Effect of artichoke leaves extract against potassium bromate induced renal injury in rats and its possibility adding in some edible salads

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مجلة البحوث في مجالات التربية النوعية

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تأثير مستخلص أوراق الخرشوف ضد إصابة الكلى ببرومات البوتاسيوم في الفئران وإمكانية إضافته في بعض السلطات الصالحة للأكل

د.دينا البشوتي

الملخص

يهدف هذا البحث إلى دراسة تأثير مستخلص أوراق الخرشوف على ذكورالفئران المصابة بالتسمم الكلوى ومدى إمكانية إضافته لبعض السلطات (سلطة بابا غنوج ، سلطة الطحينة ، سلطة التونة ، سلطة الزبادى) بتركيزات 3% ، 6% و 9% . ولهذا الغرض تم تحليل التركيب الكيميائى لمستخلص أوراق الخرشوف كما أجريت الدراسة على 40 فأر من ذكورالألبينو والتي تم تقسيمهم إلي خمس مجموعات متساوية العدد كل مجموعة بها 8 فئران، المجموعة الأولى هي مجموعة الفئران الطبيعية الغير مصابة ، أما باقى المجموعات تم إصابتهم بمركب برومات البوتاسيوم (200مج/كجم وزن الجسم جرعة واحدة)لإحداث الإصابة الكلوية وتم إعادة تقسيمهم إلى المجموعة الثانية الفئران المريضة الغير معالجة المصابة ،المجموعة الثالثة والرابعة والخامسة تمت معالجتهم بمستخلص أوراق الخرشوف بتركيزات 3% ، 6% و 9% على التوالي واستمرت الدراسة لمدة 6 أسابيع وجميع المجموعات تتغذى على الغذاء القياسى .أوضحت نتائج التحليل الكيميائى للمستخلص أن قيم الكربوهيدرات والرماد والبروتين والدهون كانت 73.50±0.01 ، 14.80±0.07، 8.20±0.10، 3.50±0.02 جرام/ 100جرام بينما كانت الفينولات 44.35±0.05ميكروجرام/100جرام .

كما أوضحت النتائج أن تناول مستخلص أوراق الخرشوف صاحبه انخفاض معنوى في مستوى الكوليسترول الكلي ، الجليسريدات الثلاثيــة ، كوليسترول البروتينات الدهـــنية المنخفضة الكثافة ،البروتينات الدهنية المنخفضة جدا في الكثافة، ووظائف الكلى (اليوريا والكرياتنين وحمض البوليك) ، وارتفاع معنوي في الوزن المكتسب وكوليسترول البروتينات الدهنية العالية الكثافة وأنزيمات النشاط المضاد للأكسدة (CAT, GSH, SOD) وذلك بالمقارنة بالمجموعة الضابطة الموجبة. كما أظهر الفحص الهستوباثولوجى أن المستخلص له تأثير علاجى على الكلى .هذا وقد أظهرت السلطات التي دخل في اعدادها المستخلص بتركيز 3% ، 6% درجة تقبل جيدة. وتوصي الدراسة بضرورة ادخال مستخلص أوراق الخرشوف ضمن أغذية مرضي الكلى

الكلمات الرئيسية: مستخلص أوراق الخرشوف ،بروميد البوتاسيوم، دهون الدم ،وظائف الكلى ، مضادات الأكسدة ، الخواص الحسية ، الفئران .

Effect of artichoke leaves extract against potassium bromate induced renal injury in rats and its possibility adding in some edible salads

Abstract

This study aimed to determinate some chemical composition of artichoke leaves extract and investigates the treatment effect of artichoke leaves extract on injured renal in experimental rats and its possibility of adding it to salads (eggplant salad, tahini salad, tuna salad and yogurt salad). Chemical composition, phenolic content and flavonides from the extract were measured .Forty male albino rats were divided into five equal groups (8 rats for each group).Group1: negative control group and renal injured rats groups by KBrO3 (200 mg/kg BW gavaged once dose) which reclassified into positive control group and treated groups with 3,6 and 9% artichoke leaves extract (ALE). Chemical composition of artichoke leaves extract showed the values of carbohydrate, ash, crude protein and lipids were 73.50±0.01, 14.80±0.07, 8.20±0.10 and 3.50±0.02 g/100g respectively but phenolic fractionations were 44.35+0.05 µg/100g . The biological results demonstrated that all nephrotoxic rat groups treated with 3%,6% and 9% (ALE) showed significant increase in body weight gain . The results declared that all nephrotoxic rat groups which treated with 3%,6% and 9% (ALE) showed significant decrease in the values of serum cholesterol, TG , LDL-c , VLDL-c , uric acid, urea and creatinine while showed significant increase ($p<0.05$) in the values of serum HDL-c, antioxidant enzymes (CAT, GSH, SOD) compared with positive control group. Histopathological studies showed protective effects of (ALE) on kidney tissues. Results also showed good acceptance for salads treated with 3%, 6% (ALE) . The study recommended adding (ALE) to diet of nephrotoxic patients .

