



## REVIEW ARTICLE

# A Review of Herbal Antioxidants Effective on Hyperlipidemia in Iranian Ethnobotanical Knowledge and with Their Mechanisms of Action

Ali Soleimani, Ozra Asham\*

Department of Cardiology, School of Medicine, Urmia University of Medical Sciences, Urmia, Iran

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## KEYWORDS

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**ABSTRACT:** Elevated blood lipid levels can lead to the deposition of lipids within the vascular walls, resulting in vessel constriction. Prompt and appropriate intervention for hyperlipidemia is crucial not only to prevent the onset of coronary artery narrowing but also to hinder its progression and potentially facilitate its reversal. Many plants, including vegetables and fruits, demonstrate cholesterol-lowering properties attributed to their fiber content. This study aims to identify medicinal plants within Iranian ethnobotanical knowledge that exhibit potential efficacy in managing hyperlipidemia. This review employed reputable databases to aggregate data on phytotherapeutic species with potential efficacy in managing hyperlipidemia. A comprehensive search strategy was implemented, utilizing specific keywords such as 'medicinal plants,' 'blood lipids,' 'hyperlipidemia,' 'phytotherapy,' and 'ethnobotany' in both English and their respective translations. The selected articles underwent a rigorous screening process, adhering to criteria such as publication date within the past twelve years, unrestricted access, and substantial information on the impact of botanical species on hyperlipidemia. Based on the obtained results, it was determined that the medicinal plant's *Thymus vulgare*, *Apium graveolens*, *Cichorium intybus*, *Fumaria officinali*, *Cynodon dactylon*, *Heracleum rawianum*, *Anthemis altissima*, *Gundelia tournefortii*, *Anthriscus sylvestris*, *Silybum marianum*, *Tragopogon aureus*, *Trigonella foenum-graecum*, *Solanum nigrum*, *Berberis vulgaris*, *Glycyrrhiza glabra*, *Cichorium intybus*, *Arum elongatum*, *Rheum ribes*, *Mentha spicata*, and several other medicinal plants are used in different regions of Ayaran for hyperlipidemia. The use of indigenous medicinal plants from Iran in the management of hyperlipidemia, grounded in ethnobotanical knowledge, is not only historically significant but also supported by contemporary scientific research. These botanical agents can effectively lower blood lipid levels through various mechanisms, including the inhibition of lipid absorption and the enhancement of metabolic rates. The growing interest in traditional medicine and the utilization of these botanical resources has gained popularity due to their inherent advantages and reduced side effects compared to synthetic pharmaceuticals. Continued scholarly investigation in this area holds promise for the development of innovative and effective therapeutic agents derived from these plants.

## INTRODUCTION

Hyperlipidemia, a common metabolic disorder characterized by elevated blood lipid levels, can lead to the

\*Corresponding author: asham.o@umsu.ac.ir (O. Asham)  
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accumulation of fat in arterial walls, forming atherosclerotic plaques and increasing the risk of cardiovascular diseases [1]. Prevalent in developed countries, its prevalence rises with age, especially in men [2]. Lifestyle factors such as high-fat diets, inactivity, and obesity contribute to its increased prevalence [2]. The pathophysiology of hyperlipidemia involves an imbalance in lipoprotein metabolism, leading to excessive lipid accumulation in the blood [3]. Elevated low-density lipoprotein [LDL] and decreased high-density lipoprotein [HDL] are key indicators of this disorder [4]. Oxidized LDL can adhere to arterial walls, accelerating atherosclerosis and potentially leading to arterial blockage and reduced blood flow to vital organs [4]. Genetic factors, such as familial hypercholesterolemia, can also contribute to hyperlipidemia by impairing LDL destruction [5]. Environmental factors, including a diet rich in saturated and trans fats, physical inactivity, and excessive alcohol consumption, can further exacerbate hyperlipidemia [5]. Additionally, diseases like diabetes and hypothyroidism can be secondary factors [5]. Hyperlipidemia is a significant risk factor for cardiovascular diseases and is more prevalent in individuals with unhealthy lifestyles [6]. Lifestyle modifications, including dietary changes, increased physical activity, and weight loss, can effectively reduce blood lipid levels and mitigate the associated risks. Furthermore, pharmacological interventions, such as statins, are widely used to manage this disorder [7]. Traditional medicine and medicinal plants offer a promising complementary and alternative approach to managing hyperlipidemia [8]. These botanical agents can effectively regulate lipid metabolism and reduce cholesterol and triglyceride levels [8]. Unlike chemical drugs, which often have numerous side effects, medicinal plants are generally associated with fewer adverse effects and can be used safely over extended periods [8]. Emphasizing a holistic approach and maintaining bodily balance, traditional medicine strengthens the body's systems and focuses on preventing diseases rather than solely treating symptoms [9]. In managing hyperlipidemia, traditional medicine employs principles such as balanced diets, the use of plants with anti-inflammatory and fat-reducing

