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التأثيرات العلاجية لبذور البطيخ والكرنب الأحمر والجرجير على أكسدة الدهون المحدثة بواسطة برومات البوتاسيوم في الفئران

Therapeutic Effects of Watermelon, Red cabbage and Rocca Seeds on Lipid Peroxidation in Rats Induced by Potassium Bromate

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المستخلص:

صنفت الوكالة الدولية لبحوث السرطان (IARC) بروومات البوتاسيوم (KBrO3) على أنها مادة مسرطنة للبشر، وتم تقييد استخدامها في معالجة الأغذية لأنها تسبب سمية متعددة للأعضاء في البشر وفئران التجارب. هدف البحث: تم تصميم هذا البحث لدراسة التأثيرات العلاجية لبذور البطيخ والكرنب الأحمر والجرجير على أكسدة الدهون المحدثة بواسطة بروومات البوتاسيوم في الفئران. تم استخدام ٢٥ فأر أبيض بالغ يتراوح وزن الفأر (١٥٠±١٠) جرام، وتم تقسيمهم إلى خمس مجموعات متساوية (كل مجموعة ٥ فئران) وتركت إحداها تتغذى على عليقة أساسية طوال فترة التجربة كمجموعة ضابطة سالبة، أما الأربع مجموعات المتبقية فتم حقنهم باستخدام بروومات البوتاسيوم بجرعة ١٢٥ ملجم / كجم من وزن الجسم لتحفيز الإجهاد التأكسدي، ثم تركت واحدة منهم كمجموعة ضابطه موجبة تغذت على عليقة أساسية طوال فترة التجربة، ثم تم تغذية الثلاث مجموعات المتبقية على ٥% بذور كل من البطيخ والكرنب الأحمر والجرجير كل منهم على حده لمدة ٢٨ يوم. وفى نهاية التجربة تم تجميع عينات السيرم وعمل الطرد المركزي ثم تم تقدير مستوى انزيمات الاكسدة ودهون الدم والجلوكوز وبروتينات الدم وانزيمات الكبد ووظائف الكلي. أظهرت جميع الفئران التي تم تغذيتها عن طريق الفم على ٥ ٪ من بذور كل من البطيخ والكرنب الأحمر والجرجير زيادة معنوية في مستوى الليبوبروتينات مرتفعة الكثافة وانزيمات الاكسدة وبروتينات الدم وكذلك انخفاض معنوي في الكولسترول ودهون وجلوكوز الدم والبيليروبين وانزيمات الكبد ووظائف الكلى. وقد أظهرت مجموعة بذور الجرجير ٥٪ أفضل تأثير علاجي ثم بذور الكرنب الأحمر ٥٪ وأخيراً بذور البطيخ ٥%على التوالي. بذور البطيخ والملفوف الأحمر والجرجير لها تأثير علاجي ضد بروومات البوتاسيوم المسببة لأكسدة الدهون.

الكلمات المفتاحية:

أكسدة الدهون ، بروومات البوتاسيوم ، بذور، الفئران.

Therapeutic Effects of Watermelon, Red cabbage and Rocca Seeds on Lipid Peroxidation in Rats Induced by Potassium Bromate

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Abstract:

International Agency for Research on Cancer (IARC) had classified potassium bromate ($KBrO_3$) as a human carcinogenic agent and its application in food processing was restricted as it induces multiple organ toxicity in humans. The present investigation was designed out to study the therapeutic effects of the seeds of water-melon, red cabbage and rocca against lipid peroxidation induced by potassium bromate. Twenty-five (25) Sprague-Dawley adult male albino rats weighing 150±10g were randomly distributed into 5 equal groups, 5 rats each. Group 1(normal rats) was fed on the basal diet as a negative control group (C -ve). The other 4 groups were intraperitoneal injected by a single dose of potassium bromate at a dose of 125 mg/kg body weight for oxidative stress induction, one of them left as control positive group (C +ve) and the rest three groups were orally fed on 5% seeds of either water-melon, red cabbage or rocca. At the end of the experiment period (28 days), blood serum was collected, centrifuged then the serum levels of oxidation enzymes, blood lipids, glucose, blood proteins, liver enzymes and kidney functions were determined. All rats orally fed on 5% seeds of water-melon, red cabbage and rocca showed significant increase in HDL, oxidation enzymes, blood proteins and significant decrease in cholesterol, lipids, glucose, liver enzymes and kidney functions. Rocca seeds 5% group showed the best therapeutic effect then red cabbage seeds 5% and finally for water-melon seeds 5%, respectively. The seeds of water-melon, red cabbage and rocca have therapeutic effect against lipid peroxidation induced by potassium bromate.

