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Chemical characteristics and biological activity of Pomegranate seeds and Red Beet in Hypercholesterolemia Rats

الخصائص الكيميائية والنشاط البيولوجي لبذور الرمان والشمندر الاحمر فى الفئران المصابة بفرط كوليسترول الدم

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Abstract

Fruits and vegetables are capable of providing additional physiological benefits, including preventing or delaying the onset of a range of chronic diseases. In this study used of some phytosterols and antioxidants from Pomegranate seeds and Red Beet sources to reduce the harmful effects and work to inhibit some of the biological changes caused by oxidized cholesterol in the rats.

This can be achieved by feeding adult male albino rats (20 rats) of average weight (١٥٠ ± 10g) randomly divided into two main groups. The results showed that when fed experimental diets, it had an effective effect on blood lipid levels and had the ability to reduce low-density lipoprotein (LDL), liver and kidney functions, oxidative stress, and histopathological examination of the liver and kidneys.

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It can be concluded that red beets and pomegranate seeds are considered to have excellent nutritional quality. They are a great source of health-promoting polyphenols in terms of their antioxidant properties. In addition, they have a positive effect on blood glucose and cholesterol levels and improve the level of liver and kidney enzymes.

Key words; pomegranate, beets, biological activity and Histopathological

INTRODUCTION

Diets high in fruits and vegetables are widely recommended for their health- promoting properties. Fruits and vegetables have historically held aplace in dietary guidance because of their concentrations of vitamins, especially vitamins C and A; minerals, especially electrolytes; and more recently phytochemicals, especially antioxidants. Additionally, fruits and vegetables are recommended as a source of dietary fiber **(Slavin and Lioyd, 2023).**

Mostafidi et al., (2020) showed that food insecurity, malunutrition and life- style diseases such as obesity, high blood pressure, carcinogenesis, and diabetes ar among the most important glodal issues that have increased demand for health foods, especially fruits and vegetables.

Epidemiological, toxicological and nutritional studies suggested an association between fruit and vegetable consumption and lower incidence of chronic diseases, such as coronary heart problems, cancer, diabetes, and Alzheimer's disease **(Ceiestino and Font, 2020)**.

Red beets is a vegetable with a low fat content, but rich in carbohydrates, starch, soluble fibers, proteins, being a product with moderate caloric value. Beet roots are rich in vitamins C, A, E, K. They have an important content of B- vitamins (B1-

thiamine, B2-riboflavin, B3-niacin, B5-pantothenic acid, B6-pyridoxine, B9-folates and B12-cyancobalamin), as well as folic acid **(Babrykin et al., 2019, Lechner and Stoner, 2019).** Red Beet is a natural dye formed by different pigments belonging to the class of Betalains, substances indole derived, which have as a precursor Betalamic acid and are characteristic of the Caryophyllate plants. To these belong the Betacyanins, red purple pigments, whose main component is Betanin, others are: isobetanin, probetanin and neobetanin; Betaxanthins, yellow-orange pigments which in plants include vulgaxanthin, miraxanthin, portulaxanthin and indicaxanthin; other of Betalains degradation products are light brown **(Ferrara, 2020).** Many studies indicate that eating more plant foods, like beetroot, decrease the risk of obesity overall mortality, diabetes, and heart disease and promote a healthy complexion and hair, increased energy, and overall lower weight **(Shuaibu et al., 2020).**

Punia et al., (2022) reported that the presence of bioactive compounds in beetroot contributes to various biological activities like antioxidant, anti- inflammatory, anticarcinogenic, hepatoprotective and cardioprotective. However, the extraction, processing and storage methods pose a significant challenge in terms of betalain stability, thereby effecting its biological activities. Due to this reason, utilization of beetroot bioactive compounds is quite restricted in food and pharmaceutical industries.

Beetroot juice has the ability to cure liver and kidney diseases, particularly the buildup of fatty deposits in the liver caused by alcohol abuse, protein deficiency or diabetes **(Neha et al., 2018).** Researchers hypothesized this was likely due to the high nitrate levels contained in beet juice and that the high

nitrate vegetables could prove to be a low-cost and effective way to treat cardiovascular conditions and blood pressure **(Shuaibu et al., 2020).**

Kareem and Jameel, (2022) reported that blood was collected from animals in order to study liver functions in red beet parameters which included [serum aspartate aminotransferase (AST), serum alanine aminotransferase (ALT), serum alkaline phosphatase (ALP).

Pomegranate seeds

The edible part of the pomegranate fruit (50%) consists of 40% arils and 10%seeds. Arils contain 85%water, 10%total sugars, mainly fructose and glucose, and 1.5% pectin, organic acid, such as ascorbic acid, citric acid, andmalic acid, and bioactive compounds such as phenolics and flavonoids, principally anthocyanins **(Viuda-Martos et al., 2010).** The seed cover of the fruit contains delphinidin-3-glucoside, cyanidin-3-glucoside, delphinidin- 3,5-diglucoside, cyanidin-3,5-diglucoside, pelargonidin-3,5-diglucoside, and pelargonidin-3-glucoside with delphinidin- 3,5-diglucoside being the main anthocyanin in pomegranate juice **(Elfalleh et al., 2012).**

Gil et al., (2000) reported that pomegranate juice possessed a 3-fold higher antioxidant activity than that of red wine or green tea and 2-, 6-, and 8-fold higher levels than those detected in grape/cranberry, grapefruit, and orange juices, respectively. The determination of the antioxidant capacity of pomegranate components and their derivatives is being given greater importance by researchers and those involved in the agro-food industry for use as natural additives to replace synthetic antioxidants, whose use is increasingly restricted due to the secondary effects they may produce.

Experimental results indicated that the peel was the strongest one, and the petal, the stamen and the receptacle were of about a same level, but the leaf was weaker than them. The polyphenol content was significantly correlative to the antioxidant effect and antibacterial activity, which indicated that polyphenols were the main active compounds of pomegranate **(Zhang et al., 2010).**

Toxicity of the polyphenol antioxidant punicalagin, abundant in pomegranate juice, was evaluated in rats and experimental results indicated that no toxic effects or significant differences were observed in the treatment group compared to controls, which was confirmed via histopathological analysis of rat organs **(Álvarez-Cervantes et al., 2021)**

MATERIALS AND METHODS

Materials

1-Pomegranate (seed) (Punica granatum L.) and red beet (Betavulgaris L.) were purchased from local market in Giza, Egypt.

2-Rats were purchased from the Experimental Animal House, Food Technology Research Institute, Agricultural Research Center, Ministry of Agriculture, Giza, Egypt.

3-Flour, salt, oil, egg, baking powder, yeast, butter and sugar were purchased from Benha, Local market, Egypt.

4-Chemicals: Folin-Ciocalteu's phenol reagent (2N), Sodium Carbonate (99.8%) (NaCO3), sodium nitrite (NaNO2), Aluminum chloride (Alcl3), sodium hydroxide (NaOH) and 2, 2-Diphenyl-1-picryhydrazyl (DPPH) were purchased from Sigma-Aldrich (St. Louis, Mo, USA). The kits were purchased from Gamma-Tread Company, Cairo, Egypt.

Methods

3.2.1 Preparation of pomegranate (seed and peel) powder, pomegranate peel, beets and parsley

After washing, the raw materials by under running water and cut into slices were dried by solar energy at the National Research Center (NRC), Dokki, Egypt. Then grind it into a fine powder in an electric grinder and pack it in polyethylene bags and kept it in the refrigerator at 4 ± 1°C.

3-2-2 Extraction of antioxidant compounds

The extractions were performed using a fine powder (1g) as reported by **(Batista, et al., 2011).**

3-2-3-Chemical Analysis

Approximate content

Approximate analysis (moisture, fat, crude protein, ash and crude fiber) were determined as according to the methods of **AOAC, (2000).** Carbohydrates were calculated by difference.

Caloric value

Caloric value of the products was calculated using the appropriate factor as described by **(FAO/WHO/ UNU, 1985)**.

Determination of minerals

Mineral contents iron (Fe), zinc (Zn), calcium (Ca), potassium (K), sodium (Na) and Phosphor (P) in samples were digested by using a pye Unicum SP 1900 Atomic Absorption Spectroscopy instrument (Perkin Elmer model 4100 ZL) as described by the **A.O.A.C. (2000)**, at Soils, Water and Environment Research Institute (SWERI), ARC, Giza, Egypt.

Determination of total phenols, total flavonoids and antioxidant activity

-Determination of total phenol content

Total phenols and Total flavonoids content were estimated based on procedures described by **(Batista et al., 2011).**

-DPPH radical assay

The electron donation ability of the obtained ethanol extracts was measured by 2, 2-diphenyl-1-picrylhdrazyl radical (DPPH) according to **(Hanato et al., 1988).**

3-2-4-Biological evaluation

-Ethics approval and consent to participate

The National Institute of the healthy guide for laboratory animal care and used NIH (publication No. 8023 revised 1978 and updated 2011) approved all experimental animal conduct in this study. Animal experiments strictly complied with the legal requirements or guidelines in the country and/or state or province for the care and use of animals including [Arrival guideline.2.0 updated in July 2020].

