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Effects of Iodine Treated Water and different water sources on some biochemical and physiological changes in blood of New zealand white rabbits .

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Summary

Twenty-four weaned male New Zealand white rabbits 4 weeks old, were used in the present study. Rabbits were randomly divided into three equal groups, 8 rabbit each, according to the type of drinking water. Group I received iodine- treated tap water .Group II received non iodine treated tap water (control group). Group III received non iodine treated ground water. Blood samples were collected from all animal groups every4 weeks from the onset of experiment for a duration of 16 weeks old to study the effect of drinking iodine- treated water, tap water and ground water on some blood parameters , thyroid hormones and growth performance in rabbits. The results indicated that ,concentrations of serum calcium, magnesium , sodium and copper levels showed a significant increase. However ,the levels of serum inorganic phosphorus and potassium were decreased in rabbits drank iodine treated tap water. Serum thyroxine (T4) and 3,5,3 triiodothyronine (T3) showed a highly significant increase. However, the values of serum total lipids, total cholesterol and creatinine concentrations were decreased. Serum albumin and glucose levels were increased after drinking iodine- treated tap water as compared with the untreated control group. A significant increase in body weight, daily body weight gain, carcass weight and some organs weights as liver and kidney were observed in iodine- treated tap water group .

Regarding the effect of water sources (tap water and ground water) the obtained results indicated that, concentrations of serum calcium, magnesium and potassium showed a marked increase. However, the levels of serum inorganic phosphorus ,copper, and zinc showed a significant decrease after drinking ground water. The level of serum thyroid hormonse (T3 and T4) ,total lipids , total cholesterol and urea concentrations were decreased in rabbits drank ground water. However, the value of serum total protein ,albumin ,creatinine and glucose levels were increased as compared with untreated tap water (control group).There was no significant effect of water sources(tap and ground water) on live body weight,daily body weight gain,carcass weight and organs weight in rabbits drank ground water than those drank tap water .

This study indicated that ,iodine added to the drinking tap water at the rate of 5ppm was improved the growth performance, thyroid functions and most related blood parameters investigated .This study also showed that,using drinking ground water to rabbits induced a significant changes in the level of most serum constituents .

Introduction

The importance of water and watering equipment on the productive performance of broiler chickens was reported by **pesti et al. (1985)** . Minerals in drinking water are more readily absorbed than food because water does not usually contain chelating agents which might prevent absorption of elements **(porter et at.,1988) .**

Many farms in desert area depend upon wells as source of drinking water that may be contain some elements higher than the permissible limits, which may have an adverse effect on animal health and production **(EL-Sayed, 1991).** Several studies have been undertaken on sheep, goat, poultry and cattle to determine the changes of various physiological function due to the effect of drinking salinity water **(Hussan, 1987; Balnave and Yoselewitz, 1988) .**

It is well documented that iodine is an essential nutrient in poultry diets. Triiodothyronine (T3) and thyroxine (T4) have pronounced physiological effect in the control of respiration and energy metabolism as well as in the biogensis of the mitochondria . Their production is important in conditions such as disease, starvation or hibernation that lead to altered metabolic status **(Lomo et al., 1996).**

It has been reported that, dietary iodine is efficiently absorbed from the gastrointestinal tract **(Miller et al., 1975 ; Stole et al.,1973).** This would suggest that the added iodine may have an effect on the endocrine system, particularly the thyroid gland . A second possibility is an alteration of the microflora of the gut , thus increasing the availability of nutrients to the bird . A third possibility is a benefit from effect of the established role of iodine as a water sanitizer . Furthermore, **kruger et al . (1981) and Stanley et al (1884)** reported that, improved growth in egg type pullets and broiler chickens, using low levels of supplemented iodine in the drinking water . Although many reports were published on the use of iodine as a growth stimulant to increase body weight in chicks **(EL–Agrab , 1991and Carpenter et al., 1992)** yet no attempts have been made to determine the effect of the addition of iodine in the drinking water on the performance, biochemical and physiological changes of rabbits .

Accordingly, the interest arises to investigate the effect of iodine addition to the drinking water and water sources on some metabolic activities with special reference to some blood parameters in relation to growth performance in growing New Zealand white rabbits .

Materials and Methods

Twenty-four, male New Zealand white rabbits, weaned at 28 days of age were used in these experiments. Rabbits were housed in separated stainless steel cages provided with feeders and automatic drinkers. The animals fed on a balanced commercial rabbits pelleted ration and water was supplied ad-libitum. They were kept at a constant environmental and nutritional condition throughout the period of the experiment .

Rabbits were randomly divided into three equal groups, each one consists of 8 rabbits as follows:

Group I : Given tap water treated with 5 ppm active iodine (Iodophore Compound, Crown Chemical Company limited Ambrehurst kent).

Group II: Drinking non-iodine treated tap water (control group).
Group III: Received non-iodine treated ground water.

Chemical analysis of tap and ground water are presented in Table (1). The rabbits were weighed at the beginning of the experiment and periodically every week till they reached 16 weeks of age.