Key words:

Lipid peroxidation, $KBrO_3$, seeds, rats.

Introduction:

Potassium bromate is found in water as additive (**Himata *et al*., 1994**) and hair solution (**Chipman *et al*., 1998**). KBrO3 induces chromosomal aberration and promoting tumorigenesis (**Sai *et al*., 1992**) due to elevation of 8-hydroxydeoxyguanosine levels in deoxyribonucleic acid induced by oxidative stress (**Wattenbe, 1990**).

International Agency for Research on Cancer classified potassium bromate as a carcinogen agent in humans as inducing multiple organ toxicity not only in humans but also in experimental rats **(Naif *et al*., 2018)**. Potassium bromate induces renal cell tumor formation in rats classified as a genotoxic carcinogen according to positive mutagenicity (**Ishidate *et al*., 1984**). Oxidative stress process is an imbalance between accumulation of oxygen reactive in cells and the ability of a biological system leading to cell and tissue damage **(Pizzino *et al*., 2017)**.

Watermelon seeds containing nutrients in the diet and have healthy benefits according to contents of fiber, minerals, phenolics and antioxidant **(Betty *et al*., 2016)**. Also, they rich sources of protein, vitamin B, minerals, and fats moreover phytochemicals **(Braide *et al*., 2012)**. Moreover, watermelon seeds have hypoglycemic effect due to contents of tannins, saponins, phytochemicals as well as soluble fiber (**Nassiri *et al*., 2009**).

The consumption of red cabbage (*Brassica oleracea*) associated with reducing cardiovascular diseases (**Jahangir *et al*., 2009 and Cartea *et al*., 2011**). Cabbage is a good source of ascorbic acid as well as significant amounts of glutamine and other amino acids relating anti-inflammatory properties. The principle constituents of red cabbage are isothiocyanates (glucosinolates), vitamins A, B, C and anthocyanins which is a group of phenolic natural pigments that found to have 150 flavonoids, moreover, red cabbage extract has also preventive oxidative stress induced in the liver **(Sterling, 2000).**

Rocket as one of cruciferous vegetables have anticancer compounds called as glucosinolates, which had anti-secretary as soon as anti-ulcer and cytoprotective properties **(Al-qasomi *et al*., 2009).**

Therefore, this work was designed to study the therapeutic effects of the seeds of water-melon, red cabbage and rocca against potassium bromate induced lipid peroxidation in rats.

Material and Methods:

Materials: Seeds:

The tested seeds in the study were the seeds of water-melon, red cabbage and rocca which were purchased from local market in Shebein El-Kom, Menoufia, Egypt.

Chemicals:

Potassium bromate ($KBrO_3$) as a powder in white color purchased from El-Gomhoria Company for Drugs and Medical Equipment, Cairo, Egypt.

Rats:

Twenty-five (25) adult male Sprague-Dawley albino rats, weighing 150 ±10 g which obtained from Research Institute of Ophthalmology, Medical Analysis Department, Giza, Egypt.

Basal diet:

Basal diet consisted of casein, sucrose, corn oil, choline chloride, vitamins mixture, mineral mixture, cellulose, and corn starch which purchased from El-Gomhoria Company for Drugs and Medical Equipment, Cairo, Egypt.

Methods:

Experimental design:

Twenty-five (25) Sprague-Dawley adult male albino rats fed with basal diet for 7 days till the beginning of the experiment. After that, rats were randomly divided to five equal groups (n=5 rats) as follows: Group 1(normal rats) was fed all over the experimental period on the basal diet as a control negative group (C -ve). The rest four groups were intraperitoneal injected by 125 mg/kg body weight for single dose of potassium bromate to induce oxidative stress induction as the method prescribed by **Khan and Sultana (2004).** All groups were fed for 28 days according to these groups:

Group (1): (C -ve) rats (n=5) were fed on basal diet only along the experimental period.

Group (2): (C +ve) rats (n=5) were kept without any treatment and fed on basal diet along the experimental period after single intraperitoneal injection with potassium bromate (125 mg/kg B.Wt).

Group (3): Rats (n=5) were fed on basal diet containing 5% water-melon seeds along the experimental period after single intraperitoneal injection with potassium bromate (125 mg/kg B.Wt).

Group (4): Rats (n=5) were fed on basal diet containing 5% red cabbage seeds along the experimental period after single intraperitoneal injection with potassium bromate (125 mg/kg B.Wt).

