



Original Article

# Hypolipidemic effect of ethanol extract from *Mesona chinensis* Benth. in high fat diet-induced obesity mice

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**Abstract:** *Mesona chiensis* Benth. is a natural and safe pharmaceutical ingredient with many nutrients and special medical functions. The aim of this study was to investigate the prevention and treatment effect of ethanol extract from *Mesona chiensis* Benth. on the plasma lipid concentration of high fat diet-induced obesity mice. Male white mice (*Mus musculus*) 5 - 6 weeks of age were fed a high-fat diet including standard pellets (65% in weight) and boiled lard (35% in weight) for 6 weeks model obese mice. The study was divided into 2 periods: the prevention period for 4 weeks and the treatment period for 15 days. Prevention group (normal-weight mice) received ethanol extract of *Mesona chinensis* Benth. (400 mg/kg bw) and be fed a high-fat diet for 4 weeks. Treatment group (obese mice) received ethanol extract of *Mesona chinensis* Benth. (400 mg/kg bw) and be fed a high-fat diet for 15 days. The finding of the present investigation showed that mice fed a high-fat diet had significantly higher levels of TC, TG and TC/HDL-C compared to those in mice fed a normal diet. Body weight (bw) was significantly and positively correlated to TG ( $r = 0.53, P < 0.05$ ) and TC ( $r = 0.33, P < 0.05$ ) levels. After 4 weeks of receiving ethanol extract of *Mesona chinensis* Benth., the TG concentration and TC/HDL-C of the prevention group were significantly lower than those of the control group. After 15 days of treatment with obese mice, no statistically significant differences in blood lipid concentrations were observed compared with mice receiving fenofibrat and NaCl. In conclusion, ethanol extract of *Mesona chinensis* Benth. has the effect of preventing hyperlipidemia in mice fed a high-fat diet.

**Keywords:** *Mesona chiensis* Benth., hypolipidemic, high fat diet, obesity mice.

## 1. Introduction

Nowadays, dyslipidemia - a disorder of lipoprotein metabolism [1] - is a growing health

problem throughout the world. Dyslipidemias may be manifested by elevation of the total cholesterol (TC), the "bad" low-density lipoprotein (LDL) cholesterol and the

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triglyceride (TG) concentrations, and a decrease in the "good" high-density lipoprotein (HDL) cholesterol concentration in the blood [1]. Several factors, such as a high caloric diet, age, lack of exercise, smoking, alcohol consumption, and genetic predisposition have been linked with dyslipidemia. Especially, obesity due to a high fat diet is a high risk factor for dyslipidemia [2]. Dyslipidemia has become a challenge for the health sector, affecting both health, psychological and labor productivity [3]. Although dyslipidemia does not cause any symptoms, it increases the risk of cardiovascular diseases such as atherosclerosis and coronary heart disease [4]. According to the World Health Organization, by 2020, cardiovascular disease, coronary artery disease, and stroke with atherothrombosis are three most common causes of mortality and disability in the world. Management of dyslipidemia is considered primary and secondary prevention of coronary heart disease [5].

Facing the risk of dyslipidemia, finding a safe, effective, and economical treatment is essential. However, the use of drugs has caused some unwanted side effects such as cognitive impairment, hyperglycemia, etc. Therefore, the treatment of dyslipidemia by medicinal plants combined with dietary changes and physical activity has increased in recent years [6]. Reasons for the increased popularity of these herbal medicines may include their relatively low cost compared to orthodox medicines, availability, and efficacy. Many natural products such as extracts of plant-derived compounds appear to be applied as a treatment for lipid lowering, such as *Nelumbo nuficera* Gaertn [7], *Andrographis paniculata* (Burm. F.) [8], *Pterocarpus marsupium* [9], *Cleome droserifolia* [10]. The researchers continue looking for more effective and safer hypolipidemic agents from natural sources [11, 12].

*Mesona chiensis* Benth. (grass jelly) is an ideal, natural and safe pharmaceutical ingredient with many nutrients and special medical functions. It is an important agricultural and

medicinal plant of high economic value in Southeast Asia and China, which has been extensively studied in recent years [13]. Some studies have shown that *Mesona chiensis* Benth. contain 17 amino acids (including seven essential amino acids), carbohydrates, fats, fiber, polyphenols, and flavonoids [14, 15]. *Mesona chiensis* Benth. has also been shown to reduce the amount of glucose and triglycerides in humans. It is also considered as a herb that may have the potential to prevent chronic diseases and diseases related to overweight and obesity [16].

With the extremely beneficial effects of the compounds found in this plant, mice testing is a model that needs to be used to evaluate the effects of compounds in the prevention and treatment of dyslipidemia, contributing to the addition of new medicinal resources for traditional medicine. However, in Viet Nam, so far, studies on the *Mesona chiensis* Benth.'s prevention and supportive therapeutic effects for dyslipidemia have been limited. Therefore, the aim of this study was to investigate the prevention and treatment effect of ethanol extract from *Mesona chiensis* Benth. on the plasma lipid concentration of high fat diet-induced obesity mice.

