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Drgham HY Al- Zwean
Department Public Health,
College of Veterinary Medicine,
University of Baghdad/Iraq

Correspondence
Drgham HY Al- Zwean
Department Public Health,
College of Veterinary Medicine,
University of Baghdad/Iraq

The effect of water treated with potassium permanganate ($KMnO_4$) and chlorine on some hygienic and physiological parameters in the local rabbits

Drgham HY Al- Zwean

Abstract
This study was conducted to evaluate the disinfection potency of $KMnO_4$ or chlorine in treated water on some hygienic and physiological parameters of local male rabbits, thirty – two males randomly divided into four groups: first group (free chlorine water) negative control, second(tap water) positive control, third($KMnO_4$ 1ppm), and fourth (($KMnO_4$ 2ppm). Blood samples were taken and serums were obtained. The results revealed that the parameters (Hb: 17.76 g/dl, PCV%: 42.69, total protein: 7.02 g/dl, albumin: 4.86 g/dl, and globulin: 2.86 g/dl) were significantly (P<0.05) higher in the tap water group as compared with the other groups. Whereas, the levels of the ALT (39.93 IU/L), AST (25.94 IU/L), and ALP (30.31 IU/L) were significantly (P<0.05) lower in the tap water group as compared with other groups. In conclusion: This study was confirmed the validity of tap water for animals public health.

Keywords: Tap water, $KMnO_4$, chlorine, liver enzymes, rabbits

1. Introduction
The water is an fundamental nutrient which involved directly or indirectly in all basic physiological function and process that occurring within the animal body, also is a medium for transportation of nutrients, waste products, hormones, and other chemical messenger, and aids in the movement of food through the gastrointestinal tract, and is a major component of secretions and the body fluid system such as saliva, blood, urine, sweat and milk [1, 2].
Water is one of the most important compound to the ecosystem, better quality of water described by it's physical, chemical and biological characteristics [3]. However it is important to note that water relative to other nutrients, is consumed in considerably larger quantities, therefore water availability and goodness are extremely important for animal health, prosperity and productivity [1, 4]
Limiting water availability to livestock will depress production rapidly and severely, and poor goodness drinking water is often a factor limiting intake, considering that water is consumed in large quantities, if water is poor goodness there is an increased risk that water contaminants could reach a level that may be harmful [3, 5].
The key properties that must be taken into consideration while assessing water goodness for livestock include, sensory (organoleptic), physiochemical, chemical, excess minerals compound [6, 7], therefore water for livestock should be tested periodically, with regard drinking water goodness guideline for livestock [8].
Decisions to improve poor- goodness source water used for livestock drinking water by using water treatment devices, drinking water is disinfected to inactivate water pathogens and the most common form of disinfection is chlorination, although ozone and UV light, $KMnO_4$ are also used in some plant of the world [9, 10]. Traditionally chlorine is widely used as disinfectant and pre-oxidation of drinking water due to its efficacy and cost – effectiveness, however it also reacts with natural organic matter present in water and lead to the formation of potentially toxic chemicals known as disinfection by- products (DBPs) [11-13] and the possible effects of (DBPs) on reproductive outcomes is supported by many laboratory studies on animals [14-16].
Therefore, as above and due to using chlorine for disinfection of water and the addition of chlorine to raw water lead to formation (DBPs) which has carcinogenic effects, also the pre-chlorination is being progressively restricted in most western countries, [17] with regard and in the main time the $KMnO_4$ is an oxidizing agent widely used throughout the water industry,

it has also been used as a disinfectant for raw water and generally used to destroy the organic matters [18] and reduced the level of the (DBPs), and pathogens to less than detectable levels [19]. $KMnO_4$ may be useful in controlling the formation of (DBPs) by oxidizing precursors and reducing the demand for other disinfectants instead of chlorine and has many potential uses as an oxidant and can inactivate, attacks wide range of various water borne pathogenic microorganisms, also inactivation efficiency depend upon the permanganate concentration, contact time, temperature, pH and presence of other oxidizable materials [20].

Therefore, this study was conducted to determine the comparative effectiveness of water treated with $KMnO_4$ or Chlorine on some hygienic and Physiological parameters of local male rabbits.

