# Improvement effect of tomato seeds and vitamin C on potassium bromate induced renal injury in rats

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**Abastract :**Fifty-four adult male of white albino rats (Sprague Dawley Strain) were injected with a single intra-peritoneal dose of potassium bromate at level 125 mg /kg body weight to induce renal injury. Rats classified into non treated positive control group and five treated groups that were tomato seeds powder, tomato seeds extract, vitamin C, tomato seeds powder with vitamin C and tomato seeds extract with vitamin C groups. The study was conducted for ten weeks. The results revealed that, the treatment of renal injured rats with tomato seeds powder or extract with or without vitamin C showed improvement of nutritional results as a significant increase in final weight, weight gain and food intake compared to positive control group. The value of Food efficiency ratio (FER) was significantly increased in tomato seeds powder, tomato seeds extract, tomato seeds powder with vitamin C and tomato seeds extract with vitamin C groups compared to positive control group. Values of blood hemoglobin (HB), packed cell volume (PCV) and red blood cells; serum high density lipoprotein cholesterol (HDLc), glutathione transferase (GST), catalase & superoxide dismutase (SOD) , and kidney glutathione peroxidase (GPX) & glutathione transferase (GST) were significantly increased in all treated groups compared to positive control group. The values of serum cholesterol, cholesterol/HDLc ratio, triglyceride, low density lipoprotein cholesterol (LDLc), creatinine, uric acid, urea & nitric oxide (NO) and kidney malondialdehyde (MDA) were significantly decreased compared to positive control group. White blood cells was significantly increased in tomato seeds powder with vitamin C and tomato seeds extract with vitamin C groups while the value of serum very low density lipoprotein cholesterol (VLDLc) was significantly decreased in tomato seeds powder, tomato seeds extract, tomato seeds powder with vitamin C and tomato seeds extract with vitamin C groups compared to positive control group.

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## 1. Introduction

Tomato (*Solanum lycopersicum.*) is one of the most widely cultivated vegetable crops. There is a particular interest in tomato so-called "Mediterranean diet" which has recently been associated with a healthier lifestyle. Tomato products include tomato sauce, tomato ketchup, and tomato paste and tomato juice. These have become the favorites of many people due to their high contents of nutritional components (Persia et al., 2003). Tomatoes are rich sources of antioxidant components such as the carotenoid lycopene, vitamin C, and a range of polyphenols. The potentially protective properties of these antioxidants are of great interest and the consumer has already become aware of their potential importance. Tomatoes can cure diarrhea, gall attack, indigestion and restore liver function (Rozzi 2002 and Abd El-Ghany et al., 2011). Tomato pomace is a mixture of tomato skin, pulp and seeds that remain after the processing of tomato. This by product remains from squeeze of tomato is rich in protein, energy and crude fiber. Tomato seed is the major by-product of the tomato paste manufacturing industry and is a potential raw material for producing alternative fuels. Tomato paste manufacturing units generate 7.0–7.5% solid waste and 71–72% of this waste is pomace, tomato seeds by-product accounts for approximately 10% of the fruit and 60% of the total tomato industry waste (Sogi et al., 2005). A naturally occurring compound found in the seeds of ordinary tomatoes has been discovered to have a major beneficial effect on long term health and blood circulation. The tomato seed compound does not appear to have any known side effects which may be a major advantage in helping people to improve the health of their blood stream and reduce the risk of heart attack and stroke (del Valle, et al., 2007).

Vitamin C is not produced in the body, so it needs to be consumed through food. Vitamin C is good for gums, bones and blood vessels and also stimulates the bodies' immune system, fights infections, promotes wound healing and helps iron absorption. Vitamin C is an important antioxidant and helps protect against cancers, heart diseases and stress. It is part of the cellular chemistry that provides energy, essential for sperm production, for making collagen, involved in the building and health of

cartilage, joints, skins and blood vessels (Champe and Harvey, 1994).

There is a need for studying the health beneficial effect of tomato seeds separately or with vitamin C in improving renal function in experimental rats.

