Tikrit Journal of Veterinary Sciences (2024) 3(1): 130- 139
DOI : *10.25130/tjvs.3.1.11*

IRAQI Academic Scientific Journals

Tikrit Journal of Veterinary Science
http://tjvs.tu.edu.iq/

The influence of selenium on ruminants ' reproduction: A Review

Fatima Juma Azgar[1]
Dep. of Surgery and Obstetric, College of Veterinary Medicine, University of Kirkuk, Kirkuk, Iraq[1]

ARTICLE INFO.
Article history:
-Received: 12/ 12/ 2023
-Accepted: 25/ 3/ 2024
-Available online: 30/ 6/ 2024

Keywords
selenium, reproductive ,ruminants

Corresponding Author:
Name: Fatima Juma Azgar
E-mail: fatmaasgar@uokirkuk.edu.iq
Tel: :

ABSTRACT

In general, farm animals in this region(Kirkuk) have low reproductive efficiency when compared to other parts of the world. One of the most important ways to raise the reproductive efficiency of animals by following regular reproductive and nutritional programs to improve the performance of the animal by using vitamins and minerals as food additives, which are important for the growth and reproduction of animals. Through the current article, we try to highlight the importance of selenium in the reproductive animals.

1. Introduction

The result of the large number of reproductive problems in animals in the region, which led to a decrease in reproductive efficiency, and its coincidence with the recent rise in fuel and animal feed prices, caused an increase in animal meat prices in general (1). Beef, sheep, goats, and buffalo meat are the most consumed sources of meat (2), especially sheep (3). Given the growing population of Iraq, it is likely to have greater economic importance in the near future (4) due to its high prices .

Meat is often regarded as a valuable feed for humans, as it contains numerous vital elements such as proteins, vitamins, lipids, and minerals (2), and this led to an increase in animal and meat prices.

The body needs specific vitamins and minerals to maintain key processes, particularly reproduction (5-6). According to the United Nations, there are 111 chemical elements that make up living organisms(7) , 50 of them are considered essential for maintaining the general health of mammals, in addition to the six basic elements, which include

carbon, hydrogen, nitrogen, oxygen, sulfur, and phosphorus, which the body needs to make proteins, nucleic acids, carbohydrates, and fats, which constitute the basic material for all living organisms (8). The animals typically get their minerals by eating natural feeds and fodder and from inorganic salts that are added to the ration (9). Basic minerals in animals or living organisms are generally divided into two basic groups, which include elements that the body needs in large quantities, called major minerals, and others that it needs in small quantities, called small or rare minerals (9-10). According to their physiological functions, minerals are typically divided into four basic categories(11):

1- Minerals serve as structural elements in the organs and tissues of the body. Which include Ca, P, Mg, Fl, and Si in bones and teeth as well as P and S in the proteins of muscle.

2- Minerals that are electrolytes that present in human fluids and tissues are involved in physiology. The role of membrane permeability, acid-base equilibrium, and tissue stimulation in the maintenance of osmotic pressure (e.g. Na, K, Cl, Ca and Mg in blood and cerebrospinal fluid.(

3- Catalytic: Minerals that function as cofactors necessary for enzymatic activation or as catalysts in enzymatic systems (e.g., Fe, Cu, Zn, Mn, and Se involved in cytochromes, ceruloplasmin, carbonic anhydrase, pyruvate carboxylase, and glutathione peroxidase, respectively).

4- Minerals that regulate cell division and differentiation include those that are regulatory (e.g. Ca, in signaling transduction; Zn, in DNA transcription).

2. Trace mineral functions

The roles of tiny minerals are categorized into 4 main groups. (12)

1-Purpose of Structure

Minerals that make up structural elements of bodily organs and tissue are referred to as having structural function. One example is the role zinc plays in maintaining membrane and molecular stability.

2-Function in Physiology

Minerals in human fluids and tissues work as electrolytes to maintain osmotic pressure, acid-base equilibrium, and membrane permeability, which are all necessary for physiological function.

