ISSN 2706-6819 Vol.7, Issue 4: 85-93, DOI: 10.25236/IJFM.2025.070411

Safety and Hypolipidemic Efficacy of Korean Red Ginseng Formula Tablet: A Randomized, Double-Blind and Placebo-Controlled Clinical Trial

Ping Zheng[1,a], Yunting Hong[2,b], Ming Zhang[1,c], Huijuan Xiao[1,d], Jing Li[3,e], Yi Yang[4,f,*]

[1]Nutrition Department, Tianjin Third Central Hospital, Tianjin, China
[2]Health Management Center, Tianjin Third Central Hospital, Tianjin, China
[3]Laboratory Department, Tianjin Third Central Hospital, Tianjin, China
[4]Scientific Research Center, Conbio Technology Group Co., Ltd., Tianjin, China
[a]zhengping0406@163.com, [b]hongyunting123@163.com, [c]zjx0113@sina.com, [d]xhj60000@163.com, [e]429189029@qq.com, [f]18622281699@163.com
[*]Corresponding author

Abstract: *This study evaluates the efficacy of Korean Red Ginseng Formula Tablet (KRGT) in reducing blood lipid levels through a human feeding trial. A previous study identified the KRGT, which improves blood lipids, by studying human hepatocellular carcinoma (HepG2) cells and animal models[1]. This randomized, double-blind, placebo-controlled trial lasted 60 days. In total, 113 participants who passed the health assessments were randomly assigned to either the trial or placebo group based on their blood lipid levels. The trial group received KRGT, whereas the control group received a placebo, with both groups taking four tablets twice daily. Changes in serum total cholesterol (TC), triglyceride (TG), low-density lipoprotein cholesterol (LDL-C), and high-density lipoprotein cholesterol (HDL-C) levels were observed pre and post-intervention.The study observed no adverse changes in the mental state, sleep, diet, or bowel movements of the participants before and after the intervention. Blood tests, urinalysis, stool analysis, and blood biochemistry results were normal in both groups throughout the study period. After 60 days, the trial group exhibited significant reductions in TC, TG, and LDL-C levels compared with baseline ($P<0.01$). Moreover, compared with the placebo group, the trial group showed significant decreases in serum TC, TG ($P<0.01$), and LDL-C levels ($P<0.05$), with no significant difference in HDL-C levels ($P>0.05$). The total efficacy rate in the trial group was 25.5%, which was significantly higher than that in the placebo group ($P<0.01$). KRGT demonstrated clear lipid-regulating effects in humans and was well tolerated. This study confirmed the safety of KRGT and provided valuable insights into its mechanism of action in blood lipid regulation.There are numerous clinical and animal experiments proving the lipid-lowering effects of red ginseng, Crataegus Fructus and Cassiae Semen, but there has been no research on the lipid-lowering effects of this compound yet.*

Keywords: *Dyslipidemia, Korean Red Ginseng Formula Tablet, Randomized Controlled Trial*

1. Introduction

Dyslipidemia is commonly characterized by elevated levels of TC,TG, and LDL-C. Dyslipidemia is a significant risk factor for the onset and progression of various cardiovascular and cerebrovascular diseases. Over the past three decades, the prevalence of dyslipidemia among Chinese adults has surged to 40.4%, a notable increase since 2002. Elevated serum TC levels alone are projected to contribute to approximately 9.2 million cardiovascular disease events in China between 2010 and 2030 [2].

At present, the main drugs used to treat hyperlipidemia are statins, which have certain side effects such as statin associated muscle symptoms and gastrointestinal reactions [3]. 5-30% of the population has a certain degree of statin intolerance, which reduces medication adherence [4]. In addition, some people have borderline elevated blood lipids, which may not be sufficient to reach the level where medication can be taken, but blood lipids can be controlled through diet or the consumption of nutritional substances. It is important to search for and screen natural plant active ingredients with lipid-lowering effects and low side effects to delay or assist in the occurrence and development of hyperlipidemia, effectively reduce patient pain and disease burden, and improve the overall health level of the population.