Keywords: Artichoke leaves extract , KBrO3, lipid profile, kidney functions, antioxidants enzymes , sensory evaluation, rats.

Introduction

The kidney is an important organ that the body needs to perform several important functions including maintaining balance, regulating of the extracellular environment, such as detoxification and excretion of toxic metabolites and drugs **(Ferguson *et al.*, 2008)**. Due to its high vessels and complex metabolic activities, many drugs and environmental antibiotics cause toxicity of the kidney **(Elsayed *et al.*, 2014).** Diagnose kidney disease with objective measures of kidney damage and function has been recognized as a major burden to public health. The population prevalence of chronic kidney disease has exceeded 10%, and is more than 50% in high-risk subpopulations. Risk of kidney disease has a noticeable genetic component **(Eckardt *et al.*, 2013).** Nephrotoxicity is one of the most common kidney problems caused by various toxic compounds **(Yadav *et al.*,2017**).

An important side effect of many antibiotics that may lead to acute kidney failure, especially in patients with renal insufficiency if taken without considerations . Potassium bromate (KBrO3) is widely used as a food additive **(Oloyede and Sunmonu,2009).** It is also an essential by product of water disinfection, in spite of its well-known oxidative cell and tissue damage. **(Elgendy and Bayomy ,2020).** The nephrotoxicity caused by KBrO3 has been attributed to its ability to trigger reaction production of oxygen species (ROS), lipid peroxidation and 8- hydroxyguanosine modification in renal DNA **(Spassova *et al.*, 2015).** *Cynara scolymus* is a perennial herbaceous plant belonging to family Asteraceae and usually known by the name of artichoke has been reported to have anti oxidative anti diabetic, anti microbial, cholesterol biosynthesis inhibitor, nephroprotective, anti-inflammatory properties (**Salem *et al.*, 2019).** In addition, it offers protection against degenerative changes such as cancer. In folk medicine, *C. scolymus* has been used as astringent, blood cleanser,

cardiotonic, detoxifier, digestive stimulant, diuretic, hypoglycemic and hypocholesterolemic as well medicine for liver complaints **(Kraft, 1997 and Lattanzio *et al.*, 2009).** *Cynara cardunculus var. scolymus* or globe artichoke is mainly cultivated as a food crop. It is a perennial plant that is largely native to the mediterranean region in Southern Europe and Northern Africa. In addition to food, artichoke is used in tea and preparing alcoholic drinks. Studies on the medicinal properties of artichoke have continued over the past six decades **(Aljefree and Ahmed ,2015***)*. These variable therapeutic actions of artichoke cannot be attributed to one component of the plant and it could be because of the presence of many bioactive components that produces synergistic pharmacological effects **(Sharma *et al.*,2019).** The aqueous artichoke leaves extract contains caffeoylquinic acid with chlorogenic acid being the most abundant (0.30%), and luteolin-7-O-glucoside (0.15%) as a major flavonoid (**Magielse *et al.*, 2014**).So, the current research aimed to study the effect of artichoke leaves extract against potassium bromate induced renal injury in male rats and its possibility of adding to some edible salads.

Materials and Methods

Materials

Fresh artichoke leaves (*Cynara scolymus L.*) were obtained from the Agricultural Research Center, El- Dokki, Giza, Egypt.

Ingredient of salads

Sesame tahini raw, lemon juice, salt table, cumin powder, parsley raw, eggplant raw, onion, garlic, lettuce, tuna, olive oil and yogurt were obtained from the local market of Damietta governorate ,Egypt.

Chemicals and Kits

Vitamins, minerals, cellulose, choline chloride , diagnostic kits and potassium bromate (KBrO3) were purchased from El-Gomhoria Company for Trading Drugs ,Chemicals and Medical Equipment's, Cairo, Egypt.

Animals

40 male albino rats (Sprague Dawley strain) weighing 150±5g were obtained from Food Technology Research Institute, Agriculture Research Center, Giza.

Methods

A-chemical study

Chemical analysis of artichoke leaves extract

Proximate analysis involving crude protein, crude ash, and crude fat were determined according to Association of Official Analytical Chemists **A.O.A.C (2005).** Carbohydrates content was calculated by difference. Flavonides and phenolic contents in artichoke leaves extract were estimated according to (**Burda and Oleszek ,2001)**.

Preparation of aqueous extracts of artichoke leaves

Artichoke fresh leaves were separated and cleaned. Leaves were dried at 50°C in a hot air oven for 12 hours **Adejuyitan *et al.*, (2008).** Dried artichoke leaves was grounded using a porcelain grinder and passed through mesh with pores 1 mm in diameter. Aqueous extract was made according **Sofrata *et al.*,(2007)**. Dried artichoke leaves 30, 60, 90 grams were added each only to liter of distilled water and boiled for six minutes to get 3, 6, 9 % concentrations of artichoke leaves extracts and left for 15 min to cool. Therefore, aqueous extract was filtered by 0.2 mm filter paper to remove particulates .