## 2. Materials and Methods

### A – Materials:

Fifty-four adult male of white albino rats (Wister Strain) weighing 102±7 g, were obtained from experimental animals center in Medicine collage of King Saud University in Riyadh. Tomato fruits samples were obtained from Best Factory for food industry in Egypt. The basal diet was prepared according to NRC (1995) which composed of casein (200g/kg), corn starch (497g/kg), sucrose (100g/kg), cellulose (30 g/kg), corn oil (50g/kg), mineral mixture (100g/kg), vitamins mixture (20g/kg) and DL-methionine (3g/kg). Both potassium bromate ($KBrO_3$) and vitamin C were purchased from Somatco Co., in Riyadh. Vitamin C was administered by stomach tube in dose 5 g/100g rats.

### B- Methods

A mixture of tomato seeds and skins was obtained as the byproduct of whole tomato processing. Seeds were separated from the skin by water floatation wherein seeds sunk to the bottom and skin floated. The seeds were collected. The seeds were washed with tape water several times, and dried in air oven at 50ºc and grinded in blender, then the powder packaged in polyethylene bags and kept until use. Tomato seeds powder was added in basal diet as 10 % in substitution of fiber. To prepare tomato methanol extract, 100 gram of tomato powdered was added to 1000 ml of 70% methanol (v/v) at room temperature for 20 hours with slowly rotated during this time. After filtration, ethanol was evaporated at low pressure at 30 ºc and was immediately administered to rats at dose 500 mg/kg body weight by stomach tube (WHO 1983).

Rats were kept under observation for seven days before experiment and fed on basal diet and water ad libitum for adaptation. Rats were injected with a single intra-peritoneal dose of potassium bromate at level 125 mg /kg body weight to induce renal injury (Kahan and Sultana 2004). Rats classified into non treated positive control group and five treated groups that were tomato seeds powder, tomato seeds extract, vitamin C, tomato seeds powder with vitamin C and tomato seeds extract with vitamin C groups. The study was assigned for ten weeks.

The food intake was calculated daily and the body weight gain was recorded weekly. Food efficiency ratio (FER) was determined by Chapman et al., (1950) as following: FER = weight gain (g)/ food intake (g). At the end of experiment, the rats were anesthetized, blood sample were collected in clean centrifuge tubes. Blood hemoglobin (HB), packed cell volume (PCV) and red and white blood cells were estimated according to Drabkin (1949) and Mc Inory, (1954), Carleton (1976), respectively.

Serum cholesterol, triglyceride, and high density lipoprotein cholesterol (HDLc) were estimated according to Allain et al., (1974), Scheletter and Nussel (1975) and Kostener (1977), respectively. In addition, creatinine, urea and uric acid were estimated according to Bonsens and Taussky, (1984), Kanter (1975) and Fossati et al., (1980), respectively. Serum glutathione transferase (GST), catalase, nitric oxide (NO) and superoxide dismutase enzymes (SOD) were estimated according to Habig (1974), Claiborne (1985), Green et al., (1981) and Beuchamp and Fridovich, (1971), respectively. Kidney glutathione peroxidase (GPX), glutathione transferase (GST), and malondialdehyde (MDA) were determined according to Weiss et al. (1980), Habig et al., (1974) and Draper et al., (1993), respectively. Very low density lipoprotein (VLDL c) and low density lipoprotein cholesterol were calculated according Friedewald (1972) and Fruchart (1982) as following: VLDL c = (TG/5), LDL-c = (Total cholesterol – VLDL-c – HDL-c) while athrogenic index (cholesterol /HDL-c ratio) was calculated according to Castelli and levitar (1977). The biochemical analyses were occurred in laboratory of department of Nutrition and Food Science, King Saud University in Saud Arabia.

### C-Statistical analysis

All the obtained data were statistically analyzed by SPSS computer soft ware. The calculated occurred by analysis of variance ANOVA and follow up test LSD (Artimage and Berry 1987).

## 3. Results

Table (1) showed that, the treatment of renal injured rats with tomato seeds powder or extract with or without vitamin C showed improvement of nutritional results. All treated groups showed a significant increase in final weight, weight gain and food intake at $p< 0.01$& 0.001 compared to positive control group. The value of Food efficiency ratio (FER) was significantly increased in tomato seeds powder, tomato seeds extract, tomato seeds powder with vitamin C and tomato seeds extract with vitamin C groups compared to positive control group.