3-Role of Catalysis

Since it relates to the catalytic role of metalloenzymes in enzyme and hormone systems, catalytic function is perhaps the largest category for trace minerals. Trace elements are used in metalloenzymes as structural constituents. The enzyme activity is diminished upon removal of the trace element or absence of sufficient trace mineral levels. Many metalloenzymes are necessary for a variety of metabolic processes, including the creation of energy, the breakdown of proteins, the reproduction of cells, and the synthesis of antioxidants.

4- Regulatory Purpose

Zinc's ability to affect transcription and iodine's position as a component of the hormone thyroxine, which is linked to thyroid health and energy metabolism, serve as examples of regulatory function.

Animals require selenium (Se) as a trace mineral necessary to maintain healthy

physiological functions and as a significant dietary source of antioxidant protection (13,14). Selenium content in soil is low in many parts of the world, resulting in insufficient levels of selenium in feed and crops, as is evident in the soils of South Sinai, in addition to the excessive salinity of irrigation water, which makes growing plants unable to meet their selenium needs (15) then it causes selenium deficiency in the animal .

3.The effect of selenium on reproduction in females

Animals' reproductive physiology depends heavily on micro mineral balance, which can lead to a variety of issues including reduced reproductive effectiveness. As a result, appropriate trace mineral supplementation and absorption are necessary for a variety of metabolic processes, including growth and reproduction. Correcting a mineral imbalance frequently leads to an improvement in the animals' ability to reproduce, fertility, and general health (9).

To maximize reproduction in dairy cattle, the minerals should be prioritized as the third most important nutrient after protein and energy (16). The production of hormones and steroids for reproduction as well as the intracellular elimination of free radicals are just a few of the processes that micronutrients play a role in, additionally, it plays a significant function in the metabolism of proteins, carbohydrates, and nucleic acids. Mineral excess or deficiency may have an impact on milk supply, embryonic development, survival rate, postpartum recovery activities, and the development and survival of infants(9). Due to the lack of different clinical symptoms that would enable the producer to identify the deficiency, a silent or marginal lack of minerals in animals may pose a greater issue than an acute mineral deficit, animals still develop and reproduce, although at a slower pace (9). Se deficiency is less common in livestock than Se toxicity due to the narrow safety margin (the variation between normal necessary and toxic dose) for Se, but it is still a cause of weak, silent, or irregular oestrus cycles, retained placenta, early embryonic death in the fetus, stillbirth or weak offspring, and abortions in dairy animals (17). Insufficient amounts of selenium in animals raise the risk of cystic ovarian cancer, mastitis, and merits; these diseases can be avoided by taking supplements of selenium. (18). It has also been shown that the rate of first pregnancies has increased with the presence of Se (19), while (20) observed that supplementing dairy cows with selenium alone 20 days before delivery had no discernible impact on the rate of conception or the frequency of the estrus cycle, but that supplementing with vitamin E dramatically decreased the incidence of placental retention and the day's need for the first service of birth, Selenium and vitamin E function together physiologically (21). While in the incidence of estrus, fertility, and prolificacy in ewes, as well as the live weight gains of lambs up to 60 days of age, were significantly improved by the

administration of Se and Se + vitamin E(22).

Additionally linked to inadequate uterine involution, silent heat, and compromised selenium levels are these symptoms (23). As (24) pointed out in his study on grazing dairy heifers, trace element supplementation, in addition to lowering postpartum anestrus . Se appears to be effective in ovarian tissue, particularly follicles ,also Se produces ten times more in the follicles of major bovine ovarian follicles than in the CL, where it localizes in granulosa cells., according to x-ray fluorescence imaging , Se special localization to big follicles, together with its recognized role in antioxidant defense, suggests that it may shield the egg from oxidative stress and DNA damage during folliculogenesis(25). While(26) showed that Se acts directly on granulosa cells to increase growth and estrogen synthesis, estradiol production is important for reproductive success because it increases the release of gonadotropin-releasing hormone, which causes the preovulatory luteinizing hormone surge. (27) observed that bovine oocytes grown in the presence of Se displayed fewer dead cells and increased embryo hatching rates than unsupplemented oocytes. These findings show that Se has various roles in bovine reproduction, acting on the follicle to promote folliculogenesis and directly on the oocyte to protect against cell damage.

