Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 4, 2021, Pages. 2506 – 2520
Received 05 March 2021; Accepted 01 April 2021.

Effect of Selenium and Zinc Doses and Interaction between Them on Production Performance and Some Carcass Traits of Awassi Lambs

Yazin A.M.Al-Taie and Mozhir K.K.Almahdawi
Department of Animal Production /College of Agriculture and Forestry, University of Mosul/Iraq.
mozhir2007@uomosul.edu.iq

Abstract

This experiment was conducted in breeding field of sheep that belong to Department of Animal Production / College of Agriculture and Forestry, University of Mosul. The aim of this study was to find out effect of oral dosing of selenium and zinc, and interaction between them on productive performance and some of carcass characteristics of fattening Awassi lambs that lasted for 90 days period. Twenty-four heads of Awassi lambs (males), were selected for this study with close ages ranging between 5.5-6 months, and their initial weights were similar at beginning of experiment, Where average of initial weight ranged between 21.00 - 22.56 kg.The lambs were randomly distributed into four treatments with rate of six lambs per treatment, the first treatment was called a control treatment, and second treatment of lambs was dosed by using oral dosing method, at a dose of 0.5 mg of selenium per head, and the dose was repeated three times a week, the third treatment of lambs was dosed by mouth with 50 mg of zinc/head, and this dose was repeated three times per week, and fourth treatment was dosed by mouth with combination of selenium and zinc in the same previous doses, and dosing process was repeated three times per week for each head.All lambs consumed a standardized, concentrated diet consisting of 55% crushed black barley, 37.5% wheat bran, 5% wheat straw, 0.5% urea, 1% salts and limestone, with a protein level of 13.65% and metabolize energy level of 2619 K_{cal} of this concentrated diet. The results of current study indicated that there were high significant differences ($P\leq0.01$) in rates of final weight, empty body weight, daily and total weight increases between control than for lambs treated with selenium, zinc and interaction between them. The rates of initial weight of lambs were 22.273, 22.776, 22.423, 22.686 Kg and final weight 37.656, 38.493, 41.346, 43.250 kg and empty body weight 34.353, 35.156, 37.997, 39.533 kg ,daily weight gain 170, 174, 210, 228 gm /day and total weight gain 15.383, 15.717, 18.923, 20.563 kg/lamb for four transactions.As for carcass characteristics, the results showed high significant differences ($P\leq0.01$) in rates of hot and cold carcass weights between control treatment than for experimental treatments of lambs with dosed of selenium and zinc and interaction between them. The average of hot carcass weight was 18,606, 19,846, 20,733, 21,406 kg, and cold carcass weights were 18,326, 19,548, 20,422, and 20,811 kg of four treatments according to the order. On the other hand, results indicated that there was a significant effect ($P\leq0.05$) of cross-dose on rates of ocular muscle area, subcutaneous fat layer, and dressing percentage relative to live weight of lambs between selenium and zinc than for control treatment. Also, results showed significant effect($P\leq0.05$) of dosing with selenium and zinc and overlap between them than for first treatment without dosing (control) in rates of weights of thighs, ribs, shoulders and back (major cuts) and forearm weight of secondary cuts of Awassi lambs for four treatments according to sequence. We conclude from this study that dosing of lambs with selenium and zinc and interaction between them led to emergence of a significant superiority on lambs growth and daily weight gains, total weight gains. The significant improvement was reflected in weight gain of the lambs that treated with selenium and zinc and interaction between them showed a significant improvement on weights of the hot and cold carcass weights of major cuts , area of ocular muscle, and a significant decrease in two characteristics of thickness of the subcutaneous fat layer and proportion of the dressing attributed to the live weight compared to the control treatment.

Keywords: selenium, zinc, oral dosage, growth of lambs, carcass traits.

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 4, 2021, Pages. 2506 – 2520
Received 05 March 2021; Accepted 01 April 2021.

Introduction

Some studies (Solaiman et al., 2006) indicated that mineral elements are necessary, albeit in very small proportions for ruminants.Because most forage plants contain different ratios of trace elements necessary for health and growth and to maintain the highest productivity of animals in processes of metabolism, growth and reproduction. Moreover, they stimulate to work of enzymes in processes of digestion, absorption and metabolism (Princewill et al., 2015). While other studies (Hassan et al., 2017 and Palani et al., 2018) indicated that it is necessary to add mineral elements to the feed or by oral dosing of sheep for their role in protecting body cells from free radical damage due to their role as an inhibitor of fatty acid oxidation as well as to maintain the health of animals and improve their production performance. Among the mineral elements necessary for the growth that require provision for animals is selenium, which is an essential and necessary component for growth and maintenance of production and reproduction of ruminant animals.Also, it participates in metabolism and stimulates activity of immune system of the body (Zurczynska et al., 2013) and it has a great association with zinc and copper in blood serum, it is a trace element that affects the metabolism and health status of animals (Palani et al., 2018). Also, selenium stimulates growth and activates the work of enzymes of the animal's body, as it is included as part of the enzyme glutathione peroxidase (GPX) glutathione peroxidase in processes of oxidation and reduction, as it works as an antioxidant defense system if it maintains animal and human health (Fayiz and Hatem, 2017) which indicates that it is associated with glutathione in blood (Belstein and Whanger, 1986) and is involved in many enzymatic reactions in metabolism of body tissues. Therefore, selenium is considered to be a required factor for protein synthesis (Pavlata et al., 2009). Its lack of feeds for ewes and their lambs causes great losses of sheep industry, difficulty in feeding and inactivity, and a high level of fragility of red blood cells of lambs (Abood et al., 2012). It was found that an injection in the last months of pregnancy for ewes led to a significant increase in number of white blood cells, enhanced the activity of the body's immune system and the elimination of some types of cancer, which was reflected in the improvement of the productive performance and health status of the animal (Soliman et al., 2012).

