

Original Article



Effect of unripe fruit extract of *Momordica charantia* on total cholesterol, total triglyceride and blood lipoproteins in the blood of rats with hyperlipidemia

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ABSTRACT

Hyperlipidemia is a major risk factor for the development of cardiovascular disease. In this study, the effects of an unripe fruit extract of *Momordica charantia* on total cholesterol, total triglyceride and lipoproteins in the blood of mice with hyperlipidemia were investigated. In this study, 28 adult male Wistar rats weighing 210 to 250 g were selected and randomly divided into four groups of seven. One group was on a normal diet and the other groups were fed a high-fat diet for 8 weeks to develop hyperlipidemia. Experimental groups in this study were included group 1: control, oral administration of normal food without any drugs or extracts. Group 2: hyperlipidemia mice, feeding with normal food. Group 3: hyperlipidemia mice with a diet containing 4%. Group 4: hyperlipidemia mice with a diet containing 8%. The animals were fed by gavage at a dose of 4% and 8% of *M. charantia* powder solution for 15 days. Blood samples were taken and the level of total cholesterol, total triglyceride, and high-density lipoproteins (HDL) were measured enzymatically. The amount of low-density lipoproteins was calculated by Friedewald's formula. Data were analyzed using the analysis of variance. Experimental results showed that immature fruit powder of *M. charantia* quarantine significantly reduced serum triglycerides in group 8% mice fed rats fed a high-fat diet. Moreover, immature fruit powder of *M. charantia* increased the level of high-density lipoproteins. There was a statistically significant difference between the level of cholesterol and the level of low-density proteins (LDL). The highest reduction belonged to the group receiving immature powder. The results of the experiment showed that the unripe fruit extract of *M. charantia* has strong antilipidemic effects on rats fed with a high-fat diet.

Keywords:

Momordica charantia, Total Cholesterol, Total Triglyceride, Hyperlipidemia

1. Introduction

Cardiovascular diseases are the leading cause of death in industrialized and developing countries. Disorders of fat metabolism and oxidative stress in the body are the main risk factors for the onset and progression of these diseases[1]. In addition, in cardiovascular disease; inappropriate amounts of circulating fats are a major risk factor for sclerosis and its subsequent

complications such as acute heart attack or hypertension[2]. In general, repeated angiography has shown a direct correlation between decreased plasma lipids and reduced progression of sclerosis [3]. Low-density lipoprotein (LDL) has had many acute and chronic effects on blood vessels, with a 1% increase in serum LDL increasing the risk of cardiovascular disease by 2%. In addition, a 1% reduction in HDL (Low-Density Lipoprotein) has increased the risk of these

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diseases by 3-4% [4].

Lowering cholesterol and LDL-C through non-pharmacological strategies such as intake of certain foods and various plant compounds, support the heart and enhance health [5]. Today, special attention is paid to the use of natural compounds, especially herbal compounds in the treatment of diseases. Studies on the effects of plant extracts on animals have shown positive results in reducing blood lipids. The presence of active ingredients such as flavonoids, polyphenols, enterokinones, sterols, and tannins in the studied extracts justifies the effect of these extracts in reducing blood cholesterol and eliminating free radicals. Evidence shows that research on medicinal plants, in addition to using their natural compounds in treatment, leads to the use of chemical structures of natural compounds as a model for the structure of other drugs[6].

The value of medicinal plants is mainly due to the production and function of secondary active compounds [7]. Secondary metabolites are the main sources of active ingredients in many micro- and nano-drugs [8-10]. Although these materials are primarily made by directing genetic processes, their production is significantly influenced by environmental factors. It is generally believed that the production of secondary metabolites to regulate plant adaptation to adverse factors and environmental stresses is considered as the beginning of a kind of defense current to maintain the balance of vital activities. Thus, pharmaceutical products, unlike all agricultural products that suffer in terms of production in a stressful situation, may have more chemical production in this situation and, as a result, be more economically efficient in nature [11-14].

At present, medicinal plants have received more attention due to their optimal potential in the discussion of prevention and treatment. It is estimated that today 70% of the global community has an approach to the use of various medicinal plants in different ways in daily life, diet and treatment of diseases [15-17].

Bitter melon with the scientific name *Momordica charantia* belongs to the

Cucurbitaceae family [18]. This plant is one of the famous vegetables of South Asia, which originates from eastern India and southern China and is cultivated for food and medicine. Carla seeds are believed to have been transported from Africa to Brazil during the slave trade and spread to other parts of the world due to their medicinal importance. Its wild and domestic cultivars are scattered in the tropics[19]. *Momordica charantia* is a plant-like plant that has often been used as a medicine since time immemorial. This climbing plant belongs to the squash family, commonly known as bitter gourd or bitter melon in English and Carla in Bengali [20].

Momordica means bitter and all parts of the plant, including the fruit, have a bitter taste. The fruit is spindle-like and resembles a small cucumber. The young fruit is an emerald green that turns orange or yellow when ripe. It is a herbaceous plant that grows in tropical Asia, the Amazon, East Africa and the Caribbean and around the world and is cultivated for use as a vegetable as well as in traditional medicine [21]. But the exceptional property of Carla in terms of nutritional value, fruit due to high amounts of iron and ascorbic acid [22]. Carla's medicinal value in regulating and controlling diabetes and fighting diseases has attracted the attention of scientists around the world [23-25].

The use of *Momordica charantia* fruit as 1 and 2% in healthy mice, after 2 months, reduced fasting blood sugar ($P<0.002$) and hemoglobin, glycosylation ($P<0.004$). Diet also reduced cholesterol and LDL-C levels by 2% ($P<0.001$) but other biochemical factors did not show any significant changes[25-27]. Consumption of *Momordica charantia* oil has reduced LDL-C but has no effect on total cholesterol[26, 28].

There are contradictory results that do not definitively prove the use of this plant for patients with diabetes and hyperlipidemia, and according to local and local evidence about the effect of Carla on blood lipids [29, 30]. In this study, the effect of Carla Existing on the level of blood lipids in laboratory rats, which if approved can be used as an available source with hyperlipidemic properties.

