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The Effect of Instant Lentil-Purslane (Portulaca Oleracea) Leaves Soup on Potassium Bromate-Induced Hepatotoxicity in Experimental Rats

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ABSTRACT

This article aimed to produce lentil-purslane dried soups containing 0, 5, 10, and 15% purslane leaves powder. The chemical and sensory properties of the soup samples were studied. Besides, investigating the effects of feeding experimental rats intoxication by Potassium Bromate in 80% dried soups at different levels of purslane leaves powder on blood serum lipid profile, liver functions, and oxidative stress biomarkers. The present results indicated that with the increasing levels of purslane leaves powder, the contents of protein, ash, fat, and fiber were gradually increased, while carbohydrates and moisture contents were gradually decreased. Also, vitamins, minerals, total phenol and DPPH radical scavenging activity were gradually increased. Correspondingly, all sensory properties of lentil-purslane dried soups were acceptable. Moreover, the feeding rats on lintel-purslane dried soups intoxication by KBro3 caused gradual decline of lipid profile levels of triglycerides, total cholesterol, low-density lipoprotein cholesterol, but high-density lipoprotein cholesterol was increased compared to the positive control group. So, the atherogenic index was gradually decreased. Additionally, the group was fed on 15% purslane had the lowest liver enzymes and the highest levels of total protein, albumin, globulin, and A/G ratio. Moreover, serum antioxidant enzymes were increased, but malondialdehyde was lower than the positive group. Thus, the oxidative stress biomarkers were decreased, so this study recommended incorporating purslane leaves powder in the daily diet to protect the liver and avoid oxidative stress biomarkers that cause many diseases.

KEYWORDS: lentil, purslane, poisoning, liver, oxidative stress biomarkers

1. INTRODUCTION

People are more interested in eating healthy food, even though food manufacturers want consumers to notice the "healthier" foods on the shelves to meet consumer needs (Plasek et al., 2020). Dehydrated vegetative soups can be just as nutrient-dense as homemade soups. They may also help people eat more vegetables and fit within a balanced, sustainable diet (van Buren et al., 2019). Thus, it could be advantageous to enhance the human health (Gallo et al., 2017). A nutritious soup made with grains, legumes, and vegetables is generally preferred.

The edible plant plays an essential role in health care administration and substantially contributes to weight management and feed effectiveness as a result of its pleasant taste and nutritious contents (Kunle et al., 2017). Grain legumes or pulses, including chickpea, pigeon pea mung bean, urban peanut, cowpea lentil, and soybean, are vital grain pulses (Dasgupta and Roy, 2016). Lentil is an important and basic legume crop in numerous African and Asian countries. Lentil sprouts are known by various names, such as Mercimek (in Turkey), Adas (in Arabic), Messer (in Pakistan and Ethiopia), and Heramame (in Japan) (Joshi et al., 2017 and Sidhu et al., 2022).

Lentil is the best source of protein (Khazaei et al., 2019). Its capacity for antioxidants is higher than that of other legume species (Grela et al., 2017). Lentil contains saponins, glycosides, lectins, and bioactive peptides that consist of defending proteins, protease inhibitors, prebiotic oligosaccharides, and fermentable fibers. Which act as chemopreventive and antitumor activities (Attlee, 2017) and lower several medical disorders, including cancer, diabetes mellitus, cardiovascular disease, and hypertension (Dhull et al., 2023). Furthermore, the physical, nutritional, and sensory qualities of the final products can be improved by using lentil powder as a functional food constituent (Marchini et al., 2021).

Portulaca oleracea (purslane) is a plant belonging to the Portulacaceae Juss family well-known as an edible vegetable, It is common throughout the world's tropical and temperate climates (Rahimi et al., 2019). It is thought to be one of the most important unfamiliar plants in Egypt it is recognized as "Reglah (Rousseaux, 2023). Purslane, as an edible resource and high-quality medicinal, has broad application prospects in multiple fields due to its polysaccharide components (Wang et al., 2023). It is added to soups, and its leaves and soft stem are used raw in salads. The green purslane is used as a pickle or for cooking (Uddin et al., 2014) tea drinks, and noodles (Chen et al., 2019). Purslane protein is a rich source of amino acids such as leucine, isoleucine, Iysine, cysteine, methionine, tyrosine, phenylalanine, valine, and threonine besides glutathione. It has a high content of omega-3 , ascorbic acid, a-tocopherol, and ß-carotene, (Sultana and Rahman, 2013, Chugh et al., 2019 and Habibian et al., 2020). Purslane contains fatty acids, alkaloids, flavonoids, polysaccharides, terpenoids, and sterols (Gabr et al., 2021 and Khalil et al., 2023). Fresh leaves contains 3.2mg/g alpha-linolenic acid five times higher than in spinach and lettuce. Good content of long-chain PUFAs, eicosapentaenoic acid (20:5, ω-3) 0.01mg/g, and docosahexaenoic acid (22:6, ω-3) 0.004mg/g fresh leaves. Too, purslane is very likely to be a beneficial component in cosmetics (Uddin et al., 2014).

Purslane can help prevent chronic and neurological disorders resulting from oxidative stress because it has antioxidant activities, anti-inflammatory and antihypertensive actions, antidiuretic, antitumor, hypoglycaemic, and lipid-lowering properties (Chugh et al., 2019), anti-cancer (Azarifar et al., 2018), and antimicrobial properties (Khalil et al., 2023). On the other hand, because raw purslane leaves, stems, and buds have a high oxalate content, it is not advised for those who are prone to kidney stones to regularly consume them. However, pickling and boiling purslane lowers the amount of soluble oxalate in the processed product (Poeydomenge and Savage, 2007). Furthermore, produced soup powder containing purslane leaves and seeds powder is a apposite choice for conference the human nutritional needs (Bader et al., 2022). Likewise, mixed purslane, lentils, and sweet potatoes; a compelling mixture of textures, tastes, and colors; visually and gustatory appealing; attractive organoleptic, (Fukalova Fukalova et al., (2022). In traditional Chinese medicine that due to the anticancer effects of purslane polysaccharide, purslane soup is primarily used to treat bacillary dysentery and enteritis. Additionally, purslane is used with other herbs to treat intestinal cancer. Also, Simmering purslane in a broth with green beans will help remove heat and aid in detoxification of the body. It can be used as a functional (Wang et al., 2023).