As for zinc, it is the minor largest trace mineral element, as it promotes growth and participates in reproduction of animal's body and is distinguished by that it cannot be stored in animal's body **(**Swain et al., 2016). Therefore, it is necessary to administer to the animal, either in addition to feed or via oral dosing, due to its role as an antioxidant, as it acts as a cofactor for many enzymes and participates in many biological reactions (Peter et al., 2003). It was also found that zinc is necessary for growth hormone, as it plays an important role in metabolism process and activates work of enzymes that contribute to creation of new red blood cells instead of ones that are lost (McDowell,2013).At the same time, zinc is one of the essential elements that ruminants need in performing their vital functions in growth and reproduction, enhancing activity of the immune system and causing genetic mutations (Underwood and Suttle, 1999). Zinc also participates in cell defense system against oxidative stress and therefore animals need it because of its effectiveness in activating work of enzymes and proteins that contribute to the synthesis of vitamin A and the excretion of carbon dioxide out of the body. It also destroys free radicals and maintains stability of the red blood cells (RBC) membranes. As Baltaci et al. (2004) showed that zinc is essential for growth and moreover, it improves daily feed intake, feed conversion efficiency and weight gain for lambs treated with zinc.Also, Kundu et al.,(2014) was found that adding zinc in sheep's diet which leads to a significant improvement in productive and reproductive performance and food conversion efficiency of sheep. In another study, Al-Joulaq (2020) was found significant differences between lambs groups treated with zinc compared to the control group in rates of final weight, empty body weight, daily and total weight gain and some of carcass characteristics.

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 4, 2021, Pages. 2506 – 2520
Received 05 March 2021; Accepted 01 April 2021.

Moreover, zinc has other vital functions which are very necessary. It stimulates growth and cell division processes and the perpetuation of reproductive epithelial cells necessary for development of the fetus **(**Hostetler et al. 2003 and Robinson, 2006). In another study, Palani et al. (2018) found significant improvement in daily and total weight and feed conversion efficiency for zinc, selenium and mixed supplementation compared to the control group.The research problem relates to fact that zinc and selenium are among the most deficient minerals in the diets of farm animals, and because they are of great importance through their essential role in a significant improvement in growth, productive and reproductive performance, and food conversion efficiency of sheep (Page et al., 2016). Therefore, it is necessary to administer the two elements (zinc and selenium) to sheep, as their deficiency causes changes in animal behavior and growth (Ebrahim et al., 2016).

Therefore, this study aimed to know effects of selenium and zinc dosing and synergy between them on productive performance of lambs and some of the carcass characteristics of the Awassi lambs.

Materials and work Methods

This experiment was implicated on 24 of Awassi lambs (males) were selected with very close ages between 5.5-6 months, as well as same in rates of initial weight with ranged between 21.00-22.56 kg at beginning of the experiment. All lambs were placed in a large semi-enclosed hall in animal field, which administratively and technically follows for Animal Production Department, College of Agriculture and Forestry/ University of Mosul and this hall contains from inside on many small compartments of which four of them were exploited, and these compartments are equipped with metal feeds and manholes for drinking water, and floor of the barn was made of cement and slightly sloping to drain old water. This experiment included oral dosing of Awassi lambs with doses of selenium, zinc, and a mixture of two mineral elements, to study effects of selenium and zinc on production characteristics, some carcass characteristics, and some blood characteristics. During the experiment, all lambs consumed a standard concentrated diet with identical levels of crude protein and energy represented (table 1), to get used to eating concentrated feed, and then an increase in daily food intake was performed and I follow in feeding lambs is method of group feeding in form of free feeding ad lib for groups of these lambs, where concentrated feed is presented daily in two meals, the first at eight in morning and the second at four in evening, and next morning and before morning meal for the lambs is presented, the remaining feed is collected of animal feeders and weighed with a scale for feed to calculate amount of daily feed intake for each group separately, and this process continued throughout the duration of experiment. Moreover, all the lambs went out daily to graze for four hours to eat short grasses as coarse green fodder and to obtain vitamin A found in green fodder in the pastures. The lambs were randomly distributed into four weight groups, which were similar in live weight. Then these weighted totals were distributed randomly into four parameters as follows:

First treatment (control diet): without dosses of selenium and zinc.

The second treatment: The lambs was dosed with selenium at 0.50 mg /head for three times per week.

The third treatment: The lambs was dosed with 50 mg/lamb of zinc for three times per week.

Fourth treatment: It was dosed with combined with selenium and zinc at the same doses for three times a week.Each group has its own treatment. A statistical analysis of initial weights was performed to ensure that there were no significant differences between the mean of the initial weights and that there were no individual differences between lambs groups at the beginning of the experiment.

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 4, 2021, Pages. 2506 – 2520
Received 05 March 2021; Accepted 01 April 2021.

Table 1.The components of concentrated diet and its chemical analysis in fattening experiment of Awassi lambs.

Items	Percentage
1. Black barley .	55
2. Wheat bran .	37.50
3. Wheat straw .	5
4.Urea .	0.05
5. limestone .	1
6. Salts .	1
Total	100%
Chemical composition	
1.Dry matter (%).	98.04
2.Crude protein (%).	13.65
3. Ether Extract (%).	2.54
4.Crude Fiber (%).	10.17
5.Ash (%).	4.82
6.Nitrogen Free Extract (%).	66.86
7.Metabollize Energy (%).	2619

Chemical analysis of concentrated suspensions according to Al-Khawaja et al., (1978).

* The percentage of dry matter in concentrated diet was estimated according to Perry et al., (2004).

At the end of experiment period, The lambs was fasting for 12 hours before slaughter of all lambs, and on next day the slaughtering process was conducted for lambs.Then carcasses were cut into major pieces (thigh, loin, ribs and shoulders) and secondary pieces (neck, chest, loin and forearm) according to cutting shown by ABDUL RAHMAN et al.,(2013).Also, the dressing percentage was calculated by two methods, the first was on basis of percentage of cold carcass weight, and second method was related to weight of empty body (Al Jalili et al.,1985, Gardner et al.,2015). The area of ocular muscle on cuts between twelfth and thirteenth ribs according to reported of Rouse et al., (1970) and Jaqoub et al.,(1987) and Al-Joulaq, (2020).Also was measured by means of translucent drawing with several small and sequential squares and the area of each of them is 1 cm by matching this translucency along the boundaries of the ocular muscle, the area of ocular muscle was calculated, and thickness of fat layer over twelfth rib was measured by taking an average of three readings with a small transparent ruler. Statistical analysis of the data was performed by method of complete randomized design (C.R.D.), Completed Randomized Design according to stated of AL-Zubaidy and AL-Falahy, (2016), in order to find out effect of doses of selenium and zinc and overlap between them on the studied traits. The statistical analysis and comparison of the significant differences was carried out using the Duncan test (1955) polynomial method between means of the studied traits through application of the statistical program (SAS, 2012) by using an electronic computer.

Results and Discussion

The results of this study included studied traits which were some it was before the slaughter and others what was after slaughtering of the lambs, and its results can be explained as follows:

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 4, 2021, Pages. 2506 – 2520
Received 05 March 2021; Accepted 01 April 2021.