Preparing of salads recipes

Salads (eggplant salad, tahini salad, tuna salad and yogurt salad) were prepared according to **Saba (1995)**, water used in preparing salads were replaced with artichoke leaves extracts at 3%,6% ,9% concentrations respectively .

Table (1) composition of salads

Eggplant salad			
Eggplant salad	**Eggplant salad 3% (ALE)**	**Eggplant salad 6%(ALE)**	**Eggplant salad 3% (ALE)**
250g Eggplant 50 g onion 120g raw tahini 20 ml lemon juice 3g garlic raw 2g salt 2s cumin 5g parsley 40ml water	250g Eggplant 50 g onion 120g raw tahini 20 ml lemon juice 3g garlic raw 2g salt 2s cumin 5g parsley 40ml ALE(3%)	250g Eggplant 50 g onion 120g raw tahini 20 ml lemon juice 3g garlic raw 2g salt 2s cumin 5g parsley 40ml ALE(6%)	250g Eggplant 50 g onion 120g raw tahini 20 ml lemon juice 3g garlic raw 2g salt 2s cumin 5g parsley 40ml ALE(9%)
Tahini salad			
Tahini salad	**Tahini salad 3% (ALE)**	**Tahini salad 6% (ALE)**	**Tahini salad 9% (ALE)**
120g raw tahini 20 ml lemon juice 3g garlic raw 2g salt 2s cumin 5g parsley 40ml water	120g raw tahini 20 ml lemon juice 3g garlic raw 2g salt 2s cumin 5g parsley 40ml ALE(3%)	120g raw tahini 20 ml lemon juice 3g garlic raw 2g salt 2s cumin 5g parsley 40ml ALE(6%)	120g raw tahini 20 ml lemon juice 3g garlic raw 2g salt 2s cumin 5g parsley 40ml ALE(9%)
Tuna salad			
Tuna salad	**Tuna salad 3% (ALE)**	**Tuna salad 6% (ALE)**	**Tuna salad 3% (ALE)**
300g canned tuna(one peace) 70g tomato 80g onion 50gm lettuce 3g salt 5g cumin 10ml lemon juice 10 ml olive oil 30ml water	300g canned tuna(one peace) 50g parsley 70g tomato 80g onion 50gm lettuce 3g salt 5g cumin 10ml lemon juice 10 ml olive oil 30ml ALE(3%)	300g canned tuna(one peace) 50g parsley 70g tomato 80g onion 50gm lettuce 3g salt 5g cumin 10ml lemon juice 10 ml olive oil 30ml ALE(6%)	300g canned tuna(one peace) 50g parsley 70g tomato 80g onion 50gm lettuce 3g salt 5g cumin 10ml lemon juice 10 ml olive oil 30ml ALE(9%)
Yogurt salad			
Yogurt salad	**Yogurt salad3% (ALE)**	**Yogurt salad 6% (ALE)**	**Yogurt salad 9% (ALE)**
150 g yogurt Strained of whey 2g salt 5g soft dry mint 20 ml water	150 g yogurt Strained of whey 2g salt 5g soft dry mint 20 ml ALE(3%)	150 g yogurt Strained of whey 2g salt 5g soft dry mint 20 ml ALE(6%)	150 g yogurt Strained of whey 2g salt 5g soft dry mint 20 ml ALE(9%)

Sensory properties

Sensory properties of salads recipes was evaluated by 10 trained panelists, according to **Sammak (2016)**.

B-biological study

KBrO3 induced renal injury

Solution of KBrO3 was prepared in drinking water and given orally (200 mg/kg bwt gavage once) to cause renal injury in rats.

Preparation of experimental animals

All rats (40 rats) fed on basal diet for one week, as adaptation period, rats were randomly divided into five groups of eight rats each. All rat groups fed on basal diet according to **Reeves *et al.*, (1993)**. The basal diet consists of protein (10%) , corn oil (10%) , choline chloride (0.2%) ,cellulose (5%), the salt mixture (4%) was prepared according **Hegested *et al.*, (1941)** and the vitamin mixture (1%) was prepared according to **Ain (1993)** .The first group served as a negative control, fed on basal diet only. The other four groups were fed on basal diet and received 200 mg/kg bw of potassium bromate by stomach tube once dose according to **Kurokawa *et al.*, (1990)** .Then, rats reclassified into four groups which were positive control and treated rat groups with 3%, 6% and 9 % artichoke leaves extract (ALE).The treatment period is designed for six weeks.

