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Research Article

EFFECT OF QUINOA SEEDS POWDER CONSUMPTION ON RENAL OXIDATIVE STRESS IN RATS

Ali Monahi Nazal Al Shammari

Faculty of Home Economics, the Public Authority for Applied Education and Training, Kuwait

A R T I C L E I N F O

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A B S T R A C T

In recent years, a quinoa seed has sparked much interest as a healthy natural cereal. In present study aimed to clear effect of quinoa at (2, 5 and 10%) against potassium bromate in rats. Thirty male rats were divided into six groups. The first group fed on basal diet. The other treated five groups injected with potassium bromate and reclassified into positive control, group treated with ALA and three groups treated with quinoa seeds at concentrations (2, 5 and 10%).

The results showed that, (+ve) group had significant decrease in final weight, weight gain, feed efficiency ratio (FER), protein efficiency ratio(PER), (HB), (PCV), plasma glutathione transferase(GST), plasma catalase, plasma superoxide dismutase(SOD), kidney SOD, kidney glutathione peroxidase (GPX), and kidney GST but significant increase in serum (AST&ALT) enzymes, alkaline phoshatase(AP), creatinine ,uric acid, nitric oxide(NO) and kidney (MDA) compared to (-ve) group. quinoa seeds groups showed significant decrease in PCV, plasma GST, kidney GPX and GST.

ALA group decrease in serum uric acid compared to (-ve) while quinoa seeds groups showed significant increase in serum uric acid compared to (-ve). On the other side , they increased significantly in final weight, weight gain, FER, HB, plasma (GST, SOD &catalase) and kidney (SOD, GPX and GST) but showed significant decrease in serum AST, ALT &AP enzymes, creatinine, uric acid, NO and kidney MDA compared to (+ve) group.

INTRODUCTION

Quinoa (Chenopodium Quinoa Willd) is one of the seeds plant that has been used like the cereals. Quinoa has high nutritional value because of its proteins, and essential amino acids such as lysine, leucine, isoleucine, methyonine and cystine. It does not contain gluten, so it can be healing disease allergic to wheat (Gorinstein, *et al*., 2008).

Quinoa seeds (Chenopodium quinoa) contain significant amounts of phytochemicals as: flavonoids, phenolic acids, phytosterol, saponins, fat-soluble vitamins, fatty acids and trace elements (Paśko, *et al*., 2008).

Quinoa seeds rich in sugar, vitamin C, A, fibers, and minerals (Hopper, 2013). These materials have a wide range of biological activities likely antibacterial, antiinflammatory, antiulcer, antitumor and antithrombotic (Barrett, 2006).

Potassium bromate used as a food additive in products, fish paste, fermented beverages, bread-making and drinking-water (Kurokawa *et al*., 1990). Pharmacokinetic studies on KBrO3 have shown that this compound is contacted with renal tubular epithelium as oxidative stress which enhances kidney cellular proliferation and causes renal cell tumors (Fuji *et al*., 2004).

This study aimed to investigate the effect of quinoa seeds consumption on renal oxidative stress induced by potassium bromate in experimental rats.

Corresponding author:* **Ali Monahi Nazal Al Shammari
Faculty of Home Economics, the Public Authority for Applied Education and Training, Kuwait

MATERIALS AND METHODS

Materials

Potassium bromate (KBrO3)

Potassium bromate is a white powder odorless, purchased from El-Gomhoria Co., Cairo, Egypt. The rats received a single intra-peritoneal injection of potassium bromate (KBrO3) at a dose level 125 mg /kg body weight (Kahan and Sultana 2004).

Alpha Lipoic Acid ®:-

Lipoic acid is an organosulfur effectiveness compound derived from octanoic acid, purchased from El-Gomhoria Company

Quinoa seeds

Quinoa seeds (Chenopodium Quinoa Willd) were obtained from the Crops Intensification Research Section Field Crops Research Institute, Agricultural Research Center. Egypt.

Experimental animals

Thirty male albino rats (Sprague Dawley Strain) were obtained from National Research Center, Dokki, Egypt weighted 110±5 g, animals were fed on standard diet according to NRC (1995). Ethical guidelines were maintained in animal handling during the study and permission was obtained from the concerned Department in Public Authority for Applied Education and Training, Kuwait.