1.Productive performance of Awassi lambs:

The results of this study indicated in table (2) that Awassi lambs used at the beginning of this experiment were highly homogeneous in live weight, size and age. For this reason, the statistical analysis did not showed significant differences in rates of initial weight between four groups of lambs. The initial weight of lambs at beginning of the experiment was 22,273, 22,776, 22,423, and 22,686 kg for four treatments respectively.As for final weight of lambs, the results reported a high significant effect ($P \leq 0.01$) between first, second,third treatments than for the fourth treatment.The result was in favor of second, third and fourth experimental treatments, compared to the first group (control). The final weight averages were 37,656, 38,493, 41,436 and 43,250 kg for four treatments, respectively. The empty body weight of the lambs was calculated by knowing weight of the rumen contents minus of the final weight of lambs before slaughtering in this experiment (Al-Jalili et al.,1985). Among the results presented in table (2), it indicated existence of highly significant differences ($P \leq 0.01$) on empty body weight between the first and second treatments than for the third and fourth treatments.The rates of empty body weight reached 34,353, 35,156, 37.997 and 39,533 kg for four treatments respectively. As for daily and total weight increase of lambs, the results shown in table (2) high significant ($P \leq 0.01$) superiority in favor of the second (selenium) and third treatments (zinc) and the fourth (synergism of selenium and zinc) as measured by first treatment free of selenium and zinc. The daily weight increase was 170, 174, 210, 228 g / day, and total weight increase was 15.383, 15.717, 18.923, 20.563 kg/head for four treatments, respectively. It was noted from the performance and growth results of lambs in table (2) a highly significant superiority ($P \leq 0.01$) in final weights and empty body weights , and daily and total cumulative weight increase in favor of lambs treated with selenium and zinc and mixing between them compared to the control group. The reason for this is due to selenium and zinc, which to work in breaking down the celleloselic bonds in e food intake, and this leads to activation of the activity of microorganisms in the rumen of lambs and thus they work to maintain the microbial balance within the rumen environment and thus lead to improving the efficiency of nutritional conversion and thus improving response of the lambs to deposition of muscle tissue in different tissues of lambs body during development, thus improving daily and total weight gain of Awassi lambs (Hilal et al., 2016 and Ballantine et al., 2002). In terms of effect dosing lambs with selenium in improving overall weight gain of lambs, the reason may be due to role of selenium in protecting immune cells and increasing their efficiency, which leads to production of large quantities of immune bodies (Ig) of lambs and thus increase their weight, which in turn leads to an increase in animal's health level (Al-Tamimi; 2001). These results are consistent with results of Radostits (1999), Abdel-Ghany et al. (2008), Rodinova et al. (2008) who found significant differences in rates of weight gain between the lambs groups treated with selenium and zinc than the control group. The results agreed with Abrahem et al. (2019) who found significant differences in final weight and weight gain in favor of Awassi lambs groups that were dosed with different proportions of selenium - vitamin E compared to comparison group without dosing with selenium-vitamin E.Also,the results were consistent with results of Dhari and Kassim, (2019) who observed a significant increase in rates of weight gain of Awassi lambs in favor of Awassi lambs groups to which selenium and vitamin E were added in fattening diets compared to control group without addition of selenium and vitamin E in an experiment that lasted for 90 days. These results are inconsistent with the results of Hernandez-Calva (2013) and Sushma et al. (2015) and Abdou (2019) who did not notice any significant effect of selenium by dosing in mouth of lambs on weight gain rates among groups of lambs treated with selenium over the control group. With regard to amount of daily feed intake and efficiency of the feed conversion of Awassi lambs, the analysis of the two characteristics was not performed due to the grouping feeding of groups of lambs in this experiment

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 4, 2021, Pages. 2506 – 2520
Received 05 March 2021; Accepted 01 April 2021.

(table 2). The daily feed intake was 1,250, 1,360, 1,380, and 1.467 kg of feed/day, and efficiency of feed conversion was 7.31, 7.78, 6.56, and 6.42 kg of feed / kg of weight gain, respectively.The results of this study were identical with what was reported by Mallaki et. al., (2015), Towaje et al., (2018), Ramadan et. al., (2018) who found a significant increase in rates of daily and total weight gain of animals when dosed with zinc compared to the control group. These results differed with results of the Turnera et al., (2005), Mei et al. (2009), Tameem Eldar (2012), Olivia et al. (2018), Budde et. al., (2019) who observed an insignificant arithmetic improvement in rates of daily weight gain when adding zinc in animal diets used in their scientific experiments. .

Table2.Effects of doses of selenium, zinc and combination between them on productive performance of Awassi lambs.

The studied traits	1st treatment (control)	2nd treatment (Selenium)	3rd treatment (zinc)	4th treatment Combination (selenium + zinc)
1. Number of lambs:	6	6	6	6
2. Initial weight^{NS} (kg).	22.273 ± 0.46A	22.776 ± 0.36 A	22.423 ± 0.55 A	22.686 ± 0.21 A
3. Final weight (kg).**	37.656 ± 0.31 C	38.493 ± 0.01 C	41.346 ± 0.17 B	43.250 ± 0.90 A
4.Empty body weight (kg)**	34.353 ± 0.91 B	35.156 ± 0.41 B	37.997 ± 0.41 A	39.533 ± 1.25 A
5.Daily weight gain (gm/day)**	170 ± 7.66 B	174 ± 3.84 B	210 ± 8.08 A	228 ± 11.34 A
6.Total weight gain (kg)**	15.383 ± 0.68 B	15.717 ± 0.35 B	18.923 ± 0.72 A	20.563 ± 1.02 A
7.Amount of feed intake: (Kg/day).	1.250	1.360	1.380	1.467
8.Feed conversion : (kg feed/ kg overweight)	7.31	7.78	6.56	6.42

An adjective whose mean carries different letters within horizontally indicates significant differences at probability level of 0.05 or 0.01. NS: The differences are not significant. * The differences are significant at probability level of 0.05. ** The differences are high significant at a probability level of 0.01.