Group (5): Rats (n=5) were fed on basal diet along the experimental period containing 5% rocca seeds along the experimental period after single intraperitoneal injection with potassium bromate (125 mg/kg B.Wt).

Blood Sampling and serum analysis:

At the end of the experiment period (28 days), rats were sacrificed, then blood samples were collected and centrifuged then stored frozen at -20°C according to **(Malhotra, 2003).**

Glutathione peroxidase (GPx) was measured due to the method of **Paglia and Valentine (1967)**, catalase (CAT) according to the methods of **Iwase *et al*., (2013)** and Superoxide dismutase (SOD) estimated as the method of **Arthur and Boyne (1985)**. Total cholesterol (TC) was determined according to **Allen, (1974)**, and high density lipoprotein (HDL-c) according to **Lopez (1997)**. The calculation of low density lipoprotein (LDL-c) was carried out according to the method of **Lee and Nieman (1996)**, atherogenic index (AI) was calculated according to **Kikuchi *et al*., (1998)** as a sum of LDL plus VLDL divided by HDL and triglycerides determined according to **Fossati and Prencipe (1982)**. Moreover, Serum glucose determined according to **Kaplan (1984)**. Serum total protein (TP) determined according to the test of **Gomal *et al*., (1949)**, albumin was carried out as the method of **Doumas *et al*., (1971)** and globulin was calculated as **Charry and Sharma (2004)**. Total bilirubin was determined due to the method of **Doumas *et al*., (1985)**, direct and indirect bilirubin were measured according to **Sepulveda and Osterberg (1943)**, whilest, albumin/globulin (A/G) was calculated. Meanwhile, liver enzymes including, aspartate amino transaminase (AST) and alanine amino transferase (ALT) activities were determined according to **Tietz (1976)**, while alkaline phosphatase (ALP) activity was determined according to **Belfield and Goldberg (1971)**. Finally, kidney functions including urea which measured according to the enzymatic method of **Patton and Crouch (1977)**, creatinine which measured according to kinetic method of **Henry (1974)** and uric acid which measured according to the colorimetric method of **Fossati and Prencipe (1980)**.

Statistical Analysis:

Statistical significances were achieved by SPSS (v.20, IBM SPSS Statistics, US) at $p \leq 0.05$ by using the means of one-way analysis of variance (ANOVA) followed by low significant difference post hoc multiple comparisons.

Results and Discussion:

1. Effect of vegetable seeds on GPX, CAT and SOD in rats inflicted with lipids peroxidation by potassium bromate

Data listed in table (1) show the effect of the seeds of (water-melon, red cabbage and rocca) on glutathione peroxidase (GPx), catalase (CAT) and superoxide dismutase (SOD) in rats inflicted with lipids peroxidation by potassium bromate.

Table (1): Effect of the seeds of (water-melon, red cabbage and rocca) on GPx, CAT and SOD in rats inflicted with lipids peroxidation by potassium bromate

Parameters Rats group	GPx (ng/ml) Mean±SE*	CAT (mmol/L) Mean±SE*	SOD (U/L) Mean±SE*
Control (-ve)	39.50±2.22 [a]	80.10±2.99 [a]	36.80±0.93 [a]
Control (+ve)	16.20±1.09 [d]	52.00±3.25 [e]	18.60±0.81 [d]
Water-Melon Seeds 5%	36.00±2.11 [c]	65.30±1.92 [d]	26.60±0.71 [c]
Red Cabbage Seeds 5%	38.60±1.18 [b]	70.40±1.19 [c]	27.10±0.88 [c]
Rocca Seeds 5%	39.00±1.98 [ab]	75.30±2.01 [b]	31.90±0.39 [b]

- *SE means standard error.
- Letters of (a, b, c, d, e) in one column significantly differ at $p \leq 0.05$.

It could be observed for (C +ve group) that the mean value ± standerd error (Mean ±SE) for glutathione peroxidase (GPx) was 16.20±1.09 ng/ml compared to 39.50±2.22 ng/ml in (C -ve) normal rats ($P \leq 0.05$). These results declare that there were significant decrease in GPx for control positive rats as compared to normal rats as a result of potassium bromate oxidation induced in rats. All rats injected by potassium bromate then orally fed by the seeds of (water-melon, red cabbage and rocca) at a dose of 5% each showed significant increase in (Gpx) as compared to control positive group which were 36.00±2.11, 38.60±1.18, 39.00±1.98 and 16.20±1.09 ng/ml, respectively. The group injected by potassium bromate then orally fed by rocca seeds at a dose of 5% showed non significant change when compared to (C -ve) normal rats.