2. Materials and Methods

2.1. Study community

This study was performed experimentally on 28 adult male Wistar rats with a weight range of 210 to 250 g and an average age of 8-9 weeks. The mice with their special feed were purchased from the laboratory animal breeding center of Zahedan University of Medical Sciences and transferred to the zoo of the research house of Zabol University Veterinary School, where the experiments were performed.

Immediately after entering the test site, the animals are kept in polyethylene cages with dimensions of 50 × 30 cm with humidity conditions of 60-55%, temperature c30 + 22 and a 12-hour lighting cycle (7 am to 7 pm) and to adapt to Environmental conditions were fed freely for 2 weeks with normal diet and city tap water. After the adaptation period, the weight of all mice was measured and then randomly divided into four groups of 7, including:

Experimental group 1: Healthy control group, receiving basic (normal) food without any medicine or extract.

Experimental group 2: Hyperlipidemic control group, feeding with basic (normal) food.

Experimental group 3: Hyperlipidemic control group, feeding with basic food (normal) and Carla fruit powder solution at a dose of 4%.

Experimental group 4: Hyperlipidemic control group, feeding with basic (normal) food and Carla fruit powder solution at a dose of 8%.

Each group was kept on separate shelves under the same conditions and studied.

2.2. Induction of obesity

2.2.1. Induction of obesity using a high-fat diet

Obesity induction was prepared daily by administering a high-fat diet (Table 1) for 8 weeks in three groups of rats (two experimental groups and one hyperlipidemic

control group) at the Agricultural Biotechnology Research Institute, University of Zabol. It contains the following ingredients (Tabl1 1).

2.3. Collection of plants

Carla fruits of Indian cultivar (Figure 1) in dimensions of 10-15 cm were collected from the farms of Jihad Agricultural Research Office of Zabol city in Zahak Agricultural Research Station.

Table 1. High-fat diet compounds

Ingredient	Control	Hyperr I	Hyperr II	Hyperr III	Hyperr IV
Casein	120	120	120	240	120
Corn starch	6.729	6.549	6.429	6.299	6.342
Soy oil	80	250	250	250	250
Cholesterol	0	10	10	10	10
Choline	4	4	4	4	4
Mineral mix	50	50	50	100	50
Vitamin Mixture	10	10	10	20	10
Cellulose	10	10	130	80	5.217
Calories (kcal)	4.411	4.501	4.453	4.449	4.418
	8	8	8	8	8

2.2.2. How to prepare a high-fat diet:

To prepare high-fat diets, first, the dry powders of the diet were mixed with a mixer, in successive steps, until it was completely homogeneous, then by adding soybean oil and compressing the resulting mixture diet as much as possible. It was compressed.

2.2.3. Basic diet (normal)

The standard food of rodents (compounds of normal diet in terms of grams per percent) from Behparvar Company of Tehran was considered as a plate (Table 2).

2.5. Preparation of the raw extract

In order to extract the Carla plant at the Zabol University Biotechnology Center, the Carla plant was prepared in sufficient quantities and washed with distilled water and placed in an oven at 40 ° C until completely dry and their kernels removed, and the flesh part in a porcelain mortar was thoroughly ground. The prepared powder was stored in a cool, dry place away from sunlight,

and then the dried powder of the extract was prepared in the required amount and according to the amount consumed, daily using kent scientific digital scales and in 2 ml of water. Distilled was dissolved.

Table 2. Analysis of mouse feed produced by Behparvar Company

Nutrients	Content
Raw protein%	23
Crude fat%	3.5-4.5
Crude fiber%	4-4.5
Ash%	Up to 10
Calcium%	0.95-1
Phosphorus%	0.65-0.7
Salt%	0.5-0.55
Humidity%	Up to 10
Lysine%	1.15
Mitonin%	0.33
Methionine + cysteine	0.63
Threonine%	0.72
Tryptophan%	0.25
Energy	16.16-17



Fig. 1. The appearance of Carla leaves, fruits and flowers

2.4. Treatment of animals with *Momordica charantia* powder solution

To evaluate the effects of hypolipidemia, the amount of food consumed by the animals in each group was measured and recorded each day with a scale with an accuracy of one-hundredth of a gram, and the next day after measuring the amount of leftover food, the daily feed was measured.

In hyperlipidemic rats of the two experimental groups, in addition to free

access to normal food and water, 4 and 8% of the average daily food intake of the respective group of Karella fruit powder solution was administered once daily orally (by gavage) by syringe. 5 ml tubes equipped with an oral-pharyngeal feeder-needle were fed to rats. This was done to these mice every day for about 9 days at around 9 am.

The hyperlipidemic control group was also fed with a basic (normal) food so that at the end of the experiment, the real effect of nutrition of Carla fruit powder solution on lipid changes compared to the hyperlipidemic control group could be investigated. All animals were weighed weekly using scales with an accuracy of 01%. Also, the weight of the animals was recorded at the beginning and end of treatment with Carla fruit powder solution. From the change in weight of animals during treatment, the percentage change in weight of animals during treatment with Carla fruit powder solution was calculated.

2.6. Blood sampling and isolation of blood serum

The acetone method was used for blood sampling [31]. In order to draw blood from experimental and control mice, at the end of 15 days, each of them after 14 hours of fasting and in a specific period by inhalation of diethyl ether (which has the least effect On metabolic characteristics (anesthetized) and venous blood was collected through the retro-orbital sinus of the inner corner of the eye by non-heparinized hematocrit tubes.

To separate the serum, the test tubes containing the sample were placed in a centrifuge at 4000 rpm for 10 minutes. Then the blood serum was removed. Blood serum samples were analyzed to obtain the effect of experimental diets on blood metabolites in Sina Zabol Medical Diagnostic Laboratory. Measurement of total cholesterol, triglyceride and HDL by an enzymatic colorimetric method using ELITech-Wako kits and the amount of internal variation of the test (accuracy) for the cholesterol, triglyceride and HDL-C measuring kit, respectively, 4, 4- and 4.5 and the sensitivity of the kits were 3, 4, 1 mg, respectively.