(28) observed a link between the rate of retained fetal membranes in dairy cows and serine-dependent glutathione peroxidase. In this study, circulating glutathione peroxidase concentrations were lower up to two weeks prior to the calving in cows that placentas were retained for more than 12 hours after parturition. Glutathione peroxidase, which helps minimize hydrogen peroxide and other peroxide radicals, is largely composed of selenium. Plus, Se can easily move from the cow to the fetus in the barrier formed by the placenta. (29-30).

Selenium toxicity in pregnant animals causes stillbirths, miscarriages, and weak, lethargic calves when selenium builds up in the fetus at the expense of the cow (23). While (14) observed that using selenium alone or with vitamin E in programs to synchronize estrus using CIDR increased the response in the animals, as it was noted that all animals responded within only 24 hours after withdrawing CIDR and in rates of estrus and pregnancy. For both groups, 100%.

Also Selenium supplementation is essential to keep up Se and immunoglobulin G ratios in Norduz ewe's placenta, serum, and colostrum (31).

4.The effect of selenium on reproduction in males

For the production of high-quality semen, proper food management of the breeding bull becomes even more essential , breeding bulls must provide vital nutrients to maintain life and increase semen production, energy, protein, water, vitamins, and minerals are the several types of essential nutrients , major and

trace minerals are the two categories of minerals. In male reproduction, trace minerals are crucial(32).

Selenium is essential for the healthy spermatogenesis process and the growth of testicular tissue, therefore, a selenium absence affects the morphology and concentration of sperm by impairing the function of testicular tissue (33), also

Spermatogenesis, libido, and male fertility may be affected by mineral oversupply or nutritional deficiencies (9), sodium selenite enhances the quality of semen by increasing spermatozoa motility, concentration, and volume per ejaculate while reducing the percentage of dead spermatozoa, abnormal spermatozoa, and acrosome damage(34).

Selenium plays a significant role in healthy spermatogenesis and is mostly found in seleno-proteins such Seleno-protein V and phospholipid hydroperoxide glutathione peroxidase (PHGPx/GPX4)the majority of the selenium in the testes is connected to PHGPx/GPX4. It protects cells from oxidative damage as a potent antioxidant ,additionally, it appears that PHGPx functions as a structural protein to promote healthy sperm motility (35) . In a study (36) on Kurdish rams, it was discovered that injecting animals with vitamin E and selenium had a substantial effect on growing sperm characteristics and maintaining the viability of sperm during a 7-day period of cold storage (5°c).

According to research, vitamin E and selenium have a role in maintaining sexual desire, increasing the quality of sperm, increasing the process of sperm development (37), sperm vitality, and individual sperm movement (37 and 38.(

Another study showed the combining selenium (sodium selenate) at 0.5 mg/kg feed with zinc (zinc sulphate) at 100 mg/kg feed increases the level of oxidation, testosterone a male hormone, and some biological properties in ram blood serum Kurdish(39).

5.Conclusion

We conclude from this study that selenium has a role in solving many reproductive problems in females and males, in addition to improving the reproductive efficiency of ruminants .