2. Carcass characteristics :

From a careful review of results in table (3),it was found that there were high significant differences (P≤0.01) in rates of hot and cold carcass weights for Awassi lamb between the first (control) and second (selenium) treatments than for third (zinc) and fourth treatments (selenium + zinc).While there were no significant differences between the third and fourth treatments in above two traits in (table 3).The average weight of the hot carcass was 18.606, 19.846, 20.733, 21.406 kg, and the cold carcass weight was 18,326, 19,548, 20,422 and 20,811 kg for four treatments according to sequence. The observed results in table (3) emergence of a highly significant improvement (P≤0.01) in averages of the two characteristics of hot and cold carcass weight in favor of treatments with selenium and zinc and mixing between them. Perhaps the reason for this is significant superiority in final weights of lambs treated with the method of oral selenium and zinc dosing and interfering between them in results of this study (table 2), this significant increase in weight of the animal before slaughtering the lambs was reflected in appearance of significant increases in rates of the weight of the hot and cold carcass.The second reason may be due to the fact that dosing the lambs with zinc has led to the activation of bacteria in the rumen, which contributed to the improvement of the digestibility factor of the food compounds and thus played an important role in activating the processes of absorption and metabolism

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 4, 2021, Pages. 2506 – 2520
Received 05 March 2021; Accepted 01 April 2021.

in the tissues of the lambs' body and thus this was reflected in the weights of hot and cold carcasses (Towaje et al., 2018). There is another reason that explains the significant increase in the weights of hot and cold carcasses, due to the presence of a highly significant positive correlation coefficient ($P \leq 0.01$) between the final weight of the lambs and the weights of hot and cold carcasses (0.93, 0.93) (table 4).Mahmood et al.,(2018) was supported the results of this study, who found significant superiority in the rates of hot and cold carcass weights in favor of groups of Awassi lambs that were dosed with different levels of selenium (low, medium and high) compared to control lambs (barley).Also,the results of current study came in agreement with the results of Al-Joulaq, (2020) who noticed a significant improvement in rates of the weights of hot and cold carcasses in favor of lambs that were dosed with selenium and zinc compared to the control group.In terms of zinc, the results came from Mahmood et al.,(2018) and Budde et al.,(2019) who found significant differences in two characteristics of hot and cold carcass weight between animals groups treated with zinc compared to the group not treated with zinc (control).The results of this study did not agree with results of some studies (Salman and Yildiz 2009, Gabryszuk et al., 2009, Hernandez-Calva et al.,2013, Netto et al.,2013, Olivia et al.,2018) who observed the disappearance of the significant differences in mean hot and cold carcass weights between groups of treated lambs and change the treatment with selenium and zinc. As for the averages of ocular muscle area and thickness of the subcutaneous fat layer deposited in lamb carcasses mentioned in table (3), the results of the current study confirmed the existence of a significant superiority ($P \leq 0.05$) in averages of the ocular muscle area between the first treatment without dosing with selenium than for last treatment**.** On the one hand, the results showed a significant decrease in the thickness of the subcutaneous fat layer deposited in the lambs' carcasses in treatments in which the lambs were dosed with selenium and zinc from the treatment without dosing.The average of ocular muscle area was 10.00 12.25, 13.45, 15.30 cm^2 and thickness of the subcutaneous fat layer were 6.70, 6.32, 6.25, and 5.77 mm for four treatments according to the sequence. The results of this experiment indicate a significant superiority ($P \leq 0.05$) on the ocular muscle area characteristic of experimental lambs treated with selenium and zinc, compared to control group. The significant increase in the area of the ocular muscle is due to the significant increase in the ratios of muscle and bone marrow in components of the physical inventory of carcasses at the expense of the proportion of fat (Al-Joulaq,2020). In the other direction, a significant decrease ($P \leq 0.05$) in thickness of the subcutaneous fat layer in the carcasses of lambs that were dosed with selenium and zinc compared to the group of lambs that were not dosed with selenium and zinc was attributed to this inverse relationship between the ocular muscle area and the thickness of the fat layer in the result of this study (Turner and colleagues, 2002, Maict and colleagues, 2003, Mairorao and colleagues, 2007 and Zhao et al., 2013).The results of this study are in agreement with the findings of some studies (Gabryszuk et al. 2014 and Al-Joulaq 2020) who reported a significant effect of selenium and zinc in lambs on averages of the ocular muscle area. Also,The results coincide with results of Bottger et al.,(2018) and Zhao et al. (2013) and Mahmood et al.,(2018) who confirmed in their results that dosing lambs with zinc showed a significant effect on the rates of subcutaneous fatty layer thickness. As for the dressing percentage, calculated in two methods, the first was calculated on basis of the live body weight of the lambs, and the second was on basis of the empty body weight (Al-Joulaq, 2020). The results presented in table (3) indicated that there were significant differences ($P \leq 0.05$) between the second treatment (selenium) and the last treatment (combined synergies between selenium and zinc) in mean dressing percentage calculated on the basis of live body weight. The dressing percentage calculated by the first method of Awassi lambs was 48.66, 50.78, 49.39 and 48.16% for four transactions, respectively. The emergence of the significant differences in rates of dressing percentage that calculated in the first method may be

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 4, 2021, Pages. 2506 – 2520
Received 05 March 2021; Accepted 01 April 2021.

attributed to significant differences in rates of final weight of lambs in the result of this study mentioned as a result of this study (table 2).

Table 3.Effect of doses of selenium, zinc and combination between them on some of carcass characteristics of Awassi lambs.

The studied traits	1st treatment (control)	2nd treatment (Selenium)	3rd treatment (zinc)	4th treatment Combination (selenium + zinc)
1.Hot carcass weight (kg)**	18.606 ± 0.16 C	19.846 ± 0.16 B	20.733 ± 0.07 A	21.406 ± 0.48 A
2.Cold carcass weight(kg)**	18.326 ± 0.15 C	19.548 ± 0.16 B	20.422 ± 0.07 A	20.811 ± 0.36 A
3.Ocular muscle area(cm^2)*	10.00 ± 1.60 B	12.25 ± 0.45AB	13.45 ± 0.60 AB	15.30 ± 0.60 A
4.Subcutaneous fat under layer skin*	6.70 ± 0.90 A	6.32 ± 0.10 AB	6.25 ± 0.85AB	5.77 ± 0.05 B
5.Redemption percentage on basis of live weight(%)*	48.66 ± 0.23 AB	50.78 ± 0.42A	49.39 ± 0.15AB	48.16 ± 1.41B
6.Redemption percentage on basis of empty body weight (%)NS	53.40 ± 1.01 A	55.61 ± 0.86 A	53.75 ± 0.48 A	52.75 ± 1.8 9 A

An adjective whose mean carries different letters within horizontally indicates significant differences at probability level of 0.05 or 0.01. NS: The differences are not significant. * The differences are significant at probability level of 0.05. ** The differences are high significant at a probability level of 0.01.

