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PJBS

ISSN 1028-8880

Pakistan Journal of Biological Sciences

ANSInet
Asian Network for Scientific Information
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

OPEN ACCESS Pakistan Journal of Biological Sciences

ISSN 1028-8880
DOI: 10.3923/pjbs.2019.537.544

Research Article
Purslane and Garden Cress Seeds as Source of Unconventional Edible Oils for Prevention of Hyperlipidemia

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Abstract

Background and Objective: Hyperlipidemia (HLP) is a leading cause for cardiovascular disease and atherosclerosis. Insufficient physical activity and unhealthy diet plays an important role in the progression of HLP. The present study was conducted to investigate the protective effect of 2 unconventional edible oils (purslane and garden cress) on hyperlipidemia. **Materials and Methods:** Diet high in fat and cholesterol was used as inducer of hyperlipidemia in rats for 5 weeks. Plasma and hepatic lipid profile were assessed. Plasma levels of malondialdehyde (MDA) as lipid peroxidation indicator was determined. Liver transaminases (AST and ALT) as liver function indicator and kidney function (creatinine and urea) were evaluated. **Results:** Results clarified significant elevation in plasma and liver lipid profiles, MDA, liver enzymes (AST and ALT) and kidney function (creatinine and urea) in hyperlipidemic control compared to normal control. Supplementation with purslane and garden cress seeds oils either in diet or oral showed significant improvement in all the studied parameters. **Conclusion:** Purslane and garden cress oils investigated in the current study produced significant reduction and elevation in bad and good cholesterol, respectively in plasma. Also both oils reduced hepatic lipid accumulation effectively in hyperlipidemia model in rats. Oils administration reduced plasma malondialdehyde and improves liver and kidney functions.

Key words: Purslane oil, garden cress oil, hyperlipidemia, rats, high fat diet

Citation: Doha Abdou Mohamed, Hend Abass Essa and Rasha Salah Mohamed, 2019. Purslane and garden cress seeds as source of unconventional edible oils for prevention of hyperlipidemia. Pak. J. Biol. Sci., 22: 537-544.

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Hyperlipidemia (HLP) or dyslipidemia is a disorder in lipid metabolism caused by various changes in lipid profile i.e. elevation in plasma levels of total cholesterol, triglycerides, very low-density lipoprotein cholesterol, low-density lipoprotein cholesterol, with a reduction in high-density lipoprotein cholesterol levels[1]. It is well known that nutrition represents one of the most important risk factors in the etiology and development of many diseases such as hyperlipidemia[2]. The HLP is a leading cause for cardiovascular disease and atherosclerosis and becoming a high risk factor for threatens human health[3]. High-fat diet consumption is a leading cause of hypercholesterolemia and cardiovascular disease[4]. Globally, 2.6 million deaths each year attributed to hyperlipidemia. According to a study in the years 2011-2012 conducted by the Ministry of Health and Population with the WHO office in Egypt, people 15-65 years old, showed a high fasting level of cholesterol (36.7%) and triglycerides (10.2%)[5]. National Cholesterol Education Program (NCEP) (adult treatment panel III) reported that an elevation in the level of cholesterol (non-HDL-C and LDL-C) is the main underling cause of atherosclerosis, the key underlying process contributing to most of clinical cardiovascular diseases[6]. Cardiovascular diseases are the leading cause of global mortality, accounting for 32% of the 56 million deaths[7] in 2015. Omega-3 polyunsaturated fatty acids and polyphenol play critical role in reduction of hyperlipidemia and cardiovascular disease risk[8,9].

