucose and gastro-intestinal environment of human.[10] However, no research has been conducted to investigate effect of leek extract on hyperlipidaemia in rats. The aim of this study was to investigate whether the leek extract would influence body weight gain and liver lipid levels in rats with hyperlipidaemia.

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MATERIALS AND METHODS

Preparation of Leek Extract

The commercially air-dried and cleaned leek was obtained from Mannyon pharmaceutical company, DPR Korea and identified

by comparison with the voucher specimen deposited at National drug certification institute of Pyongyang, DPR Korea. The extract used in the present study was prepared using the traditional ethanolic method. Briefly, 3 kg of dry leeks were immersed in 3 L of 90% ethanol with intermittent shaking for 24 hr, and then refluxed for 3 hr by heating. The filtrate was evaporated below 45°C under reduced pressure. The residue was designated as an alcoholic extract.

Animals

Male Wistar rats (90~100g) were purchased by Laboratory Animal Centre of the Pyongyang University of Medical Sciences. During the experiment, feed and water were available to rats at any time. The temperature was maintained at 20±2°C and the humidity was 55%. The study was approved by the Ethics Committee for Animal Experimentation, Faculty of Basic Medicine, Pyongyang University of Medical Sciences.

Diet

After 2 weeks of acclimation, the rats were randomly divided into 4 groups (n=10): Control (rats fed the normal diet only), Model (rats fed the hyperlipidaemia diet), Extract-1 (rats fed the hyperlipidaemia diet +100mg/kg of extract), Extract-2 (rats fed the hyperlipidaemia diet+200mg/kg of extract). The animals in each group were fed their experimental diets for 8 weeks. Hyperlipidaemia diet consists of 20% groundnut oil, 0.5% cholesterol and 0.25% cholic acid. Rats in Extract-1 and 2 groups were orally administrated with leek extracts at a daily dose of 100 and 200 mg/kg body weight, respectively, for 8 weeks.

Assay

The rats were observed daily and weighed weekly for 8 weeks. At the end of the feeding period, the rats were sacrificed under pentobarbital anaesthesia (100 mg/kg body weight). The liver was quickly excised and perfused with chilled 1.15% (w/v) KCl solution in order to remove all traces of contaminating haemoglobin. The tissues were blotted dry, weighed and stored at -80°C pending analysis.

Determination of Liver Lipids

Liver lipids were extracted according to the method of Folch *et al.*[11] Liver total Cholesterol (T-CHOL), High-Density Lipoproteins (HDL-CHOL), Low-Density Lipoproteins (LDL-CHOL), and Triacylglycerols (TAG) were measured by Hitachi 912 autoanalyzer.

Statistical Analysis of Data

Results were expressed as the mean and SEM. Data were analysed by one-way Analysis of Variance (ANOVA) using SPSS 16.0 and the differences between the means assessed using Dunnet's multiple range test. A P value of < 0.01 was taken as the level of statistical significance.

RESULTS

Changes of Body Weight

Table 1 shows the changes of body weights of rats in the four experimental groups.

At the 8th week, the increase of body weight in model rats was significantly higher than control group (P<0.01), while two extract groups led to decrease significantly body weight compared to model group. However, there were no significant differences (P>0.05) in two extract groups.

Changes of Liver Weight Index

Figure 1 shows the liver weight index of rats in all the groups. As shown in Figure 1, Liver weight was significantly increased in model and extract-1 rats compared to control rats, but the decrease of liver weight in extract-2 rats was lower than model rats.

Table 1: The effects of leek extract on body weight.

	Week	
	0	8
Control	96.3±3.5	170.6±5.7
Model	95.1±4.1	196.2±5.0**
Extract-1	93.8±3.9	177.5±3.3ΔΔ
Extract-2	94.0±3.4	175.4±4.2ΔΔ

Each value represents the mean ± SEM of 10 rats per group. **P<0.01 as compared with control group. ΔΔ P<0.01 as compared with model group.

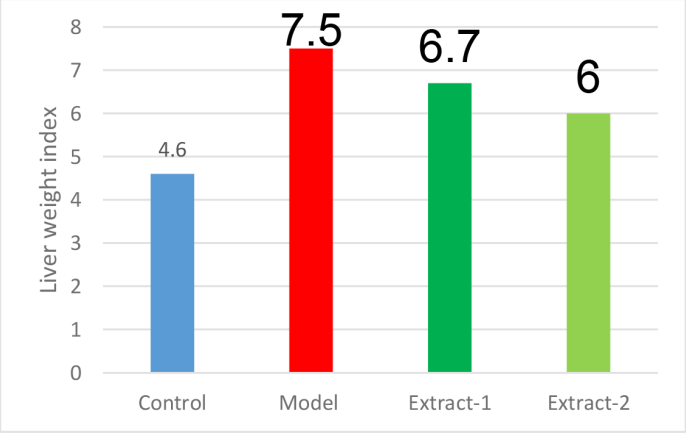

Figure 1: Liver weight index.