References

1. Al-obaidy ,M.H.A.;Palani,Z.M.R.;Sirwan,K. and Hameed,K.(2020).Effect of adding different percentages of glycerin in rations one some blood serum biochemical and antioxidants traits in male lambs awassi breed sheep .Biochemical and Cellular Archives . Vol. 20, No. 1, pp. 2253-2257. DOI: 10.35124/bca.2020.20.1.2253
2. Palani,Z.M.R.; Al-obaidy ,M.H.A.; Hameed,K. and Sirwan,K. (2020).Effect of Selenium and Zinc Supplements on Each Individual or Mixture on Some Carcass Characteristics and Glutathione Activity in Male Lambs Kurdi Breed Sheep . Plant Archives Vol. 20, pp: 231-234 .
3. AL-Tamemy,S.M.A. and Al-obaidy ,M.H.A.(2019).The Effects of omeg-3 fatty acid on Some Quality of Awassi Rams Chilied sperm . Plant Archives .Vol 19 : 131 - 134
4. Mohammed, A.K. and Abass K.S. (2021) .Effect of Age ,Lambs Sex and Birth Type on Some Hematological and Biochemical Parameters of Awassi Ewe in Iraq . Veterinary Practitioner Vol. 22 No.1, pp: 45-47 .
5. Wu, S.A.; Oldfield, J.E.; Shull, L.R. and Cheeke, P. R.(1979). Specific effect of selenium deficiency on rat sperm. Biol.Report. 20:793-789 . DOI: 10.1095/biolreprod20.4.793
6. Yousef,M.I., Abdallah,G.A. and Kamel.K.I. (2003) .Effect of ascorbic acid and vitamin E supplement on semen quality and biochemical parameters of male rabbits.Anim.Reprod.Sci . 76(1-2), 99-111. DOI: 10.1016/s0378-4320(02)00226-9
7. Karol, P.J. , Nakahara, H. , Petley, B.W. and Vogt, E. (2003). On the Claims for Discovery of Elements 110, 111, 112, 114, 116, and 118. Pure and Applied Chemistry. 75, 1601-1611. http://dx.doi.org/10.1351/pac200375101601.
8. Wolfe-Simon, F . , Blum, J.S. , Kulp, T.R., Gordonm G.W., Hoeft S.E., Pett-Ridge, J., Stolz J.F., Webb, S.M., Weber, P.K., Davies, P.C.W., Anbar, A.D. and Oremland, R.S. (2010) .A Bacterium That Can Grow by Using Arsenic Instead of Phosphorus . Science, 332, 1163-1166. http://dx.doi.org/10.1126/science.1197258
9. Lamella Ojha , Sonika Grewal , Abhishek Kumar Singh, Ravi Prakash Pal and Shahid Hassan Mir .(2018). Trace minerals and its role on reproductive performance of farm animals. Journal of Entomology and Zoology Studies, 6(4), 1406-1409 .
10. NRC . (2001). Nutrient Requirements for Dairy Cattle. 7th Revised Edition, National Academy Press, Washington DC.

11. Underwood, E.J. and Suttle, N. (2001). The Mineral Nutrition of Livestock. 3rd Edition, CABI Publishing, Wallingford.
12. Underwood, E. J. and Suttle, N. F. (1999). The Mineral Nutrition of Livestock, 3rd ed. CABI Publishing, Oxon, U.K .
13. Sordillo, L. M. (2013). Selenium-dependent regulation of oxidative stress and immunity in periparturient dairy cattle . Veterinary Medicine International .vol,2013 ,p :8. https://doi.org/10.1155/2013/154045
14. Musa, S.I., Bitto,I.I., Ayoade, J.A. and Oyedipe, O.E. (2018) .Effects of Vitamin E and Selenium on Fertility and Lamb Performance of Yankasa Sheep. Open Journal of Veterinary Medicine. 8, 167-173. https://doi.org/10.4236/ojvm.2018.89015.
15. Sadek , L.A . (1995). The effect of selenium, boron and salinity on biomass and mineral composition of Medic ago sativa Alex. J. Ages, 40 (1): 293- 304 .
16. Bindari YR, Shrestha S, Shrestha N, Gaire TN. (2013). Effects of nutrition on reproduction-a review. Advances in Applied Science Research , 4, :421-429 .
17. Randhawa S.S, Randhawa C.S.(1994). Trace element imbalances as a cause of infertility in farm animals. Recent advances in animal reproduction and Gynaecology. Proceedings of the summer institute, held at PAU, Ludhiana on July 25 to Aug 13. pp: 103-121.
18. Xiao, J . , Khan, M.Z. , Ma, Y. , Alugongo, G.M. , Ma, J. , Chen, T. , Khan, A. , Cao, Z. (2021).The Antioxidant Properties of Selenium and Vitamin E; Their Role in Periparturient Dairy Cattle Health Regulation Antioxidants . 10, 1555. https://doi.org/10.3390/antiox10101555.
19. McClure T.J, Eamens G.J, Healy P.J. (1986). Improved fertility in dairy cows after treatment with selenium pellets. Australian Veterinary Journal .63:144-146. https://doi.org/10.1111/j.1751-0813.1986.tb02952.x
20. Kim, H.S. , Lee, J.M , Park, S.G., Jeong,J.K.Jung and Im,K.S.(1997).Effecte of Vitamin E and Selenium Administration on the Reproductive performance in dairy cows . AJAS .10(3):308-312 .
21. Netto, A.S . , Zanetti, M.A . , Correa, L.B. , Del Claro, G.R.,Vieira Salles, M.S. and Vilela, F.G. (2014). Effects of Dietary Selenium, Sulphur and Copper Levels on Selenium Concentration in the Serum and Liver of Lamb. Asian-Australia's J. of Anim. Sci. 27(8): 1082–1087. DOI: 10.5713/ajas.2013.13818
22. Koyuncu,M. and Yerlikaya,H. (2007). Effect of selenium-vitamin E injections of