Blood sampling

At the end of the experimental period 6 weeks before sacrificing, rats were fasted overnight .Blood was collected and centrifuged (3000rpm), serum was separated for analysis .Serum was carefully transferred into clean cuvette tubes and stored frozen at -20◦C for analysis. During the experimental period, the food intake (FI) was recorded every day and body weight gain (BWGg) was recorded every week by calculated the following equation.

BWG (g) = final weight (g) - initial weight (g)

Biochemical analysis:

For each group analyses included the following:

Serum total cholesterol (TC) were determined according to **Allen (1974)**.Triglycerides (TG) was measured according to **Fossati and Prencipe (1982).**High density lipoprotein–cholesterol (HDL-c) was determined according to **Lopez (1977)** , whereas low density lipoprotein–cholesterol (LDL-c) were determined according to **Friedewable *et al.*,(1972)**. Determination of low density lipoprotein cholesterol (LDLC) by equation
LDL-c = TC-[HDL-c + (TG/5)] and VLDL-c = TG/5

Urea was determined according to **Pattn and Crouch (1977),** the determination of creatinine was according to **Henry (1974)**, determination of uric acid was measured by **Barham and Trinder (1972).**

Determination of antioxidant biomarkers

Determination of antioxidant biomarkers levels as reduced glutathione (GSH) was estimated by **Weiss *et al.*, (1980)**.On the other hand, the activities of superoxide dismutase (SOD) were measured according to **Spitz and Oberley (1989)** while catalase (CAT) were determined calorimetrically according to **(Aebi ,1984).**

Histopathological analysis

The histopathological studies of the renal tissues were carried out according to standard method **Drury and Wallington (1980)**. Mainly, a small piece of kidney tissue was immediately fixed in 10% formalin. These formalin fixed tissues were embedded in paraffin sectioned, stained with hematoxylin and eosin (H & E) and examined under a light microscope for histopathological analysis.

Statistical Analysis

Statistical analysis was achieved by using computer of statistical package for social science (SPSS version 11.0). The results are given as means ±SD. One way analysis of variance (ANOVA) was used to test the differences between groups **(SPSS, 1999)**.

Results and Discussion

Chemical composition contents of artichoke leaves extract

Chemical composition of artichoke leaves extract was shown in table (2). The results were determined for crude protein, total lipids, total carbohydrate, ash, flavonoids and phenolics content. The ratios were 8.20± 0.10g, 3.50±0.02g, 73.50±0.01g, 14.80±0.07 g, 8.98±0.02 µ/100 g and 44.35±0.05µ/100 g respectively. These results are in harmonization with **Ruiz-Cano et al.,(2014)** who found protein content of ALE was in the range of 8.05 to 12.5%. Hence, it contains low levels of fat (2.5– 3.7%) also there was no crude fiber in the extract **Magied *et al.*,(2016)**. Polyphenolic components were mainly found in artichoke leaves over than heads, its active compounds protect against lipid peroxidation **Bonomi and Bonomi (2001)**. Artichoke leaves extract is effective antioxidant and its health-protective prospective was accredited to its antioxidant power **Lupattelli *et al.*, (2004).** In this respect, total phenolic content (TPC) in artichoke leaves extract was high and amounted CAE (chlorogenic acid equivalents)/100 g .In addition that artichoke leaves contain 2% phenolic acids, mostly 3- caffeoylquinic acid (chlorogenic acid), plus 1.3-di-O-caffeoylquinic acid (cynarin), and caffeic acid; **(Leung and foster,1996)**.

Table (2) :Chemical composition of artichoke leaves extract

Component	Values
Crude protein (g/100 g)	8.20± 0.10
Total lipids (g/100 g)	3.50±0.02
Carbohydrate (g/100 g)	73.50±0.01
Ash (g/100 g)	14.80±0.07
Flavonides (µ/100 g)	8.98±0.02
Phenolics content(µ/100 g)	44.35±0.05

Effect of artichoke leaves extract on body weight gain (BWG) and food Intake (FI) of the experimental rats suffering from nephrotoxicity

Data shown in table (3) declared the mean values of bodyweight gain (g) and food intake (g/day for each rat) . There was a significant decrease in body weight gain for positive control group (36±0.01g), as compared to the negative control group (52.8±0.05 g).Also, body weight gain of all nephrotoxic groups treated with artichoke leaves extract at 3%,6%,9% concentrations led to significant increase as compared to the positive control group , these results are in agreement with **Abdulkhaleq *et al.*,(2018)** who declared that there was increase in body weight in groups received artichoke leaves extract using either low or high dose. In this concern **Ismail (2019)** stated that rats when orally given artichoke leaves extract (ALE) alone gained more weight as compared with the positive control group. Also, the mean values of food intake decreased in the positive control group (9.70±0.02) than that of the negative control group (15.50±0.02 g/day). Increasing levels of artichoke leaves extract led to gradual increase in food intake in nephrotoxic rats.