2. Methodology

2.1 Animals and Experimental Design

This experiment was accomplished in the animal field of Vet. Med. College- Baghdad University during February – April 2017, to find out the disinfection potency of $KMnO_4$ or chlorine in treated water on some hygienic and physiological Parameters of local male rabbits, Thirty-two local male rabbits at the age of 2-3 months.

Experimental groups were checked to ensure their health and preventive treated against the internal and external parasite, experimental animals left about 2 weeks for acclimation. The body weight was considered and all groups. The animals fed on diet pellets 100 gm/head, and offered alfalfa freely, also organized as four groups (8 each) as fallowing:

The first, drinking water free of chlorine (refreshing Boiling water) kept as negative control, second drinking (Tap water treated with chlorine) kept as a positive control, third and fourth drinking water treated with $KMnO_4$ at concentration 1ppm/L, 2ppm/L respectively. Blood samples were taken biweekly, serums obtained for biochemical analysis and blood characters.

2.2 Biochemical assay

Hemoglobin Hb, Packed cell volume (PCV%) [21-23], Total protein and it's fractions, liver function enzymes activity: Alanine aminotransferase (ALT), Aspartate aminotransferase (AST), and Alkaline Phosphate (ALP) levels were measured by commercially available kits [Syrbio Dignostic] in spectrophotometer and Reflotron [21- 27].

2.3 Test chemical applications

Solutions of potassium permanganate ($KMnO_4$) prepared at concentration (1ppm, 2ppm) [28, 29].

Water goodness criteria (tap water) checked out to assessment the level of free chlorine (ppm) by collection 60 samples and using modern digital apparatus(pocket colorimeter II Analysis for free chlorine) and follow the manufacturers instruction of specific method of measurement also this device is a very modern technology with high sensitivity (0.01 – 1.00ppm) [30].

2.4 Statistical analysis

Hematological and serological data were analyzed as a complete Randomized Design (4 treatments) (CRD). Least significant differences (LSD) was applied to detect the significant differences among different groups means at (p<0.05) level [31].

3. Results and Discussion

3.1 Blood hemoglobin (Hb) g/ dl

The result showed significant (p<0.05) differences among the groups at different periods. The second group showed significantly(p<0.05) higher values in blood hemoglobin than other groups (table 1), whereas the first and third groups ($KMnO_4$ 1ppm) participated the second group in recording higher significant differences at some times of experiment, while the fourth group showed a gradual decreasing along with advanced period.

Table 1: Effect of treated water on the hemoglobin Hb (g/dl) of local Male Rabbits (means ± SE)

Data / Groups	Acclimation period	1st two weeks	2nd two weeks	3rd two weeks	4th two weeks
Refreshing water free of chlorine	A 14.81±0.99a	A 15.12± 0.90a	AB 15.01±0.87a	BC 12.79±0.71b	B 13.74±0.95b
Tap water	A 15.01±0.31	A 14.21± 0.43	A 16.43±0.20	A 16.39±0.13	A 17.76±0.01
$KMnO_4$ 1 PPM	B 13.11±0.25	A 15.09±0.17	B 14.83± 0.37	B 13.87±0.71	C 11.01± 1.81
$KMnO_4$ 2 PPM	B 12.75±0.74	C 13.08±1.10	C 12.81±1.07	C 11.99±0.86	C 10.78±0.93

Values with different capital letters in the same column indicate significantly different results (P<0.05)

3.2 Packed Cell Volume (PCV%)

The same trend showed in PCV values as in the Hb (table 2). The second group showed significant (p<0.05) higher values than other groups.

Table 2: Effect of treated water on blood packed cell volume pcv% of local Male Rabbits (means ± SE)

Data / Groups	Acclimation period	1st two weeks	2nd two weeks	3rd two weeks	4th two weeks
Refreshing water free of chlorine	A 36.27±0.19	A 35.19± 1.10	AB 37.19±0.93	B 36.81±1.01	B 35.66±1.36
Tap water	A 35.83±2.01	A 37.95± 1.95	A 39.91±0.98	A 41.71±1.84	A 42.69±0.93
KMnO4 1 PPM	A 35.51±2.63	A 34.49±1.76	B 35.39± 0.92	B 36.75±0.37	B 32.88± 0.67
KMnO4 2 PPM	A 36.49±3.02	B 36.19±1.83	B 34.21±1.64	B 33.97±0.99	B 32.11±0.46

Values with different capital letters in the same column indicate significantly different results (P<0.05)

The gradually increased in the blood components Hb and PCV tables (1, 2) in the treated groups particularly second group could be attributed to the concentration of chlorine and $KMnO_4$. These compounds could provide a healthy environment in the digestive tract of animals, and this will lead to increasing the absorption of nutrients in the intestine. In other words, it's resulted more metabolic activation in animals and stimulate erythrocytes synthesis due to synthesis the erythropoietin in haemopoitic tissue of bone marrow. The present results agreed with results obtained by some researches [31-34]. On the other hand, the decline in these components especially, in the fourth group could be attributed to the oxidative role of $KMnO_4$ and its high concentration causing anemia [35, 36].