During the study, maintenance, administration of various substances, blood sampling and killing of animals were performed according to standard methods of working with laboratory animals and under the supervision of the ethics committee of Zabol University.

Calculation of Cholesterol Low-Density Lipoproteins (LDL-C)

LDL-C was calculated using the Friedwald formula [77].

$$\text{LDL-C} = \frac{\text{Total cholesterol}}{\text{HDL-C} + \text{Triglycerid}/5}$$

2.7. Statistical analysis of data

The SPSS-13 software package was used for data analysis. Quantitative data were presented as mean standard deviation (mean \pm SD) and significant differences between groups were analyzed by one-way analysis of variance (ANOVA) and the Duncan test. Differences were considered significant at the level of $P < 0.05$. Kolmogorov-Smirnov statistical test was used to determine the normality of data scatter distribution.

3. Results

At the beginning of the study, the amount of food consumed by the animals in each group was measured and recorded with a scale every day. Experimentally, 4 and 8% of the average daily food intake of the respective group was prepared as a solution of immature powder of Momordica quarantine fruit and fed to male rats by gavage. They were evaluated in the blood of patients with hyperlipidemia along with changes in body weight (Table 3).

In the first stage, after dividing the animals into 4 groups of 7 fasting blood samples and the average biochemical factors of cholesterol, total triglycerides and lipoproteins in the blood to assess health Groups were made (Table 4).

Then, changes in lipids and lipoproteins in the serum of rats after 8 weeks of feeding were examined using a high-fat diet to induce

hyperlipidemia. The results of this study are collected in Table (5).

Table 3. Comparison of the average food consumption and determining the amount of Carla fruit powder solution according to the average food consumption in the study groups

Gro up	Cages	Consum ed food (g/day)	Avera ge of each cage	Avera ge of group	The amount of Carla fruit powder solution in terms of the average food consumed by the group
	Number1	12.51 12.37 12.61	37.49+3- 12.50	12.50+1 2.27- 24.77+2 -12.39	100 12.39
8%	Number2	11.86	36.81+3- 12.27	12.74+1 2.88- 25.62 25.62+2 -12.81	8 x- 0.99
4%	Number3	12.45			
	Number4				

Table 4. Comparison of lipid and lipoprotein levels (in mg/dl) in the serum of healthy male rats in the first experimental period

Parame ters	Contro l group	hyperlipid emia	Experime ntal group 4%	Experime ntal group 8%
Total cholesterol	81.142 \pm 1.4	83.29 \pm 3.36	84.14 \pm 1.39	85.29 \pm 2.31
Triglyceride	55.5 \pm 6. 51	62.71 \pm 5.34	60.57 \pm 4.72	55.57 \pm 3.18
HDL	51 \pm 1.2 5	43.57 \pm 1.07	43.43 \pm 1.49	44.86 \pm 1.86
LDL	19.89 \pm 1.73	27.17 \pm 1.89	28.6 \pm 1.44	59.34 \pm 2.24

Table 5. Comparison of lipid and lipoprotein levels (in mg/dl) in serum of hyperlipidemic male rats in the second experimental period

Parame ters	Contro l group	hyperlipid emia	Experime ntal group 4%	Experime ntal group 8%
Total cholesterol	88.57 \pm 1.6 7bcd	184 \pm 1.86a	184.57 \pm 1.91a	183.57 \pm 1.53a
Triglyceride	94.29 \pm 10. 66	80.43 \pm 2.45	84 \pm 1.29	78.86 \pm 1.77
HDL	43.29 \pm 1.0 6bcd	16.86 \pm 0.46a	17 \pm 0.53a	16.14 \pm 0.4a
LDL	26.43 \pm 1.8 1bcd	151.49 \pm 1.89a	150.77 \pm 1.58a	151.66 \pm 1.87a

Values are presented as mean standard deviation (Mean \pm SD) for 7 rats in each group. A: significant difference with group 1, b: significant difference with group 2, c: significant difference with group 3, D: significant difference with the group ($P < 0.05$).

In the third stage, after blood sampling from experimental and control mice at the end of 15 days, the results of treatment with

The levels of 4% and 8% of the immature solution of Carla fruit powder are presented in Table (6).

Table 6. Comparison of lipid and lipoprotein levels (in mg/dl) in the serum of hyperlipidemic male rats in the third experimental period

Parameters	Control group	hyperlipid emia	Experimental group 4%	Experimental group 8%
Total cholesterol	89.871±1.7bcd	174.86±2.09ad	169±2.19ad	153.71±2.07abc
Triglyceride	100±7.58bcd	75.57±2.1a	78.86±14.4a	71.71±1.61a
HDL	42.57±1.21bcd	22.71±0.97a	21.43±0.61a	23.71±0.68a
LDL	27.14±1.67bcd	151.49±2.69ad	131.08±2.11ad	115.66±2.67abc

3.1. Evaluation of the effect of *Momordica charantia* unripe fruit powder solution on cholesterol

The effect of feeding different amounts (4%, 8%) of Carla unripe fruit powder solution on the reduction of total cholesterol in hyperlipidemic rats shows that if the hyperlipidemic control group returns to the hyper diet during the third stage, the mean total cholesterol of this The group decreases from 184.43 86 1.86 mg/dl to 174.86 2 2.09 mg/dl, ie by 5.20%. This decrease in the experimental groups is 8.44% and 16.30% (mean total of 12.37%), respectively. Duncan's test proves that the reduction of total cholesterol in the experimental groups 4% and 8% compared to the hyperlipidemic control group is significant. Is ($P<0.05$) (Figure 2).