Biological assay

Adult male albino rats (20 rats) of average weight (١٥٠ ± 10g) (12 weeks) were obtained and housed in the Experimental Animal House, Food Tech. Res. Aged Inst. Agri. Res. Center Giza Egypt. Rats were fed on basal diet, The constituents of salt and vitamin mixture and tap water ad-libilum for one week as an adaptation period as reported by **(Reeves, et al., 1993).**

Experimental Design

After the acclimatized period (two weeks the rats were randomly divided into two main groups. As shown in Table (a)

Table (1) Distribution animals on experimental study

Groups	Description	Adding (20% powdered/each)
G1	fed on basal diet (ve-)	-----
Hypercholesterolemia Groups		
G2	fed on Ox-cD (ve+)	-----
G3	fed on Ox-cD	Red beet
G4	fed on Ox-cD	pomegranate seeds

*All animal drink Tap water throughout experimental period.

Biological evaluation

The duration of the study was 12 weeks. Feed intake was recorded daily and body weight of rats was measured once a week. The total body weight gain and feed intake during the experimental period were also calculated. Feed efficiency ratio was calculated at the end of experimental as follows:

BWG % = (Final Weight – Initial Weight) / Initial Weight × 100

Some organs weight and relative organ weight:

Liver, kidney, and heart were weighed then stored in formalin solution 10% it was until uses in Histopathological examination.

Collection the blood samples

At the end of experimental period the rats were fasted overnight, then were anaesthetized by diethyl ether and sacrificed and blood samples were collected from eye plexuses in dry clean centrifuge glass tube without any coagulation to prepare serum by leaving the samples for 15 minutes at refrigerator. Then, the tubes were centrifugation for 15 min at 3000 rpm and the clean supernatant serum was collected and kept frozen at -20 C until analysis.

Biological parameters assay

1- Determination of serum triglycerides [TG]

Triglycerides was determined in serum using the method described by (**Fassati, 1982)**.

2- Determination of chloesterol profile

-Determination of total cholesterol (TC)

Cholesterol was calorimetrically determined according to the enzymatic method of **Rifai et al., (1999).**

- Determination of HDL-cholesterol

High-density lipoprotein cholesterol [HDL-C] was determined using the method described by **Lipez-Virella, et al., (1977).**

- Determination of VLDL- cholesterol

Very low-density lipoprotein cholesterol [VLDL-C] was calculated as reported by **Lee and Nieman, (1996)**

Calculation: VLDL-C (mg/dL) = $\frac{\text{Triglycerides}}{5}$

- Determination of LDL- cholesterol

Low density lipoprotein cholesterol [LDL-C] was calculated according to **Lee and Nieman, (1996).**

Calculation

LDL-C [mg/dL] = TC – [VLDL + HDL]

3-Coronary Risk Index [CRI]

Coronary risk index [CRI] was calculated according to **(Adeneye et al., 2010)**

Calculation

CRI (ratio) = $\frac{\text{TG}}{\text{HDL}-\text{C}}$

4-Atherogenic Index [AI]

Atherogenic index [AI] was calculated according to **(Dobiásová, 2004).**

Calculation

Atherogenic Index (AI) = log (TG/HDLC)

5- Estimation liver functions

- Determination of AST, ALT and ALP

Serum Aspartate [AST] and Alanine aminotransferase [ALT] activities were calorimetric measured according to the method described by **Reitman and Frankel, (1957)**.While, Alkaline phosphatase [ALP] was according to **Bessay, et al., (1946).**

5-Determination of kidney functions

- Determination of uric acid

Serum uric acid was determined according the method of **Barham and Trinder, (1972).**

- Determination of creatinine

Serum creatinine was determined according to the method of **Bartles, et al., (1972)**

- Determination of urea

Urea was determined as carried out by **Fawcett and Scott, (1960).**

3-2-5-Histopathological Examination

Tissues of the liver and kidney preserved in 10% formalin solution, were dehydrated in different grades of alcohol, cleared in xylene, embedding in paraffin, sectioned with microtome at 5µ thickness and finally stained with hematoxylin and eosin (H and E) and Masson's trichrome (MTC) according to **(Banchroft, et al., 1996).**

3-2-6-Technology part (Application part)

Preparation of pan bread

Pan bread was prepared according to the methods described in A.A.C.C. (2000) with some modifications by using Table (b). A percentage of the flour was replaced with the experimental samples as follows: Four samples were prepared (S1, S2, S3, S4): 5% and 10%. 15% and 20% each of red beets, parsley, pomegranate seeds and pomegranate peel, respectively.

Bread doughs were prepared by mixing all ingredients in a 300 g farinograph bowl until they reached maximum development. The resulted doughs were let to rest for 20 min at 28 - 30˚C (first proofing) then the doughs were divided into three 150 g pieces, hand-molded and put into pans for final

proofing at 32 - 35˚C and 80 - 85% relative humidity in fermentation cabinet for 60 min. Then baked in electrically heated oven with steam added during baking at 210 - 220˚C for 15 - 20 min. After baking, loaves were separated from the metal pan and allowed to cool at room temperature before sealed in polyethylene bags to prevent moisture loss then stored at room temperature (18±2˚C).

Table (2): Formulas of Pan bread **with study samples (g)**

Ingredients	Control	S1*	S2*	S3*	S4*
Wheat Flour	250	237.5	225	212.5	200
Dry yeast	3.75	3.75	3.75	3.75	3.75
Salt	2.5	2.5	2.5	2.5	2.5
Sourdough Starter	2.5	2.5	2.5	2.5	2.5
Sugar	15	15	15	15	15
Fat	15	15	15	15	15
Skim milk powder	5	5	5	5	5
Red Beet	--	5	--	--	--
	--	--	10	--	--
	--	--	--	15	
	--	--	--	--	20
Pomegranate Seeds	--	5	--	--	--
	--	--	10	--	--
	--	--	--	15	--
	--	--	--		20

* Were: S1. S2, S3 and S4 = 5%, 10%. 15% and 20% each by red beet, parsley, Pomegranate Seeds and Pomegranate Peel respectively.

3-2-7-Sensory evaluation

Pan bread was evaluated for its sensory characteristics by ten panelists from the staff of the Cereal Technology Research

Section, Agric. Res. Center. The scoring scheme was established according to the method described by **A.A.C.C. (2000)**.

3-2-8-Statistical Analysis

Statistical analysis was carried out by SPSS program (Version 19). Data were expressed as means ± SEM and the statistical analysis was per formed using one-way analysis of variance followed by Duncan's tests **(Snedecor and Cochran, 1989).**

RESULTS AND DISCUSSION

Chemical Composition of Pomegranate Seeds and Red Beet (g/100 g DM)

The chemical composition of pomegranate seeds, pomegranate peel, red beet and parsley showed in Table (3)

Chemical composition of pomegranate seeds including moisture, protein, fiber, fat, ash, carbohydrates and energy (79.24± 1.45, 1.66± 0.02, 1.58± 0.02, 1.16± 0.014, 0.34± 0.020, 16.04± 0.22 and 81.24± 1.45) respectively. Such results were agreement with **Ferry, (2022)** he said that pomegranate seeds is a good source of protein, fat, ash, fiber, carbohydrate and minerals, making it a suitable ingredient to be used in the formulation of foods with high nutritional or biological values.

Chemical composition of red beet including moisture (85.64± 1.76), protein (1.62± 0.02), fiber (2.67± 0.02), fat (0.40± 0.248), ash (0.56± 0.031), carbohydrates (9.11± 0.19) and energy (46.52± 1.45). Such results are confirmed by **Babrykin et al., (2019) and Lechner and Stoner, (2019),** they said that red beet powder have low fat content, but rich in carbohydrates, starch, soluble fiber, protein, being a product with moderate caloric value.

Table (3): Chemical Composition of Pomegranate Seeds and Red Beet (g/100g DM)

Samples	Moisture	Protein	Fiber	Fat	Ash	*Available carbohydrates	Energy value (Kcal)
Pomegranate Seeds	79.٢٤ ±١.٤٥ a	1.66 ±0.02 b	1.58 ± 0.02 d	1.16 ± 0.01 4 a	0.34 ± 0.02 0 d	16.04 ± 0.22 a	81.24 ± 1.45 a
Pomegranate Peel	7٤.52 ±٢.٠٢ b	3.65 ±0.03 a	10.59 ±0.02 a	0.77 ± 0.03 2 a	3.36 ± 0.02 6 a	7.11 ±0.15 c	49.97 ± 1.45 b
Red Beet	85.64 ±1.٧٦ a	1.62 ±0.02 b	2.67 ± 0.02 c	0.40 ± 0.24 8 b	0.56 ± 0.03 1 c	9.11 ± 0.19 b	46.52 ± 1.45 c
Parsley	8٦.90 ±٢.٣٣ a	1.56 ±0.22 b	3.45 ± 0.27 b	0.46 ± 0.25 3 b	1.14 ± 0.08 7 b	6.49 ± 0.24 d	36.34 ± 1.45 d

*Values are expressed as mean ± S.D.

**Each value in Colum followed by the same letter is not significantly different

Minerals Content (Fe, Ca, K, Zn, Mg, P and Na) in Pomegranate Seeds and Red Beet (mg/100g DM)

Data in Table (4) showed (Fe, Ca, K, Zn, Mg, P and Na) in pomegranate seeds and red beet.