The sweet potato (*Ipomoea batatas* L.) is a type of tuberous root, a member of the Convolvulaceae) family. It contains components such as minerals, vitamins, fiber, and antioxidants (Sebben et al., 2017). Moreover, it has biologically active components such as resistant starch, dietary fiber, carotenoids, and polyphenols that influence certain metabolic processes and enhance human health (Amagloh et al., 2021). Besides, garlic (*Allium sativum*) and onion (*Allium cepa*) are among the most commonly used spices and are good sources of nutrients such as protein, carbohydrates, minerals, dietary fiber, vitamins, minerals, and phytochemicals that are used as antioxidants. It could be used therapeutically for the human body (Remi, 2023) as an antioxidant, preservative, and antimicrobial (Bouhenni et al., 2019). Tomatoes (*Solanum lycopersicum* L.) are fruits, or vegetables that are high in critical components, including reducing sugars, protein, dietary fiber, minerals, vitamins, essential fatty acids, and carotenoids. The nutritional components are essential for the functioning of the body and are beneficial in ameliorating chronic diseases as they protect against cardiovascular disease, cancer, osteoporosis, and cognitive processes (Ali et al., 2020).

Potassium bromate ($KBrO_3$) is a white crystal that is frequently used as a food ingredient (Shanmugavel et al., 2020). It is a thickener, odorless, colorless, and tasteless. It is used to make the dough more elastic, particularly for preparing bread. (Yalçin and Çavuşoğlu, 2022). It is inexpensive, readily available, and regularly produced in dairy and bakery products (Oloyede and Sunmonu, 2009). It is an oxidizing agent; it is carcinogenic and genotoxic to humans and experimental animals, affecting various bodily functions in a way that is dependent on dose and duration (Ahmad and Mahmood, 2016 and Bahey and Elswaidy, 2021). Likewise, it may cause damage to the tissues of the kidneys and liver (Mohamed et al., 2023). It has multiple effects, including altered blood biochemistry and reduced antioxidant capability. Its usage should be discontinued due to these harmful effects (Altoom et al., 2018).

For these reasons, this research aimed to substituting purslane leaves by orange sweet potato powder by different concentration to enhance and improve the nutritional value and biological value of dried lentil soups. The value-added lintel soup was analyzed for the chemical composition, sensory evaluation and determining the effect of feeding experimental hepatotoxicity rats with potassium bromate ($KBrO_3$) on 80% dried soups on lipid profile, liver functions and determination of antioxidant status.

2. MATERIALS AND METHODS

2.1. MATERIALS

Fresh Purslane (*Portulaca oleracea* L.) plants were collected from private farm at (Meniat Elnaser city, Dakhlyia Government, Egypt) during July 2023. Dehulled Lentils (Lens culinaris) and orange-fleshed sweet potato (*Ipomoea batatas* L.) roots, Onion (Allium cepa), garlic (*Allium sativum*) fresh tomatoes (*Solanum lycopersicum* L.), skimmed milk powder, salt, sunflower oil and corn oil were purchased from the domestic shop of the Aswan Government, Egypt.

Male Albino rats (Sprague-Dawley) weighing 200–215 g were acquired from the experimental animal shelter of the Food Technology Research Institute, Agricultural Research Center, Giza, Egypt.

Casein, starch, choline chloride, vitamins mixer, minerals mixture Potassium bromate ($KBrO_3$), and all chemical analysis kits were given from El-Gomhoryia, company Cairo City, Egypt.

2.2. METHODS

2.2.1. Production of raw materials and lintel-purslane dried soup

Purslane leaves were cleaned with tap water and boiled for 5 minutes. The cooking water is poured off to lower the amount of soluble oxalate, according to Poeydomenge and Savage (2007), and then dried in an airy, shadowy place, according to Osman et al., (2023).

Orange-fleshed sweet potato roots were washed using the water supply to get rid of any soil and dust. After that, the roots were sliced into slices 2-3 mm thick and steamed for 5 minutes, as described by Abd-Elhak and Salem (2017).Finally, the orange sweet potato slices were dehydrated at 55°C for 12 hours in an electrical oven with an air propeller (Indeset 6-EM-IN-02, Italy).

Dehulled lentil seeds were washed with tap water to remove dust; tomatoes were washed with water; and fresh garlic and onion were peeled and cut into thin slices. 60 g of dehulled lentil seeds, 15 g of tomato, 6 g of onion, and 3 g of garlic, were mixed well and were cooked in enough tap water for 20. Then, the cooked blend was dehydrated in the same electrical oven at 55° C for 12 hours.

All the dried ingredient (lentil blend, purslane leaves, and orange sweet potato) were ground and refined by an electric mixer (Moulinex, LM207041 Super Blender. France). The powders were passed across a 150 mesh screen to take out soft powder of equal size. All the blends of lintel-purslane dried soups were used as the formula shown in Table (1). And the blends were burdened in polyethylene bags and preserved at 4° C pending analysis.

Table 1. Formulas of lintel-purslane dried soups (g/ 100g)

Ingredients	Lintel blend	Orange sweet potato	Purslane	Skim milk	Oil	Salt	Cumin	Black paper	Turmeric	Chill
LPDSC	55	25	-	10	5	3	0.5	0.2	0.3	1
LPDS1	55	20	5	10	5	3	0.5	0.2	0.3	1
LPDS2	55	15	10	10	5	3	0.5	0.2	0.3	1
LPDS3	55	10	15	10	5	3	0.5	0.2	0.3	1

LPDSC: lentil-purslane dried soups with 0% dried purslane . LPDS1: Lentil-purslane dried soups with 5% Dried Purslane LPDS2: Lentil-purslane dried soups with 10% Dried purslane LPDS3: Lentil-purslane dried soups with 15 % Dried Purslane

2.2.2. Analytical methods

The gross chemical composition of dried dehulled lentil, purslane leaves, and orange sweet potato powder and its lintel-purslane dried soups as protein, moisture, fat, ash, and cured fiber were determined according to AOAC (2010). Total carbohydrates were calculated as following: carbohydrate% = 100 - (protein % + moisture %+ ash % + fat %). Grams consumed to cover the recommended daily requirement of protein for adults (25–50 years) were calculated by using the RDA (Anon, 1989).