3. Carcass cuts

The results of this experiment indicated a significant improvement (P≤0.05) in weights of main cuts in favor of lambs that were dosed with selenium and zinc and the overlap between them (table 4), as significant differences were observed (P≤0.05) in mean thigh weights between control lambs treatment than over zinc treatment in third treatment, and on the other hand, between the first treatment without the doses of selenium and zinc compared to the last treatment (selenium + zinc) in average of ribs weights. As for averages weights of back and shoulder, the results of current study presented in table (4) showed high significant differences (P≤0.01) in average of back weights between the first (control) treatments, second (selenium) than for third (zinc) and fourth treatments (selenium + zinc)**.** Also,It was observed that there were high differences in mean shoulders weights between control treatment than for second, third and fourth treatments in which lambs were dosed with selenium and zinc and overlap between them . As for rates of ribs and forearm weights, the results of statistical analysis indicated that there was a significant effect of dosing of selenium and zinc between the first treatment and the last treatment.

With regard to effect of dosing on selenium and zinc, and the interaction between them on weights of the minor cuts presented in table (4), where the results of statistical analysis indicated the emergence of significant differences (P≤0.05) in weight of the forearm between the first treatment (control) compared

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 4, 2021, Pages. 2506 – 2520
Received 05 March 2021; Accepted 01 April 2021.

to the last treatment. As for the other parts of the minor cuts of Awassi lamb carcasses, the statistical analysis did not show any significant effect of dosing of selenium and zinc and joint synergies between them on average weights of the neck, chest and flank (table 4).The average of legs weights were 4.124, 4.583, 4.825, 4.408 kg, back 2.703, 2.081, 3.071, 3.289 kg, shoulders 2.227, 2.663, 2.743, 3.422 kg, ribs 3.149, 3.497, 3.476, 3.571 kg, neck 1.285, 1.518, 1.402, 1.503 kg and chest. 0.991, 1.161, 1.063, 1.378 kg, forearm 512.67, 564.00, 539.35, 583.32 gm and loin 0.924, 1.007, 1.084, and 1.051 kg for four transactions respectively.The above results indicate significant superiority and mathematical improvement in most of weights of major and minor cuts carcass in favor of the selenium and zinc treatments and overlap between them compared to the control treatment. The reason is perhaps that selenium is an active antioxidant substance and contributes to formation of protein tissues in the animal's body and this leads to an improvement in weight gain of lambs treated with selenium compared to a group of control lambs (Mahmood et al. 2018 and Al-Joulaq, 2020), in addition, another reason may be due to the significant positive correlation coefficients between the weights of the major cuts carcass (thighs, back, shoulders and ribs) and the final weight of lambs in the result of this study, which amounted to (0.32, 0.69, 0.53, 0.81) shown in table (5). The significant differences in weight of the forearm, which is a secondary cut of the carcasses, were attributed to significant positive correlation coefficients between the final weight of the lambs and weight of the forearm (table 5), which amounted to (0.57). In terms of the role of zinc in significant improvement of the main and secondary cuts weights in Awassi lambs, the reason is due to the role of zinc as a stimulant agent in muscle building in deposition of protein tissues in the body of animals treated with zinc compared with the control treatment (Towaje et al. 2018). As for the reason for the non-appearance of significant differences in some weights of the minor cuts such as neck, chest, loin in slaughtered lambs treated with selenium, zinc and the mixture between them (table 5), the reason is due to the presence of a non-significant mathematical correlation coefficient between the final live weight of the lambs and the weights of the neck,chest and loin in the slaughtered of Awassi lambs which it was (0.44, 029, 0.57) respectively.The results were consistent with the results of some studies (Gabryszuk et al. 2014, Mahmood et al. 2018, Al-Joulaq, 2020) who found significant differences in mean of weights of thighs, back, shoulders, ribs and forearm in the treatments in which the animals were dosed with selenium compared to the control treatment without dose. The results was agreed with the results of Elokil et al., (2019) who observed significant differences in rates of major and minor cuts weights between groups of lambs treated with zinc compared to the control group.

Table 4.Effect of doses of selenium, zinc and combination between them on major and minor of cuts carcass of Awassi lambs.

The studied traits	1st treatment (control)	2nd treatment (Selenium)	3rd treatment (zinc)	4th treatment Combination (selenium + zinc)
1.Weight of thighs (kg)* .	4.124 ± 0.04 B	4.583 ± 0.21 AB	4.825 ± 0.22 A	4.408 ± 0.05 AB
2.Weight of loin (kg)** .	2.703 ± 0.03 B	2.081 ± 0.12 C	3.071± 0.06 A	3.289 ± 0.16 A
3.Weight of shoulders (kg)**	2.227 ± 0.03 B	2.663 ± 0.32 B	2.743 ± 0.17 B	3.422 ± 0.13 A
4.Weight of ribs (kg)* .	3.149 ± 0.09 B	3.497 ± 0.21 AB	3.476 ± 0.04 AB	3.571 ± 0.04 A
5.Weight of neck (kg)NS .	1.285 ± 0.06 B	1.518 ± 0.12 A	1.402 ± 0.06 A	1.503 ± 0.11 A
6. Weight of chest (kg)NS .	0.991 ± 0.11 A	1.161 ± 0.06 A	1.063 ± 0.03	1.378 ± 0.22 A
7. Weight of forearm (gm)* .	512.67 ± 6.74 B	564.00 ± 21.28 A	539.35 ± 8.21 AB	583.32 ± 18.00 A

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 4, 2021, Pages. 2506 – 2520
Received 05 March 2021; Accepted 01 April 2021.

8. Weight of flank (kg)^{NS}.	0.924 ± 0.04 A	1.007 ± 0.23 A	1.084 ± 0.05 A	1.051 ± 0.09 A

An adjective whose mean carries different letters within horizontally indicates significant differences at probability level of 0.05 or 0.01. NS: The differences are not significant. * The differences are significant at probability level of 0.05. ** The differences are high significant at a probability level of 0.01.

Table 5. Correlation coefficients between final weight and major , minor carcass cuts of Awassi lambs.

The studied traits	Correlation coefficients
1.final weight × final weight^{NS}	1.00
2.final weight × hot carcass**	0.93
3.final weight × cold carcass**	0.93
4.final weight × thighs**	0.32
5.final weight × loin**	0.69
6.final weight × ribs*	0.53
7.final weight × shoulders**	0.81
8.final weight × neck^{NS}	0.44
9.final weight × chest	0.29
10.final weight × forearm*	0.57
10.final weight × flank^{NS}	0.29

NS: The differences are not significant. * The differences are significant at a probability level of 0.05.