Table (2) showed that values of hemoglobin (HB), packed cell volume (PCV) and red blood cells were significantly increased in all treated groups at p< 0.05 & 0.01 compared to positive control group. The value of white blood cells was significantly increased in tomato seeds powder with vitamin C and tomato seeds extract with vitamin C groups at p< 0.01compared to positive control group.

Data in table (3) represented that the value of serum cholesterol was significantly decreased at p< 0.01 & 0.001 but the value ofserum high density lipoprotein cholesterol (HDLc) was significantly increased at p< 0.01 in all treated rat groups compared to positive control group. The value of athrogenic index (cholesterol/HDLc ratio) was significantly decreased at p< 0.05 in treated groups with tomato seeds powder or extract with or without vitamin C compared to positive control group.

Data in table (4) represented that the value of serum triglyceride and low density lipoprotein cholesterol (LDLc) was significantly decreased at p<0.05, 0.01 & 0.001 compared to positive control group. The value of serum very low density lipoprotein cholesterol (VLDLc) was significantly decreased at p<0.05 in tomato seeds powder and tomato seeds extract groups and at p<0.01 in tomato seeds powder with vitamin C and tomato seeds extract with vitamin C groups compared to positive control group.

It was noticed also from table (5) that values of serum creatinine, and uric acid were significantly decreased at p< 0.05 and urea at p< 0.05&0.01 in tomato seeds powder, tomato seeds extract, vitamin C, tomato seeds powder with vitamin C and tomato seeds extract with vitamin C groups compared to positive control group.

Data in table (6) presented that serum glutathione transferase (GST), catalase, and superoxide dismutase enzymes (SOD) were significantly increased at p< 0.01&0.001 but nitric oxide (NO) was significantly decreased at p< 0.01&0.001 in treated groups that were tomato seeds powder, tomato seeds extract, vitamin C, tomato seeds powder with vitamin C and tomato seeds extract with vitamin C groups compared to positive control group.

Data in table (7) presented that the value of kidney malondialdehyde (MDA) was significantly decreased (p< 0.05,0.01&0.001) but the value of kidney glutathione peroxidase (GPX) was significantly increased at p< 0.01&0.001 and glutathione transferase (GST) was significantly increased at p< 0.05,0.01&0.001 compared to positive control group.

## 4. Discussion

Potassium bromate (KBrO3) is an oxidizing agent that has been used as a food additive, mainly in the bread-making process. KBrO3 is carcinogenic in rats and nephrotoxic in both man and experimental animals when given orally. Glutathione and cysteine degrade KBrO3 in vitro; in turn, the KBrO3 has inhibitory effects on inducing lipid peroxidation in the rat kidney. Active oxygen radicals generated from KBrO3 were implicated in its toxic and carcinogenic effects, especially because KBrO3 produced 8-hydroxydeoxyguanosine in the rat kidney (Kurokawa et al., 1990 and Geter, et al., 2006).

The improvement of our nutritional results may refer to large number of nutrients of tomato seeds. Tomato seeds are believed to be high in carbohydrates and protein, containing nearly all of the essential amino acids. Also, contain a high amount of oil, nearly two thirds of is unsaturated fatty acids. Tomato seeds are rich in minerals such as calcium, magnesium, potassium and some zinc. Tomato seed oil has high antioxidant content (Knoblich et al., 2005 and Denek and Can 2006). Tomato seeds may be limited in energy due to the high fiber content .The administration of tomato seed oil can lower serum total cholesterol, triglyceride and low-density lipoprotein cholesterol levels (Persia et al., 2003 and Li et al., 2007).

It has been reported that tomato seed extracts contain phenolic compounds whose antioxidant activity is well known. The total content of phenolics in 100 g of dry matter ranged from 70 mg in tomato seeds. The skin and seed fractions of tomato, together, contributed 53% of the total phenolics, 52% of the flavonoids, 48% of the total lycopene, 43% of the total ascorbic acid and 52% of the total antioxidant activity present in whole tomatoes. Antioxidant substances in tomato seeds can be helpful in preventing the damage caused by free radicals to body tissues leading to premature aging and many chronic degenerative diseases (Toor 2005 and Ramandeep and Geoffrey 2005). The gel that surrounds tomato seeds improves blood flow, with improvements evident as soon as three hours after ingesting it because of containing compound or mixture of substances that can prevent blood clotting, so efficacious against stroke and heart disease (Colleen 2009). Iron and vitamin C found in tomatoes promotes the synthesis of hemoglobin and the formation of new red cells, thereby helping to prevent or treat different types of anemia (Harish and Sathishkumar 2011).