Sampling :

Blood samples were collected from all animal groups, using ear vein technique, three times at 8,12 and 16 weeks from the onset of the experiments. Sera were separated by centrifugation and were stored at -20C until the biochemical analysis were performed .

At the end of the experimentl periods, 6 rabbits from each group were randomly taken and slaughtered in the morning following an overnight fast. After complete bleeding, each of the pelt, viscera, and tail were soon removed and carcass weight were calculated according to **El-Maghawry et al., (1993).** Some internal organs as liver, kidney, spleen and heart were removed at necropsy and also weighted .

Analytical Procedures :

Serum calcium was analyzed using plasma emission (spectraspan V), model V-DCP (BECKMAN). Serum inorganic phosphorus was determined colorimetrically according to the method of **Wootton (1982).** Serum magnesium, copper and zinc were determine using Atomic absorption spectrophotometer model 2380 (PERKIN ELEMER) according to the method of **Willis (1960).** Serum sodium and potassium concentrations were determined by means of a flame emission spectrophotometer. Serum T3 and T4 concentrations were determined using radioimmunoassay with a commercially available kits, manufactured by Diagnostic Products Corporation, Los Angeles, USA, cat. No., TKT31 and TKT41, respectively. Serum total protien, albumin, and globulin concentrations were determined by the methods described by **(Weichselbaum,1946), (Bartholomew and Delaney, 1966) and (Doumas and Biggs, 1972)**, respectively. Serum urea and creatinine were determined by the methods of **Chaney and Marbach (1962) and Henry et al.(1974)**, respectively. Serum lipids and total cholesterol were estimated as described by **Frings and Dunn(1970) and Zlatkis et al. (1953)**, respectively. Moreover, serum glucose concentration was estimated enzymatically with glucose oxidase as described by **(Trinder,1969**).

Table (1) Chemical analysis of tap and ground water parameters.

Water parameters (mg / L)	Tap water	Ground water	Guideline value (W.H.O.,1984)
P H	7.2	7.4	6.5-8.5
Total soluble salts	481.0	910.0	1000
Cations :			
Calcium	15.2	23.1	200
Sodium	103.0	315.0	200
Potassium	7.7	35.8	50
Magnesium	305	53.6	150
Anions :			
Carbonate	0.0	4.0	200
Bicarbonate	6.0	136.0	300
Sulfate	203.2	300.8	400
Chloride	75.0	347.0	250
Nitrate	12.0	23.0	10
Nitrite	0.0	2.0	No guideline value set

Statistical analysis:

The obtained data were statistically analyzed and the significant difference between groups was evaluated by t-test as explained by **(Snedecor and Cochran, 1982).**

Results

The results obtained concerning the effect of iodine- treated tap water on serum minerals and some blood constituents in male New Zealand rabbits have been statistically summarized in Table (2and 3). Serum calcium and magnesium levels showed a significant increase after 4 and 12 weeks of experiment. However, serum inorganic phosphorus level showed a significant increase at 12 weeks. A significant increase in serum sodium level was observed at 4 weeks, followed by a highly significant increase at 8 and 12 weeks of experiment .Serum potassium concentration showed a highly significant increase at 8 weeks , followed by a significant increase at 12 weeks. The value of serum copper level showed a significant increase at 4 weeks. This increase became non-significant at 8 and 12 weeks of experiment. Also, serum zinc level showed a non-significant increase throughout the experimental periods.

The concentrations of serum thyroxine (T4) and 3,5,3 triiodothyronine (T3)showed a highly significant increase at 12 and 8 weeks, respectively. However, T4 level at 4 and 8 weeks and T3 level at 4 and 12 weeks showed a non-significant increase. A significant decrease in serum total lipids and highly significant decrease in serum total cholesterol concentrations were showed at 4

weeks of experiment, followed by a non significant decrease at 8 and 12 weeks.Serum total protein and globulin levels showed a non-significant increase throughout the experimental periods. However, a significant increase in serum albumin level was observed at 4 and 12 weeks, followed by a non-significant increase at 8 weeks . Serum urea concentration showed a non-significant decrease throughout the experimental periods. However, the value of serum creatinine level showed a significant decrease at 8 weeks, followed by a highly significant decrease at 4 weeks and very highly significant decrease at 12 weeks of experiment. Serum glucose level showed a highly significant increase at 4 weeks and 8 weeks, followed by a non significant increase at 12 weeks in comparison with the rabbits drank non-iodine-treated tap water (group II).

Rabbits supplemented with 5ppm iodine in drinking water recorded a significant increase in body weight, average daily body weight gain, carcass weight, liver and kidney weights. However, heart and spleen weights showed a non-significant increase as compared with untreated groupTable (6and7) .