** The differences are high significant at a probability level of 0.01.

We conclude from the results of the current study that administration of selenium and zinc, or both together, by oral dose for lambs, was higher significantly on rates of daily and total weight gain, hot and cold carcass weights, and ocular muscle area in experimental groups of lambs compared to non-treated control lambs.

Acknowledgment

I extend my thanks and gratitude to the Presidency of the Department of Animal Production, the Deanship of the College of Agriculture and Forestry and the Presidency of the University of Mosul for their efforts and their encouragement for us who helped us in completion of this research.

References

1. Abdel-Ghany,H.;LpezArellano,A.E.;RevillaVazquez,R.;Ramirez-Bribiesca,A.andTortora-perez,E.J. .2008.Effect of pre and postpartum selenium supplemention in sheep,J.Anim.Vet ,Adv.7: 61-67.
2. Abdou,R.Ahlam,.2019.Effect of selenium and vitamin E injection on nutritive value and performance of Baladi doe goats in Southern Sinai. Australian Journal of Basic and Applied Sciences; 13(5): pages 11-25 ,DOI: 10.22587/ajbas.2019.13.5.2. Cairo,Egypt.
3. ABDUL-RAHMAN,SHAMSUR REHMAN,SOHAIL AKHTAR ABDULLAH,MUHAMMED SUBHAN QURESHI AND SAEED UR RAHMAN,.2013.DETERMINATION OF MEAT YIELD AND DRESSING PERCENTAGE OF TURKI, AFGHAN ARABI AND BALUCHI SHEEP BREEDS IN AFGHANISTAN. Sarhad J. Agric. Vol.29, No.1, 113-117.,Peashawer ,Pakistan.

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 4, 2021, Pages. 2506 – 2520
Received 05 March 2021; Accepted 01 April 2021.

4. Abood,H.K;A.,M.H.Judi,;A.A.AL-Ani,.2012.The effect of experimentally induced vitamin E and selenium deficiency on Creatine Kinase (CK) and Aspartate Amino transferase (AST) activities in Awassi ewes and their newborn lambs. Kufa Journal For Veterinary Medical Sciences,(1),132-137.Iraq.
5. Abrahem, Mohammed. S.,Wissam. J.Mohammed and Wasem.K.Ahmead,.2019. EFFECT OF INJECTING DIFFERENT LEVELS OF VITAMIN E AND SELENIUM IN SOME PHYSIOLOGICAL CHARACTERISTICS OF BLOOD AND MILK YIELD AND COMPOSITIONS IN AWASSI EWES. Euphrates Journal of Agriculture Science-11 (2):7-11 , Mosul, Iraq.
6. Al-Jalili, Zuhair Fakhri, Atallah Saeed, Salwa Lilo Aziz, 1985. Production and Preservation of Meat, First Edition, Technical Institutes Foundation, Ministry of Higher Education and Scientific Research:p. 186.
7. Al-Joulaq,Nawfal Abdul-Ghani Mohammad Amin,.2020.EFFECT OF DOSSING OF ZINC AND VITAMIN E ON PRODUCTIVE PERFORMANCE, CARCASS CHARACTERISTICS AND SOME BIOCHEMICAL BLOOD OF AWASSI LAMBS. Master thesis. College of Agriculture and Forestry - University of Mosul / Iraq.
8. Al-Khawaja, Ali Kadhum and Elham Abdullah Al-Bayati and Samir Abdul Ahad Matti, 1978. Chemical composition and nutritional value of the feed materials, chemical composition and nutritional value of Iraqi feed materials. A bulletin issued by Nutrition Department - General Livestock Directorate- Agriculture and Agrarian Reform - Enlarged and Revised Third Edition- Baghdad - Iraq.
9. Almahdawi, Mozhir Kadhum Kaiber and Ossama Yousif Kashmoula, 2009. Effect of using various sources of energy in diet on productive characteristics and some of carcass characteristics of local lambs. Tikrit University Journal of Agricultural Sciences: 9 (2): 534-545.
10. Al-Tamimi, Muhammad Jassim Hassan, 2001. Effect of Vitamin E and Selenium on Reproductive Performance of Awassi Sheep.Master Thesis, Faculty of Agriculture,Baghdad University. Iraq.
11. Al-Zubaidy, K.M.D. and M.A.H.Al-Falahy,.2016.Principles and procrdures of statistics designs and experimental designs.Ministry of Higher Education,and Scientific Research, University of Duhok ,College of Agriculture.,page:(183-187).Kurdistan Region/Iraq .
12. Baltaci; A.K., R.Ku, Mogulkoc, I.A, Bediz, C.S, A.Ugur,.2004.Opposite effects of zinc and melatonin on thyroid hormones in rats. Toxicol. 195:69-75.
13. Ballantine, H.T., Socha, M.T., Tomlinson, D.D.A., Johnson, A.B., Fielding, A.S., Shearer, J.K.& S.R. Van Amstel. (2002) . Effects of feeding complexed Zinc manganese copper and cobalt to late gestation and lactating dairy cows on claw integrity, reproduction, and lactation performance .The Prof .Anim. Sci.,18(3): 211-218.
14. Belstein, M.; and P.D. Whanger ,.1986. Deposition of dietary organic and inorganic selenium in rat erythrocyte proteins. J. Nutr., 116: 1701-1710.

15. Bottger, J.D, D.L.Hixon, G.E. Moss, B.W. Hess, R.N. Funston and D.C. Rule,.(2018). Effect of feeding lambs high linoleat or high linoleatse alfflower seeds on fatty acid profiles of adipose tissue , milk and blood plasma of primiparous beef heifers.J.Anim.Sci.78(1): 275.

16. Budde, M. Ashley, Karen Sellins, Karen E. Lloyd , John J.Wagner, Jeff S. Heldt, Jerry W. Spears, and Terry E. Engle,.2019. Effect of zinc source and concentration and chromium supplementation on performance and carcass characteristics in feedlot steers. Article in Journal of Animal Science; doi: 10.1093/jas/skz016.Page (1-10),January,U.S.A .
17. Dhari,.A.,Emad & Waleed Y.Kassim,.2019. Effect of Adding Selenium with or Without Vitamin E and Combination of them on some of Productive and Physiological Characteristics of Awassi Lambs. Basrah J. Agric. Sci., 32(2): 115-125,Basrah,Iraq.
18. Duncan,DB.,1955.Multiple ranges and multiple 1st test.Biometrics; 11 : 1-12., USA.

19. Ebrahim, Z.K.; A.A. Goma; and M.A. Lebda ,.2016. Behavioral and biochemical alterations in sheep with trace elements deficiency: A trial for treatment.American Journal of Life Science Researches. 4: 93-103.

