THERAPEUTIC EFFECT OF PURSLANE, CORIANDER AND CELERY SEEDS ON HYPERCHOLESTEROLEMIC RATS

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**Therapeutic Effect of Purslane, Coriander and Celery Seeds on Hypercholesterolemic Rats**

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**Abstract:**

A significant risk factor for cardiovascular illnesses is hypercholesterolemia. In traditional medicine, seeds like celery, coriander, and purslane are well-known for their medicinal properties. This research sought to determine how celery, coriander, and purslane affected hypercholesterolemic rats. 42 male albino rats were divided into seven groups with six animals each for 60 days: negative control fed on a basal diet, positive control hypercholesterolemic rats were fed on a basal diet +1% cholesterol. Four group fed as positive control with 20% of celery, coriander, purslane and mixture of seeds. The last group demonstration oral drug rosuvastatin (10 mg/kg/day). The present study showed that hypercholesterolemia caused significantly increases in body weight gain, food intake and FER as well as total cholesterol (TC), total triglycerides (TG), low density lipoprotein (LDL-c), very low density lipoprotein (VLDL-c), total lipid, phospholipid, urea, creatinine, total protein, albumin, globulin and MDA and decrease in and high density lipoprotein (HDL-c), GSH and SOD in positive control. Supplemented diet of hypercholesterolemic rats with seeds, especially (20% mixture of seeds) lead to significant (p < 0.05) decrease in body weight gain, food intake and FER as well as total cholesterol (TC), total triglycerides (TG), low density lipoprotein (LDL-c), very low density lipoprotein (VLDL-c), total lipid, phospholipid, urea, creatinine, total protein, albumin, globulin and MDA and significant increase of HDL, GSH and SOD comparing with negative control. Our findings suggested that the supplementation diet with celery, coriander and purslane seeds caused obvious reduction in lipid levels in a hypercholesterolemia disease which prevent from the development the cardiovascular diseases.

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Key words: Celery, Coriander, Purslane, Lipid profile and Hypercholesterolemia

INTRODUCTION

Hypercholesterolemia and hyperlipidemia relate to high levels of cholesterol, low-density lipoproteins (LDL), triglycerides, and very low-density lipoproteins (VLDL). Excessive fat deposition in circulatory vessels results in plaque formation, artery wall obstruction, and, eventually, a stroke or heart attack (Stapleton et al., 2010). Cardiovascular disease, diabetes, and hypertension are all consequences of hyperlipidemia and hypercholesterolemia (Hopkins et al., 2003; Stapleton et al., 2010). Controlling the kind and amount of lipids in the diet, exercising, and using a lipid-lowering diet can help to manage hyperlipidemia and hypercholesterolemia. The medical establishment is up against a hurdle in curing hypercholesterolemia without causing any negative side effects (Islam et al., 2011). One of the main risk factors producing CVDs is hyperlipidemia. It is characterised by a rise in one or more plasma lipids, proteins, phospholipids, and plasma lipoproteins, including triglycerides and cholesterol (Shattat, 2014). Cardiovascular risks rise with the development of hyperlipidemia because the buildup of plasma lipids in the artery wall causes widespread vascular remodelling, localised inflammation, and the development of atherosclerotic plaques (Porez et al., 2012). Recently, numerous attempts have been made to use specific common plants that are already well-known in conventional medicine for containing biological components that can be used to lower lipid levels in the body to help lower cholesterol (Rhee et al., 2005 and Kim et al., 2007). The diet of choice should include functional foods like spices and herbs because they contain antioxidants with a great group of bioactive compounds that includes phenolic compounds, flavonoids, sulphur-containing compounds, alkaloids, tannins, phenolic diterpenes, and vitamins. It is preferable to prevent dietary problems rather than treat them and it is preferable to change one's diet rather than taking medicine (McCormick, 2017).

Celery (Apium graveolens L.) is a plant that belongs to the Apiaceae family (Dolati et al., 2018). It is a typical fragrant vegetable that is eaten
every day around the world (Tashakori-Sabzevar et al., 2016). Both the whole plant and its seeds have been used as food and medicine (Hassanen et al., 2015). Celery seeds yield volatile or essential oils in amounts ranging from 1.8 to 3.4 percent; this oil comprises 20% selinene and 60% limonene (Powanda et al., 2015). The phytochemical components of celery, such as bergapten, flavonoids, glycosides, furanocoumarins, furocoumarin, limonene, psoralen, xanthotoxin, and selinene, aid in the prevention of coronary and vascular diseases. Just a few of their pharmacological properties include spermatogenesis induction, anti-dysmenorrhea, anti-hypertension, and cardiovascular disease prevention (Salehi et al., 2019). In the same vein, celery oil contains one of the most essential bioactive components known as phthalide, which has a positive impact on health by protecting against cholesterol, cancer, and high blood pressure. Sedanolide is the most active phthalide molecule, which reduces tumours in cancer patients (Dąbrowska et al., 2020).

Coriander, also known as Coriandrum sativum, is a member of the Apiaceae or Umbelliferae family (Abdelkader et al., 2018). 0.8% percent of yellow oil with a nice aroma and oxygenated monoterpenes (80.47%) and monoterpenic hydrocarbon (6.45%) were produced from coriander seeds. (Pande et al., 2010). The main element of coriander essential oil is linalool, which is colourless and has a distinctive odour, sweet, soft, warm, and aromatic flavour (Msaada et al., 2007). Coriander has a wide range of bioactivities. Coriander seed aqueous extract has diuretic qualities, and seed and root extracts have antioxidative characteristics (Tang et al., 2013). In obese-hyperglycemic hyperlipidemic rats, oral administration of coriander extract regulated glycemia and reduced high levels of insulin, total cholesterol, LDL-cholesterol, and triglycerides (Aissaoui et al., 2011).