ISSN 2706-6819 Vol.7, Issue 4: 85-93, DOI: 10.25236/IJFM.2025.070411

For thousands of years, traditional Chinese medicine has played an important role in medical treatment. Nowadays, traditional Chinese medicine is widely used to treat chronic diseases and has advantages such as low drug resistance and fewer side effects [5]. Traditional Chinese medicine formulas have unique advantages in the treatment of hyperlipidemia: abundant sources of drugs, flexible formulations, individualized treatment, minimal side effects, and diverse lipid-lowering mechanisms. Meanwhile, the characteristics of traditional Chinese medicine prescriptions being multi-component, multi-target, and multi mechanisticoften result in the material basis of their pharmacological effects being specific combinations rather than derived from any single active compound [6].

The main raw materials of the KRGT are red ginseng extract, Crataegus Fructus extract, and Cassiae Semen extract. Research has indicated that all three components exhibit lipid-lowering effects. Studies investigating Panax ginseng supplementation have demonstrated significant reductions in TC (by 0.17 mmol/L), TG (by 0.11 mmol/L), and LDL-C (by 0.24 mmol/L) [7]. In another clinical study, post-intake analysis revealed statistically significant reductions in TG and TC levels within the Mountain-cultivated ginseng persimmon vinegar (MPV) group compared to baseline ($P<0.05$). Furthermore, compared with the control group, MPV consumption led to significant decreases in blood neutral fat and TC levels, along with a noteworthy elevation in HDL-C levels ($P<0.05$) [8]. Animal studies have further illustrated the ability of ginseng to reverse weight gain, hyperlipidemia, and hyperglycemia induced by a high-fat diet [9]. Crataegus Fructus, historically used for heart protection and digestive support in traditional Chinese medicine, has emerged as a promising nutritional supplement for treating conditions such as diabetes, dyslipidemia, and fatty liver disease. Experimental studies have demonstrated the lipid-lowering effects of Crataegus Fructus extracts in various animal models [10-16]. Our findings indicate that obtusifolin sourced from *Cassia obtusifolia* seeds exhibits significant counteractive effects against alterations in body weight, TC, TG, LDL-C, and HDL-C levels induced by hyperlipidemia [17]. Rabbits fed *Cassia tora* seed extract at a dose of 500 mg/kg body weight demonstrated significant hypolipidemic activity [18]. The ethanol extract from Cassiae Semen has shown efficacy in attenuating lipid accumulation in white adipose tissue [19]. Clinical trials examining the efficacy of processed *Cassia obtusifolia* L. seed powder have yielded promising outcomes, demonstrating a reduction in weight and cholesterol levels in patients who are overweight [20]. These findings supported the theoretical basis of the lipid-lowering effects of KRGT. This study holds significant value in elucidating the mechanisms of action of KRGT and advancing the development and promotion of related products.

2. Materials and Methods

2.1 Ethical Statement

This clinical research was approved by the Medical Ethics Committee of Tianjin Third Central Hospital, China(Approval No.2021-054-01). This clinical study was conducted at the Tianjin Third Central Hospital, Tianjin, China. The research was performed in compliance with the Declaration of Helsinki, informed consent was obtained from all participants, and their privacy rights were strictly respected throughout the study.

2.2 Materials

KRGT, offered by the Korean Ginseng Corporation, presents as brown oval tablets with a product specification of 0.5 g per tablet, packaged in four tablets per pack. Storage conditions recommend keeping the product sealed and stored in a cold, dry location for up to 24 months. The daily intake quantities of raw materials: 1.5 g of Red ginseng extract, 1.8 g of Crataegus Fructus extract, 0.6 g of Cassiae Semen extract, and 0.1 g of excipient. Red ginseng extract is derived from raw material through numerous processes, including water extraction, filtration,concentration, drying and sieving, yielding 50%. The raw material of Crataegus Fructus was extracted using 60% ethanol, followed by concentration and drying to obtain extracted powder with a 20 % yield. The raw material of Cassiae Semen undergo extraction with 60% ethanol, concentration, and drying, yielding extract powder with a 7% yield. The nominal ingredients of KRGT include total ginsenosides, total anthraquinone, and total flavonoids. A placebo, identical to the trial sample in taste, dosage form, packaging, and appearance but lacking functionality, consisted of maltodextrin, caramel, magnesium stearate, hydroxypropyl methylcellulose, sucrose fatty acid ester, and silica.

ISSN 2706-6819 Vol.7, Issue 4: 85-93, DOI: 10.25236/IJFM.2025.070411

2.3 Inclusion Criteria

1) Participants aged 18–65; 2) Under normal dietary conditions, blood lipid levels measured after fasting for 12–14 h, with at least two blood lipid test results within 6 months, show serum TC levels ranging from 5.18 to 6.21 mmol/L, and serum TG levels ranging from 1.70 to 2.25 mmol/L; 3) Participants who have obtained informed consent and voluntarily agreed to participate in the trial.