properties, and regular physical exercise [9]. In recent years, there has been a significant increase in the use of medicinal plants for hyperlipidemia, driven by a desire for more natural treatment methods and a reduction in concerns related to chemical drug side effects [10]. Medicinal plants are considered effective alternatives or supplements due to their ability to reduce LDL cholesterol and increase HDL cholesterol [11]. Furthermore, the long-standing tradition and experience in using these plants have fostered trust in herbal treatments, leading to a greater tendency to utilize them [12]. This review aims to investigate and report on the medicinal plants employed in Iranian ethnobotanical traditions for the management of hyperlipidemia.

## MATERIALS AND METHODS

### *Search strategy*

To gather information on medicinal plants effective in managing hyperlipidemia, this review study utilized reputable databases. Key terms such as "medicinal plants," "blood fat," "hyperlipidemia," "medicinal plants," and "ethnobotany," along with their English equivalents, were employed in the search. The selected articles underwent a rigorous screening process, adhering to criteria like publication date within the past twelve years, unrestricted access, and substantial information on the impact of plants on hyperlipidemia.

### *Data analysis*

Following the selection of final articles, data pertaining to medicinal plants with potential efficacy in managing hyperlipidemia were extracted from ethnobotanical studies conducted in various regions of Iran. The collected information was organized into a tabular format.

### *Flowchart*

In the flowchart below, the steps of selecting and reviewing articles are shown in Figure 1.