In Egypt there is a large gap between the production of oils and the actual consumption. It is important to search for unconventional sources of vegetable oils, especially rich in omega-3 fatty acids, which possess health benefits. So in this research we studied two types of vegetable seeds rich in their content of oils. Dietary intervention by using edible plants oil rich in omega-3 fatty acids is a good strategy for management/or prevention of cardiovascular diseases. So in the present research two plant seeds rich in omega-3 fatty acids were evaluated in animal model of hyperlipidemia. The studied seeds are purslane and garden cress. Purslane (*Portulaca oleracea* L.) is one of the medicinal plants mostly used, throughout temperate and tropical areas of the world[10]. Purslane is one of the richest plant sources in omega-3 fatty acids[11,12], as well as purslane contain high levels of β-carotene, α-tocopherols and phenolic compounds which make it a health food for patients with cardiovascular diseases and may reduce oxidative stress and inflammation[13]. *Lepidium sativum*, famous as garden cress possesses hypolipemic, antioxidant and anti-inflammatory effect[14,15]. Garden cress seeds are containing 18-24% fat[16] of which ~34% of total fatty acids are linolenic acid[15]. Garden cress oil is also showed an ideal ratio of omega-3 fatty acids and omega-6 fatty acids, which possesses a cardio-protective effect[17,18]. The objective of the present study was evaluation of the protective effect of purslane and garden cress seeds oils as an unconventional edible oils on hyperlipidemia in rats.

MATERIALS AND METHODS

Materials: All the study was done in Department of Nutrition and Food Sciences, National Research Centre, Cairo, Egypt. The study was done during October, 2018-April, 2019.

Plant materials: Garden cress seeds, purslane seeds were purchased from local markets, Cairo, Egypt.

Animals: Male Sprague Dawley rats weighing 100-128 g (113.8±8.381 as Mean±SD) were used in the present study. Animals were obtained from Animal house of National Research Centre, Cairo, Egypt. Animals were kept individually in stainless steel metabolic cages; water and food were given *ad-libtium*.

Diets: Experimental diets were prepared as in Table 1. High fat and high cholesterol diet were used for induction of hyperlipidemia in rats according to the method of Gao *et al.*[1] with modification by using coconut oil as source of fat instead of lard. Salt mixture and vitamin mixtures were prepared according to Briggs and Williams[19] and Morcos[20], respectively. Oil soluble vitamins were given orally in a dose of 0.1 mL/rat per week.

Methods

Preparation of purslane and garden cress oils: Purslane seeds and garden cress seeds were crushed and pressed with laboratory type of (screw press machine with speed 15 rpm and 35°C) Carver hydraulic press under 10.000 lb/in (pic) pressure for 1 h at room temperature according to the method of Ustun *et al.*[21]. The produced meal was kept in deep-freeze until used.

Assessment of fatty acids of purslane and garden cress oils: Fatty acid methyl esters of the studied oils were prepared according to AOAC[22] to be subjected to GLC analysis of fatty acids. Assessment of the methyl ester was carried out by injecting 2 µL into a Hewlett Packard HP-system 6890 gas chromatograph equipped with FID. The HP-5 capillary column (30 m×0.32 mm i.d.; 0.25 µm film thickness) was used to separate the different methyl esters. The chromatographic

analysis conditions were: Initial temperature 70°C with a hold for 1 min, then rose to 120°C at a rate of 40°C min^{-1} with 2 min hold then the temperature was finally raised to 220°C at a rate of 4°C min^{-1} with another 20 min hold. The injector and detector temperatures were 250 and 280°C, respectively. Identification of the fatty acid methyl esters were carried out by direct comparison of retention times of each of the separated compounds with standards of the fatty acid methyl esters analyzed under the same conditions. Quantization was based on peak area integration.

Preparation of oil emulsion for rat oral dose: Purslane seeds oil and garden cress seeds oil were prepared in form of oil-in-water emulsions using Tween 80 as surfactant. All oil emulsions were stored for only a week during the feeding experiment.

Postprandial triglyceride in rats: About 24 rats were divided into 4 groups, 6 rats in each group. Rats were fasting overnight (12 h). Blood samples were collected from fasting rats and then rats in each group were given 1 oral dose of corn oil, coconut oil, garden cress oil or purslane oil, respectively (2 g kg^{-1} rat b.wt.). Serial blood samples were collected at 2, 4 and 6 h after oil ingestion in rats.