The obtained data Table (4and 5) shows the effect of drinking ground water on serum minerals and some blood parameters in male New Zealand white rabbits. Serum calcium level showed a highly significant increase at 4 and 12 weeks. This increase became non-significant at 8 weeks. A non-significant decrease in serum inorganic phosphorus level was observed at 4 and 8 weeks. This decrease became highly significant at 12 weeks. A significant increase in serum magnesium level was noted at 4 weeks of experiment. This increase became non-significant at 8 and 12 weeks. A highly significant increase in serum sodium level observed at 4 weeks. This increase became significant at 8 weeks and non-significant at 12 weeks of experiment. A non-significant increase in serum potassium level was noted at 4 and 8 weeks, followed by a highly significant increase at 12 weeks. Serum Copper concentration showed a non-significant decrease at 4 and 8 weeks of experiment, followed by a significant decrease at 12 weeks. A significant decrease in serum zinc concentration showed at 4 and 8 weeks of experiment. This decrease became non-significant at 12 weeks as compared with untreated tap water (group II).

Serum T4 and T3 levels showed a highly significant decrease at 8 weeks. However, the value of serum T4 and T3 at 12 and 4 weeks were significantly decreased. Serum T4 level showed a non-significant decrease at 4 weeks, while serum T3 level showed such decrease at 12 weeks of experiment. The value of serum total lipids showed a significant decrease at 4 and 8 weeks, followed by a highly significant decrease at 12 weeks. Serum total cholesterol concentration showed a significant decrease at 4 weeks. This decrease became non-significant at 8 and 12 weeks of experiment. Serum total protein level showed a significant increase, while serum albumin level showed a very highly significant increase at

4 weeks. However, at 8 and 12 weeks of experiment a non-significant increase in serum total protein and albumin levels was reported. Serum globulin level showed a non-significant increase throughout the experimental periods. Serum urea level showed a significant decrease at 4 and 12 weeks. This decrease became non-significant at 8 weeks. Serum creatinine concentration showed a non-significant increase at 4 and 8 weeks followed by a significant increase at 12 weeks. The value of serum glucose level showed a non significant increase at 4 and 12 weeks of experiment, this increase became highly significant at 8 weeks as compared with the untreated tap water (control group).

The obtained results showed that, there was no significant differences between non-iodine treated tap water and ground water used in the present work in their effects on live body weight, daily body weight gain, carcass weight, and organs weight as liver, heart, kidney and spleen in growing rabbits throughout the experimental periods (4-16 weeks), Table (6 and 7).

Discussion

The obtained results Table (2) revealed that, serum calcium level showed a significant increase in rabbits drank iodine-treated tap water. Such, increase in serum calcium concentration may be attributed to the stimulation of Ca2+-ATPase activity induced by thyroid hormones specially triiodo thyronine (T3), **Davis et al.,(1962).** Another suggestion for the increase in serum calcium concentration was the apparent increase of calcium absorption and retention by increasing the level of thyroxine hormone due to the beneficial effect from the addition of iodine to the drinking water. ON the other hand, serum inorganic phosphorus level showed a significant decrease in rabbits drank iodine treated water. The decrease in serum inorganic phosphorus level may be attributed to the high serum calcium concentration as recorded by **Chicco et al. (1973)** who reported that, high dietary calcium increased fecal phosphorus and reduced its serum level. Moreover, the increase in serum phosphorus level may be due to the increase in serum magnesium concentration as observed in the obtained results and confirmed by the finding of **(Chester et al.,1989).**

Serum sodium concentration showed a highly significant increase in rabbits drank iodine-treated tap water. However, the value of serum potassium level showed a highly significant decrease. Such increase in serum sodium concentration may be due to the stimulation of Na+K+-ATPase activity by thyroid hormones **(Edelman,1975).** However, the decrease in serum potassium level may be attributed to the direct effect of thyroxine on electrolyte and water metabolism, which increase the excretion of water, potassium and chloride.

This would suggest that the added iodine may have an effect on the endocrine system, particularly the thyroid gland, **(Miller et al.,1975)** . Moreover, O'Neill **and Mikkelso (1987)** mentioned that, Na+-K+ ATPase enzyme plays an

important role in the regulation of over all metabolism and responsible for ionic haemostasis in both extra and intra cellular component. So, the increase in serum sodium level and decrease of serum potassium concentrations in rabbits drank iodine treated water may be attributed to the alteration in Na+-K+pump mechanism. This attribution was supported by the results of **O'Neill and Mikkelso (1987).**

The obtained data revealed that , the value of serum copper concentration in rabbits drank iodine-treated tap water showed a significant increase. However, the value of serum zinc level showed a non significant increase. The increase in serum copper concentration could be attributed to preferential release of triiodothyronine (T3) by the thyroid gland under the influence of small amount of pituitary hormone **(Nejad et al.,1973).**

It could be noted that, the influence of added iodine level on minerals metabolism was more remarkable when these minerals were determined in the blood serum. Metabolism of calcium, inorganic phosphorus , magnesium, sodium, potassium, and copper were changed significantly after their absorption from the gut. This alteration may be attributed to the regulation mechanism inside the body which control the minerals metabolism. **Richards (1989)** showed that, metallothionein in animals has a key role in many aspects of the metabolism of some minerals including zinc, copper, and iron in tissue uptake, transport, storage and detoxification.