3.2. Evaluation of the effect of immature fruit powder solution of *Momordica charantia* on the superiority of glyceride

Triglycerides in the hyperlipidemic control group decreased by 6.04% after discontinuation of high cholesterol nutrition. While in the experimental groups, this decrease was 6.11% and 9.06% (mean total 7.60%) of the Duncan test, respectively, which showed the reduction of triglyceride in the experimental group 8 compared to the hyperlipidemic control group was significant.

The effect of different experimental treatments on serum triglyceride levels in rats is shown in Figure 3.

3.3. Evaluation of the effect of *Momordica charantia* unripe fruit powder solution on HDL

The increase in HDL in the hyperlipidemic control group at the end of the third period of the experiment compared to the second period (Figure 3-4) is not significant and is considered a test error. However, the mean HDL in the experimental groups after adding the solution of immature Carla fruit powder showed an increase of 26.05% and 46.90%, respectively (Figure 4).

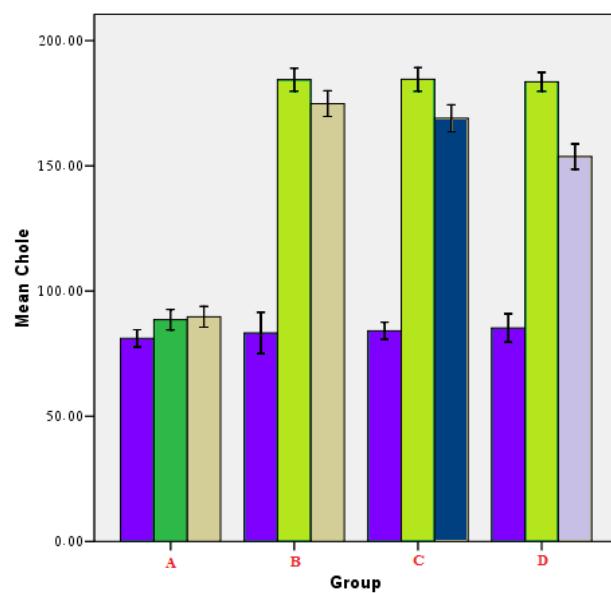


Fig. 2. Average cholesterol concentration (mg / dl); A (healthy control), B (hyperlipidemia), C (treatment by 0.4), D (treatment by 0.8).

* This symbol is used when the significance level is not zero but less than the test error (assumed in this dissertation 0.05); ** This symbol is used when the significance level (Sig) is zero.

3.4. Evaluation of the effect of *Momordica charantia* unripe fruit powder solution on LDL

At the end of the LDL test in the control group, hyperlipidemia decreased from 151.49 89 1.89 mg/dl (second period) to 137.03 69 2.69 mg/dl (third period), ie by 9.55%. In the experimental groups, this decrease reaches 13.06% and 23.74%. Duncan's test proves that the decrease in LDL in experimental groups 4% and 8% is significant compared to the hyperlipidemic control (Figure 5).

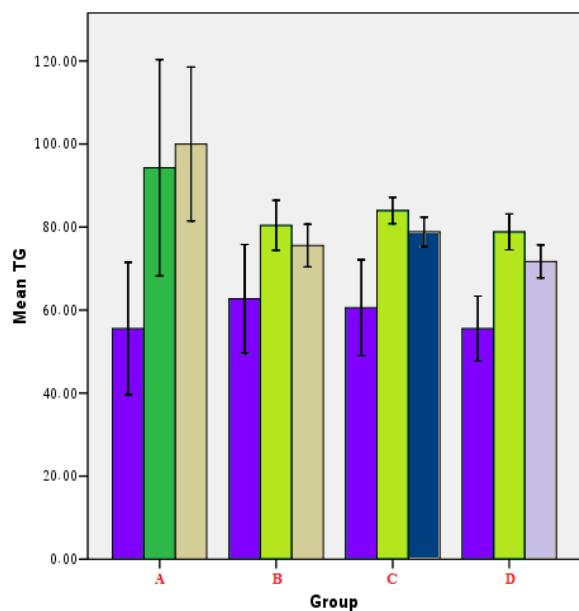


Fig. 3. Mean triglyceride concentration (mg / dl); A (healthy control), B (hyperlipidemia), C (treatment by 0.4), D (treatment by 0.8).

* This symbol is used when the significance level is not zero but less than the test error (assumed in this dissertation 0.05); ** This symbol is used when the significance level (Sig) is zero.

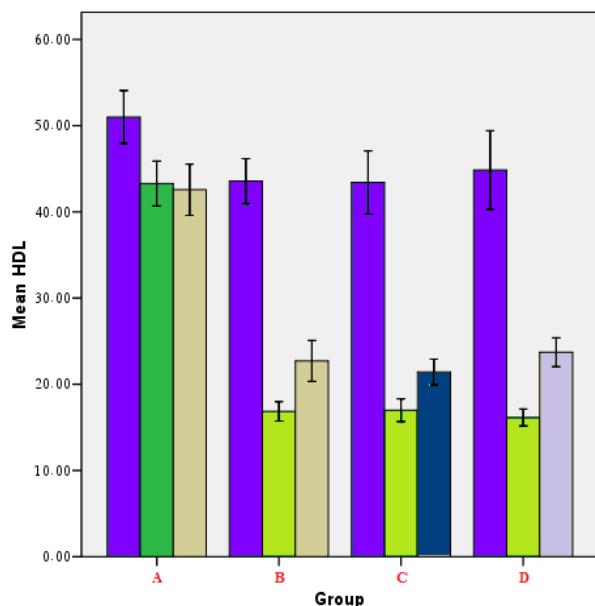


Fig. 4. Mean HDL concentration (mg / dl); A (healthy control), B (hyperlipidemia), C (treatment by 0.4), D (treatment by 0.8).

* This symbol is used when the significance level is not zero but less than the test error (assumed in this dissertation 0.05); ** This symbol is used when the significance level (Sig) is zero.