Design of the animal experiment: About 36 rats were divided into 6 groups each comprised 6 rats. The 1st was normal group where rats were received a balanced diet all over the study period for 5 weeks, while group 2 was the hyperlipidemia group, where rats were fed on high fat high cholesterol diet all over the study period, this group served as hyperlipidemia control. Rats in group 3 and 4 were fed on high fat high cholesterol diet containing 10% purslane bread or garden cress oil all over the study period, while rats of group 5 and 6 were fed on high fat high cholesterol diet and given oral dose of purslane or garden cress oil (300 mg kg^{-1} rat b.wt.) all over the study period. During the experiment, body weight and food intake were recorded once weekly. At the end of the study total food intake, body weight gain and feed efficiency ratio (Body weight gain/total food intake) were calculated. This study has been carried out according to the Medical Research Ethics Committee, National Research Centre, Cairo, Egypt and followed the recommendations of the National Institutes of Health Guide for Care and Use of Laboratory Animals (Publication No. 85-23, revised 1985).

Blood and tissue sampling: Blood samples were collected from all rats after an overnight fasting at the end of the experiment (5 weeks) for the determination of total cholesterol[23] (T-Ch), high density lipoprotein-cholesterol[24] (HDL-Ch), low-density lipoprotein-cholesterol[25] (LDL-Ch) and triglycerides[26] (TG). T-Ch/HDL-Ch ratio was calculated. Very low density lipoprotein-cholesterol (VLDL) was calculated by subtracting triglycerides on 5, while non-HDL-Ch was calculated by subtracting from total cholesterol. Plasma malondialdehyde[27] (MDA) was determined as indicator of lipid peroxidation. The activities of aspartate transaminase[28] (AST), alanine transaminase[28] (ALT) were determined as indicator of liver function. Plasma level of creatinine[29] and urea[30] were determined as indicator of kidney function. Liver was immediately removed, weighed and stored at -20°C till analyzed. Relative weight of liver of each animal was calculated as follows:

$$\text{Relative liver weight} = \frac{\text{Absolute liver weight (g)} \times 100}{\text{Final body weight (g)}}$$

Extraction and determination of hepatic lipids: Total hepatic lipids were extracted and weighed according to the procedure of Folch *et al.*[31]. In brief, liver tissues were homogenized with chloroform:methanol (2:1) for lipids extraction. After the extraction and evaporation, tissue lipids were re-dissolved in isopropanol and liver cholesterol[23] and triglyceride[26] levels were estimated enzymatically.

Statistical analysis: The results of animal experiments were expressed as the Mean±SE and they were analyzed statistically using the one-way analysis of variance ANOVA followed by Duncan's test. In all cases $p<0.05$ was used as the criterion of statistical significance.

RESULTS

Fatty acids methyl esters: Table 2 represents fatty acid profile of purslane and garden cress seeds oil. Fatty acids methyl esters of purslane and garden cress seeds oil revealed the presence of high percent of unsaturated fatty acids 65.7 and 63%, respectively. Saturated fatty acids were present in both oils by similar percent 25%. Palmitic acid (19.6%) was the major saturated fatty acid present in purslane oil, while arachidic acid (12.4%) was the higher saturated fatty acid present in garden cress oil. Oleic acid was present in purslane and garden cress seeds oil by 22.6 and 22.2%, respectively. Purslane and garden cress seeds oil oils contain linoleic acid as omega-6 fatty acid by 26.9 and 10.7%, respectively.