It is well known that vitamin C acts as an antioxidant by protecting the body against oxidative stress and helps protect the body from toxins and

chemical pollutants. Vitamin C has an impact on cardiovascular disease, hypertension, chronic inflammatory diseases, and diabetes. It is also a cofactor in at least eight enzymatic reactions and performs numerous physiological functions in the human body including the synthesis of collagen, carnitine, and neurotransmitters; the synthesis and catabolism of tyrosine; and the metabolism of microsome (Padayatty et al., 2003 and Gropper et al.,2004). Vitamin C acts as a reducing agent, cholesterol and work to lower the accumulation of cholesterol in the cell wall. HDLc helps to reduce the risk of heart disease by scavenging cholesterol. Vitamin C stimulates an enzyme that regulates the conversion of cholesterol into bile acids, which are then eliminated from the body in the feces (Naidu 2003).

It is concluded that discarding tomato seeds during home cooking or commercial processing can result in significant losses of antioxidants and donating electrons and preventing oxidation to keep iron and copper atoms in their reduced states. Vitamin C may be useful in lowering serum uric acid levels, resulting in a correspondingly lower incidence of gout (Naidu 2003). Vitamin C represents one of the most prominent antioxidants both in plasma as well as intracellulary, exerting beneficial effects by an inhibition of lipid peroxidation and by reducing endothelial dysfunction (Deicher and Horl 2003). Vitamin C may increase the beneficial HDLc consumption of tomato seeds with vitamin C have ability to improve healthy status of kidney which exposed to oxidative stress by potassium bromate.

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**Table (1): Body weight gain, food intake and food efficiency ratio (FER) of the experimental rat groups**

| Groups / Variables | Control (+ve) | Tomato seeds powder | Tomato seeds extract | Vitamin C | Tomato seeds powder +Vitamin C | Tomato seeds extract + Vitamin C |
|---|---|---|---|---|---|---|
| Initial Weight(g) | 102.36± 3.61[a] | 104.55± 3.22[a] | 103.25± 3.11[a] | 104.77± 4.11[a] | 105.22± 4.21[a] | 102.96± 3.67[a] |
| Final Weight(g) | 157.97± 5.11[c] | 196.69± 3.99[a**] | 198.86± 4.27[a***] | 182.18± 4.11[b**] | 203.43± 6.77[a***] | 200.57± 7.25[a***] |
| Weight gain (g) | 55.61± 5.21[c] | 92.14± 9.14[a***] | 95.61± 8.13[a***] | 77.41± 7.22[b**] | 98.21± 9.12[a***] | 97.61± 9.71[a***] |
| Food intake(g/w) | 12.11± 1.20[b] | 15.12± 1.51[a**] | 15.05± 1.35[a**] | 14.59± 1.21[a**] | 15.41± 1.60[a**] | 15.12± 1.71[a**] |
| FER | 0.071± 0.002[b] | 0.102± 0.003[a**] | 0.101± 0.001[a**] | 0.081± 0.002[b] | 0.103± 0.001[a**] | 0.102± 0.004[a**] |

Significant with control group * P<0.05 ** P<0.01 *** P<0.001
Mean values in each raw having different superscript (a, b, c, d) are significant