Table (3): effect of artichoke leaves extract on body weight gain (BWG) and food Intake (FI) of the experimental rats suffering from nephrotoxicity

Groups	(BWG) (g)	FI/g/day
Negative control(-)	52.8 ± 0.05^{a}	15.50 ± 0.02^{c}
Positive control (KBrO3)	36 ± 0.01^{e}	9.70 ± 0.02^{e}
KBrO3 +3% ALE	40.75 ± 0.04^{d}	13.80 ± 0.04^{d}
KBrO3 +6% ALE	42.50 ± 0.02^{c}	16.00 ± 0.01^{b}
KBrO3 +9% ALE	44.20 ± 0.05^{b}	16.90 ± 0.03^{a}

Means with different letters in the same column are statistically significant at P≤0.05)

Effect of artichoke leaves extract on serum lipid profile of the experimental rat groups suffering from nephrotoxicity

Results in table (4) demonstrated that rats in the positive control group have higher cholesterol ,triglycerides (TG), low density lipoprotein–cholesterol (LDL-c) and very low density lipoproteins (VLDL-c)levels, whereas have lower HDL level as compared to rats in the negative control group. The results also declared significant decrease ($p<0.05$) in cholesterol ,low density lipoprotein–cholesterol (LDL-c) ,triglycerides(TG) and very low density lipoproteins (VLDL-c) in nephrotoxic rat groups which treated with ALE at 3,6,9% concentrations comparing to positive control group (PC). Hence, these results showed significant increase ($p<0.05$) in high density lipoprotein cholesterol (HDL-c) in groups treated with 3,6,9% ALE concentrations compared to control positive group.

The action for lipid lowering effect of artichoke leaves extract (ALE) have been considered. Interaction with 3-hydroxy-3-methylglutaryl coenzyme A (HMG-CoA) reductase, liver sterol regulatory element binding proteins and acetyl-CoA C-acetyltransferase (ACAT) by Luteolin are proposed mechanisms **(Gebhardt,2002).**

In addition that ,several studies have examined the effect of (ALE) in reducing cholesterol , compounds especially cynarine has a great role in reducing plasma cholesterol levels **Basulaiman *et al.*,(2013).**Studies also showed that these effects may be because of the monocaffeoylquinic acids and cynarine present in artichoke. On the other hand **Nazani *et al.*,(2006)** revealed that ALE caused a significant reduction in total cholesterol, triglyceride and LDL-C levels and also a significant increase in HDL-C levels.

Table (4): Effect of artichoke leaves extract on serum lipid profile of the experimental rat groups suffering from nephrotoxicity

Groups	TC (mg/dl)	TG (mg/dl)	HDL-c (mg/dl)	LDL-c (mg/dl)	VLDL-c(mg/dl)
Negative control(-)	78.40± 0.05^{e}	58.23±0.05^{e}	45.35±0.02^{a}	21.4±0.03^{e}	11.65±0.01^{e}
Positive control(KBrO3)	139.50±0.01^{a}	111.90±0.07^{a}	27.30±0.02^{e}	89.82±0.01^{a}	22.38±0.03^{a}
KBrO3 +3% ALE	123.80±0.15^{b}	101.26±0.04^{b}	32.76±0.04^{d}	70.79±0.02^{b}	20.25±0.10^{b}
KBrO3 +6% ALE	104.30± 0.08^{c}	83.65±0.10^{c}	37.90±0.01^{c}	49.67±0.07^{c}	16.73±0.01^{c}
KBrO3 +9% ALE	88.10± 0.03^{d}	69.20±0.01^{d}	39.85±0.08^{b}	34.41±0.01^{d}	13.84±0.08^{d}

Means with different letters in the same column are statistically significant at (P≤0.05)

Effect of artichoke leaves extract on kidney functions of the experimental rat groups suffering from nephrotoxicity

Results in table (5) showed the effect of artichoke leaves extract on kidney functions (uric acid ,urea and creatinine) in nephrotoxic rats.

Results declared that rats in the positive control group showed high level of kidney functions (2.70±0.21, 49.90±0.10, 1.20±0.12 mg/dl, respectively) for uric acid ,urea and creatinine compared to rats in the negative control group (1.65±0.27, 23.82±0.12 , 0.68±0.10 mg/dl, respectively). These results also demonstrated that all nephrotoxic rat groups which treated with ALE at 3,6,9% concentrations declared significant decrease (P<0.05) in the values of kidney functions (uric acid ,urea and creatinine) comparing with the control positive group. The best results of kidney functions was at the ratio 9% artichoke leaves extract (1.99±0.10, 26.50±0.07, 0.73±0.05 mg/dl, respectively) for uric acid ,urea and creatinine.

