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The role of selenium in reproduction of sheep

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Abstract
This review explores enhancing the reproductive performance and semen quality of sheep for optimal production and profitability. One element that has caught the attention of many researchers is selenium (Se), which plays a crucial biological role in improving reproductive efficiency, boosting antioxidant activity, enhancing semen characteristics, and supporting the immune system in both humans and animals. Se contains enzymes, such as glutathione peroxidase, which help to scavenge free radicals within cells and promote overall health. By incorporating Se into sheep management practices, farmers can potentially maximize their production and profitability while ensuring the health of their flocks. It's important to make sure that sheep have enough Se in their diet or by injection to prevent damage from free radicals and maintain their reproductive health. Supporting the antioxidant protection system is vital for this mineral, which helps counteract the harmful effects of these unstable molecules on cells. Ensuring that sheep have access to enough Se helps to maintain optimal semen quality and reproductive performance. It is noticeable that Se can synergize with vitamins and minerals to give good results in enhancing reproductive performance and semen quality. This review encompasses the studies that have been carried out to evaluate the beneficial impact of Se on sheep reproduction.

Keywords: Selenium, reproductive performance, semen quality, antioxidants

Introduction
Globally, sheep husbandry is significantly impacted economically by reproductive performance success in different production systems [1]. Reproductive performance requires good management in order to approach reproductive potential and achieve high production and profitability [2] in livestock farming. Enhancing reproductive performance necessitates employing reproductive techniques as a way to boost production and profitability, according to an abundance of studies [3, 4, 5, 6, 7, 8, 9, 10]. However, outcomes are subject to change due to a number of variables that affect reproductive performance, such as genetics, nutrition, and the environment [11, 12, 13, 14]. The majority of sheep raised in different regions graze to meet their nutritional needs [15]. Therefore, the amount of qualitative content and balanced consumption of nutrients in the field and grazing determine the sheep feed system [16]. The evidence demonstrating that excessive or insufficient nutritional supplementation has an effect on animal reproduction performance demonstrates that proper nutrition is required to maintain animal reproductive performance [17].
Se is an important element for many animals [18] and it can be found in soils, biomass, the atmosphere, and water systems [19] which is divided into two groups: organic and inorganic, organic Se includes selenium methionine, selenocysteine, and selenium-methyl-selenocysteine, while inorganic Se includes selenate and selenite [18]. Generally, Se is present in a variety of geological locations in the world [20]. Studies indicate that Se functions as an antioxidant [21] immune protect [22] health and reproductive functions [20] in the body. However, animals need a small amount of Se, but larger amounts are harmful [23]. Therefore, sheep receiving therapeutic or supplemental Se must have small safety margins and negligible absorption [24]. Due to the presence of enzymes like glutathione peroxidase, thioredoxin reductase, and iodothyronine deiodinases, particularly glutathione peroxidase, which converts H_2O_2 to H_2O and eliminates the lipid peroxides that free radicals in cells produce, Se plays a significant role in cells [25]. Additionally, it protects cells from oxidative stress by scavenging free radicals within the cells [26].
Se plays a role in stimulating ovarian activity when Se is high in the blood, while low Se leads to ovarian inactivity [27]. Therefore, low Se endogenous in ewes influences the levels of

estrogen and progesterone during mating and conception [28] and for this reason, before or during the time that sheep flocks are grazing, the information required about the concentrations of Se in pastures must be displayed [29, 30]. These data are displayed to promote the investigation Se concentrations are allowed to be consumed, but avoid high doses that lead to toxicity [31]. On the other hand, ewes that are in the late stages of pregnancy may undergo alterations by using Se nutritional supplements, which enhance oxidative stability and elevate the level of glutathione peroxidase in ewes' and lambs' blood [32]. Lambs, as a consequence, produce more growth and have a stronger immune system than dams and lambs from poor Se regions [20].

A role for Se in semen is to increase its ability to fertilize and enhance conception by reducing spermatic membrane lipid peroxidation and oxidative damage and decreasing sperm acrosome membrane damage [33]. However, the reproductive system is influenced by dietary Se insufficiency and surplus, which lead to decreased sperm parameters [34] or possibly lead to an approach that impacts fertility and infertility [35]. Otherwise, Se acts as an antioxidant when the addition (1µg/ml) semen extender shows changes in sperm parameters, including decreased spermatic membrane lipid peroxidation and oxidative damage to sperm, to enhance semen characteristics then can be applied to artificial insemination [36].