Minerals of pomegranate seeds including Fe (0.31± 0.020), Ca (10.35± 0.223), K (3.21± 0.023), Zn (0.39± 0.252), Mg (3.01± 0.03, P (8.32± 0.18) and Na (3.41± 0.02). such results are confirmed by **Dadashi et al., (2013)** they showed that PS had the highest level of phosphorus (2766.3mg/kg) and

magnesium (2052.0mg/kg), while the highest calcium (675.3mg/kg) and potassium (3724.6mg/kg) were related to SH.

In the same table minerals of red beet including Fe (1.09± 0.014), Ca (15.81± 0.034), K (313.14± 4.33), Zn (0.36± 0.032), Mg (23.96± 0.02), P (38.73± 2.33) and Na (73.93± 2.60). such results of red beet minerals are in line with **USDA, (2019)** who stated that red beet content of Na (78.0), K (325.0), P (40.00), Mg (23.0±2.0), Ca (16±3.5), Mg (0.359±0.04), Zn (0.365±0.015), Cu (0.075) and Fe (0.80).

Table (4): Minerals Content (Fe, Ca, K, Zn, Mg, P, Fe and Na) in Pomegranate Seeds and Red Beet (mg/100gDM)

Samples	Fe	Ca	K	Zn	Mg	P	Na
Pomegranate Seeds	0.31 ± 0.020 ^{c}	10.35 ±0.223 ^{c}	3.21 ± 0.023 ^{c}	0.39 ± 0.252 ^{b}	3.01 ± 0.03 ^{c}	8.32 ± 0.18 ^{c}	3.41 ± 0.02 ^{c}
Red Beet	1.09 ±0.014 ^{b}	15.81 ± 0.034 ^{b}	313.14 ± 4.33^{b}	0.36 ± 0.032 ^{b}	23.96 ± 0.02 ^{b}	38.73 ± 2.33 ^{b}	73.93 ± 2.60 ^{a}

*Values are expressed as mean ± S.D.

**Each value in Colum followed by the same letter is not significantly different.

Vitamins Content (Vit. C, Thiamine, Riboflavin, Niacin, Pantothenic acid, Choline, Vit. B6 and vitamin K) in Pomegranate Seeds and Red (mg/100g DM)

Data in Table (5) showed (Vit. C, Thiamine, Riboflavin, Niacin, Pantothenic acid, Choline, Vit. B6 and K) in pomegranate seeds and red beet.

Vitamins of pomegranate seeds including Vit. C (10.29± 0.21), Thiamine (0.06± 0.020), Riboflavin (0.05± 0.020),

Niacin (0.28± 0.020), Pantothenic acid (0.38± 0.020), Choline (7.34± 0.14), Vit. B6 (0.08± 0.02) and K (16.40± 0.02). Such results were agreement with **Ferry, (2022)** he said that whole, fresh pomegranate contains important vitamins and minerals. There is 16mg of vitamin C in a medium-sized fruit, which is about 18% of the recommended daily value based on a 2,000-calorie diet. A medium-sized pomegranate also contains 28% of the recommended daily intake of vitamin K for women and 21% for men.

The same table showed that Vitamins of red beet including Vit. C, Thiamine, Riboflavin, Niacin, Pantothenic acid, Choline, Vit. B6 and K (4.44±0.23, 0.03±0.008, 0.04±0.014, ND, 0.16±0.020, 6.21±0.24, 0.07±0.02 and 0.19±0.03) respectively. Such results are confirmed by **Babrykin et al., (2019) and Lechner and Stoner, (2019)** they reported that red beets is a vegetable rich in vitamins C, A, E, K. They have an important content of B-vitamins (B1- thiamine, B2-riboflavin, B3-niacin, B5-pantothenic acid, B6-pyridoxine, B9-folates and B12-cyancobalamin).

Table (5): Vitamins Content (Vitamin C, Thiamine, Riboflavin, Niacin, Pantothenic, Choline, Vitamin B 6 and Vitamin K (phylloquinone) in Pomegranate Seeds and Red Beet

Samples	Vit. C	Thiamine	Riboflavin	Niacin	Pantothenic acid	Choline	Vit. B6	K (phylloquinone)
	(mg/100gDM)				(mcg/100g)			
Pomegranate Seeds	10.29 ±0.21 ^{b}	0.06±0.020 ^{ab}	0.05±0.020 ^{a}	0.28±0.020 ^{b}	0.38±0.020 ^{ab}	7.34 ±0.14 ^{b}	0.08±0.02 ^{a}	16.40± 0.02 ^{b}

Red Beet	4.44± 0.23 c	0.03±0.008 b	0.04±0.014 a	--	0.16±0.020 b	6.21 ±0.24 c	0.07±0.02 a	0.19±0.03 c

*Values are expressed as mean ± S.D

**Each value in colum followed by the same letter is not significantly different.

Antioxidants activity, Total phenolic content and Total flavonoids (mg/100g DM)

Data in Table (6) and showed antioxidants activity, total phenolic content and total flavonoids showed in pomegranate seeds and red beet.

Antioxidants activity, total phenolic content and total flavonoids of pomegranate seeds were (96.37± 1.45, 244.54± 4.63 and 48.39± 2.02) respectively. Such results are confirmed by **Jain et al., (2014)** he said that phenolic compounds, together with flavonoids, anthocyanins, and tannins, are the main group of antioxidant phytochemicals that are important due to their biological and free radical scavenging activities**.**

In the same table antioxidants activity, total phenolic content and total flavonoids of red beet were (95.61± 1.43, 442.79± 5.20 and 545.89± 5.48) respectively. Such results correspond with **Lechner and Stoner, (2019) and Masih et al., (2019)** they found that the carotenoids in red beetroot are β-carotene and lutein, which are strong antioxidants against several cancersat powerful antioxidants, such as triterpenes, sesquiterpenoids, carotenoids, coumarins, flavonoids (tiliroside, astragalin, rhamnocitrin, rhamnetin, kaempferol), betalain and phenolic compounds. Red beet (Beta vulgaris L.) leaf is a good source of natural antioxidants such as betalains, flavonoids, polyphenols, vitamins, and folic acid. Total phenol

content in red beet is the highest among 23 vegetables that have been studied **(Vinson et al., (1998)**.

Table (6): Antioxidants activity, Total phenolic content and Total flavonoids (mg/100gDM)

Samples	Antioxidant activity	Total phenolic content	Total Flavonoids
Pomegranate Seeds	96.37 ± 1.45[a]	244.54 ± 4.63[c]	48.39 ± 2.02 [c]
Red Beet	95.61 ± 1.43[a]	442.79 ± 5.20[b]	545.89 ± 5.48[a]

*Total antioxidant activity, total phenolic content and total flavonoids.

**Each value in Colum followed by the same letter is not significantly different.

Effect of Feeding Rats of Pomegranate Seeds and Red Beet on Body Weight Gain (BWG) and Feed Efficiency Ratio

Effect of Feeding Rats of pomegranate seeds and red beet on body weight gain (BWG) and feed efficiency ratio in Table (7).

BWG (g)

The mean value of BWG levels in control (-) group was (135.08± 3.48). Results illustrated that, rats in control (+) group was (215.75± 4.33), showed significant difference in the mean value of BWG, as compared to control (-) group. While rats in red beet and pomegranate seeds groups was (176.03± 2.90 and 168.54± 2.60) respectively, showed significant decrease in the mean values of BWG, as Compared to control (+) group.

BWG (%)

The mean value of BWG (%) levels in control (-) group was (89.98± 2.60). Results illustrated that, rats in control (+)

group was (141.66± 3.75), showed significant difference in the mean value of BWG (%), as compared to control (-) group. While rats in red beet, parsley, pomegranate seeds, pomegranate peel and mixture groups was (117.67± 3.17 and 111.71± 4.33) respectively, showed significant decrease in the mean values of BWG (%), as compared to control (+) group. On the other hand, the highest value recorded in red beet group.

Feed Efficiency Ratio (FER)

The mean value of FER levels in control (-) group was (0.32± 0.03). Results illustrated that, rats in control (+) group was (0.53± 0.02), which significant increase in the mean value of FER, as compared to control (-) group. While rats in red beet and pomegranate seeds groups were (0.28± 0.02 and 0.28± 0.02) respectively, showed significant decrease in the mean values of FER, as Compared to control (+) group. On the other hand, the highest value recorded in red beet group and the lowest mean value in pomegranate peel group.

Table (7): Effect of Feeding Rats of Pomegranate Seeds and Red Beet on Body Weight Gain (BWG) and Feed Efficiency Ratio

Items / Groups	Initial Body Weight (g)	Final Body Weight (g)	BWG **(g)**	BWG **(%)**	FER
Control (-)	148.15±3.48 [a]	283.57 ±4.91 [c]	135.08±3.48 [d]	89.98±2.60 [d]	0.32± 0.03 [b]
Control (+)	152.53±3.17 [a]	368.62 ±5.48 [a]	215.75±4.33 [a]	141.66± 3.75 [a]	0.53± 0.02 [a]
Red Beet	150.11±3.48 [a]	324.48 ±4.33 [b]	176.03±2.90 [b]	117.67± 3.17 [b]	0.28± 0.02 [b]
Pomegranat	151.35±2	319.89	168.54±2	111.71±4	0.28

e Seeds	.60[a]	±5.20 [b]	.60[bc]	.33 [bc]	±0.02 [b]

*Values are expressed as mean ± S.D
* Were: pomegranate seed and red beets by 20% each /one.
***Each value in Colum followed by the same letter is not significantly different.