Purslane (Portulaca oleracea L.) is a widely distributed weed in the Portulacaceae family, with extensive distribution throughout the world (Petropoulos et al., 2016) and is commonly called “Rejlah” in Egypt (Shehata and Soltan, 2012). Purslane is one of the most widely used medicinal herbs, and it has been dubbed a "Global Panacea" by the World Health Organization (Alam et al., 2014). It is widely valued for the high
nutritional value of its edible plant parts, which are abundant in omega-3 fatty acids, particularly -linolenic acid (Oliveira et al., 2009). Minerals like Ca, K, and P, as well as proteins and carbohydrates, also, tocopherols, carotenoids, and ascorbic acid, are all valuable components of purslane edible sections (Szalai et al., 2010). Furthermore, antioxidant capabilities have been linked to phenolic components and oleracein derivatives of purslane leaf extracts (Sicari et al., 2018). The high content of a range of phytoconstituents in this plant was thought to be responsible for the plant's biological actions, such as antibacterial and antifungal (Oh et al., 2000). Purslane also has the potential to defend against oxidative stress induced by vitamin A deficiency (Arruda et al., 2004). Purslane also includes active compounds that can be used to treat parasitic infections including leishmaniasis and trypanosomiasis (Costa et al., 2007).

Since it is critical to find a nutraceutical that can prevent oxidative stress in hypercholesterolemia, the goal of this study was to investigate the protective effect of purslane, coriander and celery seeds and their combination to induce hypercholesterolemia in rats by monitoring lipid and lipoprotein status, liver, kidney functions and antioxidant status.

MATERIALS AND METHODS

**Materials:**

1. **Seeds** of celery (*Apium graveolens* L.), coriander (*Coriandrum sativum*) and purslane (*Portulaca oleracea* L.) were obtained from Agriculture Research Center, Giza, Egypt.

2. **Cholesterol powder** were purchased from El Gomhoria Company, Egypt. Rosuvast (Rosuvastatin) was purchased from Chemipharm Pharmaceutical Industries S.A.E. – Egypt. Each tablet contains 20 mg of (Rosuvastatin).

3. **Animals:** 42 healthy adult male albino rats (*Sprague dawely*) weighing (150 ± 10g) were purchased from the Agricultural Research Center, Giza, Egypt. International standards for the handling and use of laboratory animals were followed in all biological experimentation.
When handling animals, ethical standards were upheld, and authorization was requested from the relevant department.

4. **Basal Diet:** The basal diet was prepared according to modification of NRC (1992) as shown in Table A.

   **Table (A): Chemical ingredients of basal diet:**

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>g/kg Basal diet</th>
<th>% Basal diet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Casein</td>
<td>200</td>
<td>20</td>
</tr>
<tr>
<td>Corn starch</td>
<td>497</td>
<td>49.7</td>
</tr>
<tr>
<td>Sugar (Sucrose)</td>
<td>100</td>
<td>10</td>
</tr>
<tr>
<td>Cellulose</td>
<td>30</td>
<td>3</td>
</tr>
<tr>
<td>Corn oil</td>
<td>50</td>
<td>5</td>
</tr>
<tr>
<td>mineral admixtures</td>
<td>100</td>
<td>10</td>
</tr>
<tr>
<td>Vitamin admixtures</td>
<td>20</td>
<td>2</td>
</tr>
<tr>
<td>DL-methionine</td>
<td>3</td>
<td>0.3</td>
</tr>
</tbody>
</table>

**Chemical analysis of seeds:**

- Total ash contents, fat, fiber, protein and moisture were carried out according to the methods of (AOAC, 2000). Percentage carbohydrate was given by the following equation: $100 - (\text{ash}\% + \text{moisture}\% + \text{fat}\% + \text{protein}\%)$

- Determination of total phenols was determined according to (Slinkard and Singleton, 1977), while flavonoid according to (Zhishen et al., 1999).

**Biological experiments:**

**Experimental animal design:**

42 male albino rats were adapted for one week before the experiment, the animals were kept separately in stainless steel cages under controlled conditions, with a constant temperature of 22°C and lighting that runs on a 12-hour cycle. They also always have full access to food and water. After acclimatization periods, animals were randomly divided into seven groups with six animals each and given the following:
The first group (-ve): 6 rats were fed on a basal diet and kept as a negative control group.

Second group (+ve): 6 hypercholesterolemic rats were fed on a basal diet +1% cholesterol and kept as a positive control group (+ve control) according to Shehata and Soltan (2012).

The third group: 6 hypercholesterolemic rats were fed on a basal diet +1% cholesterol+20% celery seeds.

The fourth group: 6 hypercholesterolemic rats were fed on a basal diet +1% cholesterol+20% coriander seeds

The fifth group: 6 hypercholesterolemic rats were fed on a basal diet +1% cholesterol+20% purslane seeds

The sixth group: 6 hypercholesterolemic rats were fed on a basal diet +1% cholesterol+20% mixture of celery, coriander and purslane seeds.

The seventh group: 6 hypercholesterolemic rats were fed on a basal diet +1% cholesterol+ oral drug rosuvastatin (10 mg/kg/day) according to Fassini et al., (2011), drugs were dissolved in saline and given intravenously every day at various times.

Over the course of the 60 days, weekly change in body weight and food intake were monitored. Feed intake (gm.) was determined every two days according to Chapman et al., (1959). Body weight gain was calculated by using the following equations:

\[
\text{Body weight gain (BWG)}(\%) = \frac{\text{final weight(g)} - \text{initial weight(g)}}{\text{initial weight(g)}} \times 100
\]

Feed efficiency ratio (FED) = weight gain (g) / Feed intake (g)

**Blood sample collection:**

Rats were scarified under ether an aesthesia at the end of the experiment's 60-day run, blood samples were taken from the inner canthus of the rats' eyes, after 12 hours of fasting. According to Drury and Wallington (1980), blood samples were received into clean, dry centrifuge tubes, allowed to clot at room temperature, and then spun at 5000 rpm for
10 min to extract serum. The samples were kept in a deep freezer at -18°C until they were used for biochemical analyses.

**Biochemical analysis of serum:**

**Lipid profile were estimated as:**

- Triglycerides and total cholesterol were determined according to (Fassati and Prencipe 1982) and (Allain et al., 1974), respectively.
- HDL-C was determined according to (Lopes et al., 1977).
- LDL-C and VLDL-C were calculated by using the method of (Friedewald et al., 1972).
- Serum total Lipids was calculated accordance to (Tietz, 1976).
  \[
  \text{LDLc} = \text{Total cholesterol} - (\text{HDL-C} + \text{VLDL-C})
  \]
  \[
  \text{VLDLc} = \frac{\text{TG}}{5}
  \]
  Phospholipids = total lipid – (TG-TC).