The effect of a deficiency in dietary Se shows an increase in free radicals in the body, which reduces its capacity to defend [37]. In addition, exhaustion in the body's antioxidant capacity means that adding antioxidants to their diet can help maintain a healthy body [38]. As a result, animals' immune systems against free radicals depend on the glutathione peroxidase enzyme, which is Se -containing [28]. Sperm quality improves with antioxidants, which show spermatozoa concentration, motility, and morphology [39]. This review aims to highlight studies that examine the effects of various Se sources on reproductive performance, enhancing immunity, antioxidants, semen parameters, and synergy with vitamins and minerals.

The role of Se in the reproductive performance

Some reproductive problems in ewes are spurred on by alterations in the blood content of trace substances that affect levels of estrogen and progesterone [27]. Little focus has been placed on the period before conception or on general reproductive efficiency and health when it comes to ovarian physiology, especially the synthesis of hormones and the growth of ovarian follicles, even though Se supplementation may have an impact on ovarian function and overall female reproductive efficiency [40]. The sheep flocks in the pasture, however, require information regarding Se with a demand for individual sample analysis if there is significant intra-flock variation in blood Se concentration and deficiencies should be corrected to improve the performance and health of the herd [41]. Therefore, ewes must receive organic or inorganic Se supplements in their feed in order to increase and maintain the amount of Se in their blood. These supplements all had a substantial impact on the concentrations of urea, cholesterol, LDL, triglycerides, Na, K, Cl, and Fe in ewes [42]. Se may be advantageous during pregnancy when animals are under metabolic or nutritional stress, typically at super nutritive levels. The current consensus is that the dam's food and micronutrient status may impact the offspring's development and health [43]. On the other hand, fetal growth in sheep is controlled by an interaction between the fetus' capacity for independent growth and the maternal environment [44]. Fetal and postnatal weight is affected by the nutrition of the pregnant ewe [45]. Therefore, a variety of physiological factors, endogenous Se levels, Se sources, and administration methods can affect the dietary requirements of Se in sheep [28]. The Se concentration interactions between the fetus and the dam during pregnancy show that the fetal Se disposition appears to be preserved at the expense of the dam's Se level [46]. Therefore, both during pregnancy and after lambing, body weight and body condition score are important for maintaining vital indicators [47]. Moreover, the body condition of pregnant ewes and lambs was improved by injecting ewes with 50 mg/ml of selenium (1 ml /50 mg of selenium/kg of animal weight) and lambs with 1 mg of selenium/kg of body weight at 4-7 days of age after birth. Se is effective at boosting immunity and enhancing animal performance, as evidenced by the fact that treated ewes produced more milk with higher fat content, and that the lambs' immune defense mechanisms were stimulated and improved [48]. On the other hand, Erdogan *et al.* [49] indicated that the addition of Se in the feeding of pregnant ewes (57 days prepartum and 7 days postpartum) led to an increase in Se concentration after seven days of feeding, and the role of Se is to transfer from the dam to the fetus through the placenta and increase the concentration of globulin. Therefore, immunoglobulin G, which is present in the placenta and colostrum, helps to strengthen the immune systems of newborns. This happens in two ways: first, by raising the fetus' immunity; and second, through colostrum.

Effects of prolonged Se supplementation on reproductive performance, according to Sanchez *et al.* [50] Se toxicity from feeding ewes for a prolonged period of time on Se resulted in a negative impact on reproductive performance. This Se toxicity was caused by adding Se to the diet in the amount of 0.5 mg/kg, feeding the ewes for three months prior to feeding, continuing to feed the ewes during pregnancy, and timing hormonal treatment. Se use is restricted to areas with soil deficiency. On the contrary, lamb growth and ewe health are improved when ewes are supplemented with Se-yeast at a rate of 24.5 mg Se/wk without having an adverse effect on reproductive efficiency [51].