Concerning catalase (CAT), there were significantly increase positive group compared to negative group where the Mean±SE were 52.00±3.25 and 80.10±2.99 mmol/L, respectively. All groups injected by potassium bromate then orally fed by the seeds of (water-melon, red cabbage and rocca) at a dose of 5% after they induced by potassium bromate showed significant increase in catalase as compared to control positive which were 65.30±1.92, 70.40±1.19, 75.30±2.01 and 52.00±3.25 mmol/L, respectively. Moreover, the best protective effect had been shown in rocca seeds 5% group compared to all groups.

Regarding superoxide dismutase (SOD), it was cleared in out that (C +ve) group revealed 18.60±0.81 U/L, but in (C -ve) group was 36.80±0.93 U/L. The obtained results showed significant decrease in SOD in positive group when compared to negative one. All groups injected by potassium bromate then orally fed by the seeds of (water-melon, red cabbage and rocca) at a dose of 5% showed significant increase in SOD when compared to control positive group. Meanwhile, there were nonsignificant differences between rats injected by potassium bromate then orally fed with water-melon and red cabbage at the same dose 5%, provided that the best effect was recorded for the group injected by potassium bromate then orally fed by 5% rocca seeds as compared to all tested groups.

These results confirmed by the findings of **El-Sadek (2014)** who found that treatment rat groups with *Eruca sativa* leaves, juice, oil and seeds have ability for increasing liver antioxidant enzymes, while, lowering malondialdehyde (MDA) level. Moreover, **Bennett *et al.*, (2006)** demonstrated that *Eruca sativa* seeds have free radical scavenging antioxidant which prevent oxidative damage of antioxidant molecules and antioxidant enzymes. Furthermore, **Al-qasomi *et al.*, (2009)** reported that rocket as one of cruciferous vegetables have anticancer compounds called as glucosinolates, which had anti-secretary as soon as anti-ulcer and cytoprotective properties. Furthermore, **Bruno *et al.*, (2020)** studied the hypolipidemic and antioxidant capacity of red cabbage (*Brassica oleracea L.*) and demonstrated that red cabbage used to treat diseases from dyslipidemic and oxidative stress.

The Presence of superoxide dismutase enzyme enhance the dismutation to superoxide radical in hydrogen peroxide considering importance of scavenging free radicals **(Horton *et al.*, 2002).** Moreover, the affinity of phospholipid hydroperoxide glutathione peroxidase (GSH-Px) for hydrogen peroxide (H2O2) is high in low levels, as well as, catalase (CAT)'s affinity increases with higher of H2O2 level (**Herbette *et al.*, 2007**).

2. Effect of vegetable seeds on T.C and T.G in rats inflicted with lipids peroxidation by potassium bromate

Data recorded in table (2) show the effect of the seeds of (water-melon, red cabbage and rocca) on total cholesterol (T.C) and triglycerides (T.G) in rats inflicted with lipids peroxidation by potassium bromate.

Table (2): Effect of the seeds of (water-melon, red cabbage and rocca) on T.C and T.G in rats inflicted with lipids peroxidation by potassium bromate

Parameters Rats group	T.C (mg/dl) Mean±SE*	T.G (mg/dl) Mean±SE*
Control (-ve)	121.00±1.18 [d]	125.00±1.71 [b]
Control (+ve)	205.00±2.66 [a]	177.00±3.02 [a]
Water-Melon Seeds 5%	128.00±1.40 [b]	118.00±1.41 [c]
Red Cabbage Seeds 5%	125.00±1.51 [c]	110.00±1.27 [d]
Rocca Seeds 5%	120.00±1.81 [d]	100.00±0.29 [e]

- *SE means standard error.
- Letters of (a, b, c, d, e) in one column significantly differ at $p \leq 0.05$.

As shown from data in table (2) that there was significant increase in control positive group compared to normal rats in total cholesterol (T.C), which were the Mean±SE was 205.00±2.66 and 121.00±1.18 mg/dl, respectively. All rats injected by potassium bromate then orally fed with the seeds of (water-melon, red cabbage and rocca) showed significant decrease in total cholesterol (T.C) when compared to control positive group which were 128.00±1.40, 125.00±1.51, 120.00±1.81 and 205.00±2.66 mg/dl, respectively. Moreover, the rats injected by potassium bromate then orally fed with water-melon seeds, red cabbage and rocca seeds at the same dose 5% showed considerable significant decrease as compared with control positive. Accordingly, the best treatment achieved in the group injected by potassium bromate then orally fed with rocca seeds 5%.