Effect of Feeding Rats of Pomegranate Seeds and Red Beet on some Organs Weight

The results in Table (8) illustrated the effect of Feeding Rats of pomegranate seeds and red beet on some organs weight

Liver

The results in Table (8) showed that, the mean value of liver weight in control (-) and control (+) groups were (7.52±0.12 and 11.97±0.02) respectively. While the mean value of liver weight of red beet and pomegranate seeds groups (10.28±0.02 and 9.79±0.03) respectively, showed significant differences in the mean values of liver weight compared to control (+) group.

Kidney

Data presented in Table (8) showed that, the mean value of kidney weight in control (-) and control (+) groups were (2.71±0.02 and 3.04±0.02) respectively. While the mean value of kidney weight of red beet, parsley, pomegranate seeds, pomegranate peel and mix groups (2.95±0.03 and 2.77±0.02) respectively, showed significant differences in the mean values of kidney compared to control (+) group.

Heart

Also, Table (8) showed that, the mean value of heart weight in control (-) and control (+) groups were (1.96±0.02 and 2.31±0.03) respectively. While, the mean value of heart weight of red beet and pomegranate seeds groups (2.19±0.02 and

2.16±0.02) respectively, showed significant differences in the mean values of heart, as compared to control (+) group.

Spleen

The results in Table (8) showed that, the mean value of spleen weight in control (-) and control (+) groups were (0.99±0.02 and 1.57±0.03) respectively. While the mean value of spleen weight of red beet, parsley, pomegranate seeds, pomegranate peel and mix groups (1.42±0.03, 1.31±0.02, 1.28±0.02, 1.19±0.02 and 1.13±0.03) respectively, showed significant differences in the mean values of spleen, as compared to control (+) group.

In could be seen from above results that, fed on experimental diets had a good effect on some organs weight. The present results were in agreement with **Neha et al., (2018)** who found that the researchers claims that compounds found in beetroot detoxify the liver and have the ability to cure diseases of the digestive system in human being. It encourages liver cleansing, improves liver functioning and protects it from excessive alcohol consumption. Beet root juice has the ability to cure liver and kidney diseases, particularly the buildup of fatty deposits in the liver caused by alcohol abuse, protein deficiency or diabetes.

Pomegranate contains various bioactive compounds, such as punicalagin, ellagic acid, and Gallic acid. Pomegranate and its bioactive components have many bioactivities, such as antioxidant, anti-inflammatory, antimicrobial, anti-diabetic, anti-obesity, and anticancer, hepatoprotective, and kidney protective activities, as well as prevention of Parkinson's disease and Alzheimer's disease. Furthermore, pomegranate has great potential application in the food industry. Most importantly, pomegranate **(Cheng et al., 2023).**

Table (8): Effect of Feeding Rats of Pomegranate Seeds and Red Beet, on some Organs Weight

Items / Groups	Liver	Kidney's	Heart	Spleen
Control (-)	7.5٢ ±0.12 e	2.71 ±0.02 c	1.96 ±0.02 c	0.99 ±0.02 e
Control (+)	11. 97±0.02 a	3.04±0.02 a	2.31±0.03 a	1.57 ±0.03 a
Red Beet	10.28 ±0.02b	2.95±0.03 b	2.19±0.02 b	1.42 ±0.03 b
Pomegranate Seeds	9.79 ±0.03 c	2.77 ±0.02 c	2.16 ±0.02 b	1.28 ±0.02 c

*Values are expressed as mean ± S.D

* Were: pomegranate seed and red beets by 20% each /one.

***Each value in Colum followed by the same letter is not significantly different.

Effect of Feeding Rats of Pomegranate Seeds and Red Beet on Serum Lipids Profile

The results in Table (9) showed effect of feeding rats for pomegranate seeds and red beet on serum lipids profiles including (CHOL, T.G, HDL, VLDL, LDL, CRI and AI)

Serum CHOL (mg/dl)

The mean value ± SEM of serum cholesterol in the control (-) and control (+) groups were (155.50±2.51 and 215.58±3.25) respectively. While the mean value of serum CHOL of red beet and pomegranate seeds groups (163.41±4.91 and 158.16±5.20) respectively report significant decrease in the mean values of serum cholesterol as compared to control (+) group.

Serum T.G (mg/dl)

The mean value ± SEM of serum triglycerides in the control (-) and control (+) groups were (115.18±3.75 and 176.33±4.91) respectively. While the mean value of serum T.G red beet and pomegranate seeds groups (140.70±3.17 and 134.91±2.90) respectively report significant decrease in the mean values of serum T.G as compared to control (+) group.

Serum HDL (mg/dl)

The mean value ± SEM of serum HDL in the control (-) and control (+) groups were (67.16±2.90 and 45.28±2.60) respectively. While the mean value of serum HDL of red beet and pomegranate seeds groups (58.56±3.17 and 63.41±3.75) respectively report significant increase in the mean values of serum HDL as compared to control (+) group.

Serum VLDL (mg/dl)

The mean value ± SEM of serum VLDL in the control (-) and control (+) groups were (23.06±2.60 and 39.33±3.17) respectively. While the mean value of serum VLDL of red beet and pomegranate seeds groups (21.48±2.90 and 21.18±2.02) respectively report significant decrease in the mean values of serum VLDL as compared to control (+) group.

Serum LDL (mg/dl)

The mean value ± SEM of serum LDL in the control (-) and control (+) groups were (59.02±2.60 and 178.03±4.33) respectively. While the mean value of serum LDL of red beet and pomegranate seeds groups (100.62±3.48 and 101.78±3.48) respectively report significant decrease in the mean values of serum LDL as compared to control (+) group.

Serum CRI (ratio)

The mean value ± SEM of serum CRI in the control (-) and control (+) groups were (1.96±0.02 and 2.72±0.03) respectively. While the mean value of serum CRT of red beet

and pomegranate seeds groups (1.52±0.02 and 1.22±0.03) respectively report significant decrease in the mean values of serum CRI as compared to control (+) group.

Serum AI (index)

The mean value ± SEM of serum AI in the control (-) and control (+) groups were (0.23±0.02 and 0.58±0.02) respectively. While the mean value of serum AI of red beet and pomegranate seeds groups (0.37±0.01 and 0.32±0.02) respectively report significant decrease in the mean values of serum AI as compared to control (+) group.

In could be seen from above results that, fed on experimental diets had a good effect on serum lipid profiles. The present results were in agreement with **Esmaillzadeh et al., (2006)** found that pomegranate juice significantly reduced total cholesterol, lowdensity lipoproteins (LDL), the ratio of LDL/ high-density lipoproteins (HDL), and the ratio of total cholesterol to HDL. **Lansky and Newman, (2007)** found that crude fiber provides for pomegranate seeds numerous health benefits to the body as it has ability to decrease serumlow density lipoprotein (LDL) cholesterol level.

Table (9): Effect of Feeding Rats of Pomegranate Seeds and Red Beet on Serum Lipids Profiles

Items / Groups	CHOL (mg/dl)	T.G (mg/dl)	HDL (mg/dl)	VLDL (mg/dl)	LDL (mg/dl)	CRI (ratio)	AI (index)
Control (-)	155.50 ±2.51^{b}	115.18 ±3.75^{d}	67.16±2.90^{a}	23.06± 2.60^{b}	59.02±2.60^{d}	1.96±0.02^{b}	0.23±0.02^{c}
Control (+)	215.58±3.25^{a}	176.33 ±4.91^{a}	45.28±2.60^{b}	39.33± 3.17^{a}	178.03±4.33^{a}	2.72±0.03^{a}	0.58±0.02^{a}
Red Beet	163.41 ±4.91^{b}	140.70 ±3.17^{b}	58.56±3.17^{a}	21.48± 2.90^{b}	100.62±3.48^{b}	1.52±0.02^{c}	0.37±0.01^{b}
Pomegranate	158.16±5.20^{b}	134.91 ±2.90^{bc}	63.41±3.75^{a}	21.18± 2.02^{b}	101.78±3.48^{b}	1.22±0.03^{d}	0.32±0.02^{b}

Seeds							

*Values are expressed as mean ± S.D

* Were: pomegranate seed, pomegranate peel, beets and parsley by 20% each /one.

**Each value in colum followed by the same letter is not significantly different.

Effect of Feeding Rats of Pomegranate Seeds and Red Beet on Serum Liver Function

The results in Table (10) illustrated the effect of Feeding Rats of pomegranate seeds and red beet on serum liver function including; AST, ALT and ALP (U/L)

Serum AST (U/L)

The mean value ± SEM of serum AST in the control (-) and control (+) groups were (33.48±3.17 and 67.92±3.75) respectively. While the mean value of serum AST of red beet and pomegranate seeds groups (40.50±3.48 and 40.62±3.48) respectively. Report significant decrease as compared to control (+) group.

Serum ALT (U/L)

The mean value ± SEM of serum ALT in the control (-) and control (+) groups were (17.59±2.02 and 31.84±2.33) respectively. While the mean value of serum ALT of red beet and pomegranate seeds groups (22.83±2.60 and 23.84±2.60) respectively report significant decrease as compared to control (+) group.

Serum ALP (U/L)

The mean value ± SEM of serum ALP in the control (-) and control (+) groups were (97.86±2.02 and 145.40±4.33) respectively. While the mean value of serum ALP of red beet and pomegranate seeds groups (113.42±3.17 and 111.68±4.33)

respectively report significant decrease as compared to control (+) group.