Vitamins A, B1, B3, B6, B9, and C were determined according to the AACC (1983). Total polyphenol was assessed using the Folin-Ciocalteau reagent as mentioned by Limmongkon et al., (2017). The free radical scavenging capacity of extracts was measured using the stable DPPH method as described by Hwang and Do Thi (2014).

2.2.3. Organoleptic evaluation of lintel-purslane dried soups:

The organoleptic properties of lintel-purslane dried soups were assayed after melting 10 g dry soup in 65 ml of hot water for its organoleptic appearances, i.e., flavor, color, taste, dissolution rate, thickness, and overall acceptability. The valuation was evaluated by 20 semi-trained panel members from the Department of Home Economics, Faculty of Specific Education, Aswan University, according to the method of Wang et al. (2009).

2.2.4. The biological examination:

2.2.4.1. Design of animal and empirical:

42 male Albino rats (Sprague -Dawley) weighing 200–215 g were housed under normal conditions and given an experimental meal (basal diet) for seven days intended for adaptation. After that, rats were organized into sex groups (n =7) randomly. G1(negative control group) was fed on basal diet, other groups rats G2 (positive control group),G3,G4,G5 and G6 were supplied with a basal diet and oral administration of Potassium bromate $KBrO_3$ (100 mg/kg) was performed using a specialized stomach tube for 15 days. Potassium bromate salt was dissolved in water to prepare (0.5 gm/L) for poisonous rats Altoom et al., (2018). Basal diet was prepared according to Reeves et al., (1993). Each meal's plan is listed in Table (2).

Through the experimentation time (42 days) G3,G4,G5 and G6 rats were supplemented with 14% protein when were fed with 80% lintel-purslane dried soups and oral administration of Potassium Bromate $KBrO_3$ (100 mg/kg). Rats were housed separately in stainless steel cages with good ventilation. Food intake and body weight were documented each week and at the termination of testing. Body weight gain %, food intake, protein efficiency ratio, and feed efficiency ratio were determined as methods by Chapman et al., (1959).

Table 2. Composition of basal and diets contained lintel-purslane dried soups (g / 100 g).

Ingredients	G1	G2	G3	G4	G5	G6
Casein	14	14		-	-	-
LPDSC	-	-	80	-	-	-
LPDS1	-	-	-	80	-	-
LPDS2	-	-	-	-	80	-
LPDS3	-	-	-	-	-	80
Corn oil	4	4	4	4	4	4
Cellulose	5	5	5	5	5	5
Starch	72.3	72.3	22.7	24.1	25.3	26.5
Salt mixture	3.5	3.5	3.5	3.5	3.5	3.5
Vitamins mixture	1	1	1	1	1	1
Choline chloride	0.2	0.2	0.2	0.2	0.2	0.2

LPDSC: lentil-purslane dried soups with 0% dried purslane . LPDS1: Lentil-purslane dried soups with 5% Dried Purslane LPDS2: Lentil-purslane dried soups with 10% Dried purslane LPDS3: Lentil-purslane dried soups with 15 % Dried Purslane

All the processes used in the present investigation were approved by the Research Ethics Committee at Aswan University, Egypt.

2.2.4.2 Growth parameters

At the end of termination testing, rats were deprived of food an entire night and benumbed administering diethyl ether. After collection, the blood from the rat was centrifuged. The serum was taken out for analysis. The serum was aspirated carefully, transferred into sterile cuvette tubes, and frozen at -20°C in preparation for analysis. After the end of experiment, the kidney, liver, heart, spleen, and brain were removed, and their relative ratios to the final body weight were calculated according to the technique of Chapman et al., (1959).

2.2.4.3. Lipid panel

Triglycerides (TG), Total cholesterol (TC), Low-density lipoprotein cholesterol (LDL-c), and High-density lipoprotein cholesterol (HDL-c) were evaluated according to the methods described by Allain et al., (1974), Zollner and Kirsch (1962), Fossati and Prencipe, (1982), Allain et al., (1974) and Naito and Kalpana (1984), respectively. Atherogenic index was calculated according to Castelli and Levitar (1977). Atherogenic index = Cholesterol / HDLc or LDLc / HDL

2.2.4.4. Liver functions

Serum liver enzymes such as aspartate aminotransferase (AST), alanine aminotransferase (ALT) and alkaline phosphatase (ALP) methods according to Reitman and Frankel (1957) and Belfield and Goldberg (1971) respectively. Total protein (TP) and serum albumin (A) were evaluated as techniques by Doumas et al., (1971) and Doumas et al., (1975), respectively. Serum globulin (G) was calculated as equal to (Globulin =Total Protein - Albumin) as per Coles (1974).

2.2.4.5. Oxidative stress biomarkers

Oxidative stress biomarkers were evaluated by assessing enzymatic antioxidants as superoxide dismutase (SOD), glutathione peroxidase (GPx) and catalase (CAT) and non-enzymatic as malondialdehyde (MDA) in liver homogenates according to the methods described by Marklund and Marklund (1974), Rotruck et al., (1973), Takahara et al., (1960), and Uchiyama and Mihara (1978), respectively.

2.2.5. Analytical statistics

A statistical program for social science (SPSS), version 17.00, SPSS Inc., Chicago, IL, USA using at the 0.05, level. The averages and standard deviations (SD) of the research results were reported. For continuous variables, data were analyzed using a one-way analysis of variance (ANOVA), per SPSS (2008). A P value under 0.05 was deemed as statistically significant.