As for, tri-glycerides (T.G), it is cleared that there were significant increase in control positive comparing with normal rats, which were 177.00±3.02 and 125.00±1.71 mg/dl, respectively. All groups injected by potassium bromate then treated with the seeds of (water-melon, red cabbage and rocca) at the same dose 5% showed significant decrease not only when compared to control positive group but also for control negative one which were 118.00±1.41, 110.00±1.27, 100.00±0.29, 177.00±3.02 and 125.00±1.71 mg/dl, respectively. The best treatment was for the group injected by potassium bromate then treated with rocca seeds 5%.

These results move in the same direction by the findings of **El-Sadek (2014)** who recorded that the treatment rat groups with *Eruca sativa* leaves, juice, oil and seeds could lower the levels of liver cholesterol and total lipids and increase of glycogen compared with control (+ve) group. Meanwhile, **Shahidi (2009)** reported that phytonutrients found in *Citrullus Lanatus* have carotenoid and phenolics compounds contributing in an anti-oxidative activity.

3. Effect of vegetable seeds on HDLc, LDLc, VLDLc and AI in rats inflicted with lipids peroxidation by potassium bromate

Data listed in table (3) show the effect of the seeds of (water-melon, red cabbage and rocca) on high-density lipoprotein (HDL), low-density lipoprotein (LDL), very low-density lipoprotein (VLDL) and atherosclerosis index (AI) in rats inflicted with lipids peroxidation by potassium bromate.

Table (3): Effect of the seeds of (water-melon, red cabbage and rocca) on HDLc, LDLc, VLDLc and AI in rats inflicted with lipids peroxidation by potassium bromate

Parameters Rats group	HDLc (g/dl) Mean ±SE*	LDLc (g/dl) Mean±SE*	VLDLc (g/dl) Mean±SE*	AI Mean±SE*
Control (-ve)	40.00±0.44 [a]	56.00±0.27 [d]	25.00±0.05 [b]	2.03±0.01 [d]
Control (+ve)	32.00±0.31 [d]	138.00±1.49 [a]	35.00±1.55 [a]	5.41±0.03 [a]
Water-Melon Seeds 5%	35.00±0.81 [c]	69.00±0.40 [b]	24.00±0.38 [b]	2.66±0.02 [b]
Red Cabbage Seeds 5%	36.00±0.39 [c]	67.00±0.19 [b]	22.00±0.18 [c]	2.50±0.02 [c]
Rocca Seeds 5%	38.00±0.72 [b]	62.00±0.33 [c]	20.00±0.10 [d]	2.16±0.01 [d]

- *SE means standard error.
- Letters of (a, b, c, d, e) in one column significantly differ at $p \leq 0.05$.

It could be observed from the previous table that for high-density lipoprotein(HDL), the Mean±SE of (C+ve group) was 32.00±0.31 compared to 40.00±0.44 g/dl for (C-ve) normal rats ($p \leq 0.05$), these results showed that there was significant increase in HDLc level of potassium bromate oxidative rats without treatment (C +ve) as compared to normal rats. Rats injected by potassium bromate then treated with rocca seeds 5% showed significant increase in HDLc when compared to control positive group which were 38.00±0.72 and 32.00±0.31 g/dl, respectively. Rats injected by potassium bromate then treated with water-melon seeds 5% and red cabbage seeds 5% showed non significant difference in HDLc which was higher when compared to control positive group.

Positive groups in the parameters of LDLc, VLDc and AI showed significant increases in Mean±SE as compared to control negative groups for the same parameters, moreover, all rats injected by potassium bromate then treated with all tested plant seeds at the same dose 5% showed significant decrease in all previous parameters when compared to control positive groups and the best level recorded in the group injected by potassium bromate then treated with rocca seeds 5%.

These results confirmed by the findings of **Makaepea *et al*., (2019)** who concluded that water melon promoting the body's own natural healing process, which had a role in preventing various diseases by suppressing free radicals, as well as, decreasing oxidative stress resulting in lowering cancers, diabetes, hypertension, skin problem, cardiovascular diseases, and asthma. Moreover, **Shahidi and Wanasundara**

(1992), **Brand-Williams *et al*., (1997**), **Bondet *et al*., (1997**) and **Sánchez-Moreno *et al*., (1999**) demonstrated that antioxidants can interact with oxidation process which act as oxygen scavengers and preventing lipid autoxidation in the body.