**Liver function was determined as following:**

- Aspartate aminotransferase (AST) and alanine aminotransferase (ALT) were measured according to the method described by Burtis et al., (1999).
- The activity of serum total protein (TP) concentrations was evaluated chemically using the Folin-phenol reagent and bovine serum as a standard, as described by Henry (1964).
- Serum albumin was evaluation utilization the method of Doumas and Biggs (1971).
- Serum globulin value was decorator by subtracting the albumin from total proteins accordance to Coles (1974).

**Kidny function was obtained as following analysis:**

- Serum uric acid and creatinine were determined according to the methods described by Fassati et al. (1980), and Young (2001).
Antioxidant activity:
- The activity of tissue antioxidant enzyme superoxide dismutase (SOD) was estimated according to the method described by Oyanagui, (1984).
- Malondialdehyde (MDA) is a lipid peroxidation product, have been determined using the procedure described by Mistura and Midora (1987).
- Glutathionee peroxidase activity (GPA) was determined spectrophotometrically according to the method described by Weinhold et al. (1990).

Statistical analysis:
The collected data were presented as means with standard deviations. All tests were completed using the computer programme of the statistical analysis programme (SPSS, version 24) according to McCormick and Salcedo (2017).

RESULTS AND DISCUSSION

Proximate chemical composition of celery seeds, coriander seeds and purslane seeds:
Data presented at Table (1) revealed the chemical composition, moisture, protein, ash, fat, fiber and carbohydrates of celery seeds, coriander seeds and purslane seeds.

Results showed that celery seeds recorded 8.09±0.09, 16.35±0.11, 4.11±0.02, 12.52±0.04, 22.13±0.05 and 49.30±0.19 g/100g for moisture, protein, ash, fat, fiber and carbohydrates, respectively.

While, coriander seeds recorded 9.19±0.07, 12.97±0.09, 14.83±0.04, 29.63±0.07, 8.11±0.07 and 54.88±0.19 g/100g for moisture, protein, ash, fat, fiber and carbohydrates, respectively.

On the other hand, purslane seeds scored 6.42±0.25, 26.24±0.07, 10.04±0.091, 15.17±0.04, 14.94±0.08 and 42.44±0.13 g/100g for moisture, protein, ash, fat, fiber and carbohydrates, respectively.
From previous data, it could be observed that coriander seeds were higher in moisture, fat, fiber and carbohydrates content than celery or purslane, while celery seeds were higher in ash content than coriander and purslane, when, purslane seeds were higher in protein than other seeds. These results are in harmony with those obtained by Shahwar et al. (2012) who found that coriander seeds have a low moisture content (6.20%), while were rich in protein (12.58 %) and crude fat (9.12 %), while crude fiber was (37.14%). Also, Abou raya et al. (2013) showed that coriander seeds recorded 8.8%, 15.1%, 13.4%, 6.3% and 31.6% for moisture content, crude protein, ash, crude fiber and carbohydrates, respectively.

El Gindy, (2017) reported that purslane is rich with nutritional value, especially protein, ash and fiber contents. Purslane leaves contains 22.8% protein, 6.8% fat, 26.21 ash, 2.54% fiber and 2.54 carbohydrates. Moreover, Shehata and Soltan (2012) found that purslane seed contain 5.93, 22.34, 9.10, 13.37, 15.39 and 33.87% for moisture, protein, fat, crude fiber, ash and carbohydrate. While, Celery seeds contains 6.39, 18.19, 3.25, 12.12, 20.83 and 39.22% for moisture, protein, fat, crude fiber, ash and carbohydrate. Syed and Rajeev (2012) reported that the moisture content of purslane powder was 5.14% and celery (5.1-11%). While, crude protein levels in celery seed were 18.19%.

Table (1): Chemical composition (%) of celery, coriander and purslane seeds

<table>
<thead>
<tr>
<th>Groups</th>
<th>Celery seeds</th>
<th>Coriander seeds</th>
<th>Purslane seeds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture</td>
<td>8.09±0.09 b</td>
<td>9.19±0.07 a</td>
<td>6.42±0.25 c</td>
</tr>
<tr>
<td>Protein</td>
<td>16.35±0.11 b</td>
<td>12.97±0.09 c</td>
<td>26.24±0.07 a</td>
</tr>
<tr>
<td>Total fat</td>
<td>4.11±0.02 c</td>
<td>14.83±0.04 a</td>
<td>10.04±0.091 b</td>
</tr>
<tr>
<td>Crude fiber</td>
<td>12.52±0.04 c</td>
<td>29.63±0.07 a</td>
<td>15.17±0.04 b</td>
</tr>
<tr>
<td>Ash</td>
<td>22.13±0.05 a</td>
<td>8.11±0.07 c</td>
<td>14.94±0.08 b</td>
</tr>
<tr>
<td>T.Carbohydrates</td>
<td>49.30±0.19 b</td>
<td>54.88±0.19 a</td>
<td>42.44±0.13 c</td>
</tr>
</tbody>
</table>

Each value is the mean ± SD
The values in each column with different superscript are significantly different at (p < 0.05).
Total phenols and flavonoid of celery, coriander and purslane seeds:

Bio-active compound as (total phenol and flavonoid mg/100g) for celery, coriander and parsley seeds are represented in Table (2).

Form observed data, it was found that celery seeds contain (397.84±1.51 mg/100g total phenol) and (281.33±3.51 mg/100g total flavonoid), from the same table, coriander seeds contain total phenol as (351.16±2.26 mg/100g) and total flavonoid (621.33±3.51 mg/100g), while purslane contain (539.91±1.32 and 484.33±10.06 mg/100 g) for total phenol and flavonoid, respectively.

Generally, data indicated that coriander was the highest in total flavonoid content followed by purslane then celery, while purslane seeds were higher in total phenol followed by celery then coriander.

Because of its high antioxidant activity, coriander is a good source of polyphenols and phytochemicals. Coriander leaves and seeds both contain antioxidants, although leaves have more antioxidants than seeds (Wangensteen et al., 2004). Its high pigment content, particularly carotenoids, is credited with its antioxidant properties. Its extract’s carotenoids were discovered to have a stronger hydroxyl radical scavenging capacity, protecting cells from oxidative damage (Peethambaran et al., 2012). Phenolic molecules are one of the most important and widespread groups of secondary metabolites. Based on the amount of phenol rings and the structural components that bond these rings, phenolic groups can be divided into four categories. Flavonoids (anthocyanins, flavones, and isoflavones), tannins, stilbenes, and lignans are among these groups (Balasundram et al., 2006).
Table (2): Total phenols and total flavonoids in celery, coriander and purslane seeds

<table>
<thead>
<tr>
<th>Groups Variables</th>
<th>Celery seeds</th>
<th>Coriander seeds</th>
<th>Purslane seeds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total phenols mg/100 g</td>
<td>397.84±1.51 b</td>
<td>351.16±2.26 c</td>
<td>539.91±1.32 a</td>
</tr>
<tr>
<td>Total flavonoids mg/100 g</td>
<td>281.33±3.51 c</td>
<td>621.33±3.51 a</td>
<td>484.33±10.06 b</td>
</tr>
</tbody>
</table>

Each value is the mean ± SD

The values in each column with different superscript are significantly different at (p < 0.05).