3.3 Serum Total Protein Concentration gm/dl

Table (3) revealed that the second group has significantly (p<0.05) higher values than other groups. It's obvious from the results that the trend of the protein concentrate seems to be increased gradually. However, no specific trend was detected in other groups as the trend of all other groups seems to be fluctuate.

Table 3: Effect of treated water on serum total protein concentration (g/ dl) of local Male rabbits (means ± SE)

Data / Groups	Acclimation period	1st two weeks	2nd two weeks	3rd two weeks	4th two weeks
Refreshing water free of chlorine	A 5.91±0.22	B 5.87± 0.31	AB 6.17±0.74	A 6.40±0.27	B 5.74±0.36
Tap water	AB 5.36±0.17	A 6.13± 0.26	A 6.77±0.11	A 6.92±0.17	A 7.02±0.51
KMnO4 1 PPM	A 5.74±0.41	B 5.80±0.75	B 5.74± 0.54	B 5.35±0.16	C 4.63± 0.29
KMnO4 2 PPM	B 4.99±0.39	B 5.36±0.81	B 5.71±0.27	B 5.22±0.43	C 4.71±0.31

Values with different capital letters in the same column indicate significantly different results (P<0.05)

3.4 Serum Albumin, Globulin concentration gm/dl

In tables (4 and 5) similar trends were shown for albumin and globulin content. The second group recorded significantly (p<0.05) higher values than other groups. However, the first group did not differ from the second group in all periods except the last period.

Table 4: Effect of treated water on serum albumin (g/dl) to local male Rabbits (means ± SE)

Date / Groups	Acclimation period	1st two weeks	2nd two weeks	3rd two weeks	4th two weeks
Refreshing water free of chlorine	A 3.01 ± 0.46	A 3.47 ± 0.39	AB 3.39 ± 0.15	AB 3.88 ± 0.01	B 3.59 ± 0.19
Tap water	A 3.22 ± 0.93	A 3.83 ± 0.77	A 3.90 ± 0.65	A 4.17± 0.53	A 4.86 ± 0.44
$KMnO_4$ 1PPm	A 3.37± 0.17	B 2.79± 0.21	AB 3.61 ± 0.61	B 3.29 ± 0.59	B 3.43 ± 0.49
$KMnO_4$ 2PPm	A 3.27 ± 0.19	AB 3.24±0.22	B 3.07± 0.27	C 2.47± 0.31	C 2.69± 0.43

Values with different capital letters in the same column indicate significantly different results (P<0.05)

Table 5: Effect of treated water on serum globulin (g/dl) of local male Rabbits (means ± SE)

Date / Groups	Acclimation period	1st two weeks	2nd two weeks	3rd two weeks	4th two weeks
Refreshing water free of chlorine	A 2.9 ± 0.37	B 2.40 ± 0.55	A 2.78 ± 0.34	AB 2.52 ± 0.57	B 2.15 ± 0.62
Tap water	BC 2.14 ± 0.39	B 2.30 ± 0.28	A 2.87 ± 0.21	A 2.75± 0.69	A 2.86 ± 0.53
KMnO4 1PPm	AB 2.37± 0.10	A 3.01± 0.40	B 2.13 ± 0.46	B 2.06 ± 0.74	C 1.29 ± 0.17
KMnO4 2PPm	C 1.72 ± 0.07	B 2.12±0.03	B 2.04± 0.23	B 2.05± 0.27	B 2.02± 0.68

Values with different capital letters in the same column indicate significantly different results (P<0.05)

The gradually increased in values of total protein and its fractions in the treated group whether at acclimation up to end of experiment especially second group (tables 3, 4, 5) or in some periods could be referred to the role of the chlorine and $KMnO_4$ concentration as disinfectants [37, 38]. The role of these compounds could promote the body health systems and organs like liver which is considered one of the important organs in the body [39, 40]. Moreover, it could be attributed to their role in synthesis protein components. Similar results were obtained by some studies [34, 41]. The increasing in the globulin could be due to the positive effect of the chlorine and $KMnO_4$ on humeral immunity to produce globulins [42].