3. RESULTS AND DESCUCISION

3.1. The chemical composition of lentil, orange sweet potato, purslane leaves powders, and its instance lentil-purslane dried soups

Data from Table (3) showed that the dehulled lentils powder had the highest protein content, followed by purslane leaves and orange

Table 3. The chemical composition of lentil, orange sweet potato, and purslane leaves powders and its lentil-purslane dried soups in dry weight

Parameters / Samples	Moisture %	Dry matter%	Protein %	Fat%	Ash%	Fiber%	Carbohyrate %	GDR protein
Dehulled Lentil powder	10.1 ±0.27a	89.9 ±0.27e	27.5 ±0.11a	1.5 ±0.05c	3.13 ±0.15g	5 ±0.2e	62.87 ±0.3b	229.09 ± 1.42d
Dried orange Sweet potato	9.78 ±0.13a	90.22 ±0.13e	4.32 ±0.21g	1.39 ±0.12c	5.61 ±0.20f	9.27 ±0.25d	79.41 ±0.09a	1470.23 ± 4.90a
Dried Purslane leaves	8± 0.29e	92 ±0.29a	18.22 ±0.29f	5.57 ±0.17b	17.78 ±0.18a	16 ±0.30a	42.43 ±0.33g	345.77 ± 4.12b
LPDSC	9.4± 0.18b	90.6 ±0.18d	19.39 ±0.12e	9.69 ±0.25a	6.27 ±0.23e	9.86 ±0.18c	54.79 ±0.53c	324.91 ± 1.7cb
LPDS1	9.12± 0.15cb	90.88 ±0.15cd	20.1 ±0.31d	9.72 ±0.19a	6.99 ±0.21d	10.16 ±0.21cb	53.03 ±0.17d	313.43 ±3.05cb
LPDS2	8.84 ±0.18cd	91.16 ±0.18cb	20.7 ±0.24c	9.73 ±0.27a	7.57 ±0.25c	10.42 ±0.12cb	51.58 ±0.18e	304.30 ±3.01c
LPDS3	8.56 ±0.15d	91.44 ±0.15b	21.30 ±0.17b	9.76 ±0.12a	8.23 ±0.1b	10.67 ±0.12b	50.04 ±0.24f	295.79 ±2.40c
P<	****	****	****	****	****	****	****	****

Parameters / Samples	Vit AUI	Vit. B1 Thiamine mg/100g	Vit B2) Riboflavin mg/100g	Vit. B3) Niacin mg/100g	Vit B6 mg/ 100g	Vit B9 Folate mg/100g	Vit C mg/ 100g
Dehulled Lentil powder	760 ±5c	0.21 ±0.02e	0.21 ±0.01ed	3.07 ±0.10b	0.59 ±0.01b	0.520 ±0.01a	4.200 ±0.10e
Dried orange Sweet potato	800 ±3.61b	0.12 ±0.01f	0.15 ±0.01ed	0.78 ±0.03g	0.21 ±0.01f	0.030 ±0.00e	12.00 ±0.21b
Dried Purslane leaves	1352 ±10 a	0.72 ±0.03a	1.72 ±0.1a	6.600 ±0.14a	1.02 ±0.05 a	0.190 ±0.00d	17.084 ±0.1a
LPDSC	598 ±8f	0.36 ±0.01d	0.15 ±0.01e	1.52 ±0.04f	0.28 ±0.01e	0.225 ±0.01c	9.4 ±0.1d3
LPDS1	630 ±5e	0.42 ±0.01c	0.25 ±0.01cd	1.97 ±0.01e	0.36 ±0.01d	0.236 ±0.01cb	9.72 ±0.1d
LPDS2	650 ±8.7e	0.45 ±0.0cb	0.34 ±0.0cb	2.25 ±0.0d	0.40 ±0.0dc	0.247 ±0.0b	10.12 ±0.1c
LPDS3	682 ±10.44 d	0.47 ±0.01b	0.41 ±0.00b	2.54 ±0.01c	0.45 ±0.00cB	0.252 ±0.01b	10.45 ±0.09c

LPDSC: lentil-purslane dried soups with 0% dried purslane . LPDS1: Lentil-purslane dried soups with 5% Dried Purslane LPDS2: Lentil-purslane dried soups with 10% Dried purslane LPDS3: Lentil-purslane dried soups with 15 % Dried Purslane Each statistic is the average of three replicates. SEM: Standard Error of means. (a, b, c, d, e, f, and g): means within the same column differ significantly at $p<0.05$ when accompanied by a different superscript. * P<0.05; ** P<0.01. *** P<0.001.**** P<0.0001.

sweet potato powder. Moreover, purslane leaves powder had the highest ash and fat contents after that orange sweet potato and dehulled lentil. Otherwise, orange sweet potato had the highest fiber and carbohydrate contents, followed by dulled lentils and purslane leaves powder. Moreover, the chemical composition of dulled lentils was comparable to that of Rajesh et al., (2016), who reported that the natural value of dulled lentils was 9.4–10.7, 10.7, 27.3-27.9, 1-1.9, 2.4–22.9 moisture, protein, fat, ash, fiber and carbohydrates, respectively.

The result of the natural composition of orange sweet potato powder is compatible with that of Ewunetu et al., (2023), who discovered that the sweet potato powder contained 12.6%, 4.04%, 10.67%, 6.7%, and 63.29% moisture, fat, ash, fiber, protein, and carbohydrates, respectively. Moreover, the chemical structure of purslane leaves powder conforms to that of Abd El-Aziz et al., (2014), who stated that the chemical composition of purslane leaves powder was 5.14, 17.99, 18.58%, and 16.50%

D.W moisture, crude fibers, protein, and ash contents, respectively.

Results in Table (3) showed that the purslane leaves powder had the highest contents of vitamins as Vit C, Vit A, Vit. B2, vit. B3, and Vit B6, but the lintel had the highest contents of Vit. B1 and Vit. B9 compared to those of orange sweet potato and purslane leaves powder. The results of the vitamin contents of lintel powder were agreement with those of Ganesan and Xu (2017), who found that the vitamin contents of lintel mg /100g 0.756–0.873, 0.189–0.211, 2.605–3.459, 0.540–0.698, 0. 479–0.555 and 3.4–4.5, Vit A, Vit. B1, vit. B2, vit. B3, vit B6, vit. B9 and vitamin C, respectively. The vitamins content of dried purslane leaves agreed with that of Bader et al. (2022); they found that vitamin A was 1.298, thiamine (B1), 0.039, riboflavin (B2) 0.10, Niacin 0.52, pyridoxine (B6), 0.069, folate (B9) mg/100g 0.109 and vit C mg/100g 19.00.

Results in Table (3)confirmed that the GDR protein of soups contained 15 % purslane leaves had the lowest value compared to other formulas as result to it had the highest content of protein as compared to other soups. Also, in lentil-purslane dried soups the vitamin contents were rise by rising the levels of purslane leaves powder. Each of these results were corroborated by those of Marchini et al., (2021), who detected that the utilization of lentil powder can raise the nutritional value of products. Furthermore, Upadhyay, et al., (2017) reported that enriching instant soup with purslane in legumes significantly increases nutritional benefits.