Flavonoids, phenolic acids, and tansyipropanoids, which are distinctive phytochemicals found in celery and have good antioxidant effects, bind to free radicals (Nickavar et al., 2007). Polyphenols have biological benefits that include antioxidant activity, inducers for controlling free radicals and peroxidation, and more. Due to the chemical similarities among polyphenols, free radicals can be neutralised via interactions between one or more phenolic groups and hydrogen donors (De Almeida et al., 2005). Jung et al., (2011) showed that phytochemical contents in celery were 28.17 - 34.6 mg/g for total phenolics and 16.4 – 19.6 mg/g for flavonoids. Ashoush et al. (2017) resulted that the values were 30.3 mg/g and 18.5 mg/g total phenolics and total flavonoids respectively in celery leaves.

Lim and Quahf (2007) reported that purslane phenols content was ranged between 157 and 304 mg/100g. Also, Almasoud and Salem (2014) stated that purslane has a high content of total phenol (179.89 mg/100g). Moreover, El Gindy, (2017) found that purslane has a high content of phenols and flavonoids (950 mg GAE /100g and 4953 mg QE /100g).

Nutritive and biological value of seeds on experimental rats:

Body weight gain, food intake and feed efficiency ratio (FER) of hypercholesterolemia rat groups:

As shown in Table (3), the averages of all rat groups' initial body weights after seven days of adaption (feeding on basal diet) ranged between
144 and 151 g, then after 60 days from the experiments at the end the final body weight ranged between 217 and 355 g.

Table (3): Change in body weight, food intake and FER in hypercholesterolemic rat groups fed on celery, coriander and purslane seeds.

<table>
<thead>
<tr>
<th>Rat Groups</th>
<th>Initial weight (gm)</th>
<th>Final weight (gm)</th>
<th>Weight gain (gm)</th>
<th>Weight gain%</th>
<th>Food intake (gm)</th>
<th>FER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control (-ve)</td>
<td>144.50±4.20</td>
<td>290.00±11.23</td>
<td>145.50±10.25</td>
<td>100.69±11.96</td>
<td>24.17±0.14</td>
<td>0.069±0.02</td>
</tr>
<tr>
<td>Control (+ve)</td>
<td>146.25±5.18</td>
<td>355.25±20.26</td>
<td>209.00±21.65</td>
<td>142.91±16.29</td>
<td>29.60±0.05</td>
<td>0.080±0.02</td>
</tr>
<tr>
<td>Celery seed</td>
<td>145.50±7.76</td>
<td>278.25±10.26</td>
<td>132.75±21.32</td>
<td>91.23±15.02</td>
<td>23.19±0.06</td>
<td>0.066±0.02</td>
</tr>
<tr>
<td>Coriander seed</td>
<td>148.00±5.59</td>
<td>276.25±15.21</td>
<td>128.25±16.57</td>
<td>86.66±14.18</td>
<td>23.02±0.12</td>
<td>0.063±0.01</td>
</tr>
<tr>
<td>Purslane seed</td>
<td>150.00±8.90</td>
<td>260.00±15.75</td>
<td>110.00±10.35</td>
<td>73.33±18.87</td>
<td>21.67±0.09</td>
<td>0.056±0.02</td>
</tr>
<tr>
<td>Seed mixture</td>
<td>151.00±7.34</td>
<td>258.50±20.84</td>
<td>107.50±10.86</td>
<td>71.19±13.07</td>
<td>21.54±0.07</td>
<td>0.055±0.03</td>
</tr>
<tr>
<td>Rosuvastatin drug</td>
<td>149.00±6.68</td>
<td>217.25±29.44</td>
<td>68.25±26.25</td>
<td>45.81±13.09</td>
<td>18.10±0.09</td>
<td>0.042±0.02</td>
</tr>
</tbody>
</table>

Each value is the mean ± SD
The values in each column with different superscript are significantly different at (p < 0.05).

Data presented in Table (3) show that an induced hypercholesterolemia caused a significant increase (P<0.05) in body weight gain, food intake and FER in positive control comparing to the healthy group (negative control).

Administration of different seeds (celery, coriander, purslane and mix) comparing to rosuvastatin drug and hypercholesterolemic rats caused a significant decrease (P<0.05) in body gain, food intake and FER comparing to the negative control.
Body weight can be seen as a marker for food consumption, but total food intake is a sign of the rats’ acceptance and enjoyment of the diet (Al-Amery and Takruri, 2021).

According to Barakat (2011), an induced hypercholesterolemia significantly increased (P<0.05) body weight growth. El-Kherbawy et al., (2011) exhibited significantly (P<0.05) lower body weights and feed efficiency ratios when parsley or coriander was added at 10, 15, and 20% compared to the equivalent values in normal or hypercholesterolemic rats. In addition, Shehata and Soltan (2012) revealed significant increases in body weight, food intake, and FER in rats fed a high-cholesterol diet. Beltagy et al., (2018) reported that high fat diet replaced with different levels of celery powder helped to increase food intake / day comparing to high fat diet control group.

The result of the decreasing in body weight gain due to feeding on seed mix may be attributed to the high present fiber in coriander, purslane and celery as mentioned in chemical composition (29.63, 15.17 and 12.52%, respectively).

According to Torsdottir et al. (1991), the dietary fiber slows down the stomach emptying rate, allowing rats to feel fuller for longer while delaying nutrient absorption and digestion. This results in decreased food intake and a reduction in body weight increase. Results are in line with Shehata and Soltan (2012) who observed that purslane and celery (fresh and seeds) supplementation of hypercholesteroemic mice's diet caused a decrease in body weight, food intake and FER. Niharika and Sukumar (2016) reported that purslane decreased body weight.