20. Elokil Abdel motaleb A.,Tharwat A. Imbabi, Hany I. Mohamed, Khaled F.M. Abouelezz, Omar Ahmed-Farid, Girmay Shishay, Islam, I. Sabike and Huazhen Liu,.2019. Zinc and Copper with New Triazine Hydrazone Ligand: Two Novel Organic Complexes Enhanced Expression of Peptide Growth Factors and Cytokine Genes in Weaned V-Line Rabbit. Animals 2019, 9, 1134; doi:10.3390/ani9121134 .

21. Faiz, M., and H. Hatem,. 2017. "Your guideline of cow's feeding" 1st print, pp: 178- 196.

22. Gabryszuk, M., H. Karina , J. Klewice Rearing,.2009.Fattening performance and slaughter indicators of lambs after selenium,zinc,vitamin E supplementation. Archiv Tierzzucht; 52 (3) : 309-320.

23. Gabryszuk,M.,E.Kuznicka,K.Horbanczuk and J.Oprazadek,.2014.Effects of Housing systems and the diet supplements on the slaughter value and concentration of mineral elements in the loin muscle of lambs.Asian Australas;J.Anim.Sci.vol.27.,vol.5.:726-732.

24. Gardner G.E,.A. Williams, A.J. Ball, R.H. Jacob, G.R efshauge, J.H ocking Edwards,R. Behrendt, D.W. Pethick .(2015) . Meat Science ; 99:89-98. Australia.
25. Hernandez-Calva, Luz Marina, J.Efren Ramirez-Bribiesca, Isabel Guerrero-Legarreta,Laura Hernandez-Cruz, Leonel Avendaño-Reyes, Ignacio Dominguez Vara and Lee,R. McDowell,.2013. Influence of dietary magnesium and selenium levels in finishing diets on growth performance and carcass meat quality of feedlot Pelibuey lambs. Archiv Tierzucht 56 : 30, 1-12.
26. McDowell,R.,.2013.Influence of dietary magnesium and selenium levels in finishing diets on growth performance and carcass meat quality of feedlot Pelibuey lambs. Archiv Tierzucht 56 (2013) 30, 1-12, Mexico City, Mexico.
27. Hassan, T.; W.Qureshi; S.A. Bhat; S. Majid; R.M. Mir; and P. Shrivastava,.2017. Study of serum levels of trace elements (selenium, copper, zinc, and iron) in breast cancer patients. International Journal of Clinical Oncology and Cancer Research. 2(4): 82-85.
28. Hernandez- Calva, LM., JE. Ramirez-Bribriesca, I.Guerrero-Legarreta, L.Hernandez -Cruz, I. Avendano –Reyes ,ID Vara, LR, Mcdowell,.2013.Influence of dietary magnesium and

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 4, 2021, Pages. 2506 – 2520
Received 05 March 2021; Accepted 01 April 2021.

selenium levels in finishing diets on growth performance and carcass meat quality of feedlot Pelibuey lambs. Arch. Fur Tierzuch, Arch. Animal Breed; 56 ; 303-314.

29. Hilal, E.Y.,Elkhairey, M.A.,E. & Osman, A.O.A,.2016.The role of zinc, manganse and copper in rumen metabolism and immune function; A review article. Open J. Anim. Sci., 6 (4): 304-324.

30. Hostetler,C.E, Kincaid R.L, Mirando M.A,.2003.The role of essential trace elements in embryonic and fetal development in livestock. The Veterinary Journal. 166:125-139.

31. Jaqoub, Salem Fadel, Ossama Yousif Kashmoula and Basim Hashem Taher, 1987. Study of some specific characteristics of fattened Hamdani lambs, using different sources and levels of nitrogen. Iraqi Journal of Agricultural Sciences (Zanko): 5 (4): 105-116. Iraq.

32. Kundu;M.S.De,A.K.Jeyakumar,S.Sunder,J.A.Kundu, and T.Sujatha,.2014.Effect of zinc supplementation on reproductive performance of Teresa goat. Veterinary World, 7(6):380-383.

33. Macit ,M.,V. Aksakal, E. Emsen, M.I. Aksu, M. Karaoglu ,and N. Esenbuga,.2003. Effects of vitamin E supplementation on performance and meat quality traits of Morkaraman male lambs. Meat Science 63:51-55 .

34. Mahmood , A.B., M.K. Arif, S.M.Sadq, A.A. Alhoby and Abdurahman,.2018.Effect of different levels of selenium on the carcass characteristics of karadi lambs. Iraqi Journal of Veterinary Sciences;Vol.32 ; No.1: 41-48. Sulaimania ; Iraq .

35. Mairorao, G.,C.Cavone, R.J. McCormick, A. Ciarlariello, M. Gambacorta, and A. Manchisi,.2007. The effect of dietary energy and vitamin E administration on performance and intramuscular collagen properties of lambs. Meat Science; 76:182- 188.

36. Mallaki, Mokhtar ,Mohammad Ali Nourozian, Ali Akbar Khade,.2015.Effect of organic zinc supplementation on growth, nutrient utilization, and plasma zinc status in lambs 39:75-80 .Tubitak, doi:10.3906/vet - 1405-79. Iran .

37. Mavromatis,j.;Koptopoulos, G.; Kyriakis ,S.c.; papasteriadis ; A. and Saoulidis, K.,.1999.Effects of a-tochopherol and selenium on pregnant sows and their piglets, immunity and performance.J Vet.Med.A46:545-553 .

38. Mei, Y., Zhi – Sheng, W Z and An-Guo1,.2009. Performance and Biochemical Responses in Early–Weaned Piglets Fed Diets with Different Protein and Zinc Levels**.** Pakistan Journal of Nutrition; 8 (4): 349-354.

39. Netto, Arlindo Saran, Marcus Antonio Zanetti, Gustavo Ribeiro Del Claro,.2013.Copper and selenium supplementation in the diet of Branqus steers on the nutritional characteristics of meat. Zootec ; 42; 70- 75.

40. Olivia N.,Genther-Schroeder, Mark E. Branine and Stephanie L. Hansen,.2018. Effects of increasing supplemental dietary Zn concentration on growth performance and carcass

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 4, 2021, Pages. 2506 – 2520
Received 05 March 2021; Accepted 01 April 2021.

characteristics in finishing steers fed ractopamine hydrochloride; J.Anim.Sci.,96:1903–1913. U.S.A .