All of these results were in line with those of Bader et al., (2022), who stated that purslane leaves and seed powder fortified vegetable soup powder is an excellent option for fulfilling the nutritional needs of the human due to its high Vit A and Vit C, protein, ash, and fiber contents and low energy and carbohydrate contents. This might make a high difference in lowering the protein and energy deficiencies.

Table 4. Total phenolic compounds (mg/100 g) and Antioxidant DPPH) of lentil, orange sweet potato, purslane powder, and it's lentil-purslane dried soups

Parameters / Samples	Total phenolic compound (mg /100g)	Antioxidant (%DPPH)
Dehulled Lentil powder	50.00± 1f	60.00±1.73d
Dried orange Sweet potato	41.00±1.73g	34.00±0.9e
Dried Purslane leaves	181.81±0.74 a	91.09±2.01a
LPDSC	55.49±1.16e	62.05±0.93dc
LPDS1	67.80± 0.72d	64.99± 0.5c
LPDS2	81.25± 1.15c	68.71±0.63b
LPDS3	95.09±0.35b	71.81± 0.73b
P<	****	****

LPDSC: lentil-purslane dried soups with 0% dried purslane . LPDS1: Lentil-purslane dried soups with 5% Dried Purslane LPDS2: Lentil-purslane dried soups with 10% Dried purslane LPDS3: Lentil-purslane dried soups with 15 % Dried Purslane ؛ Each statistic is the average of three replicates. SEM: Standard Error of means. (a, b, c, d, e, f, and g): means within the same column differ significantly at p<0.05 when accompanied by a different superscript. * P<0.05; ** P<0.01. *** P<0.001. **** P<0.0001

3.2. Total phenolic compounds and Antioxidant (DPPH%) of lentil, orange sweet potato, purslane leaves powders and lentil-purslane dried soups

Data indicated in Table (4) showed that the total phenolic compound of purslane leaves had the highest total phenolic compound, followed by dehulled lentil powder and orange sweet potato powder. So, the total phenolic compound of lentil-purslane dried soup was increased as levels of purslane leaves powder were increased. This result was due to the fact that purslane leave powder had the highest content of total phenolic compound compared to orange sweet potato powder and lentil. On the other hand, the dried purslane leaves powder had the highest value of antioxidants (DPPH %) compared to dehulled lentil and orange sweet potato powder. The total phenolic content of orange sweet potato powder was in agreement with that of Palmiere and Mangin, (2015). Also, the total phenolic content of lentils is comparable to that of Amarowicz et al (2009).

Table 5. Sensory properties of lentil-purslane dried soups

Parameters / Dried soups	Taste	Flavor,	Color	Thickness	Dissolution rat	Overall acceptability	Average
LPDSC	9.20 ±0.33a	9.50 ±0.32a	9.20 ±0.35a	9.00 ±0.35a	9.40 ±0.28a	9.00 ±0.30a	9.22 ±0.15a
LPDS1	9.30 ±0.31a	9.20 ±0.24ba	9.00 ±0.30a	8.20 ±0.30b	9.10 ±0.29a	8.00 ±0.33b	8.80 ±0.10b
LPDS2	8.50 ±0.34b	8.88 ±0.24b	8.10 ±0.16b	7.30 ±0.21c	8.50 ±b	7.50 ±0.23c	8.79 ±0.46b
LPDS3	7.00 ±0.29c	7.00 ±0.33c	7.70 ±0.37c	6.00 ±0.24d	7.81 ±0.30c	6.00 ±0.29d	6.92 ±0.16c
P<	****	****	****	****	****	****	****

LPDSC: lentil-purslane dried soups with 0% dried purslane . LPDS1: Lentil-purslane dried soups with 5% Dried Purslane LPDS2: Lentil-purslane dried soups with 10% Dried purslane LPDS3: Lentil-purslane dried soups with 15 % Dried Purslane Every measurement was conducted as average of ten replicates and is charted by the SD (standard deviation)). The means in the same column with different superscripts (a, b and c) : differ significantly at p<0.05. *

Moreover, total phenolic compounds of purslane powder are agreed with those of Mastud et al., (2018).

3.3. Sensory properties of lentil-purslane dried soups

Data indicated in Table (5) exhibited that the sensory attributes of lentil-purslane dried soups containing 0% purslane leaves powder had the highest values of flavor, taste, dissolution rate, thickness, color, and overall acceptability, but all scores were decreased with increasing levels of purslane leaves powder. This result harmonized with Bader et al., (2022) and Sahoul et al., (2021), who found that the incorporation of salad, Molokai, rice, cabbage stuffed, and meat kofta with 10%, 15%, and 20% fresh purslane leaves caused a reduction regularly of the sensory properties of the products.

Table 6. Nutrition and growing parameters of $KBrO_3$ poisoning rats fed on lentil-purslane dried soups

Parameters / Groups	Intent weight	Final weight	Daily weight gain	Daily food intake	Daily protein intak	FER	PER
Negative control	207 ± 2.65ba	270.33 ±8.39a	1.51 ±0.14a	30 ±2.00ba	4.2 ±0.28ba	0.051 ±0.01a	0.360 ±0.04a
Positive control	210 ±2.65ba	235 ±7.81b	0.59 ±0.15c	21.33 ±3.21c	2.99 ±0.45c	0.028 ±0.01b	0.202 ±0.06b
LPDSC	211 ±3.61ba	238.33 ±2.89b	0.65 ±0.03c	19.67 ±0.58c	2.75 ±0.08c	0.033 ±0.00b	0.237 ±0.02b
LPDS1	205 ±4.36ba	239.33 ±4.04b	0.82 ±0.05c	23 ±2.65c	3.22 ±0.37bc	0.036 ±0.01ba	0.257 ±0.04ba
LPDS2	212 ±2.00a	253.33 ± 1.53ba	0.98 ±0.07bc	25.67 ±4.04bac	3.59 ±0.57bac	0.039 ±0.01ba	0.278 ±0.05ba
LPDS3	202 ±2.00b	254.67 ±13.20ba	1.25 ±0.27ba	31 ±1.73b	4.34 ±0.24a	0.040 ±0.01ba	0.288 ±0.05ba
P<	*	**	***	**	**	*	*

LPDSC: lentil-purslane dried soups with 0% dried purslane . LPDS1: Lentil-purslane dried soups with 5% Dried Purslane LPDS2: Lentil-purslane dried soups with 10% Dried purslane LPDS3: Lentil-purslane dried soups with 15 % Dried Purslane Every measurement was conducted in at least three duplicates, and the results represent the average ± SD for each group containing seven rats. *P<0.05. **P<0.01. *** P<0.05. (a, b, and c): values in the exact same column with different superscript differ significantly at p<0.05.