**Effect of feeding on celery, coriander and purslane seeds on serum alanine aminotransferase (ALT) and aspartate aminotransferase (AST) enzymes in hyper cholesterolemic rats.**

The obtained data in Table (4) indicated that the both of ALT and AST level of control positive group recorded the highest value (437.42 and 492.94 U/L) compared with control negative group (47.45 and 109.95 U/L) with significant differences at (P<0.05). Data illustrated that the activities of
ALT and AST of hypercholesterolemic rats fed on celery, coriander and purslane seeds and their mixture, increased significantly (P<0.05) in hypercholesterolemic rats group and ranged between (71.45 to 103.00 U/L) for ALT and (227.11 and 311.30 U/L) for AST in comparison with the negative control (47.45 and 109.95 U/L). This mean that, due to the accelerated lipid peroxidation brought from the elevated cholesterol, there were significant (P<0.05) anomalies in the concentration of these enzymes. However, due to their powerful antioxidant capability, the seeds-based intervention significantly reduced (P<0.05) the abnormal levels of AST & ALT in all investigations.

The oral administration of rosuvastatin drug to hypercholesterolemic rats recorded the lowest mean values of ALT and AST (71.45 and 227.11 U/L) followed by the group fed on seed mixture (77.85 and 247.03 U/L).

Generally, data show that the hypercholesterolemic rats fed on seed mixture in diets could improve the liver function parameters (ALT and AST) in the same level with the oral rosuvastatin drug.

From the above results, ALT and AST, one of the most common liver function tests measures the levels of intracellular hepatic enzymes that have seeped into the circulation and function as a producer of hepatocytes. Additionally, ALT and AST levels serve as markers of liver function, and their return to normal values denote normal liver function. As a result, the hepatotoxic effect of rats is indicated by the rise in ALT activity in serum, which is primarily caused by the leakage of enzymes from the liver cytosol into the blood stream (Dauqan et al., 2012).

Table (4): Effect of feeding on celery, coriander and purslane on serum ALT and aspartate aminotransferase AST enzymes in hypercholesterolemia rats.

<table>
<thead>
<tr>
<th>Rats group</th>
<th>ALT (U/L)</th>
<th>AST (U/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control (-ve)</td>
<td>47.45 e ± 4.13</td>
<td>109.95 d ± 10.05</td>
</tr>
<tr>
<td>Control (+ve)</td>
<td>437.42 a ± 63.01</td>
<td>492.94 a ± 68.31</td>
</tr>
<tr>
<td>Celery seed</td>
<td>103.00 b ± 7.57</td>
<td>311.30 b ± 30.60</td>
</tr>
<tr>
<td>Coriander seed</td>
<td>79.06 d ± 9.85</td>
<td>262.65 c ± 34.09</td>
</tr>
</tbody>
</table>
According to Kim et al., (2010), the exogenous cholesterol content from diet tends to raise the activities of AST and ALT. Also, Ajdari et al., (2014) observed that feeding on hyperchlosterolamic substantially increased the ALT and AST activity in serum. These results agree with those of Beltagy et al., (2018) who resulted that rat fed a diet containing powdered celery leaves and seeds showed an improvement in the activity of the ALT enzyme because their levels of alanine amine transferase (ALT) were lower than their levels of asparate amine transferase (AST) in the same groups of rats. The phytonutrients in coriander, celery and purslane, such as omega-3 fatty acids, polyunsaturated fatty acids, and flavonoids, which have antioxidant effects against oxidative stress, may be the cause of the decreased activity of the liver enzymes ALT, AST, and ALP in the purslane-treated group, indicating its protective role against liver damage (Dkhil et al., 2011).

Moreover, Ali et al. (2011) observed that administering purslane dramatically decreased the serum levels of liver enzymes. Shehata and Soltan (2012) predicted that including celery and purslane (fresh and seed) in a hypercholesterolemic diet will help restore hepatic function by improving lipid metabolism or postponing the development of hepatic disorders. Additionally, Lee et al., (2011) stated that hypercholesterolemic rat groups administered purslane powder had lower ALT and AST activity than the hypercholesterolamic group.

**Effect of feeding on celery, coriander and purslane on serum total protein, albumin and globulin in experimental rats.**

Data in Table 8, show total protein, albumin and globulin of control and hypercholesterolamic rat groups examined celery, coriander and purslane
Therapeutic effect of purslane, coriander and celery seeds on hypercholesterolemic rats

seeds and their mixture comparing to oral rosuvastatin drug. The healthy group (negative control) recorded the lowest value of total protein, albumin and globulin (5.73, 2.96 and 2.76 mg/dL), respectively comparing to the positive control which recorded the highest value (8.12, 4.83 and 4.83 mg/dL).

Table (5): Effect of feeding on celery, coriander and purslane seeds on serum total protein, albumin and globulin in experimental rats.

<table>
<thead>
<tr>
<th>Rats group</th>
<th>T. protein (mg/dL)</th>
<th>Albumin (mg/dL)</th>
<th>Globulin (mg/dL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control (-ve)</td>
<td>5.73 ± 0.39</td>
<td>2.96 ± 0.26</td>
<td>2.76 ± 0.17</td>
</tr>
<tr>
<td>Control (+ve)</td>
<td>8.12 ± 0.51</td>
<td>4.83 ± 0.13</td>
<td>4.83 ± 0.43</td>
</tr>
<tr>
<td>Celery seed</td>
<td>7.03 ± 0.25</td>
<td>3.54 ± 0.07</td>
<td>3.45 ± 0.29</td>
</tr>
<tr>
<td>Coriander seed</td>
<td>6.68 ± 0.24</td>
<td>3.50 ± 0.07</td>
<td>3.21 ± 0.32</td>
</tr>
<tr>
<td>Purslane seed</td>
<td>6.92 ± 0.33</td>
<td>3.52 ± 0.08</td>
<td>3.36 ± 0.22</td>
</tr>
<tr>
<td>Seed mixture</td>
<td>6.67 ± 0.44</td>
<td>3.46 ± 0.04</td>
<td>3.29 ± 0.31</td>
</tr>
<tr>
<td>Rosuvastatin drug</td>
<td>6.66 ± 0.67</td>
<td>3.42 ± 0.06</td>
<td>2.98 ± 0.77</td>
</tr>
</tbody>
</table>

Each value is the mean ± SD
The values in each column with different superscript are significantly different at (p < 0.05).