1. Primary search →
2. Removing duplicate articles →
3. Checking the title and abstract →
4. Checking the full text

→ 5. Analyzing and synthesizing data and entering them into tables

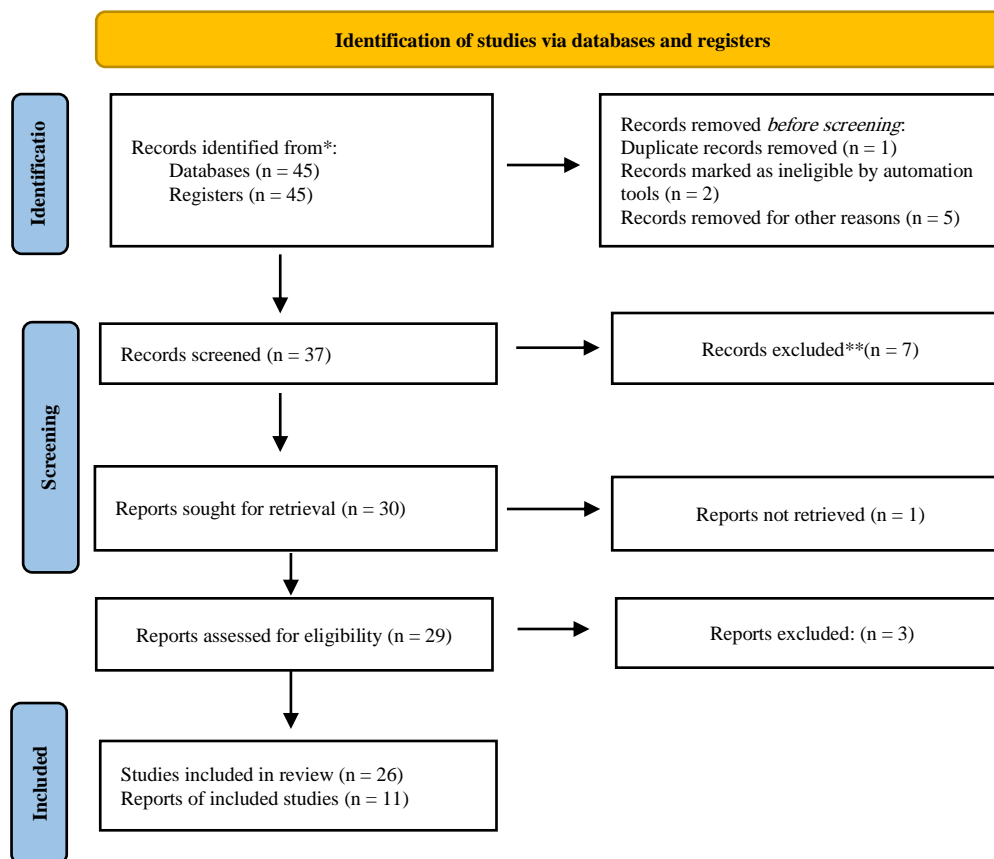


Figure 1. Search strategy flowchart

## Results

The results of the review of ethnobotanical studies in different regions of Iran showed that medicinal plants *Thymus vulgare*, *Apium graveolens*, *Cichorium intybus*, *Fumaria officinali*, *Cynodon dactylon*, *Heracleum rawianum*, *Anthemis altissima*, *Gundelia tournefortii*, *Anthriscus sylvestris*, *Silybum marianum*, *Tragopogon*

*aureus*, *Trigonella foenum-graecum*, *Solanum nigrum*, *Berberis vulgaris*, *Glycyrrhiza glabra*, *Cichorium intybus*, *Arum elongatum*, *Rheum ribes*, *Mentha spicata*, and several other medicinal plants are used in different regions of Iran for hyperlipidemi.(Table 1)

Table 1. Medicinal plants effective on hyperlipidemia in different parts of Iran based on ethnobotanical knowledge.

Scientific name	Common name	Family	Organ	Active Constituents	Anti-Hyperlipidemic Mechanism	Region
<i>Thymus vulgare</i>	Common thyme	Lamiaceae	The aerial part of the plant	Thymol, Carvacrol	Inhibits lipid peroxidation, Reduces LDL cholesterol	Urmia [13]
<i>Apium graveolens</i>	Chinese Celery	Apiaceae	The aerial part of the plant	Apiin, Flavonoids, Coumarins	Reduces cholesterol absorption, Increases lipid excretion	Behbahan [14]
<i>Cichorium intybus L.</i>	Chicory	Asteraceae	The aerial part of the plant	Inulin, Chicoric acid, Sesquiterpene lactones	Modulates lipid metabolism, Lowers serum cholesterol	Behbahan [14]
<i>Fumaria officinali</i>	Fumitory	Papavaraceae	Whole plant	Alkaloids [fumarine], Flavonoids	Enhances bile secretion, Promotes lipid metabolism	Behbahan [14]
<i>Cynodon dactylon [L.] Pers</i>	Bermuda grass manienie	Poaceae	Whole plant	Flavonoids, Saponins, Polyphenols	Reduces cholesterol absorption, Increases HDL levels	Behbahan [14]