METHODS

The rats were randomly classified into six groups (5 rats each). The first group kept as normal control fed standard diet only. The other five groups injected with potassium bromate to induce renal stress. One group served as non treated positive control while other treated groups one by Alpha lipoic acid (ALA) (10 mg/kg B.W daily) (Thirunavukkarasu, and Anuradha, 2004) others treated with quinoa seeds at concentrations (2, 3, 5 and 10%) for eight weeks. Food intake was calculated daily and the body weight gain was recorded weekly. Food and protein efficiency ratio (FER&PER) were calculated according to (Chapman *et al*., 1950).At the end of the experiment, heparenized blood was analyzed for estimation of hemoglobin (HB) and packed cell volume (PCV) according to Drabkin (1949) and Mc Inory, (1954), respectively. Serum alanine and aspartae aminotransferase (ALT, AST) , alkaline phosphates (AP) enzymes, creatinine and uric acid were estimated according to Reitman and Frankel (1957), Kind and King (1954), Hare (1950) and Fossati, *et al*., (1980), respectively. Plasma glutathione transferase (GST), catalase, superoxide dismutase enzymes (SOD) and nitric oxide (NO) according to Habig (1974), Claiborne (1985), Beuchamp and Fridovich, (1971) and Green *et al*., (1981), respectively. Two kidneys of each rat were rapidly removed and perfuse with 50 to 100 of ice cold 0.9%NaCL solution for estimation of superoxide dismutase (SOD), glutathione peroxidase (GPX), glutathione S-transferase(GST) and malondialdehyde (MDA)according to Weiss *et al*., (1980), Ellman (1958) and Uchiyama and Mihara (1978), respectively.

Statistical analysis

The obtained results of biological evaluations were statistically analyzed according (SAS, 1999). LSD at 5% level of significance was used to compare between means according to Snedecor and Cochran (1967).

RESULTS AND DISCUSSION

Data recorded in Table (1) illustrated that (+ve) group showed decreased significantly in final weight, weight gain, feed efficiency ratio (FER) and protein efficiency ratio (PER) compared to (-ve) group. The quinoa seeds, (2,5 and 10%) groups showed non significant decrease in final weight, weight gain, feed intake, FER and PER compared to (-ve) group. These results are in harmony with those obtained by Ruales *et al*., (2002) who revealed that quinoa's high bioavailability is partially because of its low content of trypsin inhibitors and reduce protein enzymatic digestion and absorption (Vega-Galvez *et al*., 2010).

Groups treated with ALA and Quinoa seeds, (2,5 and 10%) showed a significant increase in final weight, weight gain, FER and PER compared to (+ve) group, because of potassium bromate causes oxidative stress caused toxicity in kidney mice including changes in energy consumption and analysis in renal cells. (Geter *et al*., 2016). After potassium bromate, protein and gene expression have widly demonstrated cytotoxicities in kidney rats. (Ahlborn *et al*., 2019).

Table 1 Effect of ALA and Quinoa seeds on body weight gain, feed intake, FER and

PER on rat.						
Groups Variables	**Normal control**	**Positive control**	**ALA**	**2% Quinoa seeds**	**5% Quinoa seeds**	**10% Quinoa seeds**
Initial weight	110.55± 3.67[a]	110.41± 3.50 [a]	110.34 ± 3.14 [a]	109.14± 2.45[a]	108.33± 2.99 [a]	110.22± 3.11 [a]
Final Weight (g)	203.47± 13.01 [a]	154.71± 12.13b**	205.11± 14.41 [a]	189.71± 11.22 [a]	199.41± 13.78 [a]	201.14± 12.35 [a]
Weight Gain (g)	92.92± 11.33 [a]	44.30± 7.71 b**	94.77± 11.21 [a]	80.57±8.17 a	91.08± 10.22 [a]	90.92± 11.11 [a]
Food Intake (g/d))	16.65± 2.11 [a]	14.20± 2.17 [a]	16.75± 2.81 [a]	15.90± 2.11 [a]	16.35± 2.91 [a]	16.55± 2.18 [a]
FER	0.093± 0.001 [a]	0.051± 0.002 b**	0.094± 0.003 [a]	0.084± 0.003 [a]	0.092± 0.001 [a]	0.091± 0.001 [a]
PER	0.46± 0.03 [a]	0.25± 0.01 b**	0.47± 0.03 [a]	0.42± 0.03 [a]	0.46± 0.02 [a]	0.45± 0.04 [a]

Values with the same letters indicate insignificant difference and vice versa.