The obtained data Table (3) revealed that, the supplementation of water with iodine at the rate of 5ppm increased serum thyroxine (T4)and triiodothyronine (T3) levels over the untreatd water group. Similar results were reported by **EL-Mahdy and karousa (1995)** who reported that, Rabbits drank iodine treated tap water showed significant increase in serum thyroxine concentration than those drank non-iodine treated tap water . The increase of serum thyroid hormones levels is due to the supplementation of iodine which considered an essential component for thyroid hormones synthesis. As confirmed by the finding of **(Miller et al., 1975 and Stole et al., 1973)** who reported that, dietary iodine is efficiently absorbed from the gastrointestinal .tract This would suggest that, the added iodine may have an effect on the endocrine system, particularly the thyroid gland.

Regarding serum lipids concentrations the obtained data demonstrated that, there was a significant in-crease in serum total lipids and marked decrease in serum total cholesterol concentrations in rabbits drank iodine added water. The decrease in serum total cholesterol concentration may be due to higher thyroxine level which help the mobilization of cholesterol from the blood to tissues. So, in hypothyroidism cholesterol level in blood was increased .Another interpretation for the decrease in serum total cholesterol level was recorded **by Oviani et al.**

(1997) who indicated that, the higher levels of cholesterol 7 - hydroxylase, which is involved in the conversion of cholesterol into bile acids in the liver of rabbits . However, the increase in serum total lipids concentrations might be attributed to the increased action of lipoprotein lipase activity, **Buchet et al. (1977) .α**

Serum albumin level showed a significant . increase in rabbits drank iodine treated tap water. Such, increase may be due to increase of serum thyroxine concentration as reported by **Habeeb et al. (1989)** who indicated that, the increase of thyroxine stimulated the protein synthesis, and confirmed by the finding of **Daughaday, (1989)** who observed that, peripheral T3 hormone, in particular , has been showen to medulate growth hormone gene expression. However, the value of serum total protein and globulin levels were non significantly increased.

The value of serum creatinine level showed a highly significant decrease in rabbits drank iodine treated water. This results may indicated that, the addition of iodine to water may not affect on kidney function in rabbits. However, iodine supplementation at 5 ppm in water caused a highly significant increase in serum glucose level. Iodine considered essential component for thyroxine synthesis. The increase in the thyroid activity accelerate the absorption of glucose from the small intestine and increase the rate of glycogenolysis in the liver, **Dickson (1982)**

Rabbits given iodine - treated water showed an improvement in the average body weight, daily weight gain, carcass and organ weights as compared with those given the non iodinated water. It has been reported that, dietary iodine is efficiently absorbed from gastrointestinal tract **(Miller et al., 1975).** These results may suggest that the added iodine positively affected the growth and feed utilization not only through the metabolic rate as a reflection increase of the thyroid activity by increasing the secretion of thyroxine as showed in Table (6), but also through the support of intestinal microflora by iodine. The increase in the microflora growth expanded the gastrointestinal capacity and cecum activity as well as it increase the volatile fatty acids production and dry matter digestibility **(Pet–Ag 1987).** These volatile fatty acids are building blocks for the protein, fat and vitamins synthesis which is necessary to allow the increase of weight gain and feed efficiency **(Maynard et al., 1975)** . In other words, the improvement in daily gain and other growth performance could be a reflection to increase of thyroxine hormone, which in turn stimulates protein synthesis, promotes general growth, maturation, and intestinal absorption of carbohydrate as reported by **Chastain and Ganjam (1986).** The other possibility is a benefit from effects of established role of iodine as a water sanitizer. In this respects, **EL–Agrab (1991) and Emeash et al. (1994)** noticed that iodine drinking water

at the level of 5 ppm played an important role in growth stimulation as it increased body weigh of chicks .

Effect of drinking ground water on serum minerals concentrations in growing rabbits were presented in Tables (4). The obtained results showed that, serum calcium, magnesium, sodium and potassium concentrations were increased in rabbits drank ground water than those received tap water. However, the value of serum inorganic phosphorus level was markedly decreased. These results agreed well with the finding of **Ayyat et al. (1991)** who reported that, drinking salinity water in rabbits caused a significant increase in serum sodium, potassium, and calcium concentrations with no significant changes in serum magnesium level. However, **Amer (1990)** showed that, there was a significant increase in plasma sodium and potassium in goat due to drinking 1.8% salt water, while calcium and magnesium concentrations were not affected. Also, **Weeth and Hoverland (1961)** reported that, 1.2% salt water administration in summer caused a significant increase in serum potassium and sodium levels and significant decrease in serum mangnesium in growing cattle. Morever, **Abdel-Samee and EL-Masry (1992)** reported that, the drinking desalinated and saline well water significantly, enhanced the plasma levels of sodium and calcium and caused significant decrease in plasma potassium and inorganic phosphorus concentrations. The obtained results were supported by the finding **of Roth and Pintea (1977)** in their interpretation that, the increase in the water intake containing the high level of minerals and consequently the increase in plasma electrolytes consequently may. result in stress on kidney function to excrete the excess of salts through urine. Also, there was a consistent association between a high sodium intake and a high plasma potassium concentration **(Wichell 1976).** Furthermore, **Kawashit et al. (1983)** reported that, sodium urinary excretion in sheep drink salinity water was strictly and directly proportional to the level of sodium intakea among treated groups . The increase in serum calcium level in rabbits received ground water may be due to the high dietary calcium in ground water as observed from chemical analysis of water Table (1) and confirmed by **Chicco et al. (1973).** However, the decrease in serum inorganic phosphorus level may be attributed to the high dietary calcium, which increased fecal phosphorus and reduced serum phosphorus level **(Chicco et al., 1973),** or may be due to an increase in serum magnesium level as recorded by **Chester et al. (1989).**