Table 1: Composition of different diets (g/100 g)

Ingredients	Balanced diet	NAFLD diet	Purslane oil diet	Garden cress oil diet
*Casein	12.0	12.0	12.0	12.0
Corn oil	10.0	-	-	-
Coconut oil	-	20.0	10.0	10.0
Purslane oil	-	-	10.0	-
Garden cress oil	-	-	-	10.00
Sucrose	23.5	23.50	23.50	23.50
Starch	47.0	38.75	38.75	38.75
Cholesterol	-	1.00	1.00	1.00
Bile salt	-	0.25	0.25	0.25
Salt mixture	3.5	3.50	3.50	3.50
Vitamin mixture	1.0	1.0	1.00	1.00
Cellulose	3.0	-	-	-

*12 g casein has been estimated to contain 10 g protein using AOAC[22]

Table 2: Fatty acids contents of purslane and garden cress seeds oil (as percentage of total fatty acids)

Fatty acids (%)	Purslane oil	Garden cress oil
Palmitic acid (C16:0)	19.6	9.5
Stearic acid (C18:0)	5.4	3.4
Oleic acid (C18:1) ω-9	22.6	22.2
Linoleic acid (C18:2) ω-6	26.9	10.7
α-Linolenic acid (C18:3) ω-3	16.2	30.1
Arachidic acid (C20:0)	-	12.4
Total saturated fatty acids	25 .0	25.3
Total unsaturated fatty acids	65.7	63.0
Ratio of omega-6 to omega-3 fatty acids	1.7	0.4

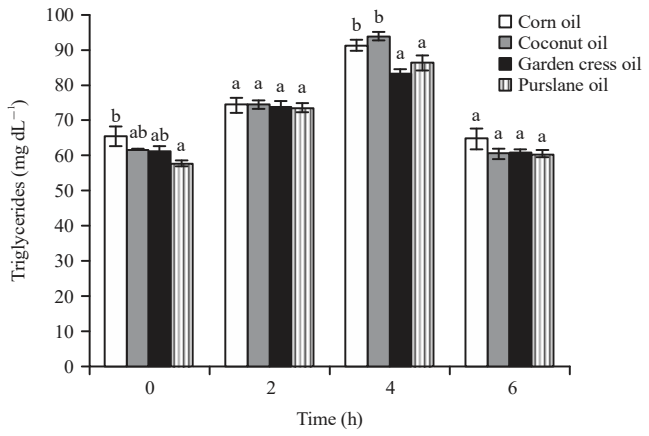

Fig. 1: Triglycerides tolerance of oils under investigation

Alpha-Linolenic acid as omega-3 fatty acid was present in purslane and garden cress seeds oil by 16.2 and 30.1%, respectively. The ratio of omega-6 to omega-3 fatty acids was 1.7 and 0.4 in purslane oil and garden cress oil, respectively.

Postprandial lipemia: Figure 1 showed the postprandial triglycerides of rats given corn oil, coconut oil, garden cress oil and purslane oil. Plasma triglycerides of rats given the different oils showed non-significant changes when different oils groups were compared with each other's. All rats showed significant elevation of plasma triglycerides levels after 2 h from oral dose of different oils compared with zero time. After 4 h from oral administration of the different oils garden cress and purslane oils showed the lower elevation in plasma triglycerides. Coconut oil elevates plasma triglycerides significantly after 4 h of oil administration compared with garden cress and purslane oils. After 6 h from oil oral administration plasma triglycerides levels of all rats were reduced similar to zero time level.

Evaluation of hypolipidemic effect of garden cress and purslane oils: Table 3 summarized changes in the biochemical parameters in all the experimental groups. Hyperlipidemic control group illustrated a significant hyperlipidemia clarified by elevation in plasma total cholesterol, non-HDL-Ch, atherogenic risk factors (T-Ch/ HDL-Ch and TG/HDL-Ch ratios) and also HDL-Ch reduced significantly in comparison with normal control group. Hepatic fat elevates significantly in hyperlipidemic control compared with normal rats group. All rats groups treated with purslane or garden cress oil showed significant improvement and hypolipidemic effect on lipid profile in plasma and liver with various degrees in comparison with hyperlipidemic control. Oral administration with both oils significantly reduced and nearly restored the values of hepatic fat to normal values.

The activities of transaminases (ALT and AST) as indicator to liver function showed significant elevation in hyperlipidemic control. Transaminases activities showed significant reduction in rats given purslane or garden cress oil. Hyperlipidemic rats showed significant elevation of lipid peroxidation as presented by MDA plasma level and this elevation was attenuated by administration of purslane or garden cress oil.