4. Effect of vegetable seeds on Glucose in rats inflicted with lipids peroxidation by potassium bromate

Data present in table (4) show the effect of the seeds of (water-melon, red cabbage and rocca) on serum glucose in rats inflicted with lipids peroxidation by potassium bromate.

Table (4): Effect of the seeds of (water-melon, red cabbage and rocca) on glucose in rats inflicted with lipids peroxidation by potassium bromate

Parameters	Glucose (mg/dl)
Rats group	Mean±SE*
Control (-ve)	95.00±1.55 [e]
Control (+ve)	220.00±2.98 [a]
Water-Melon Seeds 5%	111.00±1.49 [b]
Red Cabbage Seeds 5%	105.00±2.37 [c]
Rocca Seeds 5%	99.00±1.05 [d]

- *SE means standard error.
- Letters of (a, b, c, d, e) in one column significantly differ at $p \leq 0.05$.

According to the previous data listed in table (4), there was significant increase in positive group comparing with normal rats where the Mean±SE were 220.00±2.98 and 95.00±1.55 mg/dl, respectively. All rats injected by potassium bromate then orally fed with the seeds of (water-melon, red cabbage and rocca) at a same dose 5% showed significant decreases in serum glucose when compared to control positive group which were 111.00±1.49, 105.00±2.37, 99.00±1.05 and 220.00±2.98 mg/dl, respectively. Rats injected by potassium bromate then orally fed with rocca seeds 5% reflected the highest significant decrease in serum glucose when compared to (C +ve) group.

These results agreed with the findings of **Hazem *et al*., (2008)** who concluded that red cabbage (*Brassica oleracea*) has been found to have antioxidant, anticancer, anti hyperglycemic and hypocholesterolemic properties.

Moreover, **Arapitsas (2012)** stated that water-melon seeds contain saponins, triterpenoids, tannins, glycosides and alkaloids while not containing flavonoids, glycosides and cyanogenic glycosides. Moreover, tannins as a major polyphenol had a strong biological activity as anti-tumour, anti-mutagenic, anti-diabetic and anti-proliferative but may cause aneamia or osteoporosis if prolonged **(Varadharajan *et al*., 2012)**.

5. Effect of vegetable seeds on T.P, Alb., Glob. and A/G in rats inflicted with lipids peroxidation by potassium bromate

Data listed in table (5) show the effect of the seeds of (water-melon, red cabbage and rocca) on serum total protein (T.P), albumin (Alb.), globulin (Glob.) and albumin/globulin ((A/G) in rats inflicted with lipids peroxidation by potassium bromate.

Table (5): Effect of the seeds of (water-melon, red cabbage and rocca) on T.P, Alb., Glob. and A/G in rats inflicted with lipids peroxidation by potassium bromate

Parameters Rats group	T.P (g/dl) Mean±SE*	Alb. (g/dl) Mean±SE*	Glob. (g/dl) Mean±SE*	A/G Mean±SE*
Control (-ve)	8.40±0.03 [a]	4.70±0.01 [a]	3.70±0.03 [a]	1.27±0.002 [d]
Control (+ve)	2.10±0.05 [e]	1.10±0.04 [d]	1.00±0.05 [e]	1.10±0.003 [e]
Water-Melon Seeds 5%	6.90±0.02 [b]	3.90±0.03 [c]	3.00±0.04 [b]	1.30±0.003 [c]
Red Cabbage Seeds 5%	6.30±0.03 [d]	4.10±0.02 [b]	2.20±0.03 [c]	1.86±0.004 [b]
Rocca Seeds 5%	6.60±0.01 [c]	4.60±0.01 [a]	2.00±0.02 [d]	2.30±0.001 [a]

- *SE means standard error.
- Letters of (a, b, c, d, e) in one column significantly differ at $p \leq 0.05$.

From the table above, in (C +ve group), the Mean±SE for total protein (T.P), albumin (Alb.), globulin (Glob.) and albumin/globulin ((A/G) were 2.10±0.05, 1.10±0.04, 1.00±0.05 g/dl and 1.10±0.003, respectively, while for (C-ve group) were 8.40±0.03, 4.70±0.01, 3.70±0.03 g/dl and 1.27±0.002, respectively. These data indicated that there were significant decrease in all mentioned parameters for control positive comparing with control negative one. Also, there were significant increase in T.P, Alb., Glob. and A/G for all groups injected by potassium bromate then orally fed by all tested plant seeds at the same dose 5% when compared to control positive group.