Another suggestion for the decrease in serum inorganic phosphorus was the high potassium intake in drinking ground water Table (1) . As, confirmed by **Wylie et al. (1985)** who observed that, the infusion of potassium intra-ruminally in lamb induced decrease in phosphorus absorption. Furthermore, the increase of serum magnesium level may be attributed to increase dietary magnesium in

ground water Table (1) as stated by **Chicco et al. (1973)** and confirmed by **Chester et al. (1989)** who found that, high dietary magnesium increased the level of magnesium in serum, urine and erythrocytes of sheep.

The drinking ground water by the rabbits resulted in a significant decrease in serum copper and zinc concentrations. Similar results were reported by **EL-Sayed (1991)** Who observed that, there was a decrease in serum copper and zinc concentrations in male buffalo - calves drank well water and a higher zinc level was observed in well water analysis. Such increase in dietary zinc level induced signs of copper deficiency as confirmed by **Magee and Matrone (1960).** Apparently, the zinc copper antagonism was mediated via intestinal metallothionein, as zinc induced this metal binding protein in mucosal cell and accumulated when zinc was in excess. The zinc induced metallothionein bound copper much more strongly than zinc, so that even low concentration of copper compete favourably for the metal binding site. The resulting copper metallothionein was poorly absorbed creating copper deficiency when copper was present at a limting level. **(Hall at al.,1979).** However, the decrease in serun zinc level in rabbits drank ground water could by attributed to excessive dietary magnesium offered in ground water, which may be the cause of zinc deficiency. Since, **Quillan et al. (1980)** found that, excessive dietary magnesium stimulate the production of metalloproteins which bind zinc and reduced zinc utilization in fersian calves.

Concerning the effect of tap and ground water on thyroid hormones level, it was observed that, there was a highly significant decrease in serum T4 and T3 concentrations in the rabbit drank ground water Table (5). Similar results were reported by **Ayyat et al. (1991)** Who noted that, drinking salinity water containing 3000, 4500 and 6000 PPm to rabbits caused depressed of thyroid hormones level as compared to control group. However**, Amer (1990)** found a significant increase in serum T4 concentration in lactating goats due to drinking water containing 1.8% NaCl. The decrease in Serum thyroid hormones level may be due to a difference in peripheral conversion of T4 to T3 or T3 to T2, **(Larsons et al., 1955)**; a difference in disposal rate of T3 or T4 **(Nicoloff et al., 1972)** and elevated or diminished thyroxine binding globulin level of rabbits.

Serum total lipids and total cholesterol concentrations showed a significant decrease in rabbits drank ground water. Similar results were observed by **Hussein et al. (1992)** in buffalo - calves drinking well water . Moreover, **Azza (1992)** reported that, serum total lipids and total cholesterol concentrations were decrease in rabbits drinking synthesized hard water. Furthermore**, Borgman and lightsey (1982)** indicated that, hard water may reduce liver cholesterol concentration and the severity of cholelithiasis, and perhaps the calcium and magnesium present in the hard water may have some influence upon lipids

metabolism. The decrease in serum lipids concentration may be attributed to the action of calcium and magnesium either could be in the intestinal tract, lessening the absorption of lipids thereby lowering the biosynthesis of cholesterol or bile acids or could be in the liver and affect the cholesterol or bile acids metabolism. Moreover, **Porter et al. (1988)** indicated that lower concentration of total cholesterol, VLDL- cholesterol, and LDL- cholesterol, and greater concentration of HDL- cholesterol were found in rabbits given the hard water at several weeks.