3.4. Nutrition and growing parameters of KBrO3 poisoning rats fed on lentil-purslane dried soups

Data in Table (6) demonstrated that the positive control group had the lowest estimation of final body weight, daily weight gain, and food and protein efficiency ratio compared to other groups. This might be due to toxic-induced metabolism disturbances in rats. The results corresponded with those of Rezq (2017) and EI-Dashlouty et al., (2020), who reported that the final weight and weight gain of positive control group rats that were poisoned by $KBrO_3$ had a significant reduction compared to those of the negative group rats. Otherwise, as a result of feeding on lentil-purslane dried soups, the parameters were increased constantly compared to the positive group. This result might be due to soups containing lentils, orange sweet potatoes, onions, garlic and tomatoes, which have vitamins, polyphenols that have antioxidant properties that reduce the effect of $KBrO_3$ poisoning. This result is consistent with that of Osman et al., (2013) who reported that feeding experimental rats on lentil soup led to an improvement in the growth and physiological state of the rats' liver and kidney functions compared with a group fed on a standard basal diet. In contrast, the group fed on diet -soup containing 15% purslane leaves powder had the high significant values of daily weight gain, daily food intake, and food and protein efficiency ratio when compared to positive control group. This result was due to increase the effect of purslane leaves powder, which were contained vitamins, polyphenols, and fiber that have antioxidant activity that reduce the effect of $KBrO_3$ poisoning.

Table 7. The relative organs weights of $KBrO_3$ poisoning rats fed on lentil-purslane dried soups

Parameters / Groups	Kidney	Liver	Heart	Spleen	Brain
Negative control	1.78±0.07A	6.78± 0.20C	0.5±0.01C	0.66±0.01CB	1.5±0.01BC
Positive control	1.08±0.05ED	7.46±0.14A	0.74±0.03A	0.75±0.02A	1.58±0.02BA
LPDSC	1±0.04E	7.1±0.21B	0.71±0.02BA	0.7±0.01B	1.59±0.05A
LPDS1	1.17±0.10D2	6.52±0.16C	0.55±0.01C	0.63±0.01CD	1.53±0.02BA
LPDS2	1.28±0.12C	6.24±0.15D	0.54±0.03C	0.61±0.02ED	1.49±0.03C
LPDS3	1.4±0.09 B	6.1±0.10D	0.66±0.02B	0.58±0.02E	1.39±0.04D
P<	****	****	****	****	****

LPDSC: lentil-purslane dried soups with 0% dried purslane . LPDS1: Lentil-purslane dried soups with 5% Dried Purslane LPDS2: Lentil-purslane dried soups with 10% Dried purslane. LPDS3: Lentil-purslane dried soups with 15 % Dried Purslane Every measurement was conducted in at least three duplicates, and the results represent the average ± SD for each group containing seven rats. *P<0.05. **P<0.01. *** P<0.05. (a, b, c, d, and e): values in the exact same column with different superscript differ significantly at p<0.05.

3.5. The relative organ weights of KBrO3 poisoning rats fed on lentil-purslane dried soups

Data found in Table (7) showed that the relative organ weights of brain, kidney liver, heart and spleen of positive control group that was induced by $KBrO_3$ had the highest average as compared to other KBro3poisoning groups that were fed on lentil-purslane dried soups. This was the outcome of positive control due to it had the maximum of poisoning impact, which led to abnormal organ metabolism and an increase in the weight of the organs. These results matched those of EI- Dashlouty et al., (2020) & Kotb and Mostafa (2017), who reported that the relative weights of the lungs, heart, spleen, kidneys, and liver of the $KBrO_3$ -intoxicated rats in the positive control group were significantly higher than those of the negative control group. Additionally, when the amounts of purslane leaves powder was increased in the soup, the organs weights of the KBrO3-poisoning rats were lowered. The result of the group was fed on 0% lintel-purslane dried soup might be due to the fact that the lintel contained polyphenols and vitamins which are used as preventative components. This result is agree with that of Abdel-Atty et al., (2023). Also, the results of other lentil- purslane dried soups were due to vitamins and polyphenols found in purslane leaves powder contents that act as preventatives for the liver, kidney and brain organs.

Table 8. The lipid profile of $KBrO_3$ poisoning rats fed on lentil-purslane dried soups

Parameters / Groups	TG (mg/dl)	TC (mg/dl)	HDL-c (ml/ dl)	LDL-c (ml/ dl)	VLDL-c (ml/ dl)	LDL/HDL-c mg/dl)	CH/HDL-c (mg/dl)
Negative control	83.9 ±1.85E	106.97 ±3.58E	42.40 ±1.64CB	43.63 ±1.48E	20.93 ±1.01BC	1.03 ±0.04E	2.52 ±0.03E
Positive control	135.67 ±1.15A	187.00 ±4.36A	34.33 ±2.08D	125.00 ± 4.36A	27.67 ±2.08A	3.641 ±0.11A	5.45 ±0.22A
LPDSC	120.67 ±3.79B	170.87 ±4.01B	38.33 ±1.53CD	109.00 ±1.73B	23.53 ±1.5BA	2.84 ±0.11B	4.46 ±0.13B
LPDS1	109.67 ±2.52C	157.97 ±1.76C	40.33 ±1.53CB	97.63 ±1.58C	20 ±1.00ABCD	2.42 ±0.1C	3.92 ±0.11C
LPDS2	93.73 ±1.97D	143.63 ±1.58D	43.63 ±2.57B	82.33 ±1.53D	17.67 ±2.08CD	1.89 ±0.1D	3.3 ±0.16D
LPDS3	85.00 ±1.00E	140.33 ±4.16D	47.9. ±1A	76.00 ±2.65D	15.33 ±2.52D	1.55 ±0.08E	2.87 ±0.13E
P<	****	****	****	****	****	****	****

LPDSC: lentil-purslane dried soups with 0% dried purslane. LPDS1: Lentil-purslane dried soups with 5% Dried Purslane LPDS2: Lentil-purslane dried soups with 10% Dried purslane. LPDS3: Lentil-purslane dried soups with 15 % Dried Purslane Every measurement was conducted in at least three duplicates, and the results represent the average ± SD for each group containing seven rats. *P<0.05. **P<0.01. *** P<0.05. (a, b, c, d, and e): values in the exact same column with different superscript differ significantly at p<0.05.