Moreover, there was a significant decrease (P<0.05) in total protein, albumin and globulin in hypercholesterolamic rat groups compared to the positive control group, meanwhile, administration of celery, coriander and purslane seeds and their mixture showed significant (P<0.05) improvement in total protein, albumin and globulin compared with positive group. While there were no significant differences (P<0.05) between hypercholesterolamic rat groups fed on celery, coriander and purslane seeds and their mixture.

Feeding on seed mixture was nearly in values of oral rosuvastatin drug with no significant differences (P<0.05) for total protein, albumin and globulin.

Total protein, bilirubin, and albumin concentrations can help determine the health of the liver and the extent of any damage (Yakubu et al., 2005). Given that the liver is the primary organ involved in the synthesis
of the majority of proteins, this could be the result of liver damage. Frequently, liver cirrhosis and chronic hepatitis are associated with hypercholesterolamic. Low feed intake may also result in decreased protein absorption.

Effect of feeding on celery, coriander and purslane seeds on serum lipid profile in experimental rats:

The results of lipid profiles (total cholesterol (TC), total triglycerides (TG), high density lipoprotein (HDL-c), low density lipoprotein (LDL-c), very low density lipoprotein (VLDL-c), total lipid and phospholipid) are shown in Table (6).

Hypercholesterolemic group (positive control) exhibit significant increase (p<0.05) in TC, TG, LDL-c, VLDL-c, total lipid and phospholipid, and decrease in high density lipoprotein (HDL-c) compared to the healthy group (negative control).

Supplemented diet of hypercholesterolemic rats with different seeds (celery, coriander and purslane) and their mixture as well as oral rosuvastatin drug lead to significant decrease (p<0.05) in total cholesterol, total triglycerides, LDL-c, VLDL-c, total lipid and phospholipid, and increase in HDL-c comparing to positive control.

The hypercholesterolemic rats group feed on diet supplemented with mixture seeds recorded the lowest values of mentioned parameters (58.9, 81.54, 3.10, 16.30, 367.16 and 344.53 mg/dl), respectively which were near with the values scored with oral rosuvastatin drug (56.63, 76.88, 1.21, 15.38, 372.33 and 352.08 mg/dl), while the highest increase in HDL (40.13 mg/dl) after oral rosuvastatin drug (40.13 mg/dl).
Table (6): Effect of feeding on celery, coriander and purslane seeds on serum lipid profile in experimental rats

<table>
<thead>
<tr>
<th>Rats group</th>
<th>TC</th>
<th>TG</th>
<th>HDL</th>
<th>LDL</th>
<th>VLDL</th>
<th>Total lipid</th>
<th>phospholipid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control (-ve)</td>
<td>43.43 d</td>
<td>44.85 d</td>
<td>30.45 d</td>
<td>4.48 c</td>
<td>8.97 d</td>
<td>252.16 c</td>
<td>250.74 e</td>
</tr>
<tr>
<td></td>
<td>± 3.12</td>
<td>± 8.63</td>
<td>± 2.61</td>
<td>± 1.05</td>
<td>± 1.67</td>
<td>± 50.97</td>
<td>± 5.91</td>
</tr>
<tr>
<td>Control (+ve)</td>
<td>88.33 a</td>
<td>193.71 a</td>
<td>29.98 d</td>
<td>13.13 a</td>
<td>38.74 a</td>
<td>778.00 a</td>
<td>672.62 a</td>
</tr>
<tr>
<td></td>
<td>± 9.72</td>
<td>± 29</td>
<td>± 3.01</td>
<td>± 1.86</td>
<td>± 5.85</td>
<td>± 87.72</td>
<td>± 2.03</td>
</tr>
<tr>
<td>Celery seed</td>
<td>60.64 c</td>
<td>107.35 b</td>
<td>35.65 b</td>
<td>6.97 b</td>
<td>21.47 b</td>
<td>433.33 b</td>
<td>386.62 b</td>
</tr>
<tr>
<td></td>
<td>± 1.05</td>
<td>± 17.66</td>
<td>± 1.41</td>
<td>± 1.98</td>
<td>± 3.53</td>
<td>± 49.57</td>
<td>± 3.98</td>
</tr>
<tr>
<td>Coriander seed</td>
<td>59.36 b</td>
<td>98.67 b</td>
<td>34.29 c</td>
<td>3.12 c</td>
<td>19.73 b</td>
<td>398.50 b</td>
<td>358.79 c</td>
</tr>
<tr>
<td></td>
<td>± 8.06</td>
<td>± 11.86</td>
<td>± 1.71</td>
<td>± 0.98</td>
<td>± 7.35</td>
<td>± 29.96</td>
<td>± 7.14</td>
</tr>
<tr>
<td>Purslane seed</td>
<td>64.60 b</td>
<td>103.94 b</td>
<td>37.52 b</td>
<td>4.13 c</td>
<td>20.79 b</td>
<td>421.33 b</td>
<td>381.99 b</td>
</tr>
<tr>
<td></td>
<td>± 3.36</td>
<td>± 15.63</td>
<td>± 2.01</td>
<td>± 1.02</td>
<td>± 5.23</td>
<td>± 48.50</td>
<td>± 3.55</td>
</tr>
<tr>
<td>Seed mixture</td>
<td>58.90 b</td>
<td>81.54 b</td>
<td>40.13 a</td>
<td>3.10 d</td>
<td>16.30 c</td>
<td>367.16 b</td>
<td>344.52 d</td>
</tr>
<tr>
<td></td>
<td>± 9.35</td>
<td>± 19.6</td>
<td>± 1.48</td>
<td>± 0.51</td>
<td>± 3.93</td>
<td>± 50.82</td>
<td>± 4.98</td>
</tr>
<tr>
<td>Rosuvastatin drug</td>
<td>56.63 b</td>
<td>76.88 c</td>
<td>41.24 a</td>
<td>1.21 e</td>
<td>15.38 c</td>
<td>372.33 b</td>
<td>352.08 c</td>
</tr>
<tr>
<td></td>
<td>± 7.29</td>
<td>± 9.41</td>
<td>± 1.48</td>
<td>± 0.34</td>
<td>± 1.88</td>
<td>± 59.02</td>
<td>± 6.13</td>
</tr>
</tbody>
</table>

Each value is the mean ± SD
The values in each column with different superscript are significantly different at (p < 0.05).