It is evident from the present study that, serum total protein, albumin and creatinine concentrations were increased, while the value of serum urea level was decrease in rabbits drank ground water. The lower serum urea concentration suggest a greater utilization of amino acids for protein synthesis which is supported by the highest level of total protein and albumin recorded in the obtained results with the group of rabbits given ground water **(Abdel- Rahim et al.,1995).** In contrary **Ayyat et al. (1991)** observed that, total protein and albumin levels were lower in rabbits drinking water containing salts at the rate of 3000, 4500 and 6000 ppm . This may indicate that protein metabolism was affected as a result of drinking salinity water. On the other hand, the increase in serum creatinine concentration in rabbits drinking ground water may be due to the high levels of salts in drinking water may cause or induce kidney dysfunction in rabbits **(Ayyat et al.,1991).**

The drinking ground water by the rabbits resulted in a significant increase in serum glucose concentration. These results are in accordance with the finding of **EL-Sayed, (1991)** who reported that, there was a significant increase in serum glucose of male buffalo-calves drinking well water. Such hyperglycemia, may be due to the reduction in glucose utilization in zinc deficiency which had been reported in cattle by **Kirchgessener et al. (1976),** which was a secondary to reduce insulin release or increase insulin degradation. The obtained results were supported by **Hemsley et al . (1975)** who found that, drinking water containing high level of salts to the rabbits may result in a depression in the digestibility of different nutrients and its utilization which lead to disturbance in protein and fat metabolism and consequently decreased the nitrogen retention .

The obtained results Table (6 and 7) showed that, ,there were no significant differences between non –iodine treated tap and ground water used in their effects on live body weight , daily body weigth gain , carcass weight and weights of liver, heart and spleen .in growing rabbits throughout the experimental periods. This may refer to the reverse relationship between salinity and growth performance . However , kidney weight was heavier in rabbits drank ground water than those received tap water . In this respect, **Abdel–Samee and El-Masry (1992)** reported that, there were no significant differences in live body weight , daily body weight gain, carcass weight and weight of liver, spleen and

heart between rabbits drank either, natural saline or desalinated well water and those received fresh Nile water .

The obtained results indicated that, iodine added to the drinking tap water at the rate of 5 ppm was of favourable effect and improved growth performance, thyroid gland functions as well as most related serum biochemical blood parameters investigated with special reference to lipids, protein glucose and minerals concentrations in male rabbits. This study also showed that using drinking ground water to rabbits induced a significant changes in the level of most serum constituents. Moreover, it is also evident that, rabbits can tolerate the salinity of ground water used (910 ppm) without deterioration effects on their growth performance. Because, most of serum parameters investigated play an important role in the animal metabolism and it considered a very important factors for keeping the animal in the good health and highly producing onditions. Thus, it could be recommended that using iodine in low level as essential nutrient in rabbits diet ,and the ground water should be treated before use to reduce salinity and harmful effect in all animal farms which are presented in the desert areas .

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Table (2) Effect of drinking iodine-treated tap water on serum minerals concentrations in male New Zealand white rabbits.

Duration of drinking / week	4 Weeks		8 Weeks		12 Weeks	
Parameters	Untreated tap water	Iodine - treated tap water	Untreated tap Water	Iodine - treated tap water	Untreated tap Water	Iodine - Treated tap water
Calcium (mg/dl)	10.13± 0.22	11.46± 0.21*	11.37± 0.16	12.29± 0.12	12.05± 0.18	13.78± 0.42*
Inorganic phosphorus (mg/dl)	5.40± 0.25	4.49± 0.45	5.70± 0.46	5.03± 0.13	6.64± 0.26	5.41± 0.25*
Magnesium (mg/dl)	3.69± 0.03	3.83± 0.03*	3.78± 0.06	3.80± 0.04	3.79± 0.01	3.83± 0.02*
Sodium (mEq../L)	93.47± 7.13	125.22± 9.86*	137.91± 2.84	180.97± 10.14**	175.03± 7.66	237.78± 10.24**
Potassium (mEq../L)	5.77± 0.63	5.59± 0.20	7.56± 0.21	6.13± 0.28**	7.59± 0.12	6.89± 0.18*
Copper (ug / dl)	67.07± 2.80	76.5± 2.61*	67.53± 6.31	70.93± 4.80	77.67± 3.76	78.83± 3.39
Zinc (ug / dl)	103.67± 2.91	106.67± 2.94	111.8± 2.44	112.9± 1.95	114.33± 4.33	114.45± 4.66

Data are presented as mean ± S.E

S.E = Standard error

* : (P<0.05)
** : (P<0.01)

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Table (3) Effect of drinking Iodine- treated tap water on some serum constituents concentrations in male New Zealand white rabbits.