The lower means of globulin were recorded in the fourth group. These results could be due to the toxic properties of $KMnO_4$ especially the Mn as it could cause many adverse effects in many organs like the liver. The high concentration of manganese in the blood could be accumulated in the liver and affecting its activity in the proteins and enzymes synthesis. These results agreed with [36, 43].

3.5 Liver Function and enzymes activity (ALT, AST, ALP)

The third and fourth group showed significantly (p<0.05)

higher values in liver enzymes ALT than other groups from acclimation up to end periods of experiment table (3-6). Similar trends were obtained for AST and ALP. The third and fourth groups recorded significantly (p<0.05) higher values than the first and second groups (tables 7 and 8)

Table 6: Effect of treated water on serum Alanine aminotransferase enzyme (ALT) (IU/L) of local Male Rabbits (means ± SE)

Date / Groups	Acclimation period	1st two weeks	2nd two weeks	3rd two weeks	4th two weeks
Refreshing water free of chlorine	D 51.72±1.22	B 54.43± 0.40	C 59.31±0.91	C 63.23±0.30	C 62.04±1.10
Tap water	C 56.01±1.17	B 53.40±1.34	D 54.42±1.39	D 43.57±1.41	D 39.93±2.13
$KMnO_4$ 1PPm	A 67.33±2.76	A 70.46±3.10	B 79.35±2.09	B 87.56±2.59	A 101.61±0.93
$KMnO_4$ 2PPm	B 60.13±2.91	A 78.27±1.83	A 83.73±1.99	A 92.11±2.04	B 93.25±2.01

Values with different capital letters in the same column indicate significantly different results (P<0.05)

Table 7: Effect of treated water on serum Aspartate aminotransferase (AST) enzyme (IU/L) of local Male Rabbits (means ± SE)

Date / Groups	Acclimation period	1st two weeks	2nd two weeks	3rd two weeks	4th two weeks
Refreshing water free of chlorine	B 34.47±0.93	B 36.091±0.17	C 31.71±0.35	C 29.05±1.41	C 30.17±0.87
Tap water	A 36.73±0.51	C 33.67±0.38	C 31.83±1.10	C 28.46±0.19	D 25.94±0.72
$KMnO_4$ 1PPm	A 37.57±1.09	A 41.29±1.51	B 45.39±0.94	B 59.88±0.39	B 67.19±0.49
$KMnO_4$ 2PPm	AB 35.73±0.85	A 43.13±0.47	A 49.01±0.70	A 69.15±1.13	A 87.53±1.07

Values with different capital letters in the same column indicate significantly different results (P<0.05)

Table 8: Effect of treated water on serum Alkaline Phosphate (ALP) enzyme (IU/L) of local Male Rabbits (means ± SE)

Date / Groups	Acclimation period	1st two weeks	2nd two weeks	3rd two weeks	4th two weeks
Refreshing water free of chlorine	A 51.31± 0.71	BC 48.01±0.30	C 42.27±1.62	C 39.29±0.87	C 37.41±1.97
Tap water	A 50.09±0.62	C 43.79±0.35	C 39.38±1.31	C 37.64±1.13	D 30.31±1.16
KMnO4 1PPm	A 49.31±0.71	A 54.0.9±1.19	B 59.17±0.45	B 63.19±0.67	B 66.91±0.15
KMnO4 2PPm	B 38.29±0.84	B 48.85±0.39	A 69.51±1.17	A 72.44±1.29	A 79.30±1.83

Values with different capital letters in the same column indicate significantly different results (P<0.05).

The gradually increased in the values of ALT, AST, ALP in treated groups with $KMnO_4$ 1ppm, 2ppm could represent an oxidative stress on liver by minimized the levels of hepatoprotective of liver like glutathione as an antioxidant when metabolized manganese. These results confirmed previous results obtained by some studies [44- 46].