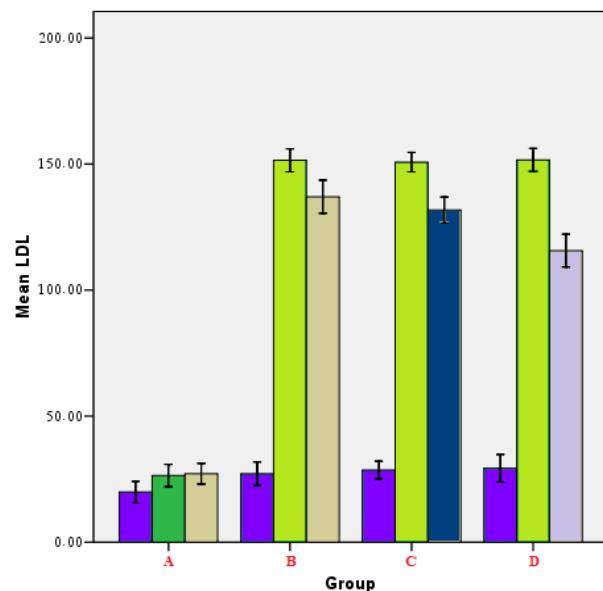


Fig. 5. Mean LDL concentration (mg / dl); A (healthy control), B (hyperlipidemia), C (treatment by 0.4), D (treatment by 0.8).

* This symbol is used when the significance level is not zero but less than the test error (assumed in this dissertation 0.05); ** This symbol is used when the significance level (Sig) is zero.

3.5. Evaluation of the effect of immature fruit powder solution of *Momordica charantia* on weight changes

The body weight of mice at the beginning of the study, the time of induction of hyperlipidemia and the end of the study of the intervention groups are summarized in Table (7) and Figure 6. As can be seen in this table, at the beginning of the study, the groups were identical in weight. Examination of the weight difference between hyperlipidemia groups shows that the average difference in weight loss in the hyperlipidemia control group and groups 4% and 8% is 1.23, / 90 and 3.30 g, respectively.

Values are presented as mean standard deviation (Mean \pm SD) for 7 rats in each group. A: significant difference with group 1, b: significant difference with group 2, c: significant difference with group 3, d: Significant difference with the group (P < 0.05).

Table 7. Comparison of weight (g) of mice in the intervention groups at the beginning of the study, the time of induction of hyperlipidemia and the end of the study

Body weight of mice	Healthy control	Hyperlipidemia	Hyper + Carla (Dose 4%)	Hyper + Carla (Dose 8%)
The beginning of the study	231.29±1.95	235.14±3.80	2314±5.15	231.4±3.80
Induction time of hyperlipidemia	247.1±1.59bcd	289.43±2.71ad	288.29±3.85a	280.71±2.5ab
End of study	250.43±3.5bcd	285.86±2.58ad	282.8±3.9ad	271.57±2.7abc

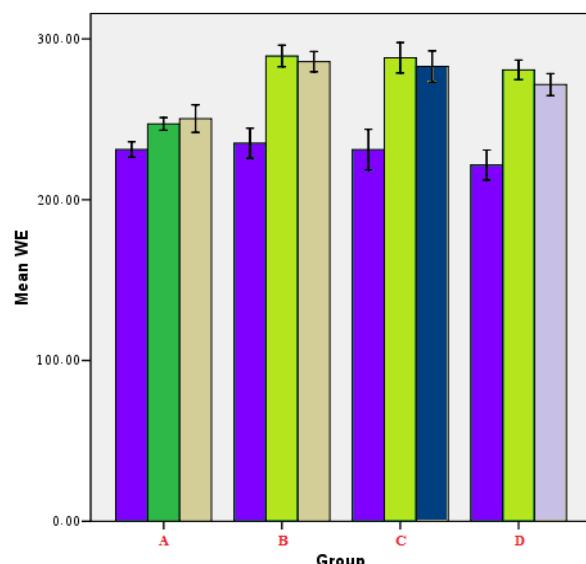


Fig. 6. Comparison of weight difference in grams between different groups at the beginning of the study, time of induction of hyperlipidemia, end of the study

* This symbol is used when the significance level is not zero but less than the test error (assumed in this dissertation 0.05); ** this symbol is used when the significance level (Sig) is zero.

4. Discussion

In this study, the effect of *Momordica charantia* unripe fruit on total cholesterol, total triglyceride and other lipoproteins in mice with hyperlipidemia was investigated. The addition of 25% soybean oil, 10% cholesterol, 13% fiber, 4,538.4 kcal/kg in eight weeks could c This study shows that oral administration (gavage) of immature fruit powder solution in a short period (15 days) was able to reduce cholesterol and LDL levels in experimental groups of 4 and 8% and triglyceride levels in 8% group and HDL levels in Increase the dose 8.

One of the main components of the fruit of *Momordica* quarantine is flavonoids[32]. This

study shows that oral administration (gavage) of immature fruit powder solution in a short period (15 days) was able to reduce cholesterol and LDL levels in experimental groups of 4 and 8% and triglyceride levels in the 8% group and HDL levels in Increase the dose 8%.

One of the main components of the fruit of *Momordica* quarantine is flavonoids[32]. The results of studies have shown that flavonoids from various plant sources, by increasing LDL receptors on the surface of liver cells and binding to apolipoprotein B, increase LDL uptake from the blood and decrease plasma lipids, and thus can prevent and treat Atherosclerosis is effective[33]. Because these flavonoids are in the form of aglycones, they have a rapid and significant intestinal absorption due to their special spatial shape. Previous studies have shown that these flavonoids inhibit arachidonic acid metabolism.