Duration of drinking / week	4 Weeks		8 Weeks		12 Weeks	
Parameters	Untreated tap water	Iodine - Treated tap water	Untreated Tap water	Iodine - treated tap water	Untreated tap water	Iodine - Treated tap water
Thyroid hormones:						
Thyroxine(T4) (ug/dl)	2.83± 0.15	3.03± 0.18	3.17± 0.08	3.22± 0.14	2.44± 0.06	2.77± 0.13**
3,5,3 Triiodothyronine(T3) (ng/dl)	70.33± 0.88	76.00± 3.46	67.67± 1.45	83.33± 1.86**	64.33± 3.18	68.00± 2.52
Lipids (mg/dl):						
Total lipids	431.50± 19.68	344.83± 14.43*	482.61± 13.01	466.67± 9.28	589.93± 40.83	577.00± 38.21
Total cholesterol	69.01± 1.99	50.41± 2.99**	67.60± 3.70	56.32± 2.55	77.55± 5.63	65.32± 2.33
Proteins(gm/dl):						
Total protein	6.17± 0.27	7.28± 0.58	6.91± 0.11	7.93± 0.40	7.48± 0.48	8.63± 0.38
Albumin	3.06± 0.06	3.29± 0.05*	3.23± 0.16	3.52± 0.06	3.38± 0.13	4.12± 0.25*
Globulins	3.11± 0.28	3.99± 0.62	3.68± 6.27	4.41± 0.36	4.10± 0.54	4.51± 0.54
Other parameters (mg/dl)						
Urea	26.6± 0.55	27.37± 0.63	24.19± 1.73	29.33± 1.61	26.66± 0.56	29.52± 2.19
Creatinine	1.24± 0.02	1.07± 0.02**	1.31± 0.02	1.16± 0.03*	1.29± 0.03	1.05± 0.02***
Glucose	95.18± 3.80	120.42± 1.20**	108.62± 1.97	120.74± 1.76**	117.25± 1.86	121.38± 1.42

Data are presented as mean ± S.E

S.E = Standard error

* : (P<0.05)
** : (P<0.01)
*** : (P<0.001)

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Table (4) Effect of drinking non - iodine-treated ground water on serum minerals concentrations in male New Zealand white rabbits.

Duration of drinking / week	4 Weeks		8 Weeks		12 Weeks	
Parameters	Untreated tap water	Untreated ground Water	Untreated tap water	Untreated ground water	Untreated tap water	Untreated Ground water
Calcium (mg/dl)	10.13± 0.22	12.03± 0.26**	11.37± 0.16	12.58± 0.28	12.05± 0.18	13.94± 0.27**
Inorganic phosphorus (mg/dl)	5.40± 0.25	4.43± 0.41	5.70± 0.46	4.91± 0.14	6.64± 0.26	4.45± 0.44**
Magnesium (mg/dl)	3.69± 0.03	3.82± 0.03*	3.78± 0.06	3.83± 0.03	3.79± 0.01	3.84± 0.02
Sodium (mEq./L)	93.47± 7.13	130.15± 4.94**	137.91± 2.84	153.83± 4.44*	175.03± 7.66	186.69± 4.66
Potassium (mEq./L)	5.77± 0.63	6.89± 0.18	7.56± 0.21	8.09± 0.20	7.59± 0.12	8.99± 0.32**
Copper (ug/dl)	67.07± 2.80	64.37± 2.99	67.53± 6.31	62.8± 2.96	77.67± 3.76	64.57± 0.66*
Zinc (ug/ dl)	103.67± 2.91	91.00± 2.08*	111.8± 2.44	95.9± 5.48*	114.33± 4.33	103.67± 3.84

Data are presented as mean ± S.E S.E = Standard error

*: (P<0.05)

** : (P<0.01)

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Table (5) Effect of drinking non- Iodine treated ground water on some serum constituents concentrations in male New Zealand white rabbits .

Duration of drinking / week	4 Weeks		8 Weeks		12 Weeks	
Parameters	Untreated tap water	Untreated ground water	Untreated tap water	Untreated ground water	Untreated tap water	Untreated ground water
Thyroid hormones:						
Thyroxine(T4) (ug/dl)	2.83 ± 0.15	2.54± 0.45	3.17± 0.08	2.63± 0.06**	2.44± 0.06	2.00± 0.12*
3,5,3 Triiodothyronine (T3) (ng/dl)	70.33 ± 0.88	62.00± 3.06*	67.67± 1.45	51.00± 2.08**	64.33± 3.18	62.00± 3.79
Lipids (mg/dl):						
Total lipids	431.50± 19.68	374.17± 6.51*	482.61± 13.01	397.33± 22.26*	589.93± 40.83	402.63± 18.31**
Total cholesterol	69.01± 1.99	60.07± 2.74*	67.60± 3.70	60.15± 1.31	77.55± 5.63	67.44± 5.60
Proteins(gm/dl):						
Total protein	6.17± 0.27	7.32± 0.35*	6.91± 0.11	7.68± 0.43	7.48± 0.48	7.99± 0.31
Albumin	3.06± 0.06	4.24± 0.04***	3.23± 0.16	3.41± 0.02	3.38± 0.13	3.49± 0.07
Globulins	3.11± 0.28	4.08± 0.38	3.68± 6.27	4.28± 0.42	4.10± 0.54	4.49± 0.27
Other parameters (mg/dl)						
Urea	26.6± 0.55	21.72± 1.24*	24.19± 1.73	20.61± 0.68	26.66± 0.56	21.65± 1.30*
Creatinine	1.24± 0.02	1.29± 0.02	1.31± 0.02	1.32± 0.03	1.29± 0.03	1.57± 0.11*
Glucose	95.18± 3.60	102.06± 5.00	108.62± 1.97	121.00± 1.71**	117.25± 1.86	122.38± 1.01

Data are presented as mean ± S.E

* : (P <0.05)
** : (P<0.01)
*** : (P<0.001)

S.E = Standard error

Table (6) : Mean values of total body weight and daily body gain in male New Zealand white rabbits under the effects of drinking iodine-treated tap water and ground water .