**Table (2): Blood HG, PCV, RBCs and WBCs of the experimental rat groups**

| Groups / Variables | Control (+ve) | Tomato seeds powder | Tomato seeds extract | Vitamin C | Tomato seeds powder +Vitamin C | Tomato seeds extract +Vitamin C |
|---|---|---|---|---|---|---|
| HG (g/dl) | 10.11± 1.25b | 12.99± 1.88a** | 13.71± 1.55a** | 13.21± 1.35a** | 13.11± 1.41a** | 13.25± 1.25a** |
| PCV % | 30.21± 3.11b | 36.29± 3.61a* | 38.61± 3.61a** | 35.61± 4.11a* | 37.96± 3.65a* | 37.88± 3.21a* |
| RBCs (x106/ µl) | 2.90± 0.77b | 3.66± 0.91a** | 3.67± 0.87a* | 3.96± 0.82a* | 4.30± 1.01a** | 4.55± 1.11a** |
| WBCs (x106/ µl) | 5.25± 0.94b | 6.88± 1.21ab | 7.21± 1.25ab | 7.11± 1.31ab | 8.11± 1.12a** | 9.36± 1.98a** |

Significant with control group * P<0.05 ** P<0.01 *** P<0.001
Mean values in each raw having different superscript (a, b, c, d) are significant

**Table (3): Serum cholesterol, HDLc and cholesterol/ HDLc ratio of the experimental rat groups**

| Groups / Variables | Control (+ve) | Tomato seeds powder | Tomato seeds extract | Vitamin C | Tomato seeds powder +Vitamin C | Tomato seeds extract +Vitamin C |
|---|---|---|---|---|---|---|
| Cholesterol | 196.14± | 137.21± | 120.14± | 149.21± | 122.14± | 117.81± |
| (mg/g) | 13.14$^{a}$ | 11.21$^{b**}$ | 12.17$^{bc**}$ | 11.81$^{b**}$ | 15.14$^{c***}$ | 13.61$^{c***}$ |
| HDLc | 25.31± | 30.21± | 33.21± | 31.41± | 31.14± | 35.21± |
| (mg/g) | 2.41$^{c}$ | 3.61$^{ab**}$ | 4.11$^{a**}$ | 3.21$^{a**}$ | 3.22$^{a**}$ | 3.41$^{a***}$ |
| Cholesterol | 7.74± | 4.54± | 3.61± | 4.75± | 3.92± | 3.34± |
| / HDLc | 1.31$^{a}$ | 0.24$^{b*}$ | 0.33$^{b*}$ | 0.43$^{b*}$ | 0.53$^{b*}$ | 0.42$^{b*}$ |

Significant with control group * P<0.05 ** P<0.01 *** P<0.001
Mean values in each raw having different superscript (a, b, c, d) are significant

**Table (4): Serum triglyceride, LDLc and VLDLc of the experimental rat groups**

| Groups / Variables | Control (+ve) | Tomato Seeds powder | Tomato Seeds extract | Vitamin C | Tomato seeds powder +Vitamin C | Tomato seeds extract +Vitamin C |
|---|---|---|---|---|---|---|
| Triglyceride | 112.21± | 91.14± | 87.21± | 98.14± | 82.14± | 77.25± |
| (mg/g) | 14.12$^{a}$ | 9.43$^{b**}$ | 9.35$^{b*}$ | 10.11$^{b**}$ | 9.21$^{bc*}$ | 8.33$^{c**}$ |
| LDLc | 148.38± | 88.78± | 69.49± | 98.18± | 74.58± | 67.15± |
| (mg/g) | 12.26$^{a}$ | 8.71$^{bc*}$ | 6.21$^{d**}$ | 9.21$^{b**}$ | 8.14$^{d**}$ | 7.31$^{d***}$ |
| VLDLc | 22.44± | 18.22± | 17.44± | 19.62± | 16.42± | 15.45± |
| (mg/dl) | 2.33$^{a}$ | 1.71$^{b*}$ | 1.65$^{b*}$ | 1.24$^{ab}$ | 1.33$^{bc**}$ | 1.37$^{c***}$ |

Significant with control group * P<0.05 ** P<0.01 *** P<0.001
Mean values in each raw having different superscript (a, b, c, d) are significant