## 2. Materials and methods

### 2.1. Materials

*Animals:* Male white mice (*Mus musculus*) weighing about 20 g (5 - 6 weeks of age) have been purchased from the National Institute of Hygiene and Epidemiology. Animals were maintained in a temperature ( $21 \pm 2^\circ\text{C}$ ) and humidity ( $50 \pm 20\%$ ) controlled room with a 12 h dark-light cycle. Mice were weighed weekly and assessed physiologically every day. Physiological parameters include: amount of feed, activity and hair.

*Plant extract:* *Mesona chinensis* Benth. was collected in 2016 in Dinh Hoa district, Thai Nguyen province. After harvest, it was dried, stored at  $25 - 35^\circ\text{C}$  in dry place. Ethanol extract

from *Mesona chinensis* Benth. was produced at the Department of Biochemistry, Faculty of Biology according to the method described earlier [17].

## 2.2. Experimental design

### 2.2.1. Making obese mouse model

Animals were divided into two groups (12 mice/group): (1) Standard diet group (SD) mice were fed standard pellets; (2) High-fat diet group (HFD) mice were fed food including standard pellets (65% in weight) and boiled lard (35% in weight). After 6 weeks, blood was collected from these mice to check plasma lipid parameters including TC, TG, HDL-C and LDL-C.

The study was divided into 2 periods: the prevention period and the treatment period.

### 2.2.2. Prevention effect of ethanolic extract from *Mesona chinensis* Benth. on high-fat diet mice

Male white mice with about 20 g in weight, were fed with a high fat diet. After 2 weeks, the mice continued to be fed a high-fat diet and divided into two groups, (six mice/group): (1) Control group received NaCl 0.9%; (2) Prevention group received ethanol extract of *Mesona chinensis* Benth. (400 mg/kg bw). After 4 weeks, blood was collected from these mice to check plasma lipid parameters including TC, TG, HDL-C and LDL-C.

### 2.2.3. Treatment effect of ethanolic extract from *Mesona chinensis* Benth. on obese mouse model

Obese mice were divided into three groups (six mice/group): (1) Control group received

0.9% NaCl; (2) Standard group received Fenofibrat (GMP; 100 mg/kg bw); (3) Treatment group received ethanol extract of *Mesona chinensis* Benth. (400 mg/kg bw) [17]. After 15 days, blood was collected from these mice to check plasma lipid parameters including TC, TG, HDL-C and LDL-C.

## 2.3. Blood index measuring

At the end of the investigation, two ml of blood samples were collected from all mice after overnight fasting. Blood was collected from hearts into tubes containing 1000 mg/L EDTA and stored at -80°C before analysis. Plasma lipid parameters (TC, TG, LDL-C, and HDL-C) were determined by automated blood analyzers (Type Architect C8000, Abbott Ltd., USA) using enzymatic methods at Medlatec Hospital in Hanoi.

## 2.4. Statistical analysis

All values were denoted by the mean  $\pm$  standard deviation. Statistical analysis were performed using SPSS software, version 16.0 (SPSS, Inc., Chicago, IL, USA). The Student's *t*-test was used for single comparisons or analysis of variance (ANOVA) for multiple group comparisons. Differences were considered as significant if two-tailed *P*-values  $\leq 0.05$ .

## 3. Results and discussion

### 3.1. Differences in plasma lipid parameters according to diet

Table 1. Plasma lipid parameters in standard diet group and high-fat diet group

Plasma lipid parameters	Standard diet group (mmol/L)	High-fat diet group (mmol/L)	<i>P</i>
TG	2.19 $\pm$ 0.41	3.50 $\pm$ 1.14	<b>&lt;0.001</b>
TC	4.64 $\pm$ 0.66	5.41 $\pm$ 1.19	<b>0.01</b>
HDL-C	1.58 $\pm$ 0.43	1.31 $\pm$ 0.51	0.64
LDL-C	2.06 $\pm$ 0.61	2.51 $\pm$ 0.87	0.09
TC/HDL-C	3.15 $\pm$ 0.95	5.28 $\pm$ 1.08	<b>0.02</b>

TG, triglyceride; TC: total cholesterol; HDL-C, high-density lipoprotein-cholesterol; LDL-C, low-density lipoprotein-cholesterol; Data are mean  $\pm$  SD. *P*-values obtained by Student *T* test. Bold values indicate significant difference between groups.

Table 1 shows the results of blood lipid indexes compared between the two groups with different diets.