Animal groups Growth performance (gm)	Untreated tap water	Iodine- treated tap water	Untreated ground water
1) 4-8weeks of age :			
Initial body weight	539.50± 39.74	537.50± 33.34	532.50± 37.73
Body weight at 8 weeks of age	1106.00± 40.61	1170.00± 43.92	1039.50± 39.94
Daily body gain	20.23± 1.41	22.59± 1.25	18.11± 1.23
2) 8-12 weeks of age :			
Body weight at 12 weeks of age	1886.38± 43.05	1994.59± 45.15	1808± 42.12
Daily body gain	27.87± 2.11	29.45± 2.35	27.45± 1.98
3) 12-16 weeks of age :			
Body weight at 16 weeks of age	2416.61± 45.65	2695.63± 47.75	2321.33±43.75
Daily body gain	18.94±1.01	25.04±1.01**	17.62±1.21

Data are presented as mean ± S.E. S.E.= Standard error **: (P<0.01).

Table (7) : Mean values of carcass weight and organ weights in male New Zealand white rabbits under the effect drinking iodine-treated tap water and ground water.

Animal groups Organ weights (gm)	Untreated tap water	Iodine-treated tap water	Untreated ground water
Carcass weight	1409.27± 44.63	1803.32± 51.51**	1295.76± 45.71
Liver	73.33± 2.79	94.17± 2.01**	70.00± 3.16
Heart	7.59± 0.67	8.29± 0.40	7.21± 0.40
Kidney	23.02± 1.76	29.19± 2.53*	26.5± 1.00
Spleen	1.80± 0.17	1.88± 0.18	1.48± 0.23

Data are presented as mean ± S.E S.E = Standard error *: (P<0.05) , **: (P<0.01).

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تأثير الماء المعالج باليود واختلاف مصادر المياه على بعض التغيرات البيوكيميائية والفسيولوجيا فى دم الأرانب النيوزيلاندية البيضاء

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تم اجراء هذا البحث على 24 من ذكور الأرانب النيوزيلاندية البيضاء بعد عمر الفطام وكانت أعمارها فى بداية التجربة 4 أسابيع وقد استهدف هذا البحث تأثير إضافة اليود وتأثير شرب المياه الجوفية على بعض القياسات الدموية ومعدل النمو فى الأرانب، تم تقسيم هذه الأرانب إلى ثلاث مجموعات فى كل مجموعة 8 أرانب حسب مصادر المياه المستخدمة للشرب . المجموعة الأولى مياه من الصنبور معالجة باليود، المجموعة الثانية مياه من الصنبور غير معالجة، المجموعة الثالثة مياه غير معالجة جوفية. تم تجميع عينات الدم من هذه المجموعات كل 4 أسابيع حتى عمر 16 أسبوع من بداية التجربة وفى كل المجموعات السابقة تم تقدير بعض القياسات الدموية وهرمون الثيروكسين ومعدل النمو . وقد أسفر البحث عن النتائج التالية:-

زيادة معنوية فى تركيز الكالسيوم والمنجنيز والصوديوم والنحاس فى دم المجموعة الأولى، كما وجد زيادة معنوية فى مستوى هرمون الثيروكسين والجلوكوز والألبيومين بينما انخفض تركيز الدهون الكلية والكلستيرول والكرياتينين بالمقارنة بالمجموعة الثانية. كما إزداد وزن الجسم ومعدل الزيادة اليومية فى الوزن ووزن الكبد والكلى بعد استخدام الماء المعالج باليود (المجموعة الأولى) أما بالنسبة للمجموعة الثالثة فقد زاد تركيز الكالسيوم والمنجنيز والبوتاسيوم بينما انخفض تركيز الفسفور والنحاس والزنك. كما انخفض أيضاً مستوى هرمون الثيروكسين والدهون الكلية والكلستيرول واليوريا فى الدم بالمقارنة بالمجموعة الثانية، بينما زاد البروتين الكلى والألبيومين والكرياتينين والجلوكوز. كما لوحظ عدم وجود فروق معنوية بين المجموعة الثالثة والثانية بالنسبة لوزن الجسم ومعدل الزيادة اليومية لوزن الجسم ووزن الذبيحة.

من هذه النتائج يمكن استخلاص أن إضافة اليود إلى مياه الصنبور بمعدل 5 جزء فى المليون يزيد من معدل النمو ووظيفة الغدة الدرقية وبعض القياسات الدموية التى تم قياسها، كما أوضحت النتائج أن استخدام المياه الجوفية فى الشرب قد أثر على مستوى بعض القياسات الدموية فى دم الأرانب.