Each value represents the mean ± SEM of 10 rats per group. **P<0.01 as compared with control group. Δ P<0.05 as compared with model group.

Table 2: The effects of leek extract on liver lipid profile (mg/g·tissue).

	T-CHOL	HDL-CHOL	LDL-CHOL	TAG
Control	4.5 ± 0.6	0.5 ± 0.1	3.6 ± 0.4	3.7 ± 0.7
Model	38.1 ± 3.2**	2.2 ± 0.3**	40.6 ± 5.9**	84.6 ± 11.6**
Extract-1	27.3 ± 4.1**	1. 4± 0.3	25.2 ± 5.3**	71.8 ± 9.5**
Extract-2	21.4 ± 2.7**ΔΔ	1.0 ± 0.2ΔΔ	19.0 ± 3.1**ΔΔ	68.5 ± 10.8**

Each value represents the mean ± SEM of 10 rats per group. **P<0.01 as compared with control group. ΔΔ P<0.01 as compared with model group.

Changes of Liver Lipid Profile

The liver lipid profile of the rats in the four experimental groups is shown in Table 2.

All indices indicated liver lipid profile were significantly increased in rats fed hyperlipidaemia compared to control rats. Liver lipid profile in extract-1 rats showed a tendency to decrease, but there was no significant compared to model rats. However, administration of extract with 200 mg/kg for 8 weeks showed the significant improvement in liver lipid profile except TAG compared to model, but all levels of lipid profile kept on increasing.

DISCUSSION

Hyperlipidaemia constitutes a major etiopathological factor for atherosclerosis. Epidemiological as well as experimental studies suggest that inflammatory process induced and intensified by common atherosclerosis risk factors as age, hyperlipidaemia, diabetes, hypertension, male sex and smoking, is responsible for degenerative changes in valvular aortic stenosis. Among these factors, hyperglycaemia and hyperlipidaemia are important risk factors for diabetes-accelerated atherosclerosis. The medicinal value of Allium plants is best known for its lipid lowering effects and antiatherogenic effects. However, whether leek belonging to the Allium family can improve hyperlipidaemia or not, it has not been fully investigated. So that, in this work, we demonstrated the effect of leek extract on hyperlipidaemia in rats. The body weights of rats were determined in each group as a general index of overall health from begin to end of experimental period time. Oral administration of leek extract showed a tendency to dose-dependently inhibit the elevation in body weight, namely, body weights at doses of 100mg/kg and 200mg/kg were significantly decreased compared to model rats. Based on the changes of body weight, it is evident that the administration of leek extract provoked a reduction in increasing body weight by hyperlipidemic diet in rats. It could be that leek extract may increase the catabolism of lipids accumulated in adipose tissue resulting in a decrease in body weight. Liver weights were significantly increased by the intake of hyperlipidemic diet as compared to control rats, and it was accompanied by significant increase in the levels of liver lipid profile. From our data, the significant decrease of liver weight in administration of extract with 200mg/kg was observed compared to model rats. On the order hand, there were markedly increase in liver lipid profile in the rats including administration of extracts as well as model compared to control. It is possible that the normal catabolism of liver lipids was impaired in the rats fed hyperlipidaemic diet with consequent accumulation of lipids in the liver. Our results showed some tendency to dose-dependently improvement of leek extract on liver lipid profile in rats. In this study, it seems that low dose (100 mg/kg) of leek extract could not exert antihyperlipidemic effect on all test in rats. We suggest that the effect of leek extract on the hyperlipidaemia in rats may be also linked to improve the catabolism of lipids and leek extract has the positive therapeutic effects on hyperlipidaemia in rats.

CONCLUSION

In conclusion, it can be hypothesized that leek extract improves catabolism of lipids accumulated in adipose tissue by hyperlipidaemia. However, further studies can confirm these effects and also investigate the potential components of leek that play a definite role in pathophysiology of hyperlipidaemia. It is however assumed that leek extract might provide a beneficial effect in hyperlipidaemia.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

ABBREVIATIONS

T-CHOL: Total Cholesterol; **HDL-CHOL:** High-Density Lipoproteins; **LDL-CHOL:** Low-Density Lipoproteins; **TAG:** Triacylglycerols.

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