In could be seen from above results that, fed on experimental diets had a good effect on serum liver function. The present results were in agreement with **Kareem and Jameel, (2022)** reported that blood was collected from animals in order to study liver functions in red beet parameters which included; serum aspartate aminotransferase (AST), serum alanine aminotransferase (ALT) and serum alkaline phosphatase (ALP).

Noori et al., (2017) they said that studies on experimental models have shown that administration of pomegranate or its juice can reduce liver enzymes including ALT, AST, and GGT. **Bouasla et al., (2016)** found that daily intake of pomegranate juice has been shown to reduce the levels of liver enzymes ALT, AST, and ALP, along with decreasing lipid peroxidation and increasing hepatic levels of antioxidant.

Table (10): Effect of Feeding Rats of Pomegranate Seeds and Red Beet on Serum Liver Function

Items / Groups	AST (U/L)	ALT (U/L)	ALP (U/L)
Control (-)	33.48 ±3.17 b	17.59 ±2.02 b	97.86 ±2.02 c
Control (+)	67.92 ±3.75 a	31.84 ±2.33 a	145.40 ±4.33 a
Red Beet	40.50 ±3.48 b	22.83 ±2.60 b	113.42 ±3.17 b
Pomegranate Seeds	40.62±3.48 b	23.84 ±2.60 b	111.68 ±4.33 b

*Values are expressed as mean ± S.D

* Were: pomegranate seed and red beets by 20% each /one

***Each value in Colum followed by the same letter is not significantly different.

Effect of Feeding Rats of Pomegranate Seeds and Red Beet on Serum Kidney Function

The results in Table (11) showed the effect of Feeding Rats of pomegranate seeds and red beet on serum kidney function including; Urea, Creatinine and Uric acid (mg/dl).

Serum Urea (15-45 mg/dl)

The mean value ± SEM of serum urea in the control (-) and control (+) groups were (19.87±2.02 and 30.16±3.17) respectively. While the mean value of serum urea of red beet and pomegranate seeds groups (32.41±2.33 and 24.66±2.02) respectively report significant decrease as compared to control (+) group.

Serum Creatinine (0.7-1.4 mg/dl)

The mean value ± SEM of serum creatinine in the control (-) and control (+) groups were (1.04±0.03 and 1.28±0.03) respectively. While the mean value of serum creatinine of red beet and pomegranate seeds groups (1.20±0.02 and 1.19±0.03) respectively report no significant decrease as compared to control (+) group.

Serum Uric acid (2.5-6.8 mg/dl)

The mean value ± SEM of serum uric acid in the control (-) and control (+) groups were (4.19±0.04 and 5.55±0.02) respectively. While the mean value of serum uric acid of red beet and pomegranate seeds groups (5.19±0.03 and 4.97±0.03) respectively report significant decrease as compared to control (+) group.

In could be seen from above results that, fed on experimental diets had a good effect on serum kidney function. The present results were in agreement with **UI-Haq et al., (2019)** who said that particularly, the antioxidant enzymes in

renal tissues and serum proteins were significantly improved, whereas lipid peroxidation, nitric oxide, urea and creatinine levels were momentously reduced in nephrotoxicity-induced rats. Furthermore, histological assessment indicated better renal portfolio in the rats treated with beet beverages. The findings suggested that red beetroot-based beverages promisingly ameliorate negative impacts of gentamicin-induced nephritic stress.

Table (11): Effect of Feeding Rats of Pomegranate Seeds and Red Beet on Serum Kidney Function

Items / Groups	Uria 15-45mg/dl	Creatinine 0.7-1.4mg/dl	Uric acid 2.5-6.8mg/dl
Control (-)	19.87 ±2.02 ^{c}	1.04 ±0.03^{b}	4.19 ±0.04^{f}
Control (+)	30.16 ±3.17 ^{ab}	1.28 ±0.03 ^{ab}	5.55 ±0.02^{a}
Red Beet	32.41±2.33 ^{a}	1.20±0.02^{ab}	5.19 ±0.03^{b}
Pomegranate Seeds	24.66 ±2.02^{bc}	1.19 ±0.03^{ab}	4.97 ±0.03^{c}

*Values are expressed as mean ± S.D

* Were: pomegranate seed, pomegranate peel, beets and parsley by 20% each /one.

***Each value in colum followed by the same letter is not significantly different.

Effect of Feeding Rats of Pomegranate Seeds and Red Beet on Oxidative Stress

The results in Table (12) showed the effect of Feeding Rats of pomegranate seeds and red beet on Oxidative Stress including (MDA and Lipid peroxide (mmol/ml))

Malondialdehyde (mmol/ml)

The mean value ± SEM of oxidative stress malondialdehyde in the control (-) and control (+) groups were (44.40±2.60 and 65.34±2.33) respectively. While the mean value of malondialdehyde of red beet and pomegranate seeds groups (62.41±3.17 and 54.99±3.48) respectively report significant differences in pomegranate seeds, pomegranate peel and mix groups as compared to control (+) group.

Lipid peroxide (mmol/ml)

The mean value ± SEM of oxidative stress Lipid peroxide in the control (-) and control (+) groups were (22.50±2.02 and 26.15±3.17) respectively. While, the mean value of lipid peroxide of red beet and pomegranate seeds groups (22.83±2.02 and 21.88±3.17) respectively report no significant differences as compared to control group.

In could be seen from above results that, fed on experimental diets had a good effect on oxidative stress. The present results were in agreement with **El - Gamal et al., (2014)** who found that in addition, treatment of rats with red beetroot extract for leads to recovery from oxidative stress via: reduction in malondialdehyde (MDA), TNF-α, IL-6 and nuclear fac-tor kappa-light-chain-enhancer of activated B cells (NF-κB) also decreased apoptosis induced by gentamicin in the kidney.

Thomas et al., (2006) said that oxidative stress is a condition that occurs due to imbalance between free radical and antioxidant productions. This will cause serious damage to biological macromolecules and disregulation of normal metabolism and physiological functions. Free radicals can cause lipid peroxidation in cell membranes, which in turn produces compounds that are toxic to cells, such as malondialdehyde (MDA). **Mayne, (2003)** who found that

elevated levels of MDA show the increased activity of lipid peroxidation.

Table (12): Effect of Feeding Rats of Pomegranate Seeds and Red Beet on Oxidative Stress

Item / Groups	Malondialdehyde (mmol/ml)	Lipid peroxide (mmol/ml)
Control (-)	44.40 ± 2.60 [d]	22.50 ±2.02 [a]
Control (+)	65.34 ± 2.33 [a]	26.15 ±3.17 [a]
Red Beet	62.41 ± 3.17 [ab]	22.83 ±2.02 [a]
Parsley	59.83 ± 4.33 [abc]	22.65 ±1.45 [a]
Pomegranate Seeds	54.99 ± 3.48 [bc]	21.88 ±3.17 [a]
Pomegranate Peel	51.94 ± 2.02 [cd]	21.90 ±2.60 [a]
*Mix	50.89 ± 3.17 [cd]	21.85 ±2.02 [a]

*Values are expressed as mean ± S.D

**Each value in Colum followed by the same letter is not significantly different.

Water Activity of Pan Bread

The result in table (13) and fig. (1) showed the water activity of pan bread in zero, 24 hour and 48 hour

Zero time:

The results showed that pan bread prepared by pomegranate peel 20% (0.9215± 0.020) was significant higher in the mean value of water activity as compared to control formulas. While the lower mean value recorded in pomegranate seeds 20%.

24 hour

The results showed that pan bread prepared by red beet 10% (0.8950± 0.020) was significant higher in the mean value

of water activity as compared to control formulas. While the lower mean value recorded in pomegranate seeds 20%.

48 hour

The results showed that pan bread prepared by red beet 5% (0.8945± 0.015) was significant higher in the mean value of water activity as compared to control formulas. While the lower mean value recorded in pomegranate seeds 20%.

Table (13): Water Activity of Pan Bread

Ingredients		Zero	24h	48h
Control	100%	0.9015 ± .0015[c]	0.8910 ±.0015[b]	.9014 ± .0018[a]
Pomegranate Seeds	5%	0.9045 ± .0015[b]	0.8915 ±.0020[a]	0.8930 ± .0020[b]
	10%	0.9130 ± .0020[a]	0.8735 ±.0015[d]	0.8725 ±.0015[d]
	15%	0.9004 ± .0018[d]	0.8825 ±.0015[c]	0.8840 ±.0015[c]
	20%	0.8745 ± .0015[e]	0.8515 ±.0015[e]	0.8560 ±.0015[e]
Red Beet	5%	0.9015 ± .0015[b]	0.8830 ±.0015[c]	0.8945 ±.0015[a]
	10%	0.9055 ± .0020[a]	0.8950 ±.0020[a]	0.8880 ±.0020[b]
	15%	0.8804 ± .0018[c]	0.8775 ±.0015[d]	0.8749 ± .0018[c]
	20%	0.8750 ± .0015[d]	0.8775±.0015[d]	0.8670 ±.0020[d]

*Each value in colum followed by the same letter is not significantly different.