The reproductive performance, blood characteristics, and immunity response were greatly influenced by Se is ability to work in synergy with vitamins. Ziaei [52] found that vitamin E and Se were added to goat diets in combination at a rate of 20 mg/kg of vit E and 0.5 mg/kg of Se, as this combination significantly increased birth weights and improved reproductive performance when compared to control goats. Musa *et al.* [53] found the use of injections of two doses (90 mg of vit E) or the use of the combination (100 mg of vit E + 1.97 mg of Se) at 14-day intervals to be effective. A 100% response rate to the onset of estrus, a pregnancy rate, and a birth rate were among the results of this technique. Therefore, using only vit E or using vit E and Se, has been shown to improve the reproductive performance of sheep and increase the weight of lambs born at birth. Moreover, Alkaline phosphatase, aspartate aminotransferase, and alanine aminotransferase were all found to be unaffected by this method's results. In contrast, the use of the two-dose regimen of vit E alone or the combination of vit E and Se increased the concentration of glutathione peroxidase, a marker of Se deficiency, in the ewes' blood, strengthening its antioxidant effects [54]. Furthermore, the synthesis response (vitamin E + Se), which improves immunity in pregnant ewes and transfers

these immune substances to newborns when they consume colostrum, was shown to increase the concentration of Immune Globulin G and Immune Globulin M [55]. However, Awassi ewes' red blood cells, body weight, daily milk production, and non-fat solids were all considerably affected by injecting 4.5 mg of vitamin E and 90 g of Se into the animals. On the other hand, the blood of ewes showed no significant change in glucose, triglycerides, total protein, albumin, or globulin [56].

Impact of selenium on the activity of antioxidants in reproductive performance

In sheep production, it is important to evaluate oxidative stress and antioxidant status during mating [57]. However, the endogenous antioxidant system controls the oxidative stress caused by the accumulation of reactive oxygen species (ROS) [58]. On the other hand, Sies and Jones [59] pointed that a broad term encompassing a variety of molecular oxygen derivatives that naturally exist as a characteristic of aerobic life is ROS, which is used to describe molecular damage caused by increased generation of various ROS. However, when an imbalance due to free radical generation and a depletion of antioxidant reserves result in harm to lipids, proteins, and DNA, it is necessary to approach a balanced strategy to maintain balance by supplementing with antioxidants in ruminant diets [38]. Furthermore, several developmental processes, such as oocyte maturation, luteolysis, and embryo implantation, are influenced by the physiological production of ROS during pregnancy that the excessive overproduction of ROS, which compromises these processes, is the root cause of reproductive failure [60]. Therefore, Se and selenoproteins play an important role in the regulation and modulation of antioxidant balance, which makes them crucial for female reproductive health [40]. On the other hand, increase the level of Se to protect against oxidative stress unless they reach toxic levels where they become prooxidant agents that release toxic free radicals that cause severe cytogenetic damage [61].

The role of Se in semen quality

For spermatogenesis to occur there must be a sufficient supply of Se for the selenoproteins in the testis. Se deficit or excess in the diet can affect spermatogenesis, which can lead to poor semen attributes as well as infertility [62]. Therefore, focuses on the role that selenoproteins contribute to the reproduction process, then on the biotic functions that Selenoproteins and Se typically carry out that are connected to the health of the entire male reproductive [63]. In an effort to understand how Se sources affect the effectiveness of reproductive and semen parameters. Stefanov *et al.* [64] found that ram reproductive characteristics can be improved by adding 1.83 g/day either organic or inorganic, proceed with the diet, leading to increases in ejaculate volume, spermatozoa motility, and survival, while these treatments had no impact on the pH of the freshly collected semen. Sodium selenite (Na2SeO3) is one of the Se sources used in the form of a soluble bolus, leading to the motility as well survival of the semen in rams being enhanced, which also increases Se concentration in serum and GSH-Px enzyme activity over time [65]. On the other hand, to determine how the season affects the characteristics of Suffolk rams' semen Marai *et al.* [66] found that during the winter, Se dietary additions orally (0.1 ppm/kg DM as sodium salenate) enhanced the majority of ram semen characteristics. Consequently, Se supplementation impacts an animal's ability to reproduce effectively and increases their libido and testosterone level [67]. Moreover, rams' semen characteristics are improved by Se supplementation in the diet, which results in a higher ejaculated volume, sperm cells' DNA, proteins, and lipids can be oxidized by ROS in high concentrations, which alters the sperm cells' vitality, motility, and morphology [39] Consequently, it enhances fertility and increases conception [68].