Kidney function as determined by plasma levels of creatinine and urea showed significant elevation in

Table 3: Biochemical parameters of different experimental groups

Parameters	Normal control	Fatty liver control	Purslane oil in diet	Purslane oil oral	Garden cress oil in diet	Garden cress oil oral
Plasma						
T-Ch (mg dL^{-1})	73.30±2.09^{b}	108.60±3.13^{a}	71.50±1.49^{b}	85.50±5.09^{abc}	94.80±1.48^{abd}	85.00±3.78^{abc}
TG (mg dL^{-1})	66.36±1.72^{b}	163.60±3.96^{a}	84.20±1.85^{ab}	84.60±5.09^{ab}	90.60±3.93^{ab}	73.40±3.49^{b}
HDL-Ch (mg dL^{-1})	39.00±0.63^{b}	25.50±0.47^{a}	26.50±0.96^{a}	30.20±0.72^{ab}	29.90±1.12^{ab}	33.40±1.24^{abc}
LDL-Ch (mg dL^{-1})	20.40±0.56^{b}	55.80±2.39^{a}	27.30±0.74^{ab}	48.00±2.70^{a}	50.10±2.80^{a}	39.40±2.58^{abc}
VLDL-Ch (mg dL^{-1})	13.30±0.34^{b}	32.70±0.79^{ab}	16.80±0.37^{ac}	16.90±1.02^{ac}	18.10±0.79^{ac}	14.70±0.6^{b}
Non-HDL-Ch (mg dL^{-1})	34.30±2.29^{b}	83.10±3.12^{a}	44.90±1.46^{adc}	55.40±4.98^{ad}	64.90±2.17^{ab}	51.60±4.20^{adc}
T-Ch/HDL-Ch ratio	1.90±0.07^{bc}	4.30±0.14^{ac}	2.70±0.1^{ab}	2.80±0.17^{ab}	3.20±0.14^{abc}	2.60±0.17^{ab}
TG/HDL-Ch ratio	1.70±0.057^{a}	6.40±0.177^{d}	3.20±0.185^{c}	2.80±0.145^{c}	3.10±0.175^{c}	2.20±0.167^{b}
MDA (nmo mL^{-1})	5.69±0.22^{b}	8.19±0.20^{a}	5.70±0.41^{b}	5.12±0.29^{b}	5.17±0.18^{b}	4.91±0.31^{ab}
ALT (IU L^{-1})	21.00±0.96^{b}	29.67±0.67^{a}	25.67±1.63^{ab}	26.83±0.79^{a}	26.33±0.84^{a}	25.67±0.67^{ab}
AST (IU L^{-1})	42.67±1.31^{bc}	65.67±1.94^{ac}	54.17±2.83^{abd}	48.33±1.02^{abc}	44.33±2.29^{bc}	46.17±1.14^{bc}
Creatinine (mg dL^{-1})	0.53±0.04^{a}	0.67±0.03^{a}	0.56±0.05^{b}	0.61±0.04^{a}	0.56±0.05^{b}	0.54±0.03^{a}
Urea (mg dL^{-1})	27.81±0.68^{c}	30.19±1.012^{c}	20.70±1.588^{ab}	26.67±0.843^{c}	29.70±1.631^{c}	29.96±1.698^{a}
Liver tissue						
Total fat (mg g^{-1} tissue)	21.00±0.63^{b}	58.30±1.80^{a}	22.70±0.88^{b}	22.70±0.88^{b}	24.80±0.79^{ab}	22.70±0.88^{b}
T-Ch (mg g^{-1} tissue)	2.23±0.11^{b}	9.63±0.33^{a}	2.65±0.2^{b}	2.65±0.2^{b}	3.27±0.18^{ab}	2.65±0.20^{b}
TG (mg g^{-1} tissue)	5.47±0.29^{b}	17.80±0.70^{a}	5.90±0.27^{b}	5.90±0.27^{b}	6.63±0.31^{bc}	5.90±0.27^{b}