These results confirmed by the findings of **El-Sadek (2014)** who said that treatment rat groups with *Eruca sativa* leaves, juice, oil and seeds could decrease total protein compared with control (+ve) group. Meanwhile, **Kataya & Hamza (2008)** showed that red cabbage had an effect against the lipid oxidative stress by the reduction of Thiobarbituric Acid Reactive Substances (TBARS) level in the live. Moreover, **Oseni and Okoye (2013**) reported that zinc found in watermelon seeds as the amount of 0.66 - 0.81 mg/100 g have important properties in the diet for many proteins and enzymes.

6. Effect of vegetable seeds on T.B, D.B and I.B in rats inflicted with lipids peroxidation by potassium bromate

Data filled out in table (6) show the effect of the seeds of (water-melon, red cabbage and rocca) on total billirubin (T.B), direct billirubin (D.B) and indirect billirubin (I.B) in rats inflicted with lipids peroxidation by potassium bromate.

Table (6): Effect of the seeds of (water-melon, red cabbage and rocca) on T.B, D.B and I.B in rats inflicted with lipids peroxidation by potassium bromate

Parameters Rats group	T.B ((mg/dl)) Mean±SE*	D.B ((mg/dl)) Mean±SE*	I.B ((mg/dl)) Mean±SE*
Control (-ve)	0.20±0.002 [d]	0.09±0.003 [c]	0.11±0.002 [d]
Control (+ve)	0.35±0.003 [a]	0.12±0.005 [a]	0.23±0.004 [a]
Water-Melon Seeds 5%	0.30±0.003 [b]	0.11±0.002 [b]	0.19±0.002 [b]
Red Cabbage Seeds 5%	0.25±0.002 [c]	0.09±0.003 [c]	0.16±0.003 [c]
Rocca Seeds 5%	0.20±0.001 [d]	0.08±0.001 [d]	0.12±0.002 [d]

- *SE means standard error.
- Letters of (a, b, c, d, e) in one column significantly differ at $p \leq 0.05$.

It could be observed for (C +ve group) that there were significant increase in total, direct and indirect billirubin when compared to normal groups which were 0.35±0.003, 0.12±0.005, 0.23±0.004, 0.20±0.002, 0.09±0.003 and 0.11±0.002 mg/dl, respectively. All rats injected by potassium bromate then orally fed with the seeds of (water-melon, red cabbage and rocca) showed significant decrease in total, direct and indirect billirubin when compared to control positive group. Moreover, all rats injected by potassium bromate then orally fed on rocca seeds at a dose of 5% showed the highest significant decrease in all previous parameters when compared to control positive. Accordingly the best treatment for decreasing total, direct and in direct billirubin achieved in the group injected by potassium bromate then orally fed on rocca seeds 5%.

These data agreed with **Cruz *et al*., (2016)** who concluded that red cabbage cause high levels of anthocyanins as well as cinnamic acids and flavonoids as the majority compounds identified by high performance liquid chromatography (HPLC), which are well-known antioxidants. Unfortunately, our results were conflicting with the findings of **El-Sadek (2014)** who confirmed that treatment rat groups with *Eruca sativa* leaves, juice, oil and seeds could significantly increase in total bilirubin compared with control (+ve) group.

7. Effect of vegetable seeds on AST, ALT, AST/ALT and ALP in rats inflicted with lipids peroxidation by potassium bromate

Data present in table (7) show the effect of the seeds of (water-melon, red cabbage and rocca) on aspartate amino trans aminase (AST), alanine amino trans

ferase (ALT), AST/ALT and alkaline phosphatase (ALP), in rats inflicted with lipids peroxidation by potassium bromate.

Table (7): Effect of the seeds of (water-melon, red cabbage and rocca) on AST, ALT, AST/ALP and ALP in rats inflicted with lipids peroxidation by potassium bromate

Parameters Rats group	AST (U/L) Mean±SE*	ALT (U/L) Mean±SE*	AST/ALT Mean±SE*	ALP (U/L) Mean±SE*
Control (-ve)	33.00±0.11 [b]	18.00±0.52 [d]	1.83±0.02 [b]	59.00±1.08 [e]
Control (+ve)	195.00±1.08 [a]	58.00±0.88 [a]	3.36±0.03 [a]	301.00±2.51 [a]
Water-Melon Seeds 5%	31.00±0.81 [c]	20.00±0.11 [b]	1.55±0.03 [c]	90.00±1.11 [b]
Red Cabbage Seeds 5%	29.00±0.42 [d]	19.00±0.14 [c]	1.53±0.02 [d]	87.00±1.55 [c]
Rocca Seeds 5%	27.00±0.19 [e]	19.00±0.09 [c]	1.42±0.01 [e]	81.00±0.80 [d]

- *SE means standard error.
- Letters of (a, b, c, d, e) in one column significantly differ at $p \leq 0.05$.