2.4 Exclusion Criteria

1) Individuals aged under 18 or over 65 years old; 2) Pregnant or lactating women, individuals with allergies or sensitivities to the investigational product; 3) Those with severe diseases such as cardiac, hepatic, renal, or hematopoietic disorders, and patients with mental illnesses; 4) Participants who have taken lipid-lowering drugs or similar medications in the past 2 weeks, which may affect the interpretation of the results; 5) Patients with hyperlipidemia; 6) Participants who have not consumed the investigational product as instructed, or those with incomplete data that may affect the assessment of efficacy or safety.

2.5 Experimental Design

The participants were stratified into two groups using a random double-blind method, taking into account major factors that could influence the outcomes, such as blood lipid levels, age, sex, body mass index (BMI), waist-to-hip ratio (WHR), and body fat percentage. A balance test was performed to ensure comparability between the two groups, with a minimum of 50 participants assigned to each group.

Expert statisticians (not involved in the final data analysis) used the SPSS software to generate random numbers to randomize the participants into groups. These random numbers were then enclosed within two separate emergency envelopes. One envelope was handed to the sample administrator, who distributed the placebos and test samples to the participants based on their corresponding serial numbers. The data manager retained the other envelope for use in case of unblinding.

2.6 Dosage and Usage

The experimental group received KRGT, administered at a dosage of four tablets twice daily, accompanied by water, over 60 days, whereas the control group received a placebo under identical conditions.

2.7 Statistical Method

SPSS 21.0 was used for statistical analysis. Student’s t-test was used to analyze quantitative data. The own control was performed using a matched t-test, and the mean comparison between the two groups was performed using a group t-test. Data were analyzed using the chi-square test. Statistical significance was set at a P-value less than 0.01 or 0.05.

2.8 Safety Evaluation

2.8.1 General Condition

According to the good, ordinary, and poor criteria, the study aimed to assess the participants' spiritual state, sleep quality, dietary habits, and bowel movements while measuring their blood pressure and pulse rate. A good spiritual state is characterized by high energy levels, sharp thinking, and enhanced concentration. An ordinary spiritual state denotes a satisfactory psychological condition and moderate attention level. Poor spiritual state is associated with diminished comprehension, memory impairment, and decreased concentration. A good sleep state was defined as feeling energetic the following day, experiencing no difficulty falling asleep or waking up, and experiencing fewer dreams. An ordinary sleep state suggests reduced energy levels the next day, without difficulty falling asleep or waking up, and fewer dreams. A poor sleep state is characterized by challenges in falling asleep and waking up, along with increased dream frequency. Regarding dietary conditions, a good state signifies a healthy appetite. An ordinary diet indicates a general appetite, whereas a poor diet is characterized by diminished appetite accompanied by postprandial bloating. Regarding bowel movements, a good condition entails regular and unobstructed defecation, occurring one to two times per day. Ordinary bowel movements imply less frequent but regular defecation, typically once every 2–3 days. Poor bowel movements indicated constipation or diarrhea.

ISSN 2706-6819 Vol.7, Issue 4: 85-93, DOI: 10.25236/IJFM.2025.070411

2.8.2 Blood, Urine, and Stool Routine Examination

Routine blood, urine, and stool examinations were conducted to assess the overall health status.

2.8.3 Hepatic and Renal Function Examination

Evaluation of hepatic and renal function was performed to monitor liver and kidney health.

2.8.4 Chest X-ray, Electrocardiogram, and Abdominal Ultrasound Examination

A comprehensive evaluation, including chest radiography, electrocardiogram, and abdominal ultrasound examination, was conducted once before the experiment to assess the baseline health status.

2.9 Efficacy Evaluation

2.9.1 Lipid Profile Evaluation

Measure the concentrations of TC, TG, LDL-C, and HDL-C in all subjects before and after the trial.

2.9.2 Criteria for Determining Efficacy

TC: Effective: TC decreased by>10% or reached normal levels (<5.18 mmol/L). Invalid if the criteria are not met.

TG: Effective: TG decreased by>15% or reached normal levels (<1.70 mmol/L). Invalid if the criteria are not met.