**Table (5): Serum creatinine, urea and uric acid of the experimental rat groups**

| Groups / Variables | Control (+ve) | Tomato seeds powder | Tomato seeds extract | Vitamin C | Tomato seeds powder +Vitamin C | Tomato seeds extract +Vitamin C |
|---|---|---|---|---|---|---|
| Creatinine | 1.87± | 0.89± | 0.87± | 1.21± | 0.78± | 0.75± |
| (mg/dl) | 0.33$^{a}$ | 0.02$^{b*}$ | 0.11$^{b*}$ | 0.43$^{b*}$ | 0.12$^{b*}$ | 0.18$^{b*}$ |
| Urea | 59.16± | 43.21± | 40.21± | 45.61± | 41.31± | 39.61± |
| (µ /mg) | 6.24$^{a}$ | 4.35$^{b*}$ | 4.81$^{b*}$ | 5.18$^{b*}$ | 5.14$^{b*}$ | 4.45$^{b**}$ |
| uric acid | 4.77± | 2.71± | 3.02± | 2.71± | 2.51± | 2.11± |
| (mg/dl) | 1.11$^{a}$ | 0.88$^{b*}$ | 0.87$^{b*}$ | 0.33$^{b*}$ | 0.32$^{b*}$ | 0.25$^{b*}$ |

Significant with control group * P<0.05 ** P<0.01 *** P<0.001
Mean values in each raw having different superscript (a, b, c, d) are significant

**Table (6): Serum GST, catalase, NO and SOD of the experimental rat groups**

| Groups / Variables | Control (+ve) | Tomato seeds powder | Tomato seeds extract | Vitamin C | Tomato seeds powder +Vitamin C | Tomato seeds extract +Vitamin C |
|---|---|---|---|---|---|---|
| GST | 95.11± | 124.11± | 151.21± | 131.21± | 161.41± | 181.31± |
| (µ /l) | 9.14$^{c}$ | 12.25$^{b**}$ | 15.14$^{ab**}$ | 13.24$^{b**}$ | 16.28$^{a***}$ | 20.11$^{a***}$ |
| Catalase | 91.14± | 178.36± | 211.14± | 188.36± | 214.31± | 250.77± |
| (µ /mg)) | 10.33$^{c}$ | 18.77$^{b**}$ | 22.14$^{a***}$ | 20.76$^{b**}$ | 22.66$^{a***}$ | 25.28$^{a***}$ |
| N O | 14.33± | 7.21± | 5.14± | 6.81± | 5.11± | 3.67± |
| (µ /ml) | 2.68$^{a}$ | 1.13$^{b**}$ | 1.21$^{b**}$ | 1.01$^{b**}$ | 1.21$^{b**}$ | 0.88$^{c***}$ |
| SOD | 22.61± | 45.21± | 65.11± | 55.31± | 70.11± | 82.11± |
| (µ /mg) | 2.61$^{e}$ | 5.33$^{d**}$ | 6.21$^{b***}$ | 6.11$^{c***}$ | 7.31$^{b***}$ | 9.24$^{a***}$ |

Significant with control group * P<0.05 ** P<0.01 *** P<0.001
Mean values in each raw having different superscript (a, b, c, d) are significant.

**Table (7): Kidney MDA, GPX and GST of the experimental rat groups**

| Groups<br>Variables | Control (+ve) | Tomato seeds powder | Tomato seeds extract | Vitamin C | Tomato seeds powder +Vitamin C | Tomato seeds extract +Vitamin C |
|---|---|---|---|---|---|---|
| MDA (mmol/g) | 18.67± 1.66[a] | 11.60 ± 1.81[b*] | 9.11± 1.30b[*] | 10.31± 1.21[b*] | 8.25± 0.95[bc**] | 7.11± 0.68[c**] |
| GPX (µ /mg) | 35.77± 4.33[d] | 85.14± 5.88[c***] | 92.61± 9.41[bc**] | 87.41± 8.77[c**] | 98.61± 10.11[a***] | 112.31± 12.45[a***] |
| GST (µ /mg) | 2.01± 0.15[c] | 3.99± 0.55[b*] | 4.86± 0.88[a**] | 4.71± 0.83[a**] | 4.82± 0.66[a**] | 5.11± 0.54[a***] |

Significant with control group * P<0.05 ** P<0.01 *** P<0.001
Mean values in each raw having different superscript (a, b, c, d) are significant.