4. References

1. Bawa GS, Afolayan SB, Olumeyan DB Ashiru R. Effects of Various Durations of water deprivation on performance of weaner rabbits in a sub- Hamid environment. Pakistan Journal of Nutrition 2006; 5(6):551-554.
2. Lardner HA, Kirychuk BD, Braul L, Willms WD, Yarotski J. The effect of water quality on cattle performance on pasture. Aust. J Agric. Res. 2005; 56:97-104.
3. Manjare SA, Vhanalakar SA, muley DV. Analysis of water quality using physico – chemical paramenters tamdalge tank in kolhupur district, Maharashtra. International Journal of Advanced Biotechnology and Research. 2010; 1(20):115 -119.
4. NSW, State of New South Wales. Department of primary industries. Water requirements for sheep and cattle. Prime Facts 2007, 326- 354.
5. CCME, Canadian Council of Ministers of the Environments Canadian water quality guidelines for the protection of agricultural water uses, 2005.
6. USEPA, United States Environmental Protection Agency and Environment, Canada, State of the Great Lakes Highlights, 2007.
7. http//binational.net/solec/English/sog/2007highlights.
8. Johanna P. Water and its Importance to Animals: Rangland Management Specialist Natural Resource Conservation Service, 2012.
9. Lantagne DS, Cardinal F, Blount BC. Disinfection By-