Caffeic acid in plants with O quinol groups such as flavonoids potentially has antioxidant properties and thus may have been effective in normalizing blood lipids[34]. Antioxidants are phytochemicals that have beneficial effects in reducing atherosclerosis and other cardiovascular diseases by preventing cholesterol from sticking to the walls of arteries, reducing the oxidation of unsaturated fatty acids and reducing free radicals in preventing cell destruction [35]. Plant antioxidants have an insulin-like effect and increase glucose uptake into peripheral tissues [36]. In order to determine the mechanism of action of MC at the molecular level, two very important substances called polypeptide P and chitin attached to gala ketosis, which have insulin-like properties in fat cells, have been identified in this plant. It is visible [37, 38]. Also, the fibers and saponins in the fruit extract of this plant can reduce the oral absorption of fats [39, 40]. In addition, Carla absorbable fiber helps lower cholesterol by binding bile fatty acids and excreting them in the feces. Bile acids are compounds that use cholesterol in the liver to digest the fat produced. When excreted with the fiber in Carla, the liver must use more cholesterol to produce its bile acids [41].

Increasing the conversion of cholesterol to bile acids is also effective in reducing lipids and lipoproteins. Cholesterol hydroxylation is the first and most important regulatory step in the biosynthesis of bile acids that is catalyzed by the enzyme 7a hydroxylase. Chylomicrons cause free fatty acids to be released for burning and energy production or storage as fat. In this way, the concentration of cholesterol, which is a component of lipoproteins, is reduced, followed by the center of lipoproteins[42, 43].

This mechanism probably explains the reduction in cholesterol and lipoproteins in the present study. Since HDL is good cholesterol, higher HDL levels reduce the incidence of coronary heart disease[44, 45]. Becomes. One of the most important strategies used to increase HDL is to use a low-fat, low-cholesterol diet[46]. By reducing the conversion of LDL to oxidized form and reducing the effect of oxidized LDL, it plays a major role in protection against cardiovascular disease. The major properties of HDL are related to its associated proteins. Most of the antioxidant properties of HDL are related to the enzyme paraxonase-1, which binds to HDL and travels with it in the blood [83].In the present study, the results show that Momordicacarantia unripe fruit powder, due to its terpenoid and flavonoid compounds, like other dark squash plants, in addition to hyperglycemic effect, reduces Triglycerides is in the blood.

5. Conclusion

The results of this study showed that consumption of 4 and 8% unripe fruit powder of Momordica quarantine in the experimental hyperlipidemic model had lipid-lowering effects and it can be claimed that the lipid-lowering effects of 4% and 8% of Momordica quarantine powder and especially 8% powder The plant is prominent in experimental animal studies and may be effective in treating hyperlipidemic patients. Considering the total properties proposed for Momordicacarantia in this study, it seems that the reason for the decrease in cholesterol, triglyceride and LDL in the experimental groups could be due to compounds such as phenolic compounds and their derivatives flavonoids, fiber, antioxidant properties and

other substances contained in unripe fruit powder.

Conflict of Interests

All authors declare no conflict of interest.

Ethics approval and consent to participate

In this research, for the use of laboratory animals, ethical protocols have been followed in accordance with the guidelines for dealing with laboratory animals.

Consent for publications

All authors read and approved the final manuscript for publication.

Availability of data and material

All the data are embedded in the manuscript.

Authors' Contribution

All authors had an equal role in study design, work, statistical analysis and manuscript writing.

Informed Consent

The authors declare not to use any patients in this research.

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References

- VishnuVardhan Reddy M, Rajani A, Nikitha S, Thomas J, Hemamalini K (2014) Anti-hyperlipidemic activity of *Trichopus zeylanicus* leaves against high fat diet and triton X-100 induced hyperlipidemia. *World J Pharm Pharm Sci* 3: 1017-1025. doi: Corpus ID: 74108366
- Matos SL, Paula Hd, Pedrosa ML, Santos RCd, Oliveira ELd, Chianca Júnior DA, Silva ME (2005) Dietary models for inducing hypercholesterolemia in rats. *Brazilian archives of biology and technology* 48 (2): 203-209.