<i>Heracleum rawianum</i>	Hogweed	Apiaceae	Stem, Leaf	Furanocoumarins	Reduces lipid peroxidation, Lowers blood lipid levels	Sareyn[15]
<i>Anthemis altissima</i>	Southern Chamomile	Asteraceae	Leaf, Flower	Flavonoids, Coumarins	Promotes lipid excretion, Reduces serum cholesterol	Sareyn[15]
<i>Gundelia tournefortii</i>	Tumble Thistle	Asteraceae	Stem, Root	Flavonoids, Polyphenols	Lowers serum lipid levels, Increases HDL levels	Sareyn[15]
<i>Anthriscus sylvestris</i>	Cow parsley	Apiaceae	Leaf, Root	Flavonoids, Polyphenols	Lowers serum lipid levels, Increases HDL levels	East of Khozestan[16]
<i>Gundelia tournefortii L.</i>	Tumble thistle	Asteraceae	Stem	Flavonoids, Saponins, Sesquiterpenes	Reduces LDL oxidation, Inhibits cholesterol synthesis	East of Khozestan[16]
<i>Silybum marianum L.</i>	Milk thistle	Asteraceae	Root, Fruit	Silymarin	Protects liver cells, Lowers cholesterol	East of Khozestan[16]
<i>Tragopogon aureus Boiss</i>	Goatsbeard or Salsify	Asteraceae	Fruit, Leaf	Flavonoids, Phenolic acids	Inhibits lipid absorption, Reduces triglycerides	East of Khozestan[16]
<i>Trigonella foenum-graecum L.</i>	Fenugreek	Papilionacea	Seed	Saponins, Diosgenin, Fiber	Inhibits cholesterol absorption, Lowers triglycerides	East of Khozestan[16]
<i>Solanum nigrum L</i>	European black nightshade	Solanaceae	Fruit	Solanine, Solasonine, Flavonoids	Modulates lipid metabolism, Reduces cholesterol synthesis	East of Khozestan[16]
<i>Berberis vulgaris L</i>	Barberry	Berberidaceae	Fruit	Berberine	Inhibits cholesterol synthesis, Increases bile secretion	Meshkin Shahr [17]
<i>Glycyrrhiza glabra L.</i>	Licorice	Fabaceae	Rhizome	Glycyrrhizin	Inhibits LDL oxidation, Reduces cholesterol absorption	Meshkin Shahr [17]
<i>Cichorium intybus L.</i>	Chicory	Compositae	Leaf, Root	luteolin	Modulation of Lipid Metabolism	Abadeh [18]
<i>Arum elongatum</i>	Arum	Araceae	Leaf	Saponins, Alkaloids	Promotes lipid metabolism, Reduces blood lipid levels	Abadeh [18]
<i>Glycyrrhiza glabra L.</i>	Licorice	Leguminosae	Root, Leaf	Glycyrrhizin	Inhibits LDL oxidation, Reduces cholesterol absorption	Abadeh [18]
<i>Rheum ribes L.</i>	Syrian rhubarb	Polygonaceae	Leaf	Anthraquinones, Tannins, Polyphenols	Enhances lipid metabolism, Reduces cholesterol	Abadeh [18]
<i>Gundelia serriola L.</i>	Tumbleweed	Asteraceae	The aerial part, Stem	Quercetin, kaempferol	Inhibition of Cholesterol Synthesis, Modulation of Lipid Metabolism	Amol [19]
<i>Onopordum heteracanthum</i>	Cottonthistle	Asteracea	Flower	Quercetin, luteolin and saponins	Inhibition of Lipid Absorption	Raz and Jargalan [20]
<i>Gundelia tournefortii L</i>	Tournefort's gundelia	Asteracea	The aerial part	kaempferol	Inhibition of Lipid Absorption	Mobarakeh [21]
<i>Mentha spicata L</i>	Spearmint	Lamiaceae	Flowering shoot	Menthol, Rosmarinic acid, Flavonoids	Reduces cholesterol absorption, Modulates lipid metabolism	Mobarakeh [21]
<i>Rumex crispus L.</i>	Curly dock	Polygonaceae	Leaf	Emodin, chrysophanol	Enhancement of Bile Acid Secretion	Mobarakeh [21]
<i>lilium sativum L.</i>	Garlic	Amaryllidaceae	Bulb	Quercetin	Modulation of Lipid Metabolism	Mashhad [22]
<i>Anethum graveolens L.</i>	Dill	Apiaceae	Fruit	Carvone, limonene, dillapiole	Modulation of Lipid Metabolism	Mashhad [22]
<i>Paliurus spina-christi</i>	Garland thorn	Rhamnaceae	Fruit, Leaf	Quercetin, kaempferol	Reduction of Cholesterol Absorption	Dehloran and abadan [23]
<i>Rheum ribes L.</i>	Syrian rhubarb	Polygonaceae	Stem	Emodin, rhein	Promotion of Bile Secretion	Dehloran and abadan [23]

Based on the data presented in the table, the following conclusions can be drawn as a comprehensive analysis of the effects of medicinal plants on reducing blood lipids:

Various plants from different families, such as Lamiaceae, Apiaceae, Asteraceae, and Polygonaceae, have been

utilized. This diversity reflects the high potential of these plant species to offer bioactive compounds that can influence lipid metabolism and reduce lipid levels.

Active compounds like flavonoids, saponins, polyphenols, and specific substances such as silymarin and carvacrol

play significant roles in these processes.

Most plants impact body fat levels through a variety of mechanisms. Common mechanisms include reducing cholesterol absorption, increasing bile secretion, inhibiting LDL oxidation, and regulating lipid metabolism. These mechanisms are widely employed and demonstrate that plants not only help lower cholesterol but also balance LDL and HDL levels.