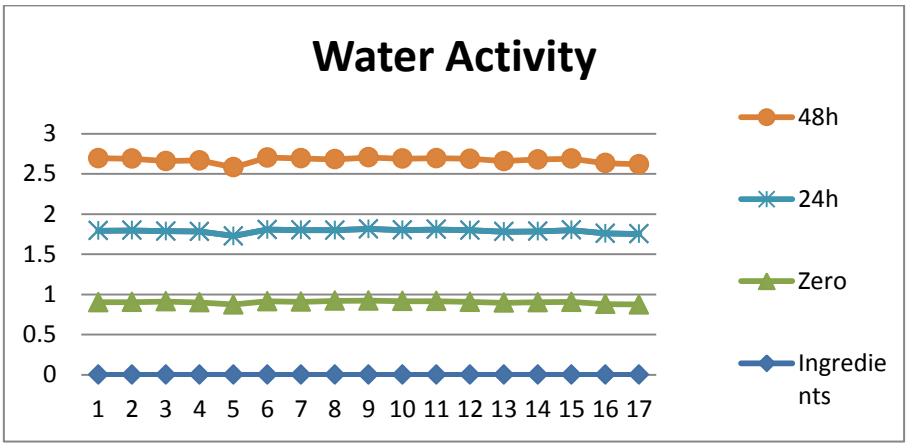


Fig. (1): Water Activity of Pan Bread

Sensory Attributes of Pan Bread

Organoleptic evaluation of crust color, crumb color, distribution of crumb, flavor, taste and general appearance of pan bread with pomegranate seeds and red beet shown in table (14) and fig. (2).

Pomegranate seeds

Results showed that taste score of prepared pan bread samples from (15.03±2.02 to 18.93±2.60). Formula (control) recorded the best results of taste score while formula (20%) had the lowest score. On the other hand, the general appearance score of prepared pan bread samples were ranged from (16.46±2.33 to 18.93±1.45). Formula (control) recorded the best results of general appearance score while formula (15%) had the lowest score. Statistical analysis of the obtained data showed that there were significant difference of general appearance score between control samples and other samples.

Pomegranate seeds						
Items	Crust color	Crumb color	Distribution of crumb	flavor	Taste	General appeara

Samples						nce
control	13.96 ±2.02 a	14.16 ±2.60 a	14.96 ±2.33 a	13.76 ±2.02 a	18.93 ±2.60 a	18.93 ±1.45 a
5%	13.76 ±2.33 a	12.86 ±2.02 a	12.93 ±2.90 a	13.06 ±2.60 a	17.83 ±2.02 a	17.53 ±2.60 a
10%	14.50 ±1.52 a	13.13 ±2.02 a	13.36 ±2.33 a	13.76 ±2.33 a	16.83 ±2.60 a	17.96 ±1.20 a
15%	10.83 ±0.88 a	11.96 ±2.02 a	11.46 ±2.02 a	12.96 ±1.76 a	16.13 ±2.02 a	16.46 ±2.33 a
20%	12.03 ±2.02 a	12.53 ±1.45 a	11.93 ±1.45 a	12.53 ±2.02 a	15.03 ±2.02 a	16.60 ±1.15 a

Table (14): Sensory Attributes of Pan Bread with pomegranate seeds

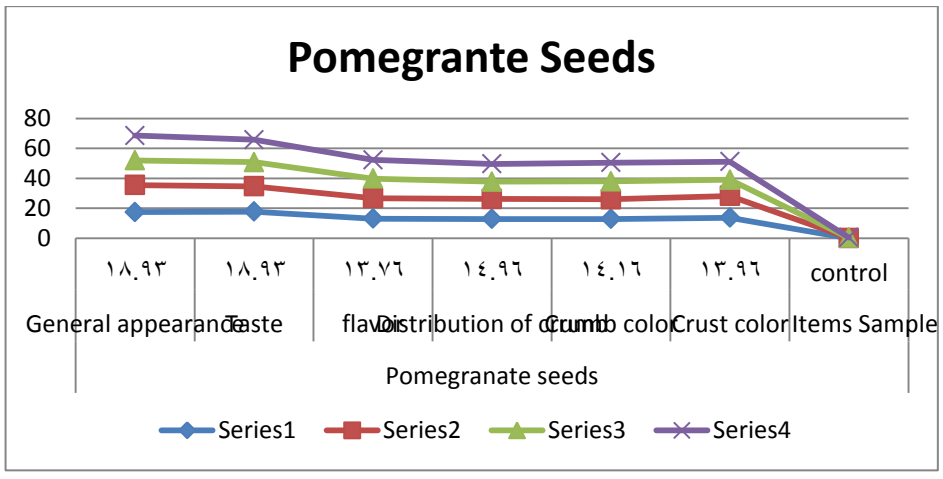


Fig. (2): Sensory Attributes of Pan Bread with pomegranate seeds

Red beet

Results in table (15) and fig. (3) showed that general appearance score of prepared pan bread samples were ranged from (14.06±1.45 to 18.93±1.45). Formula (control) recorded the best results of general appearance score while formula (20%) had the lowest score. Statistical analysis of the obtained data showed that there were significant difference of general appearance score between control samples and other samples.

Red Beet						
Items / Samples	Crust color	Crumb color	Distribution of crumb	Flavor	Taste	General appearance
control	13.96 ±2.02 [a]	14.16 ±2.60 [a]	14.96 ±2.33 [a]	13.76 ±2.02 [a]	18.93 ±2.60 [a]	18.93 ±1.45 [a]
5%	13.23±2.66 [a]	13.33 ±1.45 [a]	12.06 ±2.02 [a]	12.46 ±2.02 [a]	18.06 ±2.33 [a]	16.93 ±2.60 [a]
10%	11.30 ±2.64 [a]	12.96 ±1.76 [a]	11.86 ±2.60 [a]	12.16 ±1.45 [a]	17.56 ±1.76 [a]	16.23 ±1.76 [a]
15%	11.56 ±2.60 [a]	11.96 ±2.60 [a]	12.36 ±1.76 [a]	12.53 ±2.60 [a]	14.93 ±2.02 [a]	14.83 ±2.02 [a]
20%	11.23 ±1.76 [a]	11.76 ±1.45 [a]	12.23 ±1.45 [a]	13.06 ±2.33 [a]	12.73 ±1.7	14.06 ±1.45 [a]

					6 [a]	

Table (15): Sensory Attributes of Pan Bread fortified with red beets

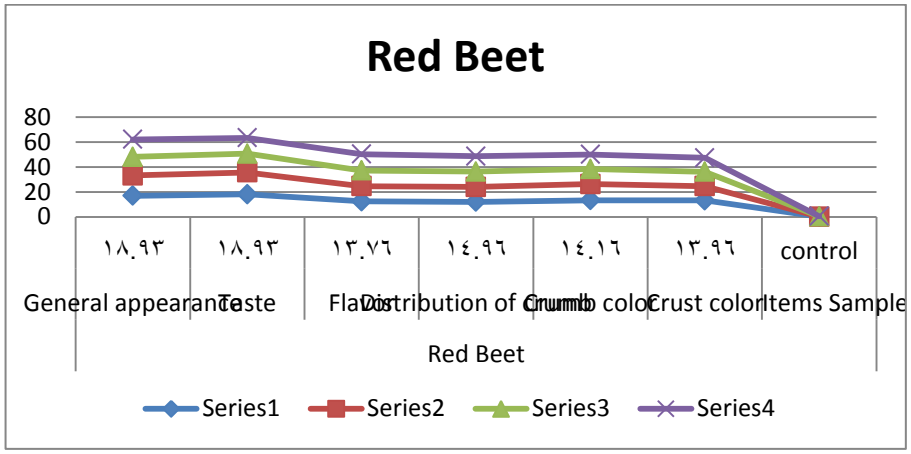


Fig. (3): Sensory Attributes of Pan Bread fortified with red beet

Texture Analyzer for pan bread

Table (16): Texture Analyzer for Pan Bread with pomegranate seeds

The results of pomegranate seeds in table (16) showed that the concentration of 15% in 48 hours highest in hardness, concentration 20% in 24 hours highest in adhesiveness, concentration 5% in zero time highest in resilience and cohesiveness, concentration 5% in 24 hours highest in springiness and chewiness concentration 15% in 48 hours highest in gumminess.

Pomegranate seeds						
Characteristics	Storage Time	Control	5%	10%	15%	20%
Hardness (n)	Zero time	13.97	28.86	33.49	45.70	36.76
	24 H	17.11	41.99	37.90	53.56	51.73
	48 H	23.77	42.55	44.95	65.80	58.08
Adhesiveness	Zero time	0.20	0.50	0.50	0.40	0.90
	24 H	1.00	1.00	0.80	0.30	0.90
	48 H	0.10	0.30	0.00	0.10	0.10
Resilience	Zero time	0.23	0.14	0.10	0.10	0.09
	24 H	0.17	0.13	0.10	0.09	0.13
	48 H	0.19	0.10	0.09	0.09	0.08
Cohesiveness	Zero time	0.63	0.43	0.35	0.33	0.23
	24 H	0.50	0.41	0.32	0.29	0.25
	48 H	0.48	0.32	0.29	0.27	0.21
Springiness	Zero time	7.19	6.17	5.98	5.73	4.97
	24 H	5.34	7.34	5.93	4.87	5.51
	48 H	7.49	6.16	5.37	6.81	5.73
Gumminess	Zero time	8.81	12.30	11.72	15.06	8.28
	24 H	8.50	17.04	12.21	15.52	12.87
	48 H	11.41	13.74	13.18	17.89	12.39
Chewiness	Zero time	63.40	75.90	70.10	86.30	41.20
	24 H	45.40	125.10	72.40	75.60	70.90
	48 H	85.50	84.60	70.80	121.80	71.00

Table (17): Texture Analyzer for Pan Bread Fortified with red beet

The results of red beet in table (17) showed that the concentration of 20% in zero time highest in hardness, concentration 20% in 24 hours highest in adhesiveness, concentration 5% in zero time highest in resilience, concentration 5% in 48 hours highest in cohesiveness and springiness, concentration 20% in 48 hours highest in gumminess, concentration 10% in 48 hours highest in chewiness.