HDL-C: Effective: HDL-C increase >0.104 mmol/L. Invalid if the criteria are not met.

Total effective: TC, TG, and HDL-C levels met the effective standards.

3. Results

3.1 Participants Recruitment and Screening

Informed consent was obtained from 113 participants who were subsequently randomly allocated to the trial and control groups based on their blood lipid levels while also considering significant influencing factors such as age, sex, and diet. Within the time window, six participants in the trial group and five in the placebo group did not undergo re-evaluation, meeting the exclusion criteria. Consequently, 51 eligible participants were included in the trial and placebo groups. The dropout rates for the trial and placebo group participants were 10.5% and 8.9%, respectively.

3.2 Results of Balance Test

Based on the data presented in Table 1, both groups demonstrated comparability regarding age, sex, dietary patterns, blood lipid levels, BMI, WHR, and body fat percentage, with no statistically significant differences observed before the trial commencement (P>0.05).

Table 1 Comparison of general material between the two groups before the test ($\bar{x}$ ±SD).

Name	Test group (n=51)	Control group (n=51)
Age (years old)	58.22±7.56	58.00±7.81
Male/Female	17/34	18/33
body mass index (BMI)	25.11±3.16	24.88±3.17
waist hip ratio (WHR)	0.90±0.06	0.88±0.06
body fat rate(%)	28.18±4.79	29.48±5.42
TC (mmol/L)	5.64±0.36	5.61±0.34
TG (mmol/L)	1.89±0.20	1.92±0.19
HDL-C (mmol/L)	1.25±0.26	1.24±0.31
LDL-C (mmol/L)	2.83±0.81	2.76±0.66

ISSN 2706-6819 Vol.7, Issue 4: 85-93, DOI: 10.25236/IJFM.2025.070411

3.3 Results of Efficacy Evaluation

Table 2 show that the serum levels of TC, TG, and LDL-C were significantly decreased in the test group before and after administration (P<0.01). In contrast to the placebo group, serum TC and TG levels significantly decreased (P<0.01), serum LDL-C levels significantly decreased (P<0.05), and serum HDL-C levels did not significantly decrease (P>0.05).

Table 3 shows that the efficacy rates of TC and TG in the trial group were markedly higher than those in the placebo group (P<0.01), with no significant difference in the efficacy rate of HDL-C (P>0.05). Among the 21 and 25 valid cases of TC and TG in the test groups, respectively, both decreased to normal levels after the trial. The total efficacy rate of the test group was 25.5%, which was significantly higher than that of the placebo group (P<0.01), suggesting that KRGT possesses lipid-lowering effects.

Table 2 Comparison of TC, TG, LDL-C and HDL-C in the two groups before and after the test($\bar{x}$ ±SD, mmol/L).

Indicator		Test group(n=51)	Control group (n=51)
TC	Before test	5.64±0.36	5.61±0.34
	After test	5.39±0.48**##	5.68±0.44
	Reduction rate(%)	4.42±6.50##	-1.38±6.28
TG	Before test	1.89±0.20	1.92±0.19
	After test	1.73±0.26**##	1.97±0.29
	Reduction rate(%)	8.15±13.03##	-2.81±10.73
LDL-C	Before test	2.83±0.81	2.76±0.66
	After test	2.60±0.78**#	2.89±0.70
HDL-C	Before test	1.25±0.26	1.24±0.31
	After test	1.28±0.25	1.24±0.26
	Rise value	0.03±0.17	-0.01±0.20

Comparison within groups**P<0.01, comparison between groups #P<0.05 ##P<0.01

Table 3 Comparison of effective rate in two groups after the test.

Indicator		Test group (n=51)	Control group (n=51)	P value
TC	Valid cases	21	7	P<0.01
	Effective rate (%)	41.2	13.7	
TG	Valid cases	25	5	P<0.01
	Effective rate (%)	49.0	9.8	
HDL-C	Valid cases	16	12	P>0.05
	Effective rate (%)	31.4	23.5	
Total effective rate (%)		25.5	2.0	P<0.01

3.4 Results of Safety Evaluation

Table 4 shows that most participants maintained good overall health throughout the study. No adverse changes were observed in the participants' mental state, sleep patterns, dietary habits, or bowel movements before and after the trial. Moreover, the participant's blood pressure and heart rate remained within normal range before and after the trial. Overall, the trial intervention did not adversely affect the participants' general well-being.