**Reference**


1. Abd El-Ghany, M.A., Ramadan, M.A. and Hassanan, S.M.M. (2011): Antioxidant Activity of Some Agro-Industrial Peels on Liver and Kidney of Rats Exposed to Oxidative Stress. World Journal of Dairy & Food Sciences, 6 (1):105-114.
2. Allain, C.C., Richmond, N. and Rosechloy, P. (1974): Cholesterol enzymatic colorimetric test. Clin. Chem., 19 (20): 1350-470.
3. Artimage, G.Y and Berry, W.G (1987): Statistical Methods 7th Ed. Ames, Iowa Stata University Press, 39-63.
4. Beuchamp, C. and Fridovich, J. (1971): Superoxide dismutase. Improved assay an assyapplicable to acryloamide gels. Anal Biochem. 44: 276-287.
5. Bonsens, K. E. and Taussky, D. H. (1984): Determination of serum creatinine .J Chem Inv, 27: 648-660.
6. Carleton, H. (1976): Carleton's Histopathological Technique 4th ed, Lonodon, Oxford University Press, New York, Toronto.
7. Castelli, T and levitar, Y. (1977): Atherogenic index, Curr presc P. 39.
8. Champe, P.C. and Harvey, R.A. (1994):Lippincott's Illustrated Reviews, Biochemistry 2 Ed. Lippincott Rave Publishers Inc. USA. Pp328-350.
9. Chapman, D.G., Gastilla, R. and Campbell, T.A. (1950): Evaluation of protein in food. I. A. Method for the determination of protein efficiency ratio. Can. J. Biochem. Physio. I (37) 679-686.
10. Chaudiere, J. and Ferrari-Illiou, R. (1999): Intracellular antioxidants: from chemical to biochemical mechanisms. Food Chem Toxicol; 37:949-62.
11. Claiborne, A. (1985): Catalase activities. In: Greenwald, R.A. (Ed.),CRC Handbook of Methods in Oxygen Radical Research. CRC Press, Boca Raton, pp. 283–284.
12. Colleen, V. (2009): Forget aspirin for heart health: Eat tomato (Seeds) instead .Food and health, 12:57.
13. Deicher, R. and Horl, W.H.(2003):Vitamin C in chronic kidney disease and hemodialysis patients. Kidney Blood Press Res. 26(2):100-6.
14. del Valle, M., Cámara, M. and Torija, M. E. (2007): The nutritional and functional potential of tomato by-products. ISHS Acta Horticulturae 758: X International Symposium on the Processing Tomato.
15. Denek, N. and Can, A. (2006): Feeding value of wet tomato pomace ensiled with wheat straw and wheat grain for Awassi sheep. Small Rumin. Res., 65 (3): 260–265
16. Drabkin, D. (1949): The standardization of hemoglobin measurements. Am. J. Med. Sci., 21 (7): 710.
17. Draper , H.H., Squires, E.J., Mahmoodi, H., Wu, J., Agarwal, S. and Hadley, M. (1993): A comparative evaluation of thiobarbituric acid methods for the determination of malondialdehyde in biological material. Free Radic. Biol. Med. 15, 353-363.
18. Fossati, P., Prencipe, L. and Berti, G. (1980): Use of 3,5dichloro-2-hydroxybenzene sulfonic acid /4-amlnophenazon chromogenic system in direct enzymatic assay of uric acid in serum and urine. Clin. Chem., 26: 227-231.
19. Friedewald, W.T., Levy, R.I. and Fredrickson, D.S. (1972): Estimation of the concentration of low-density lipoprotein cholesterol in plasma, without use of the preparative ultracentrifuge. Clin Chem 18, 499–502.
20. Fruchart, G.G. (1982): LDL-Cholesterol determination after separation of low density lipoprotein. Rev. Fr. Des. Laboratories, 103: 7:117.
21. Geter, D.R., Ward, W.O., Knapp, G.W., DeAngelo, A.B., Rubis, J.A., Owen, R.D., Allen, J.W. and Delker, D.A. (2006):Kidney toxicogenomics of chronic potassium bromate