The results of this study are consistent with the research results of Trung and Ngoc (2008) [18] and the study of Mai et al. (2007) [19] on white rats with 40% calories of lipid-based diets. In both of these studies, the concentrations of TG, TC, and LDL-C significantly increased compared to the control group (a normal diet of 12% of dietary calories) with  $P < 0.05$ . Enkhmaa et al. (2005) experimented on feeding 8-week-old male mice with an atherogenic-diet containing 3 g cholesterol and 15 g cocoa butter/100 g per day. After 8 weeks, the TG, TC, LDL-C concentrations of these mice increased markedly [20].

Dietary fat is one of the most important environmental indicators associated with the incidence of cardiovascular diseases [21]. The cholesterol ratio, calculated by dividing TC by HDL-C (good cholesterol), is a number that is helpful in predicting atherosclerosis, the process

of fatty buildup in the walls of the arteries. The results of our study have shown significant differences in cholesterol ratio between different diets.

### 3.2. Correlation between bw and plasma lipid parameters

Our data showed that bw was significantly and positively correlated to TG and TC (Table 2).

In human, many studies have also shown that obesity is one of the causes of dyslipidemia, which is characterized by an increase in TG, TC, LDL-C and a decrease in HDL-C. The study of Loan and Binh on over 300 subjects of hypertension indicated that weight was correlated with plasma lipids, however, this correlation was low [22]. Research by Hanh et al. (2017) also showed that there was a positive correlation between waist circumference and TG concentration ( $r = 0.232$ ,  $P < 0.05$ ) [23]. Meanwhile, studies on the correlation coefficient between bw and blood lipid indexes on mice were limited.

Table 2. Pearson's correlation analysis for bw and plasma lipid parameters

	Bw	TG	TC	HDL-C	LDL-C	TC/HDL-C
Bw	1	0.53*	0.33*	-0.24	0.25	0.19
TG	0.53*	1	0.75*	-0.09	0.42*	0.72*
TC	0.33*	0.75*	1	0.14	0.77*	0.16
HDL-C	-0.24	-0.09	0.14	1	-0.39	-0.54*
LDL-C	0.25	0.42*	0.77*	-0.39	1	0.39
TC/HDL-C	0.19	0.72*	0.16	-0.54*	0.39	1

Values presented are  $r$ -values; \* significant correlation with  $P$  at least  $< 0.05$ ; -, negative correlation. Bw, Body weight; TC, Total Cholesterol; TG, Triglyceride; HDL-C, High-Density Lipoprotein-Cholesterol; LDL-C, Low-Density Lipoprotein-Cholesterol.

### 3.3. Prevention effect of ethanolic extract from *Mesona chinensis* Benth. on high-fat diet mice

Figure 1 shows the results of blood lipid indexes between the control group and the prevention group.

Figure 1 shows that TG concentration and TC/HDL-C among the prevention group were lower than that of the control group. Specifically,

TG concentration of the prevention group were 2.83 mmol/L, lower than that of the control group of 31.48% ( $P = 0.02$ ). TC/HDL-C of the prevention group were 3.56, lower than that of the control group of 30.87% ( $P = 0.03$ ). Thus, *Mesona chinensis* Benth. extract has a preventive effect on hyperlipidemia.

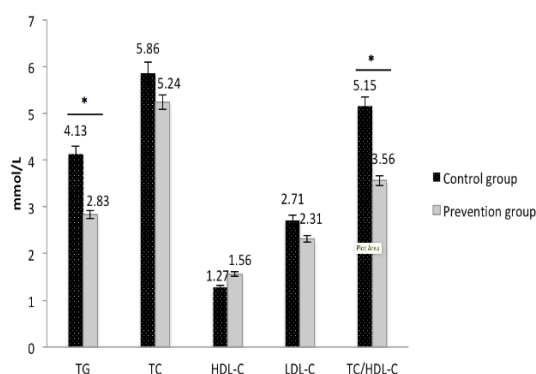


Figure 1. Differences in plasma lipid parameters between the two experimental groups.

\* significant between the two experimental groups with  $P < 0.05$ ;  $P$ -values obtained by Student  $T$  test. TC, Total Cholesterol; TG, Triglyceride; HDL-C, High-Density Lipoprotein-Cholesterol; LDL-C, Low-Density Lipoprotein-Cholesterol.

According to research by N.Q. Trung (2008) [19], Mulberry leaf extract also has the effect of preventing blood lipid disorders in experimental white rats. Specifically, TG, TC and LDL-C concentrations among rats received strawberry leaf extract decreased by 8.47%, 4.55%, and 2.63%, respectively.

A study on 11 men aged 20-40 showed that *Mesona chinensis* Benth. extract supplementation (0.5 g and 1.0 g) suppressed the post-prandial triglyceride concentrations at 210 min ( $P = 0.003$  and  $P = 0.006$ ) and 240 min ( $P = 0.008$  and  $P = 0.012$ ), respectively [16].