Red beet						
Characteristics	**Storage Time**	**Control**	**5%**	**10%**	**15%**	**20%**
Hardness (n)	Zero time	13.97	26.35	41.06	64.87	86.28
	24 H	17.11	33.74	40.17	73.43	70.94
	48 H	23.77	41.88	70.10	74.02	92.06
Adhesiveness	Zero time	0.20	0.20	0.40	0.30	0.10
	24 H	1.00	0.40	0.20	8.40	10.20
	48 H	0.10	0.00	0.30	0.20	0.30
Resilience	Zero time	0.23	0.21	0.12	0.11	0.07
	24 H	0.17	0.13	0.11	0.09	0.07
	48 H	0.19	0.14	0.11	0.09	0.07
Cohesiveness	Zero time	0.63	0.55	0.39	0.33	0.27
	24 H	0.50	0.41	0.33	0.28	0.20
	48 H	0.48	0.41	0.34	0.30	0.26
Springiness	Zero time	7.19	7.11	6.29	5.58	4.92
	24 H	5.34	6.99	6.13	5.93	5.88
	48 H	7.49	7.58	7.07	6.92	5.35
Gumminess	Zero time	8.81	14.37	16.06	21.33	22.90

	24 H	8.50	13.69	13.29	20.43	14.47
	48 H	11.41	17.36	23.62	22.15	23.62
Chewiness	Zero time	63.40	102.20	101.00	119.00	112.70
	24 H	45.40	95.70	81.50	121.10	85.10
	48 H	85.50	131.60	167.00	153.30	126.30

Histopathological Examination of Liver:

Light microscopic examination of liver sections of rats from group 1 revealed normal histological architecture of hepatic lobules (Photos. 1 & 2). In contrariwise, liver of rats from group 2 exhibited histopathological damage characterized by hepatocellular steatosis (vacuolization) (Photos. 3, 4, 5 & 6), Kupffer cells activation (Photos. 4 & 5) and slight portal fibroplasia (Photo. 6). Otherwise, liver of rats from group 3 showed Kupffer cells activation (Photos. 7, 8 & 9) and small focal hepatocellular necrosis associated with inflammatory cells infiltration (Photo. 10). Meanwhile, liver of rats from group 4 exhibited Kupffer cells activation (Photos. 11, 12, 13& 14), necrosis of sporadic hepatocytes (Photos. 11, 12 & 13) and infiltration of inflammatory cells in the portal triad (Photo. 14).

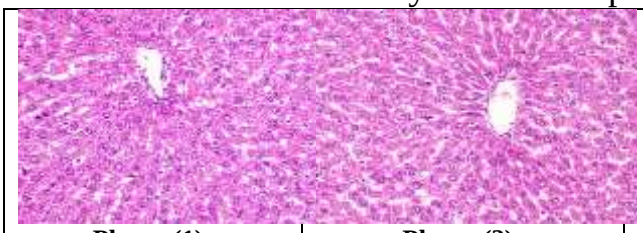


Photo. (1): Photomicrograph of liver of rat from group 1 showing normal histological architecture of hepatic lobule (H & E X 400).

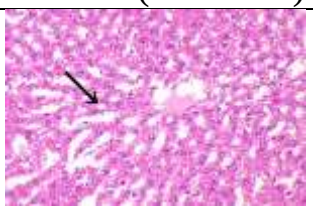


Photo. (2): Photomicrograph of liver of rat from group 1 showing normal histological architecture of hepatic lobule (H & E X 400).

Photo. (3): Photomicrograph of liver of rat from group 2 showing hepatocellular steatosis (black arrow) (H & E X 400).

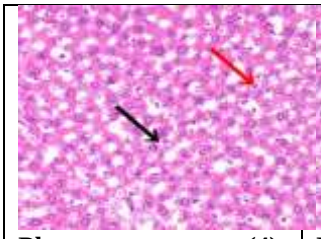
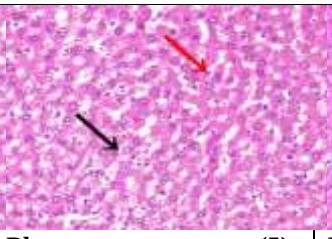
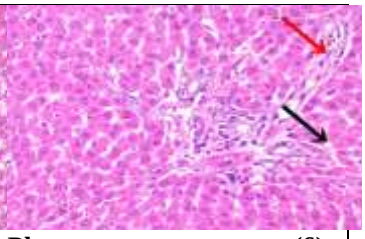
		

Photo. (4): Photomicrograph of liver of rat from group 2 showing hepatocellular steatosis (black arrow) and Kupffer cells activation (red arrow) (H & E X 400).	**Photo. (5): Photomicrograph of liver of rat from group 2 showing hepatocellular steatosis (black arrow) and Kupffer cells activation (red arrow) (H & E X 400).**	**Photo. (6): Photomicrograph of liver of rat from group 2 showing hepatocellular steatosis (black arrow) and slight portal fibroplasia (red arrow) (H & E X 400)**

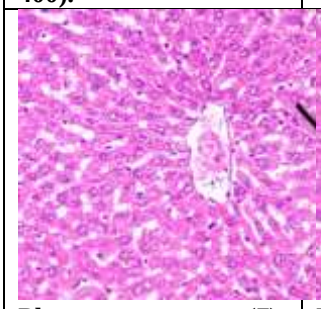
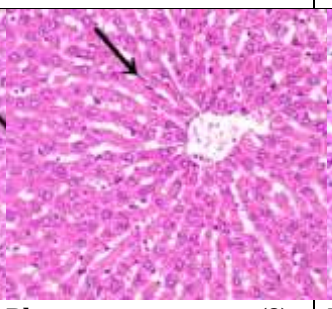
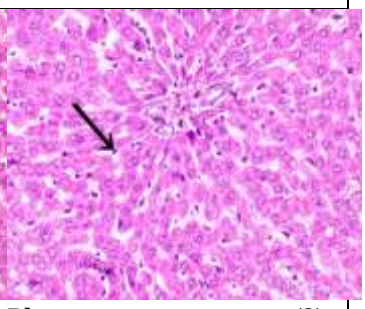

		

Photo. (7): Photomicrograph of liver of rat from group 3 showing Kupffer cells activation (black arrow) (H & E X 400).	**Photo. (8): Photomicrograph of liver of rat from group 3 showing Kupffer cells activation (black arrow) (H & E X 400).**	**Photo. (9): Photomicrograph of liver of rat from group 3 showing Kupffer cells activation (black arrow) (H & E X 400).**

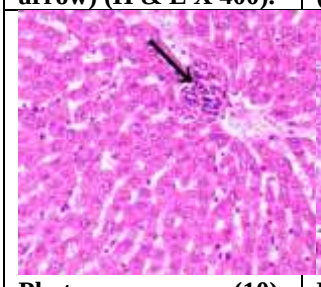
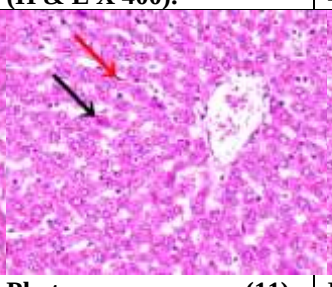
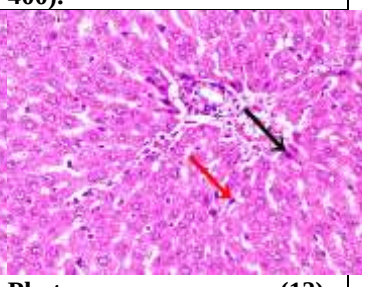

		

Photo. (10): Photomicrograph of liver of rat from group	**Photo. (11): Photomicrograph of liver of rat from group 4**	**Photo. (12): Photomicrograph of liver of rat from group 4 showing**

3 showing small focal hepatocellular necrosis associated with inflammatory cells infiltration (black arrow) (H & E X 400).	**showing Kupffer cells activation (red arrow) and necrosis of sporadic hepatocytes (black arrow) (H & E X 400).**	**Kupffer cells activation (red arrow) and necrosis of sporadic hepatocytes (black arrow) (H & E X 400).**

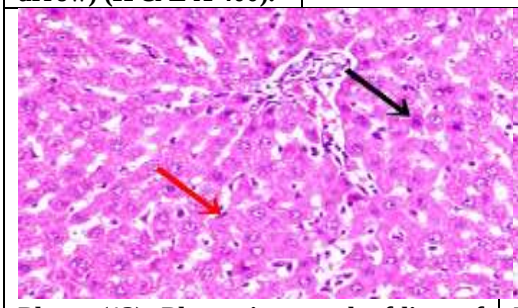


Photo. (13): Photomicrograph of liver of rat from group 4 showing Kupffer cells activation (red arrow) and necrosis of sporadic hepatocytes (black arrow) (H & E X 400).