Table 5 presents the results of routine blood examinations, urinalysis, stool analysis, and blood biochemistry for the experimental and control groups before and after the trial, indicating predominantly normal findings. The ECG, abdominal ultrasound, and chest X-ray results for participants in the experimental and placebo groups were within normal limits.

ISSN 2706-6819 Vol.7, Issue 4: 85-93, DOI: 10.25236/IJFM.2025.070411

Table 4 Comparison of safety indicators in the two groups before and after the test ($\bar{x}$ ±SD).

	Test group (n=51)						Control group (n=51)					
	Before test			After test			Before test			After test		
	Poor	Average	Good	Poor	Average	Good	Poor	Average	Good	Poor	Average	Good
Mental condition	4	4	43	2	5	44	3	4	44	2	4	45
Sleep condition	3	4	44	1	5	45	2	5	44	2	5	44
Diet condition	2	4	45	1	5	45	2	3	46	2	3	46
Defecation	4	2	45	3	3	45	2	3	46	3	2	46
Systolic pressure (mm/Hg)	129.69±14.67			129.51±13.20			130.33±16.59			130.71±15.18		
Diastolic pressure (mm/Hg)	75.04±8.19			74.47±7.92			76.02±10.58			75.80±9.51		
Heart rate (times/minute)	70.33±8.05			69.96±7.38			69.47±11.00			69.08±9.85		

Table 5 Changes of blood routine, urine routine, stool routine and blood biochemical indexes before and after the test ($\bar{x}$ ±SD).

	Test group (n=51)		Control group (n=51)	
	Before test	After test	Before test	After test
WBC ($\times10^9$/L)	6.64±1.96	6.28±1.34	6.67±1.47	6.61±1.39
RBC ($\times10^{12}$/L)	4.57±0.41	4.63±0.40	4.66±0.38	4.71±0.42
PLT ($\times10^9$/L)	245.49±51.52	252.04±52.08	254.98±53.47	260.96±56.16
HGB (g/L)	138.08±14.03	139.90±13.37	141.18±14.54	144.04±14.43
TP (g/L)	72.54±3.59	71.56±4.15	71.77±5.49	70.95±5.88
Alb (g/L)	46.35±1.97	46.24±2.64	46.09±4.13	45.66±4.10
ALT (U /L)	21.82±16.27	23.33±16.49	19.10±18.02	19.69±10.31
AST (U /L)	20.18±9.60	22.29±12.02	18.35±8.15	20.20±6.52
Urea (mmol/L)	5.32±1.24	5.00±1.18	5.13±1.33	4.79±1.10
Cre (μmol/L)	68.90±13.87	67.04±13.39	66.33±12.48	65.16±10.96
FPG (mmol/L)	5.41±1.18	5.41±1.14	5.64±1.57	5.81±1.54
Urine routine	Normal	Normal	Normal	Normal
Stool routine	Normal	Normal	Normal	Normal

3.5 Adverse Event

No allergies or other adverse reactions were reported in either the experimental or placebo group during the trial. Furthermore, after the follow-up visits, neither the experimental nor the control group exhibited any side effects or allergic reactions, such as nausea, flatulence, diarrhea, or abdominal pain, throughout the trial period.

4. Discussion

Blood lipids closely related to clinical practice include cholesterol and TG. In this study, the TG, TC, LDL-C, and HDL-C levels were selected as efficacy indicators to evaluate the lipid-lowering effects of the study product. The research findings demonstrated a significant lipid-lowering effect consistent with the anticipated experimental outcomes.

The key active ingredients in KRGT are red ginseng, Crataegus Fructus, and Cassiae Semen extracts. Studies have suggested that their combination may yield better outcomes in lowering blood lipid levels. For instance, Li HB et al. investigated the effects of Cassiae Semen and Crataegus Fructus extracts and their formulations on blood lipid regulation in hyperlipidemic mice. They revealed that prescription groups outperformed individual extract groups [21]. Yang B observed the hypolipidemic effect of Crataegus Fructus and Cassiae Semen and their combination, indicating superior symptom improvement and a greater reduction in blood lipid levels in patients [22]. Hedansanqi Tiaozhi Tang extract, comprising Notoginseng, Danshen, Crataegus Fructus, and Lotus leaves, suppressed weight gain, reduced lipid levels, and ameliorated liver function and pathological features induced by a high-fat diet [23].