3. Raggi P, Genest J, Giles JT, Rayner KJ, Dwivedi G, Beanlands RS, Gupta M (2018) Role of inflammation in the pathogenesis of atherosclerosis and therapeutic interventions. *Atherosclerosis* 276: 98-108. doi: <https://doi.org/10.1016/j.atherosclerosis.2018.07.014>
4. Yang N, Lin M, Wang B, Zeng W, He Y, Peng H, Zeng J, Wu Z, Zhong Y (2016) Low level of low-density lipoprotein cholesterol is related with increased hemorrhagic transformation after acute ischemic cerebral infarction. *Eur Rev Med Pharmacol Sci* 20 (4): 673-678. doi:
5. Hayatghaibi H, Karimi I, Yousefi M (2008) Effect of *Cannabis Sativa* L. (Isfahan Variety) Powder on Serum Lipid Profile in Male Rats. *Iranian Journal of Endocrinology and Metabolism* 9 (4): 423-427.
6. Alimanesh Z, Alimanesh Z, Davari F, Shadmehri S, Ahmadi M, Hosseini SA, Dolati S, Far AH (2020) The Effect of Continued Training with Crocin on Apoptosis Markers in Liver Tissue of High Fat Diet Induced Diabetic Rats. *Molecular & Cellular Biomechanics* 17 (4): 155-163. doi: <https://doi.org/10.32604/mcb.2020.011532>
7. Akinmoladun AC, Ibukun E, Afor E, Obuotor EM, Farombi E (2007) Phytochemical constituent and antioxidant activity of extract from the leaves of *Ocimum gratissimum*. *Scientific Research and Essays* 2 (5): 163-166. doi: <https://doi.org/10.5897/SRE.9000731>
8. Alavi M, Rai M, Martinez F, Kahrizi D, Khan H, Rose Alencar de Menezes I, Douglas Melo Coutinho H, Costa JGM (2022) The efficiency of metal, metal oxide, and metalloid nanoparticles against cancer cells and bacterial pathogens: different mechanisms of action. *Cell Mol Biomed Rep* 2 (1): 10-21. doi: <Https://doi.org/10.55705/cmbr.2022.147090.1023>
9. Alavi M, Rai M (2021) Antisense RNA, the modified CRISPR-Cas9, and metal/metal oxide nanoparticles to inactivate pathogenic bacteria. *Cell Mol Biomed Rep* 1 (2): 52-59. doi: <https://doi.org/10.55705/cmbr.2021.142436.1014>
10. Alavi M, Adulrahman NA, Haleem AA, Al-Rawanduzi ADH, Khusro A, Abdelgawad MA, Ghoneim MM, Batiha GE-S, Kahrizi D, Martinez F, Koirala N (2022) Nanoformulations of curcumin and quercetin with silver nanoparticles for inactivation of bacteria. *Cell Mol Biol* 67 (5): 151-156. doi: <https://doi.org/10.14715/cmb/2021.67.5.21>
11. Shabab S, Gholamnezhad Z, Mahmoudabady M (2021) Protective effects of medicinal plant against diabetes induced cardiac disorder: A review. *Journal of Ethnopharmacology* 265: 113328. doi: <https://doi.org/10.1016/j.jep.2020.113328>
12. Fazeli-Nasab B, Shahraki-Mojahed L, Sohail-beygi G, Ghafari M (2022) Evaluation of Antimicrobial Activity of Several Medicinal Plants Against Clinically Isolated *Staphylococcus aureus* from Humans and Sheep. *Gene Cell Tissue* 9 (2): e118752. doi: <https://doi.org/10.5812/gct.118752>
13. Fazeli-Nasab B, Shahraki-Mojahed L, Dahmardeh N (2022) Evaluation of antimicrobial activity of essential oil and ethanolic extract of 10 medicinal plants on *Rathayibacter tritici* and *Xanthomonas translucens*. *Plant Biotechnology Persia* 4 (1): 10-17.
14. Valizadeh M, ur Rehman F, Hassanzadeh MA, Beigomi M, Fazeli-Nasab B (2021) Investigating the Antimicrobial Effects of *Glycyrrhiza glabra* and *Salvia officinalis* Ethanolic Extract Against *Helicobacter pylori*. *Int J Infect* 8 (4): e114563. doi: <https://doi.org/10.5812/iji.114563>
15. Shanmugam S, Manikandan K, Rajendran K (2009) Ethnomedicinal survey of medicinal plants used for the treatment of diabetes and jaundice among the villagers of *Sivagangai District*, Tamilnadu. *Ethnobotanical leaflets* 13: 189-194. doi:
16. Mehrabi A-A, Fazeli-Nasab B (2012) In vitro culture of *Allium scorodoprasum* spp. *Rotundum*: callus induction, somatic embryogenesis and direct bulblet formation. *Intl J Agri Crop Sci* 4 (1): 1-7.
17. Fazeli-nasab B, Fooladvand Z (2014) Classification and Evaluation of medicinal plant and medicinal properties of mastic. *International Journal of Advanced*

- Biological and Biomedical Research 2 (6): 2155-2161.
18. Bortolotti M, Mercatelli D, Polito L (2019) *Momordica charantia*, a nutraceutical approach for inflammatory related diseases. Frontiers in pharmacology 10: 486. doi: <https://doi.org/10.3389/fphar.2019.00486>
19. Peter EL, Kasali FM, Deyno S, Mtewa A, Nagendrappa PB, Tolo CU, Ogwang PE, Sesaaizi D (2019) *Momordica charantia* L. lowers elevated glycaemia in type 2 diabetes mellitus patients: Systematic review and meta-analysis. Journal of Ethnopharmacology 231: 311-324. doi: <https://doi.org/10.1016/j.jep.2018.10.033>
20. Sur S, Ray RB (2020) Bitter melon (*Momordica charantia*), a nutraceutical approach for cancer prevention and therapy. Cancers 12 (8): 2064. doi: <https://doi.org/10.3390/cancers12082064>
21. Chen F, Huang G, Huang H (2021) Preparation, analysis, antioxidant activities in vivo of phosphorylated polysaccharide from *Momordica charantia*. Carbohydrate polymers 252: 117179. doi: <https://doi.org/10.1016/j.carbpol.2020.117179>
22. Farina V, Gentile C, Sortino G, Gianguzzi G, Palazzolo E, Mazzaglia A (2020) Tree-ripe mango fruit: Physicochemical characterization, antioxidant properties and sensory profile of six Mediterranean-grown cultivars. Agronomy 10 (6): 884. doi: <https://doi.org/10.3390/agronomy10060884>
23. Rohde C, Wittmann J, Kutter E (2018) Bacteriophages: A therapy concept against multi-drug-resistant bacteria. Surgical infections 19 (8): 737-744. doi: <https://doi.org/10.1089/sur.2018.184>
24. Azeez SH, Jafar SN, Aziziaran Z, Fang L, Mawlood AH, Ercisli MF (2021) Insulin-producing cells from bone marrow stem cells versus injectable insulin for the treatment of rats with type I diabetes. Cell Mol Biomed Rep 1 (1): 42-51. doi: <https://doi.org/10.55705/cmbr.2021.13888.1006>
25. Saravani K, Afshari M, Aminisefat A, Bameri O (2021) Blood Sugar Changes in Patients with Acute Drug Poisoning. Cell Mol Biomed Rep 1 (2): 91-97. doi: <http://dx.doi.org/10.55705/cmbr.2021.146061.1022>
26. Thomford KP, Thomford AK, Yorke J, Yeboah R, Appiah AA (2021) *Momordica charantia* L. for hyperlipidaemia: A randomised controlled assessment of the Ghanaian herbal medicinal product MCP-1. Journal of Herbal Medicine 28: 100453. doi: <https://doi.org/10.1016/j.hermed.2021.100453>
27. Bajaj S (2018) RSSDI clinical practice recommendations for the management of type 2 diabetes mellitus 2017. International journal of diabetes in developing countries 38 (1): 1-115. doi: <https://doi.org/10.1007/s13410-018-0604-7>
28. Cortez-Navarrete M, Martinez-Abundis E, Pérez-Rubio KG, González-Ortiz M, Méndez-del Villar M (2018) *Momordica charantia* administration improves insulin secretion in type 2 diabetes mellitus. Journal of medicinal food 21 (7): 672-677. doi: <https://doi.org/10.1089/jmf.2017.0114>
29. Masi D, Spoltore ME, Rossetti R, Watanabe M, Tozzi R, Caputi A, Risi R, Balena A, Gandini O, Mariani S (2022) The Influence of Ketone Bodies on Circadian Processes Regarding Appetite, Sleep and Hormone Release: A Systematic Review of the Literature. Nutrients 14 (7): 1410. doi: <https://doi.org/10.3390/nu14071410>
30. Giagulli VA, Castellana M, Murro I, Pelusi C, Guastamacchia E, Triggiani V, De Pergola G (2019) The role of diet and weight loss in improving secondary hypogonadism in men with obesity with or without type 2 diabetes mellitus. Nutrients 11 (12): 2975. doi: <https://doi.org/10.3390/nu11122975>
31. Kardos D, Simon M, Vácz G, Hinsenkamp A, Holczer T, Cseh D, Sárközi A, Szenthe K, Bánáti F, Szathmary S (2019) The composition of hyperacute serum and platelet-rich plasma is markedly different despite the similar production method. International Journal of Molecular Sciences 20 (3): 721. doi: <https://doi.org/10.3390/ijms20030721>
32. Fatahi-Azad F, Alaf-Akbari N, Zakheri A, Andalib S, Maleki-Dizaji N, Gharah-Baghian