3.6. The lipid panel of KBrO3 poisoning rats fed on lentil-purslane dried soups

Data found in Table (8) showed that the highest TG, LDL, VLDL and TC values and the lowest HDL-C values were found in the positive control group as compared to the negative control group and other KBr03 poisoning GROUP rats that fed on lintel-purslane soups. This result is compatible with those of Naif et al., (2018) and Abdel-Latif et al., (2021). Also, the result of group was fed on lintel-purslane dried soup containing 0% purslane was due to this diet contains lintel, orange sweet potato, tomato, and garlic, which improve the lipid profile because they have vitamins, mineral fiber and phytochemicals. These results are harmonious with those of Shalaby et al., (2018) and Abdel-Atty et al., (2023), who found that lentil could improve the lipid profile of fatty liver rats, so the cardio protective effect of lentil seems to be increased HDL-C.

In the same Table, the group was fed on 15% purslane had the highest1evel of HDL-c and lowest levels of, VLDL-c, LDL-c and TG so, it had the lowest level of atherogenic index, this result might be due to the antioxidant activities´ of purslane leaves powder, this result agree with those of Shalaby et al, (2018).

3.7. Liver panel of KBrO3 poisoning rats fed on lentil-purslane dried soups

The data instituted in Table (9) showed that the liver enzymes (AST, ALT, and ALP) were increased, but total protein, albumin, globulin g/dl, and A/G ratio were lowered in the positive control group as compared to the negative control group and other groups were intoxicated by $KBrO_3$. These findings could primarily be the consequence of these enzymes leaking into the bloodstream from the liver cytosol. That gave rise to an increase in ALT and AST enzymes in the positive control rats, as described by El-Dashlouty et al., (2020) and Kotb and Mostafa (2017). Moreover, the ALP, AST and ALT serum enzymes were decreased, but total protein, albumin and globulin were progressively increased, as influenced by increasing feeding on levels of lentil-purslane soups after 8 weeks. The group fed on 0% lintel- purslane dried soup had a low level of enzymes compared to the positive group. This result might be due to lintel soups having compounds that influence reducing enzymes, such as phytochemicals and vitamins. This result harmonizes with Rahmani et al., (2014), who discovered that the red lentil extract has a preventative result on liver toxicity induced by carbon tetrachloride by decreasing levels of AST, ALT and ALP as liver enzymes.

Table 9. The liver panel of $KBrO_3$ poisoning rats fed on lentil-purslane dried soups.

Parameters / Groups	ALP (U/L)	ALT (U/L)	AST (U/L)	Total protein (g/dl)	Albumin (A) g/dl	globulin g/d (G)	A/G ratio
Negative control	114± 2.00E	32± 1.44D	28.5± 1.50E	8.83± 1.15A	5.82± 0.39A	3.01± 0.06A	1.94± 0.07A
Positive control	256± 3.00A	76.4± 1.53A	56.1± 1.01A	3.94± 1.15F	2.02± 0.11F	1.92± 0.11C	0.99± 0.05C
LPDSC	178± 1.73B	57.5 ± 1.7B	47.1± 1.56B	4.65± 0.06E	2.5± 0.2DC	2.15± 0.05BC	1.06± 0.13CB
LPDS1	146.4± 2.95C	40.2± 1.71C	39± 2.00C	5.45± 0.06D	3.1± 0.17C	2.35± 0.19BC	1.32± 0.07B
LPDS2	137± 3.00D	37± 2.00C	34.4± 1.22D	7.23± 0.1C	4.52± 0.42B	2.71± 0.37BA	1.72± 0.15A
LPDS3	120± 3.61E	32± 2.00D	30± 2.00E	8.13± 0.17B	5.22± 0.3BA	2.91± 0.26A	1.81± 0.09A
P<	****	****	****	****	****	****	****

LPDSC: lentil-purslane dried soups with 0% dried purslane . LPDS1: Lentil-purslane dried soups with 5% Dried Purslane LPDS2: Lentil-purslane dried soups with 10% Dried purslane LPDS3: Lentil-purslane dried soups with 15 % Dried Purslane Every measurement was conducted in at least three duplicates, and the results represent the average ± SD for each group containing seven rats. *P<0.05. **P<0.01. *** P<0.05. (a, b, c, d, e and f): values in the exact same column with different superscript differ significantly at p<0.05.

Table 10. Liver antioxidant enzymes of $KBrO_3$ poisoning rats fed on lentil-purslane dried soups

Parameters / Groups	SOD(µmol/mg tissue/min	GPX (µmol/mg tissue/min)	CAT (Unit/g tissue)	Hepatic MDA (µmol /g)
Negative control	3.2± 0.05A	48.23±2.25A	12.32±0.42A	8.96±0.95C
Positive control	1.46± 0.04E	18.65±0.33E	4.68±0.28E	15.27±0.55A
LPDSC	1.81±0.17D	25.9±0.10D	8±0.10D	12.47±0.46B
LPDS1	2.2± 0.1C	37.8±0.98C	9.18±0.33C	10.63±0.47C
LPDS2	2.82±0.17B	40.36±0.56C	10.3±0.3CB	9.87±0.12C
LPDS3	3.01±0.12BA	45.01±0.99B	11.01±0.79B	9±0.9C
P<	****	****	****	****

LPDSC: lentil-purslane dried soups with 0% dried purslane . LPDS1: Lentil-purslane dried soups with 5% Dried Purslane LPDS2: Lentil-purslane dried soups with 10% Dried purslane LPDS3: Lentil-purslane dried soups with 15 % Dried Purslane Every measurement was conducted in at least three duplicates, and the results represent the average ± SD for each group containing seven rats. *P<0.05. **P<0.01. *** P<0.05. (a, b, c, d, and e): values in the exact same column with different superscript differ significantly at p<0.05.