From the perspective of Traditional Chinese Medicine Theory, hyperlipidemia stems from factors such as phlegm, blood stasis, and asthenia, leading to liver, spleen, and kidney dysfunction, resulting in

ISSN 2706-6819 Vol.7, Issue 4: 85-93, DOI: 10.25236/IJFM.2025.070411

imbalanced body fluid metabolism and hyperlipidemia. Consequently, treatments typically involve Chinese medicinal herbs with functions such as strengthening the spleen and supplementing Qi, tonifying the kidneys and benefiting the liver, improving blood circulation and dissipating blood stasis, eliminating phlegm and promoting diuresis, and soothing the liver and gallbladder. Crataegus Fructus is characterized by a sour and sweet taste and affects the spleen, stomach, and liver meridians. Its purported functions include the elimination of food accumulation and dispersion of blood stasis. Cassiae Semen, on the other hand, possesses a sweet and cool nature with a bitter taste and influences the liver and kidney meridians. Its functions include clearance of the liver and eyes, promotion of diuresis, and alleviation of constipation. Red ginseng is characterized by its warm nature and slightly bitter taste. It tonifies vital energy, spleen, and lungs, promotes fluid production, alleviates thirst, calms nerves, and enhances intelligence. Their combination improves blood circulation, lowers blood lipids, and calms the liver while reducing blood pressure.

From the perspective of modern pharmacological mechanism research,ginsenosides are its main pharmacologically active ingredient. Research shows that ginsenoside Rg1 inhibits lipid synthesis and lipid uptake, and enhances lipid oxidation and lipid export to reduce hepatic steatosis of HepG2 cells by down regulating the expression of peroxisome proliferator-activated receptor gamma (PPARγ), cluster of differentiation 36, fatty acid transport protein 2, fatty acid transport protein 5,and fatty acid binding protein1 [24,25]. Total flavonoids can inhibit cholesterol synthesis by reducing the expression of hydroxymethylglutaryl-CoA reductase, upregulate the expression of low density lipoprotein receptor to promote cholesterol metabolism, and regulate lipid metabolism disorders [26]. Total flavonoids can also increase the expression levels of liver X receptor and Adenosine triphosphate-binding cassette transporter A1 by activating the activity of peroxisome proliferator-activated receptor alpha in the arterial wall, thereby promoting the reverse transport of TC and reducing its load [27]. Anthraquinones regulate body lipid metabolism by modulating the PPARγ, triglyceride hydrolase, and fatty acid synthase [28].

The inclusion criteria for this study were TC levels ranging from 5.18 to 6.21 mmol/L and TG levels ranging from 1.70 to 2.25 mmol/L. Following the guidelines outlined in China's prevention and cure guide for blood lipid disorders among adults (Revised in 2016), these ranges fall within the borderline elevation of blood lipids. The product under study is a health supplement primarily aimed at prevention rather than therapy. Thus, the inclusion criteria target individuals with borderline elevated blood lipids, particularly applicable to the target population for primary prevention of atherosclerotic cardiovascular disease.

5. Conclusions

No adverse changes were observed in the participants' mental condition, sleep patterns, dietary habits, or bowel movements pre- and post-intervention. The routine blood tests, urinalysis, stool analysis, and blood biochemistry results for the experimental and placebo groups pre and post-intervention were predominantly within normal ranges. Additionally, both groups' ECG, abdominal ultrasound, and chest X-ray results were normal. Furthermore, participants reported no adverse reactions to KRGT administration.

When comparing the test group with its baseline and the control group, a significant decrease was observed in the serum levels of TC, TG, and LDL-C. Serum HDL-C levels did not differ significantly from those in the control group. Furthermore, the total efficacy rate in the test group was significantly higher than that in the control group ($P<0.01$), suggesting that KRGT had a lipid-lowering effect.

Acknowledgements

The study was supported by a grant from the Korea Ginseng Corporation.

References

[1] M. Zheng, Y. Li, Z. Dong, Y. Zhang, Z. Xi, M. Yuan, H. Xu. (2023) Korean red ginseng formula attenuates non-alcoholic fatty liver disease in oleic acid-induced HepG2 cells and high-fat diet-induced rats. Heliyon, 9, e21846.

[2] J. R. Zhu, R. L. Gao, S.P. Zhao, G.P. Lu, D. Zhao, J.J.Li. (2016) Guidelines for the prevention and treatment of adult blood lipid disorders in China (revised in 2016), Chin. J. Circ, 31, 937-953.