Understanding cholesterol metabolism has facilitated the development of medications and dietary approaches to lower risk for cardiovascular events. Plasma cholesterol plays a significant role in the pathophysiology of atherosclerosis. Investigating dietary influences on plasma lipids and cholesterol is crucial (Al-Amery and Takruri, 2021). The increase in lipid profile in Hypercholesterolemic rats are agreement with Harnafi et al., (2009) and Kumar et al., (2011) reported that TC, TG and LDL-c levels in hypercholesterolemic control rats were significantly higher than the normal control group.

Purslane's ability to lower cholesterol could be attributed to the presence of polyphenols, flavonoids, alkaloids, and crude fibre, all of which have been proven to be effective hypolipidemic agents (El- Newary 2016).
This outcome was consistent with **Huang et al., (2011)** earlier study, which found that purslane could dramatically lower serum levels of total cholesterol (TC), triglycerides (TG), and low-density lipoprotein (LDL-C), while raising HDL-C levels (**Abdalla Junior, 2010**). By blocking pancreatic cholesterol esterase, interacting with bile acids, and reducing cholesterol solubility in micelles, polyphenolic compounds, according to **Gallo and Naviglio (2017)**, demonstrated cholesterol-lowering effect by purslane. This could delay the absorption of cholesterol. This theory is in line with the findings of **Heidrich et al. (2004)** suggested that cholesterol esterase inhibitors would be effective treatments for lowering blood cholesterol levels.

Coriander seeds contain a substance called petroselinic acid that reduces inflammation by blocking the Cox-1 and Cox-2 enzymes (**Zhang et al., 2015**). Docosahexanoic acid (DHA) and alpha-linolenic acid (ALA) are omega-3 fatty acids that encourage the release of anti-inflammatory compounds. They are also known to lower TG levels, raise HDL levels, ameliorate endothelial dysfunction, and other things (**Bradberry et al., 2013**). It is clear that coriander seeds play a function in enhancing lipid metabolism because oral administration of various doses of coriander seeds dramatically lowered the changed level of lipids.

Because it increases bile acid secretion and inhibits lipase, celery is advantageous for decreasing blood cholesterol levels (**Tsi and Tsi, 2000**). **Perumalraja and Sharief (2014)** reported that administration of celery extract resulted in a rise in HDL cholesterol and a decrease in total cholesterol, triglycerides, LDL, and VLDL. Also, **Mustafa et al., (2019)** resulted that the celery seed aqueous extract decreased triglyceride (TG) and low-density lipoprotein (LDL), while increased high density lipoprotein (HDL).

**Effect of feeding on celery, coriander and purslane seeds on blood urea and creatinine levels of experimental rats:**

As explained in Table (7), blood urea and creatinine levels of healthy rats (negative control rats and hypercholesterolemic rats which fed on
Therapeutic effect of purslane, coriander and celery seeds on hypercholesterolemic rats

celery, coriander and purslane seeds and their mixture decreased compared to the positive control group.

The lowest value of both urea and creatinine was for the negative control rat group, followed by rosuvastatin drug group, however positive control group recorded the highest urea and creatinine values (5.58 mg/dl and 0.54 mg/dl, respectively).

Data indicated that no significant difference (P<0.05) was recorded for hypercholesterolemic rats fed on diet with celery, coriander and purslane seeds and its mixture as well as oral rosuvastatin drug during the experimental period. Apparent also from the same table that gradual decrease was recorded in urea content and creatinine level of hypercholesterolemic rats fed on diet replaced with mixture seeds as a function of prolonging experimental period.

Table (7): Effect of feeding on celery, coriander and purslane seeds on blood urea and creatinine levels of experimental rats.

<table>
<thead>
<tr>
<th>Rats group</th>
<th>Creatinine (mg/dL)</th>
<th>Urea (mg/dL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control (-ve)</td>
<td>0.32 c ± 0.02</td>
<td>2.48 c ± 0.12</td>
</tr>
<tr>
<td>Control (+ve)</td>
<td>0.54 a ± 0.01</td>
<td>5.58 a ± 0.65</td>
</tr>
<tr>
<td>Celery seed</td>
<td>0.49 b ± 0.01</td>
<td>3.93 b ± 0.58</td>
</tr>
<tr>
<td>Coriander seed</td>
<td>0.46 b ± 0.02</td>
<td>3.14 b ± 0.46</td>
</tr>
<tr>
<td>Purslane seed</td>
<td>0.45 b ± 0.03</td>
<td>3.60 b ± 0.64</td>
</tr>
<tr>
<td>Seed mixture</td>
<td>0.43 b ± 0.06</td>
<td>3.47 b ± 0.58</td>
</tr>
<tr>
<td>Rosuvastatin drug</td>
<td>0.42 b ± 0.07</td>
<td>3.45 b ± 0.51</td>
</tr>
</tbody>
</table>

Each value is the mean ± SD
The values in each column with different superscript are significantly different at (p < 0.05).

Creatinine is actively discharged by the tubules and filtered by the glomerulus in the kidney. Additionally, free creatinine might be seen in blood serum (Stevenes et al., 2006). In addition to having higher blood glucose levels, hypercholesterolemic rats experienced renal changes including fat cell growth, weight gain in the kidneys, glomerular sclerosis, and inflammatory infiltrates (Palanisamy et al., 2008 and De Castro et al.,
However, rats fed on diets substituted with various amounts of celery found that celery's polyphenol content prevented renal failure (Suleria et al., 2013). These findings are in line with those of Karimi et al., (2010) who claimed that purslane's aqueous extract has pronounced nephroprotective effect and shows promise in treating acute renal injury brought on by nephrotoxins. Helal et al., (2018) resulted that 5 % purslane leaves and 2.5 % purslane leaves had the lowest uric acid, urea, and creatinine levels, with significant differences.

**Effect of feeding celery, coriander and purslane seeds on liver lipid peroxide malondialdehyde (MDA), reduced glutathione (GSH) and superoxide dismutase (SOD) contents of rats:**

Results recorded in Table (8) indicated that there was a significant decrease (P<0.05) in MDA and a significant increase (P<0.05) in GSH and SOD in all rats groups fed on celery, coriander and purslane seeds and their mixture as well as oral rosuvastatin drug compared to positive control group. Normal control rats recorded the lowest MDA level (16.02 nmol/g protein), followed by rats group with hypercholesterolaemia and oral rosuvastatin drug, then the hypercholesterolaemic rats fed on seed mixture, coriander, purslane and celery (25.25, 27.53, 30.25, 36.75 and 43.25) nmol/g protein, respectively.