exposure in F344 male rats. Translat. Oncogen. 2, 33–52.
22. Green, L.C., Wagner, D.A., Glokowski, J., Skipper, P.L., Wishnok, J.S. and Tannenbaum, S.R. (1981): Analysis of nitrite, nitrate, and [15N] nitrite in biological fluids. Anal. Biochem1., 126: 131-138.
23. Gropper, S.S., Smith, J.L. and Grodd, J.L. (2004): Advanced Nutrition and Human Metabolism (4th ed.). Belmont, CA. USA: Thomson Wadsworth. pp. 260–275 .
24. Habig, W.H., Pabst,M.J. and Takob,W.B (1974):Glutathione S-transferase. The first enzymatic step in meracapturic acid formation .J, Biol. Chem .249(22):7130-7139.
25. Harish M.C. and Sathishkumar R. (2011): Antioxidant potentials of skin, pulp, and seed fractions of commercially important tomato cultivars. Food Sci. Biotechnol. 20(1): 15-21.
26. Kanter, M.W.(1975): Clinical Chemistry. The Bobber Merill Company Inc., USA, p. 80.
27. Khan, N. and Sultana, S. (2004): Abrogation of potassium bromate induced renal oxidative stress and subsequent cell proliferation response by soy isoflavones in Wistar rats. Toxicology 201, 173–184.
28. Knoblich, M., Anderson, B. and Latshaw, D. (2005): Analysis of tomato peel and seed byproducts and their use as a source of carotenoids. J. Sci. Food Agri., 85: 1166- 1170.
29. Kostener, C. M. (1977): Enzymatic determination of cholesterol high density lipoprotein fraction prepared by polyanion precipitation. J. Clin. Chem., 22:695.
30. Kurokawa, Y., Maekawa, A., Takahashi, M. and Hayashi, Y. (1990): Toxicity and carcinogenicity of potassium bromate, a new renal carcinogen. Environ Health Perspect., 87, 309–335.
31. Li, F., Hou, T., Zhang, J., Cheng, F., Zhao, W. and Lei, C (2007): Effect of tomato seed oil on blood-fat and serum transminase in experimental hyperlipidemia rats. Journal of Northwest Normal Univerisity (Natural Science), 1:17.
32. Mc Inory, l. (1954): Amicro heamatocrit for determining the packed cell and hemoglobin concentration on capillary blood. J. Clin., Path., (7): 32.
33. Naidu, K.A. (2003): Vitamin C in human health and disease is still a mystery? An overview. J. Nutr. 2 (7):7.
34. NRC (National Research Council) (1995): Nutrient requirement. Fourth reviser edition. Pp: 29-30 National Academy Press Washington, Animals, D.C. Environ. Sci. Health, 25: 487-494.
35. Padayatty, S.J., Katz, A., Wang, Y., Eck, P., Kwon, O., Lee, J., Chen, S.and Corpe, C. (2003): Vitamin C as an antioxidant: evaluation of its role in disease prevention. Journal of the American College of Nutrition 22 (1): 18–35.
36. Persia, M.E., Parsons, C.M., Schang, M. and Azcona, J. (2003): Nutritional evaluation of dried tomato seeds. Poult. Sci., 82 (1): 141-146.
37. Ramandeep, K. T. and Geoffrey, P. S. (2005): Antioxidant activity in different fractions of tomatoes. Food Research International.38, (5):487-494.
38. Rozzi, N. L., Singh R.A. and Watkins, B.A.(2002):Supercritical and solvent extraction of lycopene from tomato processing by products J.Agric and Food Chem., 50:2638 -2643.
39. Scheletter G. and Nussel, E. (1975): Arbeitsmed Sozialmed praventimed, 10-25.
40. Sogi, D. S., Bhatia, R., Garg, S. K. and Bawa, A. S. (2005): Biological evaluation of tomato waste seed meals and protein concentrate. Food Chemistry, 89(1): 53-56.
41. Toor, R.K. (2005): Factors affecting the antioxidant composition of tomatoes (Lycopersicon esculentum). Thesis of Doctor of Philosophy, Lincoln University.
42. Weiss, C., Marker, H.S. and Lehrer, G.M. (1980): Sensitive fluorometric assays for glutathione peroxidase and reductase. Anal Biochem 106: 512–516.
43. WHO (1983): Protocol CG-04: Preparation of alcoholic extract for bioassay and phytochemical studies (APJF/IP, 1001A). Geneva, World Health Organization.

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