The nephroprotective effects of ALE can be attributed to the high antioxidant protection activity of bioactive components of artichoke leaves. The antioxidant property of ALE is due to its phenolic components, which probably responsible for reducing the oxidative stress thus improving renal tubular functions **Shanmugasundaram and Venkataraman, (2006).**

Therefore, these results are in harmonization with **Khattab *et al.*, (2016)** who declared that the oral administration of ALE significantly decreased the creatinine, uric acid, and urea levels in the blood.

Moreover, nephroprotective potential of ALE may be attributed to the existence of tannins, flavonoids, total phenols, β-carotene in plant extract that have a strong ability to penetrate free radicals like superoxide, hydroxyl and other free radicals **Lattanzio *et al.*, (2009).** On the other hand, the diuretic e_ect of artichoke helps in removing urea and toxic substances, developing a depurative effect . One of the antioxidant components found in the artichoke is the vitamin E, which in the human body is soluble in fat and has an e_ect on the oxidative stress including aging and complications as diabetes **(Lactantius, 2002).**

Table(5): Effect of artichoke leaves extract on kidney functions of the experimental rat groups suffering from nephrotoxicity

Groups	Uric acid (mg/ dl)	Urea (mg/dl)	Creatinine (mg/dl)
Negative control(-)	1.65±0.27^{c}	23.82±0.12^{e}	0.68±0.10^{c}
Positive control (KBrO3)	2.70±0.21^{a}	49.90±0.10^{a}	1.20±0.12^{a}
KBrO3 +3% ALE	2.26± 0.10^{b}	42.15±0.08^{b}	1.04±0.05^{b}
KBrO3 +6% ALE	2.12±0.18^{b}	34.72±0.15^{c}	0.91±0.07^{b}
KBrO3 +9% ALE	1.99±0.10^{b}	26.50±0.07^{d}	0.73±0.05^{c}

Means with different letters in the same column are statistically significant at (P≤0.05)

Effect of artichoke leaves extract on antioxidant parameters activity of experimental rat groups suffering from nephrotoxicity

Effect of artichoke leaves extract (ALE) on antioxidant parameters activity of experimental rat groups suffering from nephrotoxicity were determined as shown in table (6).Serum levels of antioxidant parameters SOD,CAT, GSH were determined .Data indicated that there was a significant decrease in catalase (CAT), glutathione peroxidase (GSH) and superoxide dismutase (SOD) activities in nephrotoxic rats (positive group)

compared with negative control group while the (ALE) treated groups showed a significant increase in antioxidant enzymes (CAT, GSH, SOD compared with positive control group . Hence artichoke leaves extract can increase antioxidant power.

These results were also agreed with **Salem *et al.*,(2017)** who reported that oral administration of ALE increased glutathione GSH and CAT levels. Phytochemicals found in ALE have strong direct antioxidant power by scavenging free radicals and indirectly by promoting the antioxidant defense of host **(Valko *et al.*, 2007 and Verma *et al.*, 2015).** These results were in the same line with **Abd El-Aleem *et al.*,(2009)** who reported that artichoke treatment prevented the reduction in GSH and SOD due to oxidative damage to the liver. In this respect ,**El- Boshy *et al.*,(2017)** stated that extract of artichoke leaves was able to reduce oxidative stress by reducing LPO and elevating antioxidant SOD, GPx, CAT, and GSH biomarkers indicating the renal protective impacts of ALE against DEN-induced oxidative stress. Therefore ,Polyphenolic components in artichoke leaves have active compounds protect against lipid peroxidation, protein oxidation and enhance the activity of glutathione peroxidase **(Bonomi and Bonomi ,2001)**.

Table(6): Effect of artichoke leaves extract on antioxidant parameters activity of the experimental rat groups suffering from nephrotoxicity

Groups	SOD(µ/ml)	CAT(U/L)	GSH (nmol/mg)
Negative control(-)	12.55 ± 0.05^{a}	146 ± 0.02^{a}	5.65 ± 0.01^{a}
Positive control (KBrO3)	7.30 ± 0.07^{e}	104.8 ± 0.01^{e}	3.15 ± 0.05^{e}
KBrO3 +3%ALE	8.95 ± 0.15^{d}	118.6 ± 0.05^{d}	3.80 ± 0.07^{d}
KBrO3 +6% ALE	9.33 ± 0.05^{c}	126.35 ± 0.02^{c}	4.27 ± 0.02^{c}
KBrO3 +9% ALE	9.80 ± 02^{b}	127.85 ± 0.03^{b}	4.51 ± 0.02^{b}

Means with different letters in the same column are statistically significant at ($P\leq0.05$)

Histopathological results

Histopathological checking of kidney section of normal rats showed in (photo 1), while (photo 2) induced control group showing glomerular congestion, peritubular congestion , focal necrosis of renal tubules and inflammatory cells . In this concern , (photos 3, 4, 5) showing nephrotoxic groups treated with

3%,6%,9% artichoke leaves extract indicated gradual improvement of kidney cells.