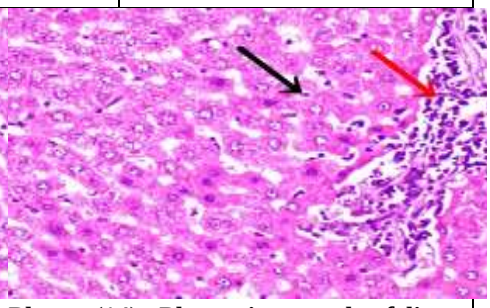


Photo. (14): Photomicrograph of liver of rat from group 4 showing Kupffer cells activation (black arrow) and infiltration of inflammatory cells in the portal triad (red arrow) (H & E X 400).

Histopathological Examination of Kidneys:

Light microscopic examination of kidneys of rats from group 1 revealed the normal histoarchitecture of renal parenchyma (Photos. 15, 16 & 17). In contrariwise, kidneys of rats from group 2 showed histopathological lesions demonstrated as vacuolar degeneration of epithelial lining renal tubules (Photos. 18, 19 & 20), congestion of renal blood vessel (Photo. 18), necrobiosis of renal tubular epithelium (Photo. 19) and intertubular mononuclear cells infiltration (Photo. 20). Meanwhile, kidneys of rats from group 3 described vacuolization of epithelial lining some renal tubules (Photos. 21, 22 & 23) and slight congestion of renal blood vessel (Photo. 23). Likewise, some sections from group 4 revealed only slight vacuolization of epithelial lining some renal tubules (Photos. 24 & 25), whereas other sections exhibited no histopathological lesions (Photo. 26).

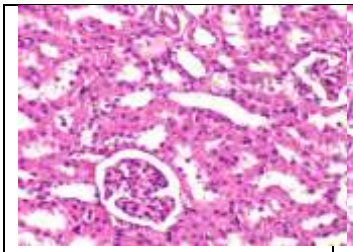
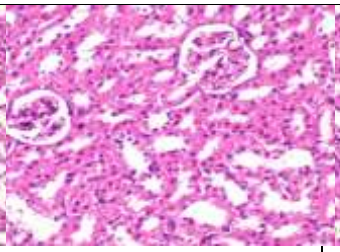
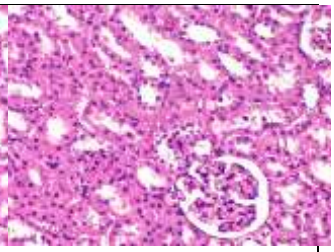
		

Photo. (15): Photomicrograph of kidney of rat from group 1 showing normal histoarchitecture of renal parenchyma (H & E X 400).	**Photo. (16): Photomicrograph of kidney of rat from group 1 showing normal histoarchitecture of renal parenchyma (H & E X 400).**	**Photo. (17): Photomicrograph of kidney of rat from group 1 showing normal histoarchitecture of renal parenchyma (H & E X 400).**

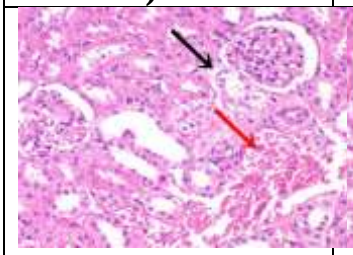
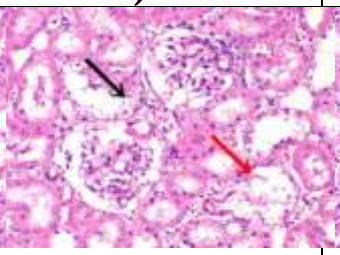
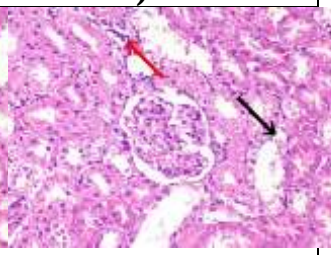

		

Photo. (18): Photomicrograph of kidney of rat from group 2 showing vacuolar degeneration of epithelial lining renal tubules (black arrow) and congestion of	**Photo. (19): Photomicrograph of kidney of rat from group 2 showing vacuolar degeneration of epithelial lining renal tubules (black arrow) and necrobiosis of**	**Photo. (20): Photomicrograph of kidney of rat from group 2 showing vacuolar degeneration of epithelial lining renal tubules (black arrow) and intertubular**

renal blood vessel (red arrow) (H & E X 400).	**renal tubular epithelium (red arrow) (H & E X 400).**	**mononuclear cells infiltration (red arrow) (H & E X 400).**

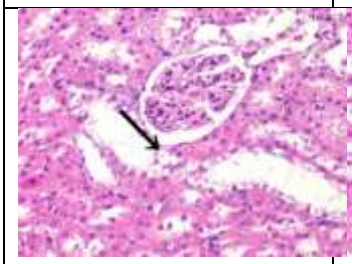
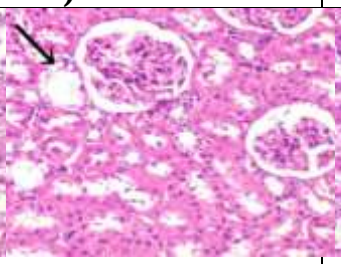
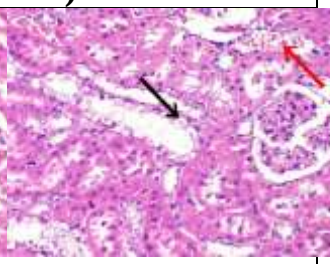

		

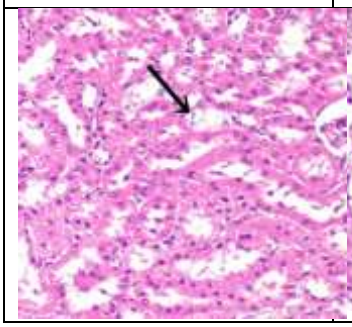
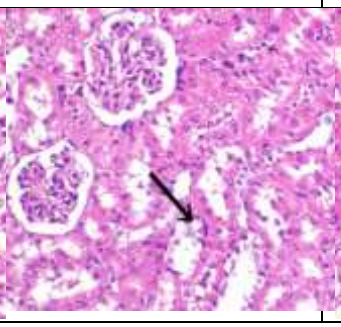
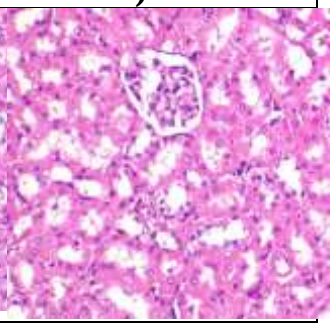
Photo. (21): Photomicrograph of kidney of rat from group 3 showing vacuolization of epithelial lining some renal tubules (black arrow) (H & E X 400).	**Photo. (22): Photomicrograph of kidney of rat from group 3 showing vacuolization of epithelial lining some renal tubules (black arrow) (H & E X 400).**	**Photo. (23): Photomicrograph of kidney of rat from group 3 showing vacuolization of epithelial lining some renal tubules (black arrow) and slight congestion of renal blood vessel (red arrow) (H & E X 400).**
		

Photo. (24): Photomicrograph of kidney of rat from group 3 showing slight vacuolization of epithelial lining some renal tubules (black arrow) (H & E X 400).	**Photo. (25): Photomicrograph of kidney of rat from group 3 showing slight vacuolization of epithelial lining some renal tubules (black arrow) (H & E X 400).**	**Photo. (26): Photomicrograph of kidney of rat from group 3 showing no histopathological lesions (H & E X 400).**

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الملخص العربى

إن الفواكه والخضروات قادرة على توفير فوائد فسيولوجية إضافية، بما في ذلك منع أو تأخير ظهور العديد من الأمراض المزمنة. تم في هذه الدراسة استخدام بعض الفينولات النباتية ومضادات الأكسدة من مصادر طبيعية وهى بذور الرمان والبنجر الأحمر للعمل على تقليل التأثيرات الضارة وتثبيط بعض التغيرات البيولوجية التي يسببها الكولسترول المؤكسد في فئران التجارب. وقد تم التحقق من هذا الهدف عن طريق تغذية ذكور الفئران البيضاء البالغة (٢٠ فأراً) بمتوسط وزن (١٥٠ ± ١٠ جم) مقسمة عشوائياً إلى مجموعتين رئيسيتين.

أظهرت النتائج أن التغذية على العلائق التجريبية كان له تأثير فعال على مستويات الدهون في الدم مثل خفض مستوى البروتين الدهني منخفض الكثافة (LDL) ورفع مستوى البروتين الدهنى مرتفع الكثافة (HDL). كما كانت لها تأثير إيجابي على وظائف الكبد والكلى، الإجهاد التأكسدي، مستويات جلوكوز والكوليسترول في الدم والفحص النسيجي المرضي للكبد والكلى.

من تلك الدراسة يمكن استنتاج أن البنجر الأحمر وبذور الرمان تعتبر من الأغذية الوظيفية كمصادر للبوليفينولات المعززة للصحة من حيث خصائصها المضادة للأكسدة.

الكلمات المفتاحية: الرمان، البنجر، الخصائص الكيميائية، النشاط البيولوجي والفحص النسيجي