ewes on reproduction and growth of their lambs. South African Journal of Animal Science .37(3):233-236.

23. Patterson H.H, Adams D.C, Klopfenstein T.J, Clark R.T, Teichert B. (2003). Supplementation to meet metabolizable protein requirements of primiparous beef heifers: II. Pregnancy and Economics. J. Anim. Sci. 81, 503-570.

24. doi: 10.2527/2003.813563x.

25. Nunes, H.P.B, Borba, A.E.S. , Silva.J.F.M. (2022). Impacts of trace element supplementation on production /reproductive postpartum performances of grazing dairy heifers from volcanic soils. Journal of Animal Behaviour Biometeorology. 10 (4) :2236. http://dx.doi.org/10.31893/jabb.22036

26. Ceko, M. , Hummitzsch, K. , Hatzirodos, N. , Bonner, W. , Aitken, J. , Russell, D. , Lane, M. , Rodgers, R. , Harris, H . (2015). Correction: X-ray fluorescence imaging and other analyses identify selenium and GPX1 as important in female reproductive function. Metallomics , 7, 188. DOI: 10.1039/c4mt00228h

27. Basini, G. , Tamanini, C . (2000).Selenium stimulates estradiol production in bovine granulosa cells: Possible involvement of nitric oxide. Domest. Anim. Endocrinol. 18, 1–17. DOI:10.1016/S0739-7240(99)00059-4

28. Lizarraga, R.M. , Anchordoquy, J.M. ,Galarza, E.M. , Farnetano, N.A. , Carranza-Martin, A. , Furnus, C.C. , Mattioli, G.A. , Anchordoquy, J.P. (2019).Sodium selenite improves in vitro maturation of bos primigenius taurus oocytes. Biol. Trace Elem. Res. 197, 149–158. DOI:https://doi.org/10.1007/s12011-019-01966-2.

29. Brzezinska-Slebodzinska, E. , Miller, J. , Quigley III, J. , Moore, J. , Madsen, F. (1994) Antioxidant status of dairy cows supplemented prepartum with vitamin E and selenium. J. Dairy Sci. 77, 3087–3095. https://doi.org/10.3168/jds.S0022-0302(94)77251-9.

30. Abd El-Ghany, H. , López-Arellano, R. , Revilla-Vázquez, A. , Ramírez-Bribiesca, E. ; Tórtora-Pérez, J . (2007) . The relationship between fetal and maternal selenium concentrations in sheep and goats. Small Rumin. Res. 73, 174–180. https://doi.org/10.1016/j.smallrumres.2007.01.020.