Data are expressed as Mean±SE, values with different superscript letters in the same row are significantly different at p<0.05 levels

Table 4: Nutritional parameters of different experimental groups

Parameters	Normal control	Fatty liver control	Purslane oil in diet	Purslane oil oral	Garden cress oil in diet	Garden cress oil oral
Initial body weight (g)	112.500±2.12^{a}	112.200±3.03^{a}	112.300±4.03^{a}	112.200±4.09^{a}	112.500±2.12^{a}	112.20±4.95^{a}
Final body weight (g)	172.817±7.16^{b}	205.550±6.91^{a}	161.967±8.05^{b}	165.450±3.13^{b}	169.033±8.38^{b}	172.40±10.15^{b}
Body weight gain (g)	60.320±5.83^{b}	93.380±6.99^{a}	49.630±11.18^{b}	53.280±5.03^{b}	56.530±9.26^{b}	60.20±10.86^{b}
Total food intake (g)	700.000±3.65^{b}	770.000±3.91^{a}	703.000±7.27^{b}	707.000±4.94^{b}	701.000±4.42^{b}	702.00±3.33^{b}
Feed efficiency ratio	0.161±0.003^{b}	0.146±0.004^{b}	0.231±0.013^{a}	0.159±0.006^{b}	0.241±0.011^{a}	0.16±0.01^{b}
Relative liver weight	2.790±0.13^{b}	3.580±0.22^{a}	4.040±0.29^{a}	3.790±0.24^{a}	4.070±0.11^{a}	4.63±0.33^{ab}

Data are expressed as Mean±SE, values with different superscript letters in the same row are significantly different at p<0.05 levels

hyperlipidemic rats in comparison with normal control. Supplementation with purslane and garden cress oil significantly reduced the elevation of kidney function.

Table 4 showed the nutritional parameters of the different experimental groups. The results obtained indicated that diet high fat and cholesterol significantly elevates body weight gain and relative liver weight in hyperlipidemic rats in comparison with normal rats' group. Administration of purslane and garden cress seeds oil either in diet or oral treatment exhibited a significant reduction in body weight gain with more reduction regard to purslane oil in diet.

DISCUSSION

The present results showed that purslane oil contains high level of linoleic acid (26.9%) followed by oleic acid (22.6%) and alpha-linolenic acid (ALA) (16.2%). These results are less than that reported by Ai *et al.*[32] and Osman and Hussein[33], whom stated that purslane seeds oil contain 40.3% ALA, 29.4% linoleic acid and 15.6% oleic acid. The difference in the ratio of fatty acids may be attributed to the source variation; soil and climatic conditions which greatly affect the seed content of the different components. Garden cress oil contains high level of ALA (30.1%) followed by oleic acid (22.2%) linoleic acid (10.7%), these results are in agreement with the results of Alshammari *et al.*[34], who reported that ALA (30%) was the major fatty acid in garden cress oil followed by oleic acid (23.5%) and linoleic acid (11.4%).

Postprandial hyperlipidemia may contribute in the increment of the progression of cardiovascular disease. Triglycerides is widely recognized that from the risk factors of cardiovascular diseases and other chronic disease is the fasting and postprandial blood triglyceride levels, however, postprandial lipemia is depends on many factors like genetic background and age as well as the amount of fats and fatty acids compositions have an important effect on postprandial response and triglyceride metabolism[35,36]. Administration of purslane seeds and garden cress oils, which contain high levels of polyunsaturated fatty acids (ω-3 and ω-6) lowered the elevation in plasma triglycerides levels, while coconut oil elevates plasma triglycerides significantly after 4 h of oil administration. The present results are in agreement with Jackson *et al.*[37]. These results proved the hypolipidemic effect of garden cress and purslane oils.