The plants studied grow in various regions of Iran, such as Urmia, Behbahan, Ardabil, Amol, and Mashhad. This geographic distribution highlights the use of local natural resources in traditional herbal treatments, which plays a crucial role in preventing hyperlipidemia.

Some plants, like *Cichorium intybus* [chicory] and *Gundelia tournefortii* [tumble thistle], appear multiple times in the table due to their extensive effects in lowering blood lipids and raising HDL levels. These repetitions indicate the significant and potent impact of these plants in anti-hyperlipidemic treatments, particularly as their lipid-lowering effects are utilized in various regions.

Given the broad effects of these plants in regulating lipid metabolism, it can be concluded that they are not only effective in reducing blood lipids but can also serve as preventive and therapeutic methods in combating cardiovascular diseases. Inhibiting cholesterol synthesis and LDL oxidation can help reduce the risk of atherosclerosis.

## DISCUSSION

Hyperlipidemia, a clinical condition characterized by elevated blood lipid levels, is a significant risk factor for cardiovascular diseases, including arteriosclerosis, heart attacks, and strokes [24]. The prevalence of hyperlipidemia in developing countries is often attributed to rapid lifestyle changes, such as unhealthy eating habits and reduced physical activity [24]. In recent years, there has been a growing interest in traditional medicine and medicinal plants as potential alternatives for managing hyperlipidemia, driven by concerns about chemical drug side effects and a desire for natural and low-risk approaches.

Medicinal plants offer a natural and traditional approach to managing hyperlipidemia, effectively lowering blood lipid levels through various mechanisms. Many medicinal plants contain antioxidant compounds that inhibit the oxidation of low-density lipoprotein [LDL], a key contributor to the development of fatty plaques and arterial blockages. Plants like milk thistle, chicory, and fumitory address hyperlipidemia through this mechanism [25-27]. Some medicinal plants, such as turmeric and olive, can reduce cholesterol absorption in the intestine, thereby lowering blood cholesterol levels [28, 29]. Plants like fenugreek and ginger can decrease cholesterol production in the liver by inhibiting cholesterol-producing enzymes [30, 31]. Chronic inflammation is a contributing factor to hyperlipidemia, and plants like ginger and thyme, with their anti-inflammatory properties, can help reduce inflammation and mitigate its effects [32, 33]. In conclusion, medicinal plants can effectively manage hyperlipidemia through multiple mechanisms. However, it is crucial to consult a healthcare professional before using these plants, especially if the individual is taking other medications [34-38]. Many of these plants contain compounds that effectively neutralize free radicals and prevent the oxidation of LDL cholesterol. Such compounds, including flavonoids, polyphenols, and essential oils, contribute to reducing oxidative stress [39]. This, in turn, lowers the risk of developing atherosclerosis and cardiovascular diseases. Medicinal plants that influence lipid metabolism can aid in the breakdown and reduction of triglycerides and LDL cholesterol levels in the blood [40]. These plants can modulate hepatic metabolic activities, enhancing the breakdown of fats and reducing lipid accumulation in the liver. Additionally, some medicinal plants can decrease cholesterol absorption in the intestines, thereby lowering blood cholesterol levels. Compounds such as saponins and dietary fibers found in these plants help reduce cholesterol absorption and increase its excretion from the body [41]. These mechanisms enable medicinal plants to effectively manage hyperlipidemia and improve cardiovascular health.

This study focuses on medicinal plants used in the ethnobotanical knowledge of Iran, which may limit the generalizability of the results to other regions and cultures

that might use different medicinal plants for hyperlipidemia. Ethnobotanical knowledge is often based on traditional uses and experiential evidence, which may not always align with scientific findings. Relying too heavily on traditional knowledge can introduce bias if not adequately supported by modern research. These are some of the study's limitations, highlighting the need for more comprehensive clinical studies and further research to better understand the effectiveness and safety of the medicinal plants reviewed in this study.

### CONCLUSIONS

Considering these factors, it can be concluded that medicinal plants recognized in traditional and ethnobotanical medicine are generally reliable, provided they are used with appropriate knowledge and precautions.

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### Conflict of interests

Informed consent was obtained from all individual participants included in the study.

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