Rats with hypercholesterolaemia (control+ve group) had the highest MDA level 16.02 nmol/g protein. It could be noticed that hypercholesterolaemic rats which treated with celery, coriander and purslane seeds showed significant decrease (P<0.05) of MDA levels as compared to positive control group.

Data also show that glutathione (GSH) and superoxide dismutase (SOD) recorded the highest levels in the negative control group (1.92 and 362.75), where the lowest GSH and SOD levels were for positive control group (0.58 and 50.50). On the other hand, there was a significant increase (P<0.05) in GSH and SOD levels for hypercholesterolaemic groups fed on celery, coriander and purslane seeds compared to the positive control group.
Data in Table 8 revealed that there was a significant increase in GSH and SOD but showed a significant decrease (P<0.05) in MDA in all rat groups which treated with celery, coriander and purslane seeds and their mixture as well as oral rosuvastatin drug as compared to the hypercholesterolemic rat group (positive).

As a marker for lipid peroxidation in cancer, MDA level has been employed (Sabitha and Shyamaladevi 1998). According to research by Szatrowski and Nathan (1991), the weakening of antioxidant defense may have contributed to the high levels of MDA in malignant conditions. Malondialdehyde (MDA), a byproduct of polyunsaturated fatty acid peroxidation in cells, is one of the ultimate products of blood peroxidation. A rise in free radicals leads to an excess of MDA generation. Malondialdehyde levels are frequently used as indicators of antioxidant status and oxidative stress.

Table (8): Effect of feeding celery, coriander and purslane seeds on liver lipid peroxide malondialdehyde (MDA), reduced glutathione (GSH) and superoxide dismutase (SOD) contents of rats

<table>
<thead>
<tr>
<th>Rats group</th>
<th>MDA</th>
<th>GSH</th>
<th>SOD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control (-ve)</td>
<td>16.02 d ± 1.60</td>
<td>1.92 a ± 0.20</td>
<td>362.75 a ± 50.56</td>
</tr>
<tr>
<td>Control (+ve)</td>
<td>106.21 a ± 10.09</td>
<td>0.58 c ± 0.02</td>
<td>50.50 d ± 6.25</td>
</tr>
<tr>
<td>Celery seed</td>
<td>43.25 b ± 4.93</td>
<td>0.72 b ± 0.20</td>
<td>62.75 c ± 7.54</td>
</tr>
<tr>
<td>Coriander seed</td>
<td>30.25 c ± 4.76</td>
<td>0.77 b ± 0.03</td>
<td>71.25 c ± 7.52</td>
</tr>
<tr>
<td>Purslane seed</td>
<td>36.75 b ± 6.85</td>
<td>0.75 b ± 0.33</td>
<td>62.79 c ± 6.82</td>
</tr>
<tr>
<td>Seed mixture</td>
<td>27.53 c ± 2.82</td>
<td>1.02 a ± 0.90</td>
<td>98.03 b ± 9.98</td>
</tr>
<tr>
<td>Rosuvastatin drug</td>
<td>25.25 c ± 3.26</td>
<td>1.05 a ± 0.79</td>
<td>119.25 b ± 12.56</td>
</tr>
</tbody>
</table>

Each value is the mean ± SD
The values in each column with different superscript are significantly different at (p < 0.05).

A dry powder celery leaf diet decreased the hypercholesterolemia, liver enzymes and blood lipids in rats. Additionally, the liver lesions in rats have decreased. According to this study, patients with hepatic illness and hypercholesterolemia may benefit from a celery diet (Belal, 2011).
Shehata and Soltan (2012) showed that mice with high cholesterol who were fed purslane, purslane seeds, celery, and celery seeds had lower liver glutathione (GSH) levels.

The hypercholesterolemic group's GSH content dramatically dropped when compared to the normal group, whereas the groups given purslane, purslane seeds, celery, and celery seeds significantly increased (P<0.05) when compared to the hypercholesterolemic group. Results are accordance with data reported by Mohamed et al., (2011) who indicated that animals who ingested purslane juice significantly increased the glutathione content in their livers, when compared to control rats. Moreover, Al-Amery and Takruri (2021) found that the blood peroxidation (MDA) values in the wild and cultivated purslane groups (10.9 ±1.6 and 10.9 ±2.8 nmol/ml, respectively) were considerably lower than the control group's MDA level (14.3 ±3.0 and 15.8 ±5.0 nmol/l. Results also approved with Hijazi and Mouminah (2017) who reported that oral pretreatments with celery leaves extracts for 6 weeks caused significant reduced tissue malondialdehyde (MDA) levels and boosted antioxidant enzyme activity. Additionally, Kajal and Singh (2019) observed that administration of coriander extract increase in level of SOD, GSH, and decrease in lipid peroxidation in terms of TBARS.

CONCLUSION

Based on the findings and our interpretations, we came to the conclusion that using celery, coriander and purslane seeds on rats with high cholesterol levels, had proved its efficiency on hypercholesterolemia, kidney and liver function in rats

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Therapeutic effect of purslane, coriander and celery seeds on hypercholesterolemic rats

The therapeutic effect of purslane, coriander and celery seeds on hypercholesterolemic rats

*Shimaa Fatihy, Mostafa Aly, Mostafa Gamal, Rashed Ramadan, Ibrahim*

**The title in Arabic:**

The title in Arabic is not clearly legible due to the distortion of the text. It appears to be discussing the therapeutic effects of specific seeds on hypercholesterolemia in rats. Further translation and clarification would be necessary for a precise understanding.

**The abstract in Arabic:**

The abstract in Arabic discusses the therapeutic effects of purslane, coriander, and celery seeds on hypercholesterolemia in rats. It mentions the preparation and administration of these seeds to rats and the observed effects on cholesterol levels.

**Key points:**

- Purslane, coriander, and celery seeds were evaluated.
- Rats were administered these seeds to study their cholesterol-lowering effects.
- The study aimed to investigate the potential of these seeds as a natural cholesterol-lowering supplement.

**Conclusion:**

The study concluded that these seeds have the potential to lower cholesterol levels in hypercholesterolemic rats, providing a natural alternative to conventional cholesterol-lowering medications.

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