As shown in Table (2), the (+ve) group showed a significant decrease in hemoglobin and packed cell volume compared to (-ve) group. ALA and Quinoa seeds, (2,5 and 10%) groups showed significant decrease in packed cell volume compared to (-ve) group.

Table 2 Effect of ALA and Quinoa seeds on blood hemoglobin (HB) and packed cell volume (PCV) on rats.

Group Variables	Normal Control	Positive control	ALA	2% Quinoa Seeds	5% Quinoa Seeds	10% Quinoa Seeds
HB(gm/dl)	12.08±2.18 [a]	7.99±1.39[b]	11.51±1.82 [a]	10.14±1.4 [a]	10.55±1.98 [a]	11.11±2.01 [a]
PCV%	38.61±3.82[a]	29.81±3.55[b*]	36.81±3.17[a]	33.79±3.47[b*]	34.14±4.01[ab]	36.71±4.11[a]

Values with the same letters indicate insignificant difference and vice versa.

Quinoa seeds, (2,5 and 10%) groups showed a significant increase in hemoglobin while ALA group and 10% quinoa seeds showed significant increase in packed cell volume compared to positive control group. These results are in harmony, with those obtained by (González *et al*., 2014) indicated that minerals content of quinoa is about twice or three times more than other cereals. It has high concentrations of all mineral (Nascimento *et al*., 2014). Quinoa seeds contain (262, 425, 612, 25.8 and 3.6mg/100g) of calcium, phosphorus, potassium, iron and zinc respectively (Hanaa and Nagib 2018)

As shown in Table (3),the positive control group showed a significant increase in serum aspartate and alanine amino transferase (AST&ALT) enzymes, alkaline phoshatase(AP) ,creatinine and uric acid compared to (-ve) group, quinoa seeds (2,5,and 10%) groups showed a significant increase in serum uric acid compared to (-ve) group group. quinoa seeds groups showed a significant decrease in serum AST, ALT&AP enzymes, creatinine and uric acid compared to (+ve) group group. The decrease in serum ALT and AST in all rats consumed quinoa may be caused by quinoa riched in polyphenols (Maha 2016) Furthermore Mona *et al*., (2017) indicated that, feeding on high cholesterol diet fortifications with quinoa seeds powder at 30% and 40% resulted in significant decrease in serum ALT and AST. Creatinine is used to measure kidney function, filtered by kidney which is a nitrogenous waste in skeletal muscle (Chaudiere and Ferrari-Illiou 1999).

Table 3 Effect of ALA and Quinoa seeds on (AST & ALT), alkaline phosphotase (Alk –Pho), creatinine and uric acid

Group Variables	Normal Control	Positive control	ALA	2% Quinoa Seeds	5% Quinoa Seeds	10% Quinoa Seeds
AST(µ /ml)	41.17±5.81^{b}	72.39±9.61 a**	40.21±4.13 ^{b}	49.37±6.01 ^{b}	51.14±8.10 ^{b}	48.21±6.15 ^{b}
ALT (µ /ml)	13.35±1.12^{b}	28.55±3.35 a**	14.11±3.65 ^{b}	15.71±1.81 ^{b}	16.28±2.01 ^{b}	18.13±3.51 ^{b}
Alk–Pho (µ/ml)	30.17±5.66^{b}	50.38±5.81 a**	32.11±3.11^{b}	37.80±4.11^{b}	38.73±4.37^{b}	38.34±5.01 ^{b}
Creatinine (mg/dl)	0.77±0.11 a**	1.95±0.15 ^{b}	0.70±0.02^{b}	0.99±0.12^{b}	0.88±0.13 ^{b}	0.75±0.01^{b}
Uric acid (mg/dl)	1.74±0.26^{c}	2.11±1.01a***	2.41±0.74^{c}	2.17±0.81^{b*}	1.83±0.77b*	4.41±0.67b*

Values with the same letters indicate insignificant difference and vice versa.