[3] S.I. Chung, S.J. Nam, M. Xu, M.Y. Kang, S.C. Lee. (2016) Aged ginseng (Panax ginseng Meyer)

ISSN 2706-6819 Vol.7, Issue 4: 85-93, DOI: 10.25236/IJFM.2025.070411

reduces blood glucose levels and improves lipid metabolism in high fat diet-fed mice. Food Sci Biotechnol, 25, 267-273.

[4] F. Shao, L.F. Gu, H.J. Chen, R.H. Liu, H.L. Huang, L.Y. Chen, M. Yang. (2017) Evaluation of Hypolipidemic and Antioxidant Effects in Phenolrich Fraction of Crataegus pinnatifida Fruit in Hyperlipidemia Rats and Identification of Chemical Composition by Ultra-performance Liquid Chromatography Coupled with Quadropole Time-of-flight Mass Spectrometry. Pharmacogn Mag, 13, 725-731.

[5] F. Shao, L.F. Gu, H.J. Chen, R.H. Liu, H.L. Huang, G. Ren. (2016) Comparation of Hypolipidemic and Antioxidant Effects of Aqueous and Ethanol Extracts of Crataegus pinnatifida Fruit in High-Fat Emulsion-Induced Hyperlipidemia Rats. Pharmacogn Mag, 12, 64-69.

[6] A. Diane, F. Borthwick, S. Wu, J. Lee, P.N. Brown, T.A. Dickinson, K.D. Croft, D.F. Vine, S.D. Proctor. (2016) Hypolipidemic and cardioprotective benefits of a novel fireberry hawthorn fruit extract in the JCR:LA-cp rodent model of dyslipidemia and cardiac dysfunction. Food Funct, 7, 3943-52.

[7] S.H. Park, S. Chung, M.Y. Chung, H.K. Choi, J.T. Hwang, J.H. Park. (2022) Effects of panax ginseng on hyperglycemia, hypertension, and hyperlipidemia: A systematic review and meta-analysis. J. Ginseng Res, 46, 188–205.

[8] H. Seo, B.D. Jeon, S. Ryu. (2015) Persimmon vinegar ripening with the mountain-cultivated ginseng ingestion reduces blood lipids and lowers inflammatory cytokines in obese adolescents. J. Exerc. Nutrition Biochem, 19, 1–10.

[9] S.I. Chung, S.J. Nam, M. Xu, M.Y. Kang, S.C. Lee. (2016) Aged ginseng (panax ginseng Meyer) reduces blood glucose levels and improves lipid metabolism in high fat diet-fed mice. Food Sci. Biotechnol, 25, 267–273.

[10] Y. Zhang, L. Zhang, Y. Geng,Y. Geng. (2014) Hawthorn fruit attenuates atherosclerosis by improving the hypolipidemic and antioxidant activities in apolipoprotein E-deficient mice. J. Atheroscler. Thromb, 21, 119–128.

[11] S. Rajendran, P.D. Deepalakshmi, K. Parasakthy, H. Devaraj, S.N. Devaraj. (1996) Effect of tinctur-e of Crataegus on the LDL-receptor activity of hepatic plasma membrane of rats fed an atheroge-nic diet. Atherosclerosis, 123, 235–241.

[12] Z. Zhang, W.K.K. Ho, Y. Huang, A.E. James, L.W. Lam, Z.Y. Chen. (2002) Hawthorn fruit is hypolipidemic in rabbits fed a high cholesterol diet. J. Nutr, 132, 5–10.

[13] Y. Luo, G. Chen, B. Li, B. Ji, Z. Xiao, G. Yi, F. Tian. (2009) Dietary intervention with AHP, a functional formula diet, improves both serum and hepatic lipids profile in dyslipidemia mice. J. Food Sci, 74 , H189–H195.

[14] J. Zhang, R. Liang, L. Wang, R. Yan, R. Hou, S. Gao, B. Yang. (2013) Effects of an aqueous extract of Crataegus pinnatifida Bge. var. major N.E.Br. fruit on experimental atherosclerosis in rats. J. Ethnopharmacol, 148, 563–569.

[15] H. Xu, H.E. Xu, D. Ryan. (2009) A study of the comparative effects of hawthorn fruit compound and simvastatin on lowering blood lipid levels. Am. J. Chin. Med, 37, 903–908.