- A, Ghorbani-Haghjou A, Fakhrjou A, Garjani AR (2010) Hypolipidemic and antioxidant effects of *Securigera securidaca* L. seed in high fat fed rats. *Pharmaceutical Sciences* 15 (4): 293-301.
33. Quideau S, Deffieux D, Douat-Casassus C, Pouységu L (2011) Plant polyphenols: chemical properties, biological activities, and synthesis. *Angewandte Chemie International Edition* 50 (3): 586-621. doi: <https://doi.org/10.1002/anie.201000044>
34. Shahrani M, Pilehvarian AA, Kheyri S, Asgari A, Farokhi E, Parvin N, Rafieian-Kopaei M (2009) Effects of *Kelussia odoratissima* Mozaffarian (KOM) extract on blood lipid in Balb/c mice. *Journal of Shahrekord University of Medical Sciences* 10: 50-56.
35. Ignarro LJ, Balestrieri ML, Napoli C (2007) Nutrition, physical activity, and cardiovascular disease: an update. *Cardiovascular research* 73 (2): 326-340. doi: <https://doi.org/10.1016/j.cardiores.2006.06.030>
36. Fazeli-Nasab B, Valizadeh M, Hassanzadeh MA, Beigomi M (2021) Evaluation of the Antimicrobial Activity of Olive and Rosemary Leave Extracts Prepared with Different Solvents Against Antibiotic-Resistant *Escherichia coli*. *Int J Infect* 8 (3): e114498. doi: <https://doi.org/10.5812/iji.114498>
37. Dabek A, Wojtala M, Pirola L, Balcerzyk A (2020) Modulation of cellular biochemistry, epigenetics and metabolomics by ketone bodies. Implications of the ketogenic diet in the physiology of the organism and pathological states. *Nutrients* 12 (3): 788. doi: <http://dx.doi.org/10.3390/nu12030788>
38. Dąbek A, Wojtala M, Pirola L, Balcerzyk A (2020) Modulation of cellular biochemistry, epigenetics and metabolomics by ketone bodies. Implications of the ketogenic diet in the physiology of the organism and pathological states. *Nutrients* 12 (3): 788. doi: <https://doi.org/10.3390/nu12030788>
39. Marrelli M, Conforti F, Araniti F, Statti GA (2016) Effects of saponins on lipid metabolism: A review of potential health benefits in the treatment of obesity. *Molecules* 21 (10): 1404. doi: <https://doi.org/10.3390/molecules21101404>
40. Cohn JS, Kamili A, Wat E, Chung RW, Tandy S (2010) Reduction in intestinal cholesterol absorption by various food components: mechanisms and implications. *Atherosclerosis Supplements* 11 (1): 45-48. doi: <https://doi.org/10.1016/j.atherosclerosisup.2010.04.004>
41. Silva Figueiredo P, Carla Inada A, Marcelino G, Maiara Lopes Cardozo C, de Cássia Freitas K, De Cássia Avellaneda Guimarães R, Pereira de Castro A, Aragão do Nascimento V, Aiko Hiane P (2017) Fatty acids consumption: the role metabolic aspects involved in obesity and its associated disorders. *Nutrients* 9 (10): 1158. doi: <https://doi.org/10.3390/nu9101158>
42. Madani H, Ahmady Mahmoodabady N, Vahdati A (2005) Effects of hydroalcoholic extract of *Anethum graveolens* (Dill) on plasma glucose and lipid levels in diabetes induced rats. *Iranian Journal of Diabetes and Metabolism* 5 (2): 109-116.
43. Murray RK, Granner DK, Rodwell VW (2006) Harper's illustrated biochemistry. vol 577.1 HAR.
44. Gordon DJ, Knoke J, Probstfield J, Superko R, Tyroler H (1986) High-density lipoprotein cholesterol and coronary heart disease in hypercholesterolemic men: the Lipid Research Clinics Coronary Primary Prevention Trial. *Circulation* 74 (6): 1217-1225. doi: <https://doi.org/10.1161/01.CIR.74.6.1217>
45. Adorni MP, Ronda N, Bernini F, Zimetti F (2021) High density lipoprotein cholesterol efflux capacity and atherosclerosis in cardiovascular disease: pathophysiological aspects and pharmacological perspectives. *Cells* 10 (3): 574. doi: <https://doi.org/10.3390/cells10030574>
46. Kontush A (2020) HDL and reverse remnant-cholesterol transport (RRT): relevance to cardiovascular disease. *Trends in Molecular Medicine* 26 (12): 1086-1100. doi: <https://doi.org/10.1016/j.molmed.2020.07.005>



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