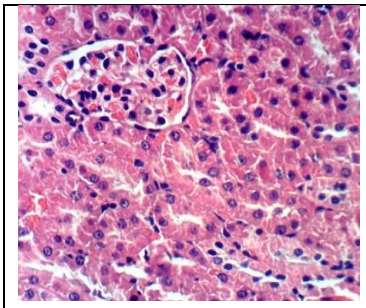

Photo (1): Kidney of rat from group 1 (normal rats) showing the normal histological structure of rats (H & E X 400).

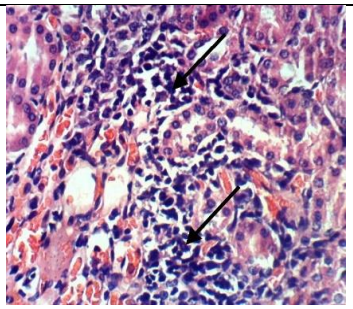

Photo (2): Kidney of rat from group 2 (positive rats) showing glomerular congestion, peritubular congestion, focal necrosis of renal tubules and inflammatory cells (H & E X 400).

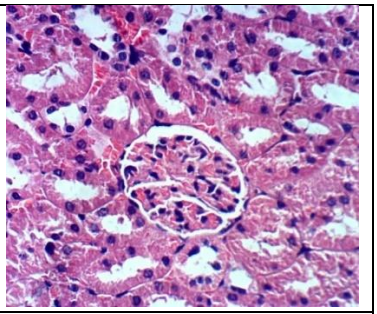

Photo (3): Kidney of rat from group 3 (rats treated with 3% ALE) showing mild vacuolation of glomerular tuft (H & E X 400).

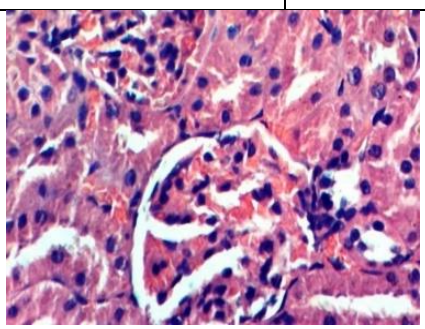

Photo (4): Kidney of rats from group 4(rats treated with 6% ALE) showing good histological structure near to normal structure of kidney cells. (H & E X 400).

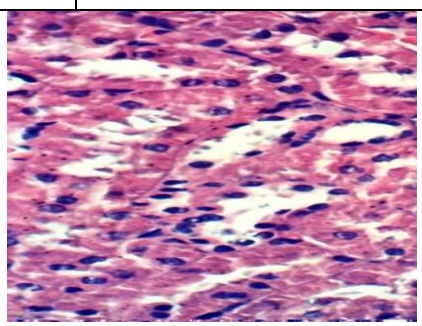

Photo (5): Kidney of rat from group 5(rats treated with 9% ALE) showing no changes of kidney structure (H & E X 400).

Effect of adding artichoke leaves extract on sensory evaluation of salads recipes

Artichoke leaves extracts can be added to food basically meat, because of its aroma and to protect food from lipid and protein oxidation **Behara (2011).** Also, artichoke leaves extract is widely used alone or in combination with other herbs to hydrate alcoholic, soft drinks and to make herbal teas or herbal medicinal products **Bonomi (2001).**

Data in tables (7-10) showed the effect of adding artichoke leaves extract (ALE) on sensory evaluation of salads recipes (eggplant salad, tahini salad, tuna salad, yogurt salad).

It could be observed that increasing ratios of artichoke leaves extract affects the scores for color, aroma, taste, texture and overall acceptability which decreased. In this concern , results showed high acceptance for salads supplemented with 3% artichoke leaves extract for all terms of sensory evaluations and the total scores were 91.50±2.55, 93.60±2.17, 92.80±1.96 , and 86.30±1.84 for (eggplant salad, tahini salad, tuna salad, yogurt salad respectively). Therefore, adding artichoke leaves extract at level 6% gave acceptable results in all salads and the total scores were 83.40±4.06 , 87.90±1.76 , 87±2.92 and77.8±2.11 for (eggplant salad, tahini salad, tuna salad, yogurt salad respectively). Whereas all salads supplemented with 9% artichoke leaves extract showed lower results for color, aroma, taste, texture and overall acceptability and the total scores were74.50±4.81d, 82.30±2.21d , 81.10±2.54d , and 68.6±1.91d for (eggplant salad, tahini salad, tuna salad, yogurt salad respectively).

Finally, it was observed that yogurt salad gave the lowest scores comparing with other salads. These results are in harmonization with **Lohr *et al.*, (2009)** who reported that yogurts containing artichoke extract taken weaker sensory acceptability for all sensory properties compared to the controls. It changed the color of this product to yellowish .Artichoke leaves extraction make yogurt showed more unpleasant flavor. Unsuitable bitter flavor of yogurt may be due to presence of sesquiterpene lactones in artichoke extracts.