41. P age, C.M., M.L.Van Emon,S. Spear, T.W. Murphy, J.G. Bowman, and W.C. Stewart,.2016. Survey of Serum Trace Mineral Concentrations in Weaned Montana Ram Lambs. Journal of Animal Science: V. 94, 274-274.USA.
42. P alani, Zirk Mohammad Rostum Khan, Hamid Ishaq Ismail Ketebani and Fereydoon Abdul Sattar Muhammadamin, 2018. Effect of selenium and zinc supplementation on some antioxidants and biochemicals in blood serum of male lambs. Faculty of Agriculture, Tikrit University, Faculty of Veterinary Medicine, Tikrit University. College of Veterinary Medicine, Sulaymaniyah University - Iraq.
43. Pavlata, L.,A. Pechova, B. Hofirek,.2009. Disorders of trace element metabolism. In: Hofirek B, Dvorak R, Nemecek L, Dolezel R, Pospisil Z et al. (eds.): Diseases of Cattle (in Czech).Ceska buiatricka spolecnost, Noviko a.s., Brno. 702–714.
44. Peter, S.; R. Laszlo; M.Andras; and R.Jozsef,.2003.Role of zinc supplement in weight gain, testicle development and semen characteristics of young rams. Research Institute of Animal breeding and Nutrition Herceghalom, Hungary.(http://www.fao.Org/regional/europe PUB/RTS50/238. Htm).
45. Perry,Tilden,Wayne,Arthur E.Cullison and Robert S.Lowery,.2004.Feed & Feeding. Sixth Edition Donated Prentice Hall Pearson Education,Library of Congress Cataloging in Publication Data,Georgia,USA.
46. Princewill, O.I.; A.E. Uchenna; O.I. Charles; and I.M. Uwaezuoke,.2015. Interactions between Dietary Minerals and Reproduction in farm Animal. Global Journal of Animal Scientific Research. 3524-535.
47. Radostits,O.M.; Gay ,C.C.; Blood,D.C.and Hinchliff ,K.W.,1999.Vet Med.9th ed .saundress company .Philadelphia,PP:770-776. Philadelphia, USA .
48. Ramadan, Sameh Gad Abdelhak, Hamada Dahy Hussein Mahboub1, Mohamed Atef Yousef Helal , Mohamed Abdallah Sallam,.2018.Effect of Vitamin E and Selenium on Performance and Productivity of Goats International Journal of Chemical and Biomedical Science ; 4 (2) : 16 - 22 .Egypt .
49. Robinson J.J, Ashworth C.J, Rooke J.A, Mitchell L.M, McEvoy T.G,. 2006.Nutrition and fertility in ruminant livestock. Animal Feed Science and Technology. 126:259-276.
50. Rouse, G.H., D.G.Topel, R.E.Vettor and T.W.Wickorsham.(1970).Carcass composition of lambs at different of development. J.Anim. Sci; 13:846 .
51. Rodinova, H.; Kroupova, V.; Travniček, J.;Staňkova,M. and Pisek, L,.2008. Dynamics of IgG in the blood serum of sheep with different selenium intake. VETERINARNI MEDICINA. 53, (50): 260-265.
52. SALMAN, M.,G. YILDIZ,.2009.Effects of different levels of organic Selenium Supplementation on fattening performance,carcass characteristics and blood GSH-Pxactivity in lambs.Revue Méd. Vét., 160, 5, 258-264 .
53. SAS,. 2012.Users guide,Statistics,Cary, NC.; Statistical Analysis System Inc. Release 9.12 Tsozo, North Carolina state University of Cary, NC,U.S.A.

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 4, 2021, Pages. 2506 – 2520
Received 05 March 2021; Accepted 01 April 2021.

54. Soliman, S.G.; C.E. Shoemaker; and G.H. D'andrea ,.2006. The effect of high dietary Cu on health, growth performance, and Cu status in young goats. Small Rum. Res.,66:85-91.
55. Soliman, E.B.,A.K.I.Abd El - Moty, A.Y. Kassab ,.2012.Combined effect of vitamin E and selenium on some productive and physiological characteristics of ewes and their lambs during suckling period. Egyptian Journal of Sheep & Goat Sciences, Vol.7 (2): 31- 42 .
56. Sushma, K., RY. Raman, KN .Nalini, RP. Baswa, T.R aghunandan, K. Sridhur,.2015.Effect of selenium supplementation on performance cost economics and biochemical profile of Nellore rams. Vet World; 8 (9); 1150-1155 .
57. Swain, P.S.; S.B.N. Rao; D.Rajendran; G.Dominic and S.Selvaraju,.2016. Nano zinc, an alternative to conventional zinc as animal feed supplement: A review. Animal Nutrition xxx, 1-8.
58. Tameem Eldar, A A ,Elamin K M ,Amin AE and Hassan H.E,.2012. Effect of energy protein levels on performance of Sudan goat ecotypes. Journal of Animal Production Advances; 2(3):146-152 .
59. Towaje , Moayed Abd Alsahib,Ahmed Hussein Kuttar and Hassan Hassan,.2018.Effect of adding different levels of zinc to the diets on performance and growth of local female goat . College of Veterinary Medicine/Green University of Al-Qasim Agriculture Research Directorate / Ministry of Technology and Science: Al-Anbar J. Vet. Sci., Vol.11 No.(2).27 - 32,Iraq .
60. Turner, K.E., K.E.McClure, W.P.Weiss, R.J.Borton, J.G.Foster,.2002**.**Alpha-tocopherol concentrations and case life of lamb muscle as influenced by concentrate or pasture finishing. Journal of Animal Science, Volume 80, Issue 10, Pages 2513–2521.USA.
61. Turnera, K.E.,S.Wildeusb, J.R.Collinsb,.2005.Intake, performance, and blood parameters in young goats offered high forage diets of lespedeza or alfalfa hay. Small Ruminant Research;59;15–23;USA.
62. Underwood, E.J. and Suttle, N.F,.1999.The Mineral Nutrition of Livestock. 3rd Edition, CABI Publishing, Wallingford, Oxon, 283-292.UK.
63. Zhao, Tianzhang, Hailing Luo, Yuwei Zhang, Kong Liu, Huina Jia, Yanfei Chang, Lijuan Jiao,and Weimin Gao,.2013.Effect of vitamin E supplementation on growth performance, carcass characteristics and intramuscular fatty acid composition of Longissimus dorsi muscle in Tan' sheep. CHILEAN journal of agricultural research 73(4);358-365. Iran .
64. Zarczynska, K.; P.Sobiech; J.Radwinska; and W.Rękawek,.2013.Effects of selenium on animal health.J.Elem.,18:329-340.