31. Rock, M. , Kincaid, R. , Carstens, G . (2001). Effects of prenatal source and level of dietary selenium on passive immunity and thermometabolism of newborn lambs. Small Rumin. Res. 40, 129–138. DOI: 10.1016/s0921-4488(01)00167-5.

32. Erdoğan ,S. , Karadaş F. , Yılmaz ,A. and Karaca ,S. (2017) . The effect of organic selenium in feeding of ewes in late pregnancy on selenium transfer to progeny . Brazilian Journal of Animal Science . 46(2):147-155.

33. Ravi Praksh Pal , Veena Mani, Shahid Hassan Mir, Ram Kumar Singh and Rachana Sharma. (2017). Importance of Trace Minerals in the Ration of Breeding Bull - A Review. Int.J.Curr.Microbiol.App.Sci . 6(11): 218-224 .doi: https://doi.org/10.20546/ijcmas .2017.611.026.

34. Calvin, H.I. , Grosshans, K. , Musicant – Shikora, S.R. and Turner, S.I.A. (1987). Developmental study of rat sperm and testis seleno proteins. J. Report. Fertile. 81(1):1-11. doi: 10.1530/jrf.0.0810001 .

35. Marai, I. F. M. , El-Darawany, A. A. , Abou-Fandoud, E. I . , and Abdel-Hafez, M. A. M. (2009). Reproductive and physiological traits of Egyptian Suffolk rams as affected by selenium dietary supplementation during the sub-tropical environment of Egypt. Archiv Tierzucht . 52. 4: 402-409. DOI:10.5194/aab-52-402-2009

36. Hemler M.E, Lands, W.E.M. (1980).Evidence of peroxide-initiated free radical mechanism of prostaglandin biosynthesis. Journal of Biological chemistry, 225, 6253-6261.

37. Alkhashab A.Th.M. and Hameed,M.M. (2017) . Effect of vitamin E and selenium injections on physical characteristics of cold semen of Karadi Rams. Euphrates Journal of Agricultural Science. 9 (4) : 1411-1418 .

38. Hamed,A. P.; T. Abdol-Mansour and N .Abbas-Ali .(2013).The influence of vitamin E on semen characteristics of ghezel rams in during cooling and frozen process. European Journal of Zoological Research, 2(5):94-99.

39. Mahmoud, G.B . , Abdel-Raheem S.M. , Hussein H.A. (2013). Effect of combination of vitamin E and selenium injections on reproductive performance and blood parameters of Ossimi rams. Small Ruminant Research. 133 : 103-108. https://doi.org/10.1016/j.smallrumres.2012.12.006

40. Zirak Mohamed Rustam khan Palani ,Z.M.R.K.; Hamid Eshag Ismael Kutaibani ,H.E.I. and Amin ,F.A.M. (2018) . Changes in Some Blood Biochemical Indicators in Kurdi Rams Response of Selenium and Zinc Supplements . Syrian Journal of Agricultural Research. 5(4).pp:87-96.

Tikrit Journal of Veterinary Sciences (2024) 3(1): 130- 139
DOI : ***10.25130/tjvs.3.1.11***

تأثير السيلينيوم على تكاثر المجترات : مراجعة

فاطمة جمعة أصغر

فرع الجراحة والتوليد، كلية الطب البيطري، جامعة كركوك، كركوك، العراق

الملخص

بشكل عام تتمتع حيوانات المزرعة في هذه المنطقة (كركوك) بكفاءة تناسلية منخفضة مقارنة بأجزاء أخرى من العالم. من أهم طرق رفع الكفاءة االتناسلية للحيوانات باتباع برامج تناسلية وغذائية منتظمة لتحسين أداء الحيوان من خلال استخدام الفيتامينات والمعادن كإضافات غذائية مهمة لنمو وتكاثر الحيوانات. ومن خلال المقال الحالي نحاول تسليط الضوء على أهمية السيلينيوم في تناسل الحيوانات .

الكلمات المفتاحية: السيلينيوم ، التناسل ، المجترات