Table (7): Effect of adding artichoke leaves extract on eggplant salad

Properties / Treatments	Color (20 scores)	Aroma (20 scores)	Taste (20 scores)	Texture (20 scores)	Overall Acceptability (20 scores)	Total (100 scores)
Control	20.00±0.94^{a}	20.00±1.08^{a}	20.00±1.21^{a}	20.00±0.58^{a}	20.00±0.80^{a}	100.00±3.37^{a}
ALE 3%	19.00 ±0.99^{b}	19.20±0.41^{b}	17.40±0.40^{b}	18.60±0.57^{b}	17.30±0.44^{b}	91.50±2.55^{b}
ALE 6%	18.30± 0.64^{b}c	17.60±0.34^{c}	15.30±0.60^{c}	17.00±0.56^{c}	15.20 ±0.55^{c}	83.40±4.06^{c}
ALE 9%	17.70±0.62^{c}	14.80±0.54^{d}	14.10±0.53^{d}	14.50±0.58^{d}	13.40±0.37^{d}	74.50±4.81^{d}

Values are expressed as mean ± SD. Means with different letters in the same column are statistically significant at (P≤0.05)

Table (8): Effect of adding artichoke leaves extract on tahini salad

Properties / Treatments	Color (20 scores)	Aroma (20 scores)	Taste (20 scores)	Texture (20 scores)	Overall Acceptability (20 scores)	Total (100 scores)
Control	20.00±0.78[a]	20.00±0.58[a]	20.00±1.06[a]	20.00±0.63[a]	20.00±1.09[a]	100.00±2.71[a]
ALE 3%	19.20 ±0.64[b]	19.40±0.37[b]	18.50±0.91[b]	18.70±0.44[b]	17.80±0.29[b]	93.60±2.17[b]
ALE 6%	18.50±0.55[c]	18.30±0.72[c]	17.10±0.70[c]	17.60±0.41[c]	16.4.0 ±0.32[c]	87.90±1.76[c]
ALE 9%	17.70±0.63[d]	17.10±0.50[d]	15.80±0.58[d]	16.50±0.55[d]	15.20±0.47[d]	82.30±2.21[d]

Values are expressed as mean ± SD. Means with different letters in the same column are statistically significant at (P≤0.05)

Table (9): Effect of adding artichoke leaves extract on tuna salad

Properties / Treatments	Color (20 scores)	Aroma (20 scores)	Taste (20 scores)	Texture (20 scores)	Overall Acceptability (20 scores)	Total (100 scores)
Control	20.00±0.37[a]	20.00±0.58[a]	20.00±0.93[a]	20.00±1.08a	20.00±0.92[a]	100.00±2.51[a]
ALE 3%	19.20±0.48[b]	19.20±0.48[b]	18.30±0.44[b]	18.50±0.41b	17.60±0.42[b]	92.80±1.96[b]
ALE 6%	18.30±0.42[c]	18.10±0.35[c]	17.00 ±0.57[c]	17.40±0.32c	16.20 ±0.32[c]	87.00±2.92[c]
ALE 9%	17.50±0.32[d]	16.80±0.42[d]	15.50±0.55[d]	16.30±0.35d	15.00 ±0.55[d]	81.10±2.54[d]

Values are expressed as mean ± SD. Means with different letters in the same column are statistically significant at (P≤0.05)

Table (10): Effect of adding artichoke leaves extract on yogurt salad

Properties / Treatments	Color (20 scores)	Aroma (20 scores)	Taste (20 scores)	Texture (20 scores)	Overall Acceptability (20 scores)	Total (100 scores)
Control	20.00±1.05[a]	20.00±0.90[a]	20.00±0.79[a]	20.00±1.43[a]	20.00±0.88[a]	100.00±2.40[a]
ALE 3%	16.70 ±0.27[b]	18.50±0.76b	17.10±0.95[b]	17.40 ±0.43[b]	16.60±0.67[b]	86.30±1.84[b]
ALE 6%	14.10±0.46[c]	17.30±0.81c	15.60±0.70[c]	15.70±0.77[c]	15.10 ±0.77[c]	77.80±2.11[c]
ALE 9%	12.80±0.53[d]	15.60±0.85d	13..50±0.80[d]	13.80±0.76[d]	12.90±0.86[d]	68.60±1.91[d]

Values are expressed as mean ± SD. Means with different letters in the same column are statistically significant at (P≤0.05)

Conclusion

From the current study it could be concluded that artichoke leaves extract helps to reduce kidney functions (uric acid, urea and creatinine) , blood cholesterol and increase antioxidant enzymes CAT, GSH, SOD in nephrotoxic rats. Artichoke leaves extract can be added to salads at 3,6% concentrations and gave good acceptance.

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