Apparently from the table, that there were significant increase in aspartete amino trans aminase (AST), alanine amino trans ferase (ALT), AST/ALT and alkaline phosphatase (ALP) of oxidative rats without treatment (C +ve group) when compared to (C -ve) normal rats. All rats injected by potassium bromate then orally fed with all tested plant seeds at the same dose 5% showed significant decrease for all mentioned parameters as compared to control positive group. Moreover, all groups injected by potassium bromate then orally fed with all tested plant seeds at the same dose 5% showed significant decrease in AST not only when compared to control positve group but also when compared to control negative one, also, the same occurred for AST/ALT parameter. Meanwhile, there were non significant differences between the group injected by potassium bromate then orally fed by red cabbage or rocca seeds at the same dose 5% in ALT parameter which were 19.00±0.14 and 19.00±0.09 U/L, respectively, provided that for Alp the best significant decrease was observed in the group injected by potassium bromate then orally fed by rocca seeds 5%.

These results confirmed by the findings of **El-Sadek (2014)** who concluded that *Eruca sativa* could help the liver twards paracetamol causing liver injury according to antioxidant activity in rats, also, treatment of rat groups with *Eruca sativa* leaves, juice, oil an seeds could lower liver enzymes and improve its function compared with control (+ve) group.

8. Effect of vegetable seeds on Creat., Urea and U.Acid in rats inflicted with lipids peroxidation by potassium bromate

Data listed in table (8) show the the effect of the seeds of (water-melon, red cabbage and rocca) on creatinine (Creat.), Urea and uric acid (U.Acid) in oxidative rats induced by potassium bromate.

Table (8): Effect of the seeds of (water-melon, red Cabbage and rocca) on Creat., Urea and U.Acid in rats inflicted with lipids peroxidation by potassium bromate

Parameters Rats group	Creat. (mg/dl) Mean±SE*	Urea (mg/dl) Mean±SE*	U.Acid (mg/dl) Mean±SE*
Control (-ve)	0.62±0.02 ^{e}	20.00±0.99 ^{e}	2.10±0.03 ^{e}
Control (+ve)	3.00±0.03 ^{a}	93.00±1.07 ^{a}	5.80±0.06 ^{a}
Water-Melon Seeds 5%	2.90±0.02 ^{b}	36.00±0.42 ^{b}	5.60±0.02 ^{b}
Red Cabbage Seeds 5%	2.70±0.03 ^{d}	31.00±0.59 ^{c}	5.40±0.03 ^{c}
Rocca Seeds 5%	2.80±0.01 ^{c}	29.00±0.31 ^{d}	5.00±0.01 ^{d}

- *SE means standard error.
- Letters of (a, b, c, d, e) in one column significantly differ at $p \leq 0.05$.

It could be observed that there were significant increase in creatinine (Creat.), Urea and Uric acid (U.Acid) levels in positive groups comparing with negative ones, which were 3.00±0.03, 93.00±1.07, 5.80±0.06, 0.62±0.02, 20.00±0.99 and 2.10±0.03 mg/dl, respectively. All rats injected by potassium bromate then orally fed on all tested plant seeds showed significant decrease in all previously parameters when compared to control positive group. Meanwhile, the group injected by potassium bromate then fed on rocca seeds 5% declaired the highest significant decrease in urea and uric acid when compared to all tested groups, while the group injected by potassium bromate then orally fed on red cabbage 5% declaired the highest significant decrease in creatinine comparing with all exeperimental groups.

These dara confirmed by the findings of **Gwana *et al*., 2014** who assessed the significant amount of citrulline, which derived from "citrullus" the Latin word for watermelon for improvement of erectile dysfunction which possesses more level of antioxidants which limit the risk of renal stones and bone loss due to elderly. Moreover, the same authers concluded that citrulline is a powerful diuretic diet with sufficient amino acid, beta-carotene which prevent heart diseases. Meanwhile, **Kataya and Hamza (2008)** recorded that red cabbage (B*rassica oleracea*) extract decrease serum glucose levels and restored renal functions and body weight loss. Furthermore, **(Igarashi *et al*., 2000 and Lee *et al*., 2002)** adopted that red cabbage had ability to counteract oxidative damage induced by toxic agents in animal tissues.

Conclusion:

The seeds of water-melon, red cabbage and rocca have therapeutic effect against lipid peroxidation induced by potassium bromate.

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