product formation and mitigation strategies in point of Use chlorination with sodium Dichloroisocyanurate in Tanzania. Am. J Trop. Med. Hyg. 2010; 83(1):134-143.
10. Environmental Canada. Simulating water and the molecules of life. Scientific American. 2004; 279:100-105.
11. Achour S, Guergazi S, Harrat N. Organic pollution of water dam in eastern Algeria and effect of chlorination in resources. Magrib. 2009; IV(14) Eds.
12. Sadiq R, Rodriguez M. Disinfection by- product (DBPs) in drinking water and predictive models for their occurrence, a review. Sci. Total. Environ. 2004; 321:21-46.
13. King WD. Epidemiological studies of disinfection by product and cancer risk. Washington DCILSI press, 2001, 243-254.
14. Stuart WK. The formation and Control of emerging disinfection by- products of Health concern. Philosophical Transaction of the Royal Society of London. 2009, 1-15. http://rata.royalsocietypubilshing.org/content367/1904/4077.
15. Patrick L, Suzanne G, Sylvie M, Christella L, Cyril C, Manuel R *et al*. Maternal exposure to drinking- water chlorination by- products and small for gestational age Neonates. Epidemiology. 2012; 23(2):267-276.
16. Nieuwenhuijsen MJ, Grellier J, Smith R, Iszatt N, Bennett J, Best N *et al*. The epidemiology and possible mechanisms of disinfection by – products in drinking water, Philosophical Transactions of the Royal Society Mathematical, Physical and Engineering Sciences. 2009, 1-5.
17. Bnjar D, Vezi D, Ismail M, Shabani A, Reka A. Variation of Trihalomethanes concentration in tetovas drinking water in the autumn season. Middle East Journal of Scientific Research. 2013; 16(6):814-821.
18. Ma J, Li G, Cher L, Xu G, Cai G. Enhanced coagulation of surface waters with high organic content by permanganate peroxidation. Water Source and Technology. 2001; 1(1):51-61.
19. Will D, Loraine D, Christy G. Case control study of colon and rectal cancer. Cancer and chlorination by products in treated water.Cancer Epidemiology, Biomarker and Prevention. 2000; (9): 813-818.
20. Basiouny M, Fouad AE, Elmitwalli T, Abu- Elkahir NY. Enhancing purification of surface water by potassium permanganate addition. Twelfth International Water Technology Conference IWTC12 Egypt, Alexandria, 2008.
21. EPA, Environmental Protection Agancy. Alternative Disinfectants and oxidants. EPA Guidance Manual, 2002.
22. Coles EN. Veterinary Clinical Pathology.4th ed. W. B. Saunders Co. Philadelphia, USA 1986; 4th ed.
23. Varley H, Gowenlock AH, Bell M. Practical Clinical Biochemistry 5th ed. 1980 William Heineman. Medical Books Ltd. London.
24. John SV, Lewis SM. Basic Hematological Techniques, Practical Hematology, 1984; 6th (ed):22-45.
25. Rifai N, Bachorik P, Aibers J. Lipids, Lipoproteins and apolipoproteins In: Burtis CA, Ashwood ER, editors Tietz Texbook of Clinical Chemistry.3rd ed. Philadelphia: W.B. Saunders company 1999, 809-861.
26. Quesenberry KE, Carpenter JW. Ferrets. Rabbits and Rodents Clinical Medicine and Surgery. 2003; 2nd ed. St. louis, Saunders, 2003, 20-151.
27. Thrall MA, Weiser G, Allison RW. Campell TW. Veterinary Hematology and Clinical chemistry. Wiley Blackwell (ed). Lippincot Williams & Wilkins 2005, 471- 574.
28. Wai T, Naim A, Arthur M. Biomedical Diagnostic and Technology. Marcel Dekker Inc. New York Basel 2002, 346-347.
29. Francis- Floyed R, Klinger RE. Use of potassium permanganate of ornamental fish. Florida Cooperative External Service, Institute of Food and Agriculture Sciences, (IFAS) 2002; University of Florida, Gainesville, 32611.
30. Hargis LG. Analytical Chemistry, Principles and Techniques. Prentice Hall, New Jersey, 1988.
31. Hach. com. what is pH, chlorine and how is it measured, A technical handbook for industry 2008; www.hach.com.
32. Ranganathan V, Selvasubrmanian S, vasanthakumars. Estimation of humeral immune response in rabbits fed with cucurbit maxima seeds. Vet. world. 2013; (7):396-399.
33. Opara M, Iwuji T, Igwa I, Etuk I, Mazwell I. Hematological and biochemical responses of adult rabbits to aqueous extract of *Ocmium Giratissium* leaves. J. Phys. Pharm. Adv. 2012; 2(9):301-306.
34. Aheman T, Abu HA, Gbor V. Hematological and serum biochemical parameters of rabbit fed varying dietary levels of water spinach (Ipomoea Aquatic) leaf meal. Advance in Applied Science Research. 2013; 4(2):370-373.
35. Jumaa MA. Effect of feeding probiotics and or *ocimum Basilicm* seeds on some productive and physiological traits in the local male rabbits. MSc. Thesis. Vet. Med. College. University of Baghdad, Iraq, 2015.
36. Baker ST, Karrersm EH. Potassium permanganate as a dangerous oxidizing agents. Mallinckrodt chemicals. Phillipsburg. NJ. 8868, 2004.
37. Worksafa PZ, Kamen SS. Animal toxicity data: potassium permanganate strong reducing agent. Thuringowa Central. Australia, 4817, 2006.
38. USEPA. United State Environmental Protection Agency. Edition of the drinking water standards and health advisories Public drinking water systems, 2009.
39. WHO. World Health Organization. Guideline for drinking water quality: incorporating first addendum 4th Geneva, 2010.
40. Ganong WF. Review of Medical Physiology. Circulating body fluid section III. blood and bone marrow. edition Megrow Hill San Francisco. 2005, 22.
41. Maysoon MN, Arieg AW, Jazaer Ab, Ghassan M. Biological study of the effect of licorice roots extract on serum lipid profile, liver enzymes and kidney function tests in albino mice. Afr. J Biotechnol. 2011; 10(59):12702-12706.
42. Kadhim QM. Effect of replacement of ground *Coriandrum sativum* and or *Trigonella Foenum Graecum* seeds in the diet on growth and some productive; reproductive traits.MSc thesis Vet. Med. Colleg. University of Baghdad, Iraq, 2013.
43. Al Zwean DHY. Effect of using licorice powder (Glycyrrhiza Glabra) supplemented with drinking water at two different does in serum lipid profile and blood proteins of local female rabbit. Journal of Biology, Agriculture and Healthcare, 2014; 4(18):15-21.
44. Blarock EM, Busch AR. The clinical effects of manganese. National laboratory. 2002; (4):156-166.

45. Zhang BY. Effect of manganese on heat stress protein synthesis of new born rats. World. J Gasteroenterology. 2002; 81(1):114-118.
46. Hussein MN, kate FS. Some hematological and biochemical effects of potassium permanganate $KMnO_4$ female mice. Journal Basrah Researches Sciences. 2008; 34(3):9-13
47. Al- Katib SR, Al-Azam AH, Habeab SA. The effect of vitamin C on ovary of female white rats treated with $KMnO_4$, histological and physiological study. Kufa J. Vet. Med. Sci. 2012; 3(2):1-16.