Omega-3 fatty acids possess beneficial effects towards prevention of many chronic diseases such as

hypertriglyceridemia and insulin resistance. Plant seeds oil become more popular and have a role in prevention and treatment of many chronic diseases due to their high content of polyunsaturated fatty acids, phenolic compounds and antioxidant compounds such as tocopherols[38]. In the present research two plant seeds rich in oil were used as source of unconventional edible oil. These seeds are purslane and garden cress, which contain high levels of omega-3 fatty acids as observed from fatty acids profile of the oils. The data of the current study showed that high fat high cholesterol diet induced hyperlipidemia characterized by significant elevation in plasma lipid profile with reduction in HDL-Ch concomitant with elevation in hepatic lipid content and liver function. In the same time, plasma MDA levels were significantly elevated in hyperlipidemic control. Hyperlipidemic diet may be led to overproduction of reactive oxygen species which lead to oxidative damage and contribute to organ injury such as liver[39]. In the current research; supplementation with purslane oil and garden cress oil to rats feeding on high fat diet either in diet or orally clarified significant improvement in all the studied parameters with different degrees. Alleviation of hyperlipidemia and suppression of the levels of hepatic lipids the present results are in agreement with the results of Diwakar *et al.*[40], Hussein[41]. Prophylactic effects of omega-3 polyunsaturated fatty acids on cardiovascular diseases was observed through increasing the level of high-density lipoprotein-cholesterol and reducing the level of triglycerides, in association with anti-inflammatory, anti-platelet activities and ameliorates the endothelial function[42,43]. Ebrahimzadeh *et al.*[13] stated that purslane used as health food for patients with cardiovascular diseases due to its high content of α-linolenic acid and carotenes. In this context Osman and Hussein[33] found that purslane seeds oil suppress the increases in body weight and plasma lipids content. Garden cress oil contains phenolic and flavonoids compound such as glycoside and tannin, these bioactive compounds possess antioxidant activity besides its content of omega-3 PUFA[44]. The high content of phenolic compounds, flavonoids and tocopherol, in addition to omega-3 fatty acids enhance the ability to improve hyperlipidemia and to inhibit lipid peroxidation by scavenging free radicals[45,46]. Diwakar *et al.*[40] reported that feeding rats with 10% garden cress seeds oil improved hyperlipidemia. Also Osman and Hussein[34] and Garrel *et al.*[47] reported that feeding omega-3 in diet improved hyperlipidemia and antioxidant enzymes. Consumption of oils rich in ALA like purslane and garden cress decreased cholesterol content in liver, due to higher cholesterol secretion into bile which leading to a depletion of into intrahepatic pool of cholesterol[39,48,49].

In the current study, feeding rats on diet containing high fat high cholesterol induced oxidative stress evident as elevation in plasma MDA level and these results improved by oil supplementation (Purslane seed and garden cress oil) concomitant with high fat feeding. These results are in agreement with the results of Valenzuela *et al.*[50] and Jeyapal *et al.*[51], whom showed that high fat diet increased liver MDA and decreased antioxidant enzymes as SOD, GSH and catalase. Also ω-3 fatty acids administration attenuates hepatic oxidative stress and triglyceride content[50]. Elevation of ALT and AST as indicator to liver function observed in rats feed on diet containing high fat in the current study was in agreement with the results obtained by previous study of Al Hamedan[52]. Excessive storage of fat in the liver affects liver functions and elevates the susceptibility to free radical attack in hyperlipidemic rats, which leads to increase hepatic fat[53]. Supplementation by purslane oil and garden cress oils represented a reduction in the activity of these enzymes as compared to hyperlipidemic fed rats. Based on this result, the present results could argue that oil of purslane and garden cress seeds may have hepatoprotective effect.

CONCLUSION

The present study concluded that purslane seeds and garden cress seeds can be used as unconventional source of edible oils with promising hypolipidemic effect.

SIGNIFICANCE STATEMENT

This study confirmed that purslane and garden cress as unconventional edible oils are good source of omega-3 fatty acids. Both oils significantly reduced postprandial triglycerides. These oils showed significant improvement in plasma and hepatic lipid profiles with different degrees. Purslane and garden cress oils can be used effectively for prevention of hyperlipidemia.

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