[16] H.J. Hu, X.G. Luo, Q.Q. Dong, A. Mu, G.L. Shi, Q.T. Wang, X.Y. Chen, H. Zhou, T.C. Zhang, L.W. Pan. (2016) Ethanol extract of Zhongtian hawthorn lowers serum cholesterol in mice by inhibiting transcription of 3-hydroxy-3-methylglutaryl-CoA reductase via nuclear factor-kappa B signal pathway. Exp. Biol. Med. (Maywood), 241, 667–674.

[17] S.Y. Zhuang, M.L. Wu, P.J. Wei, Z.P. Cao, P. Xiao, C.H. Li. (2016) Changes in plasma lipid levels and antioxidant activities in rats after supplementation of obtusifolin. Planta Med, 82, 539–543.

[18] V.K. Awasthi, F. Mahdi, R. Chander, A.K. Khanna, J.K. Saxena, R. Singh, A.A. Mahdi, R.K. Singh. (2015) Hypolipidemic Activity of Cassia Tora Seeds in hyperlipidemic Rats. Indian J. Clin. Biochem, 30, 78–83.

[19] T.F. Tzeng, H.J. Lu, S.S. Liou, C.J. Chang, I.M. Liu. (2013) Reduction of lipid accumulation in white adipose tissues by Cassia Tora (Leguminosae) seed extract is associated with AMPK activation. Food Chem, 136, 1086–1094.

[20] J.Y. Lee, W.L. Liao, Y.H. Liu, C.L. Kuo, F.W. Lung, C.L. Hsieh. (2022) Oral administration of processed Cassia obtusifolia L. seed powder May reduce body weight and cholesterol in overweight patients with schizophrenia: A 36-week randomized, double-blind, controlled trial of high and low doses. J. Ethnopharmacol, 292, 115111.

[21] H.B. Li, K.Y. Fang, C.T. Lü, X.E. Li. (2007) Study on lipid-regulating function for the extracts and their prescriptions from Semen Cassiae and fructus crataegi. Zhong Yao Cai, 30, 573–575.

[22] B. Yang. (2020) Observe the Lipid-Lowering Effects of Hawthorn, Cassia Seed and Their Compatibility. Health Care Guidelines, 25, 260–261.

[23] M. Qiu, F. Xiao, T. Wang, S. Piao, W. Zhao, S. Shao, M. Yan, D. Zhao. (2020) Protective effect of Hedansanqi Tiaozhi Tang against non-alcoholic fatty liver disease in vitro and in vivo through activating

ISSN 2706-6819 Vol.7, Issue 4: 85-93, DOI: 10.25236/IJFM.2025.070411

Nrf2/HO-1 antioxidant signaling pathway. Phytomedicine, 67, 153140.
[24] Y. Gao, S.J. Zhang, J.J. Li, J.Q. Zhao, Q. Xiao, Y.L. Zhu, J. Zhang, W.X. Huang.(2020) Effect and mechanism of ginsenoside Rg1-regulating hepatic steatosis in HepG2 cells induced by free fatty acid. Biosci Biotechnol Biochem, 84, 2228-2240.
[25] S.J. Yoon, S.K. Kim, N.Y. Lee, Y.R. Choi, H.S. Kim, H. Gupta, G.S. Youn, H. Sung, M.J. Shin, K.T. Suk. (2021) Effect of Korean Red Ginseng on metabolic syndrome. J Ginseng Res, 45, 380-389.
[26] H.M. Hui, Y. Guan, J.J. Weng, J.P. Chen, M.L. Wu, C. Cui, F. Shao, Y.C. Zhu. (2020) Effects of Hawthorn Leaf Flavonoids on Regulating Lipid and Protecting Liver and the Expression of HMGCR and LDLR in Hyperlipidemia Mice. Chinese Journal of Modern Applied Pharmacy, 37, 2599-2604.
[27] Y.Y. Gao, Q. Ou, X.D. Wei, L. Ma. (2011) The effect of total flavonoids from hawthorn leaves on PPARA, LXR, ABCA1 mRNA expression in AS model rats. Chinese Journal of Gerontology, 31, 2502-2504.
[28] S.M. Liu, C. Sun, W.H. Xie. (2009) The effect of cassia seed extract on the expression of polyester genes in hyperlipidemic model mice. Chinese Traditional and Herbal Drugs, 40, 583-587.