Preventive treatment for high-risk patients is also a concern. However, it is necessary to continue the clinical trial to demonstrate the effect of *Mesona chinensis* Benth. extract.

### 3.4. Treatment effect of ethanolic extract from *Mesona chinensis* Benth. on obese mouse model

Results of treatment of ethanolic extract from *Mesona chinensis* Benth. is shown in Figure 2.

After treatment, there was a statistically significant difference in the concentration of TG, TC and TC/HDL-C between the control group

and the fenofibrat group. However, the difference was not statistically significant between the treatment and control groups. The TG, TC, LDL-C concentrations of treatment group with *Mesona chinensis* Benth. extract tended to be lower than those of the control group and higher than those of the fenofibrat group. In contrast to the above indicators, the HDL-C concentration of the treatment group was highest. The difference in TC/HDL-C between the control group and the treatment group with *Mesona chinensis* Benth. was not statistically significant with  $P = 0.059$ . Thus, extract of the *Mesona chinensis* Benth. tended to have effect of reducing TC, TG, LDL-C, TC/HDL-C and increased HDL-C.

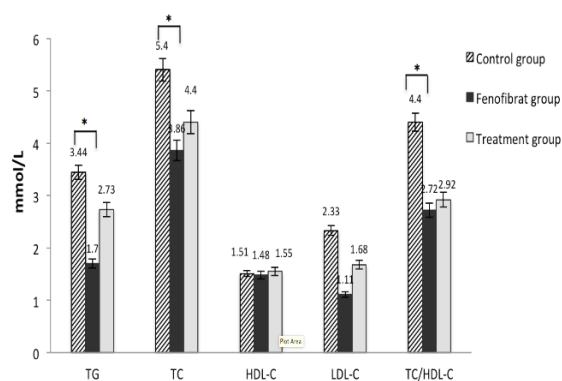


Figure 2. Plasma lipid parameters in treatment groups.

\* significant between Control group and Fenofibrat group with  $P < 0.05$ ;  $P$ -values obtained by Post-hoc test. TC, Total Cholesterol; TG, Triglyceride; HDL-C, High-Density Lipoprotein-Cholesterol; LDL-C, Low-Density Lipoprotein-Cholesterol.

Several studies demonstrated that *Mesona chinensis* Benth. contains high levels of total phenolic and flavonoid [13-16]. However, the content of these substances in different geographical areas was different. In Vietnam, total phenolic and flavonoid contents in the *Mesona chinensis* Benth. extract were 375 mg/g and 265.6 mg/g, respectively [17]. The findings of Chusak et al. (2014) suggested *Mesona chinensis* Benth. contains high polyphenolic and flavonoids that may be related to intestinal  $\alpha$ -

glucosidase inhibitory activity and may contribute to the antioxidant activity. This leads to a significant reduction in postprandial plasma TG [16].

Many studies also indicate that the herb has a role in reducing plasma lipid levels. Duyen and Huong (2014) studied the effects of *Ganoderma lucidum* (known as Lingzhi in China and Reishi in Japan) on endogenous hyperlipidemia model caused by tyloxapol. The results indicated that Red Reishi could regulate hyperlipidemia and protects the liver against oxidative damage caused by tyloxapol. The Red Reishi capsule at the dose of 2 capsules/kg bw was effective in increasing HDL-C value and reduced the increase of TG, TC, and LDL-C [24]. The study on white mice of Dao et al. (2013) also showed the same effect when giving white mice a pink lotus leaf extract [25]. Lotus leaf extract with an oral dose of 200 and 250 mg/kg bw/day is effective for the treatment of hyperlipidemia: TC decreased by 25.99% and 27.38%, LDL-C decreased by 35.57% and 37.3%, HDL-C increased 42.86% and 47.2% (respectively) compared to before treatment [25]. Thus it can be seen that herbal products have the ability to regulate blood lipids. However, in this study, the difference in blood lipid concentrations was not statistically significant because the reason was that the duration of 15 days might be short.

#### 4. Conclusions

In conclusion, mice fed a high-fat diet had significantly higher levels of TC, TG and TC/HDL-C compared to those in mice fed a normal diet. Bw was significantly and positively correlated to TG ( $r = 0.53$ ,  $P < 0.05$ ) and TC ( $r = 0.33$ ,  $P < 0.05$ ) levels. After 4 weeks of receiving ethanol extract of *Mesona chinensis* Benth. (400 mg/kg bw), the TG concentration and TC/HDL-C of the prevention group were significantly lower than those of the control group. After 15 days of treatment with obese mice, no statistically significant differences in blood lipid concentrations were observed compared with mice receiving fenofibrat and

NaCl. Thus, ethanol extract of *Mesona chinensis* Benth. has the effect of preventing hyperlipidemia in mice fed a high-fat diet.

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