Because of their interest in reproductive biotechnologists, researchers have developed a number of novel techniques to try and protect semen from freezing by employing nanoparticles [69]. Therefore, Hozyen and El Shamy [70] reported that Se nanoparticles (SeNPs) added to the semen extender different concentrations of 0.5, 1, and 2 µg/ml did not impair sperm, according to assays for DNA damage and lipid peroxidation. Moreover, it reduces sperm acrosome membrane damage as well, which leads to an improvement in sperm quality traits including motility, viability, and plasma membrane integrity, and a 30-day freeze-time [36].

Se has a significant impact on the properties of the sperm as well as the capacity to work in synergy with vitamins and minerals. Abdulnasir and Hameed [71] found that testes measures and semen parameters in Karadi rams tend to respond favorably to injections of 50 µg sodium selenite and 2.5 mg vitamin E. In addition, for a month, Barki rams' testosterone levels will rise when given twice-weekly injections of 5 mg sodium selenite and 450 mg vitamin E. This will improve the rams' ability to reproduce [72]. On the other hand, increased doses of Se cause toxicity, although the acceptable doses have no impact on reproductive function. However, 70 days after the last treatment, the ram semen returns to the normal range after received a 64-day injection of 4.5 mg of sodium selenite and 204 mg of vitamin E two times per week [73]. In addition, rams' reproductive efficiency and semen characteristics were improved by supplementing their diets with a combination of 0.3 mg/kg Se and 40 mg/kg Zn during the breeding season [74].

Impact of Se on the activity of antioxidants in semen quality

The effectiveness of physiological and hormonally based reproduction is essentially influenced by a variety of biological elements and animal physiological conditions [2]. Therefore, the males exhibited antioxidative markers that corresponded to these changes because oxidative stress and lipid peroxidation increased following weaning and as they approached puberty [75]. However, Animals' immune systems against free radicals depend on the glutathione peroxidase enzyme, which is Se -containing [28]. Se is found in the soil, plant, and animal axis, and It is essential for the construction of selenoproteins. Nevertheless, low Se levels in the body result in decreased resistance to free radicals. On the other hand, a number of factors could reduce a substance's bioavailability in the body. Therefore, Se should be appropriately absorbed because it can cause infertility in both humans and animals [37]. The benefits of dietary supplementation with Se boost male sex hormones, some hematological parameters, and antioxidant indicators [76]. Therefore, Se is enhanced for spermatogenesis and fertility due to its substantial contribution to regulating antioxidant defense systems, and appearance related to transcription and metabolic routes [63]. On the other hand, ROS are necessary for the oxidation of sperm cells' proteins, lipids, and DNA, which changes the morphology, viability, and molecular

structure of the cells [39]. However, ROS production could become unbalanced as a result of variations in Se compounds [77]. Therefore, Se sources have a greater influence on glutathione peroxidase enzyme activity, free radical suppression, and enzyme stimulation [78].

Conclusion

Se is an element vital for reproductive sheep, especially in geological locations in which low levels of Se require correcting this level in different ways as dietary supplementation, or injections taking into account the doses without reach to toxicity. Before mating, Se affects ovarian physiology through hormone synthesis and facilitates the maturation of follicles, resulting in higher rates of conception. Pregnant ewes benefit from dietary Se supplementation during the final phase of pregnancy, as Se precipitates in the fetus and boosts postpartum immunity in lambs.

It is crucial to take note of the diet in terms of spermatogenesis. If rams consume insufficient or excessive amounts of certain Se, this could lead to poor semen quality and even infertility. However, adhering to recommended dosages can boost testosterone levels and enhance semen parameters. Hence, it's important to provide dietary supplementation and ensure that rams are obtaining the appropriate balance of Se for optimal reproductive health.

At times, sheep may experience reproductive issues due to an imbalance between oxidative stress and antioxidants. To resolve this problem, it's important to provide Se sources to promote the activity of the glutathione peroxidase enzyme. This enzyme helps control the production of free radicals, which can ultimately improve semen quality and increase reproductive effectiveness. It is noticeable that selenium can synergize with vitamins and minerals to give good results in enhancing reproductive performance and semen quality.

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