In the same Table, the group fed on soup containing 15% purslane diet had the lowest liver enzymes when compared to other groups were fed on dried soups. This result might be due to the fact that purslane leave powder contained several quantities of phenol, flavonoids and vitamins, which have antioxidant activities that have been progressively reduced in AST and ALT enzymes. So, purslane leaves powder has been safeguarding the liver cells and safeguarding the liver from tumors, as found by Naeem and Khan (2013). They reported that purslane contains vitamins, minerals, steroids, saponins, alkaloids and fatty acids that have hepatoprotective C and antioxidant effects. On the other hand, the levels of liver enzymes did not reach To normal levels. These results might be because the rats still had $KBrO_3$ poisoning. So, liver enzymes will reach normal levels when the period is increased. This result harmonizes with that of Ikhajiangbe et al., (2014), who found that decreased the levels of liver enzymes indicated steadiness of the plasma membrane and protection of the liver's cells against harm caused by liver-toxic.

3.8. Liver antioxidant enzymes liver of KBrO3 poisoning rats fed on lentil-purslane dried soups

Data found in Table (10) showed that the positive control group had the lowest levels of antioxidant enzymes and the highest levels of MDA. This result might be due to $KBrO_3$ poisoning, which caused an increase in lipid peroxidation and protein oxidation, which reduced the total antioxidant power in the blood and caused increases in tissue compared to the normal control group, as found by Abdel-Latif et al., (2021). Also, the result of 0% lintel-purslane dried soup had significant increase in antioxidant enzymes and a decrease in MDA levels as compared to the positive group. This result might be due to vitamins and phytochemicals that can act as antioxidants, which can improve liver function. This result is in covenant with that of Abdel-Atty, et al., (2023), who found that lentil could improve the oxidative stress indicators of fatty liver rats.

In the same table the group was fed on 15% lintel- purslane dried soup had the highest antioxidant enzymes and the lowest MDA level compared to other groups were fed on dried soups. This result might be due to the fact that purslane leaves have potent antioxidant activities like omega-3 fatty acids, β-carotene, vitamins (A, B, C and E), and flavones that avoid lipid peroxidation of the endoplasmic reticulum and reduce inflammatory factors, so, it can play an important role in controlling liver diseases, as reported by Ikhajiangbe et al., (2014), and Javadikia and Khajei (2023).

4. CONCLUSION

From the current results, it could be concluded that purslane (P. oleracea) and lintel have potentially nutritional. Also, purslane could be used in green therapy. So, the nutritional value of lintel-purslane dried soups can be enhanced by substituting purslane leaves by orange sweet potato powder at different levels. These soups were suitable for an alternative to vegetarianism and other diets because it has a number of significant health benefits. Furthermore, consumed lintel-purslane dried soups had a lowering effect on lipid profile, atherogenic index and liver functions compared to the positive group. Moreover, oxidative stress biomarkers in $KBrO_3$ poisoned rats were decreased. So, this study recommended the incorporation of purslane leaves powder in the daily diet to protect the liver and kidneys and to avoid oxidative stress, which causes many diseases

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الملخص العربي

تأثير حساء العدس باوراق الرجلة (Portulaca Oleracea) سريعة التحضير على السمية الكبدية في فئران التجارب المستحدثة ببورمات البوتاسيوم

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تهدف هذه الدراسة الى إنتاج حساء العدس بالرجلة المجفف بإضافة مسحوق اوراق الرجلة المجففة بنسب ٠ و ٥ و ١٠ و ١٥%. ودراسة التركيب الكيميائي والخصائص الحسية للحساء الناتج. كما تم دراسة تأثير تغذية فئران التجارب المصابة بتسمم بورمات البوتاسيوم على وجبات محتوية على ٨٠% من الحساء المجفف المحتوى على مستويات مختلفة من مسحوق أوراق الرجلة على كل من صورة الدهون في الدم ووظائف الكبد والمؤشرات الحيوية الدالة على الاصابة بالإجهاد التأكسدي. اوضحت النتائج انه نتيجة لزيادة نسب مسحوق أوراق الرجلة في الحساء حدث زيادة تدريجية فى البروتين والدهون والرماد والألياف بينما حدث انخفاض تدريجي في كل من الرطوبة والكربوهيدرات، كما حدث زيادة تدريجية فى الفيتامينات والمعادن والفينول الكلي و .DPPH. كما أوضحت النتائج ان جميع انواع حساء العدس بالرجلة المجففه كانت مقبولة حسيا. وحدث نتيجة لتغذية الفئران المصابة بتسمم بورمات البوتاسيوم (KBro3) على الوجبات المحتوية على الحساء المجفف ,انخفاض تدريجيى في مستويات دهون الدم مثل الجلسريدات الثلاثية، والكوليسترول الكلي، والليبوبروتينات الحاملة للكوليسترول منخفض الكثافة،. بينما حدث زيادة في مستوى الليبوبروتينات الحاملة للكوليسترول عالي الكثافة مقارنة بمجموعة الفئران الموجبة المصابة. لذلك، حدث انخفاض تدريجى فى مؤشر تصلب الشرايين. واوضحت النتائج ان المجموعة المصابة المغذاة على الوجبة المحتوية ١٥% من اوراق الرجلة كانت اقل المجموعات فى مستويات إنزيمات الكبد وأعلاها فى مستويات البروتين الكلي والألبومين والجلوبيولين ونسبة A/G مقارنة بالمجموعات المصابة الأخرى والتي تم تغذيتها على الحساء المجفف. علاوة على ذلك، حدث ارتفاع فى مستويات الإنزيمات المضادة للأكسدة ، كما كانت اقل المجموعة المصابه فى مستويات المالونديالدهيد. وبالتالي انخفضت المؤشرات الحيوية للإجهاد التأكسدي، لذا توصى هذه الدراسة بإدخال مسحوق أوراق الرجلة في النظام الغذائي اليومي لحماية الكبد وتجنب المؤشرات الحيوية للإجهاد التأكسدي الذي يسبب العديد من الأمراض.

الكلمات المفتاحية: العدس، الرجلة، الكبد, التسمم، الكبد, للإجهاد التأكسد