As shown in Table (4), (+ve) group showed decreased significantly in plasma glutathione transferase (GST), catalase and superoxide dismutase(SOD) and a significant increase in nitric oxide(NO) compared to (-ve) group. Quinoa seeds at 2 and 5%showed a significant decrease in plasma GST compared to (-ve) group. quinoa seeds (2,5 and10%)showed a significant increase in GST, catalase, SOD and significant decrease NO compared to (+ve) group. Increase of GST activity is an indication of a cellular failure in compensating the induced oxidative stress (Virgil and George1996). These data are in same direction with those obtained by Nsimba *et al*., (2008) who revealed that natural anti-oxidants have an important action in scale down free radicals and oxidative reactions in tissue and membrane levels. Quinoa seeds are a good source in phenolic compounds may be anti-oxidant activity (Fardet., 2010). Moreover, the addition of quinoa seeds on the meal affects the oxidative state by lowering levels of (MDA) and oxidant enzyme activity in the body (Pasko *et al*., 2010a, b).

Injection of KBrO3 to rats infects decreases in kidney glutathione level and activities of renal antioxidant enzymes (Khan and Sultana, 2004).

CONCLUSION

It could be concluded that, the administration of quinoa seeds mostly at lower concentration 2% followed 5% than 10 % have an antioxidant effect on KBrO3induced renal oxidative stress in experimental rats and therefore furthermore studies on this seeds are encouraged.

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Table 4 Effect of ALA and Quinoa seeds on plasma glutathione transferase (GST), catalase, superoxide dismutase (SOD) enzymes and nitric oxide (NO).

Group Variables	Normal Control	Positive control	ALA	2% Quinoa Seeds	5% Quinoa Seeds	10% Quinoa Seeds
GST(µ /l)	271.31± 33.27 ^{a}	77.85± 8.40 c***	278.15± 31.71 ^{a}	188.35± 22.17 ^{b*}	211.31± 23.81 ^{b*}	240.21± 23.71 ^{a}
Catalase (µ /l)	385.21±55.14 ^{a}	115.55±10.14 c***	384.11±39.11^{a}	230.77±32.11^{ab}	291.61±31.61^{a}	277.11±30.91 ^{a}
SOD(µ /l)	70.13±5.22 ^{a}	21.25±3.47 b***	73.14±7.81 ^{a}	63.14±7.16 ^{a}	68.33±6.35 ^{a}	71. 31±9.23 ^{a}
NO (µmol /l)	2.17±0.33	13.99±1.44 a	2.01±1.21	4.33±1.11	3.22±1.03	3.11±1.05

Values with the same letters indicate insignificant difference and vice versa.

Table 5 Effect of ALA and Quinoa seeds on kidney superoxid dismutase (SOD), glutathione peroxidase (GPX), glutathione transferase (GST) and malondialdehyde (MDA).

Group Variables	Normal Control	Positive control	ALA	2% Quinoa Seeds	5% Quinoa Seeds	10% Quinoa Seeds
SOD(µ /mg)	110.15±21.17 ^{a}	131.25±3.81^{b***}	118.82±25.16 ^{a}	140.81±11.15 ^{a}	35.81±22.61 ^{a}	143. 32±17.34 ^{a}
GPX (µ /mg)	121.33± 17.13 ^{a}	29.14±4.19c***	120.33±21.35 ^{a}	89.59±7.95b*	118.41±11.18 ^{a}	114.38± 13.21 ^{a}
GST (µ /mg)	4.14± 0.66^{a}	1.51± 0.19c***	4.11±0.98^{a}	2.99± 0.88b*	3.45±0.97^{a}	3.29±0.77^{a}
MDA (nmol/g)	9.45± 1.98^{b}	19.34± 3.14a***	8.22±1.91^{b}	10.14±2.61 ^{b}	9.11±2.16^{b}	10.33±1.69 ^{b}

Values with the same letters indicate insignificant difference and vice versa.

As shown in Table (5), the positive control group decreased significantly in kidney superoxid dismutase (SOD), glutathione peroxidase (GPX), and glutathione transferase and a significant increase in kidney malondialdehyde while Quinoa seeds group at 2% showed a significant decrease in GPX and GST at $p<0.05$ (89.59&2.99) respectively compared to normal control group at (121.33&4.14). The Quinoa seeds at (2,5 and 10%) groups showed a significant increase in kidney superoxid dismutase, glutathione peroxidase and GST and significantly decreases in MDA compared to (+ve) group.

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