Pro Index | Journal of Science in Medicine and Life
Volume: 3 Issue: 5 Year: 2025
ISSN: 2992-9202 | http://journals.proindex.uz

Selenium in Ruminant Diets: An Antioxidant, Hormonal Regulator, and Environmental Nutritional Component: Subject Review

Esam Saeed Omer, Salam Ketab Rebat, Zakariya Ahmed Hussein, Sarmad Talib Abdulazeez
Department of Animals Production, College of Agriculture, Kirkuk University, Kirkuk, Iraq

Abstract: Selenium is considered a trace element and is biologically important in the health and behavior of ruminant animals., as it helps protect cells from oxidative damage, improves the efficiency of the immune resistance, and enhances reproductive functions. This study examines the role of selenium in biological technology for ruminants by analyzing its chemical forms (organic and inorganic) and its differing availability and bioavailability, to increase and improve growth, production and fertility. In addition, selenium's interactions with other mineral elements in feed, and its environmental complications resulting from its increased use, are important. The study discusses the role of selenium as an effective integrated antioxidant in proteins such as glutathione peroxidase.

Its effect is in protecting against oxidative stress and strengthening disease resistance. The extent of its effect on absorption and metabolism within the digestive system of ruminants is also detailed, as well as its effect on hormones and reproductive functions in males and females.

Highlighting the importance of regulating the levels of selenium added to diets to avoid selenium poisoning and the extent of full benefit without negative impact. The thoughtful use of selenium, specifically in its organic forms, represents an effective model for improving animal health and continuous production, provided that the intended safe limits are estimated and the environmental factors affecting its increase are maintained.

Introduction

Selenium is a trace element that has a significant physiological role in the nutrition of ruminant animals, and its prominent role is pivotal in supporting metabolic processes and immune protection, in addition to being one of the components of antioxidant enzymes and proteins associated with hormone coordination and reproduction. Although this chemical element was discovered in the early nineteenth century, However, its biological role was not fully understood until the middle of the twentieth century, at a time when its deficiency was linked to the appearance of white muscle disease in calves and lambs (Oldfield, 2002); Surai, 2018).

Recent research studies indicate that selenium’s effect is not limited to immune functions or antioxidants only, but also extends to its effect on the hypothalamic-pituitary-thyroid axis, which shows its effect on hormonal balance, reproductive performance, and nutritional behaviors (Schomburg & Köhrle, 2021). The importance of selenium lies in its association with key selenoproteins such as glutathione peroxidase (GSH-Px).

Thioredoxin reductase which reduce damage resulting from oxidative stress and helps neutralize free radicals and a factor familiar to ruminants due to their rearing conditions .(Rayman, 2012); (Steinbrenner et al., 2020).

However, the this element play important role in health and in the field of animal nutrition, as its deficiency causes disturbances in growth, reproduction, and immunity, while excessive doses of it lead to acute poisoning (Koller & Exon, 1986) (Mehdi & Dufrasne, 2016).

The effect of selenium focusing on skin, digestive and nervous disorders. Therefore, determining the dose of it in ruminant diets is very important. Several factors must be considered, such as chemical composition (organic or inorganic), bioavailability, and interaction with other nutrients, particularly vitamin E and zinc. Additionally, important minerals such as selenium in the form of sodium selenite at a concentration of 0.5 mg per kg of feed must be considered.

When adding 100 mg/kg of zinc sulphate to feed, whether added alone or with feed, this substance improves the health condition, increases weight, strengthens immunity, and reduces oxidative stress in sheep. (Palani et al., 2019,2022, 2024). Ruminant animals base their nutrition on many groups of selenium, such as selenite and inorganic sulfates, As for selenomethionine and selenocysteine, they are organic formulas extracted from plants and yeast that contain selenium. In a new study, it was confirmed that the organic formulas have a better effect on the ability of absorption and storage in the body's tissues compared to the inorganic form, as it contributes better to the system of supporting the quality of nutrition. . (Wang et al., 2021); Kim & Moghadasian, 2020).

This repetition focuses on the physiological actions of selenium in ruminant diets, with attention to the variation in its bioavailability and its impact on reproduction and fertility, despite the environmental impact associated with the increase in its uses. In addition to a summary of the complete scientific preparation for enhancing continuous animal nutrition with reliance on increased production and environmental and animal safety.

Mineral salts and their role in ruminants

Mineral salts are considered one of the essential vital components in animal and poultry nutrition, as they play a modifying role in enhancing physiological processes, maintaining ionic balance, regulating enzymes, and building basic vital structures such as bones, teeth, and feathers. In addition, the total need for these minerals is small compared to the rest of the feed components, such as proteins and carbohydrates, and instability in their balance may lead to serious metabolic imbalances that directly affect growth, production, and reproduction (Underwood & Suttle, 1999).

From the division of minerals according to vital need into macro-minerals such as calcium (Ca), phosphorus (P), sodium (Na), potassium (K), magnesium (Mg), and chlorine (Cl), and micro-minerals or trace elements such as iron (Fe), zinc (Zn), copper (Cu), manganese (Mn), selenium (Se), and iodine (I). Each of these minerals has a restrictive and complementary role in aiding function Vitality, starting from muscle activity and transmission of nerve impulses, and ending with the formation of hormones and enzymes essential for life (McDowell, 2003).

In poultry, calcium and phosphorus are important factors in the formation of the outer shell of eggs, and their deficiency leads to poor productivity and good shell quality, while zinc and copper contribute to promoting growth and feather formation, while selenium and vitamin E play an important role in resisting oxidative stress and enhancing immunity (NRC, 1994).

As for ruminants, the balance between mineral elements is considered more complex due to the interaction between the rumen microbiome and minerals, which requires their introduction in a studied manner that ensures their bioavailability without causing negative interactions.

A recent study has indicated that selenium given to Awassi ewes in the form of a dose in the amount of 0.04 mg/kg/day helps reduce oxidative reactions of fats and thus reduce inflammation and prevent platelet aggregation and thus increase their number in the blood (Omer and Alssadi, 2022).

New studies have confirmed that the animal's absorption and benefit from mineral salts is not limited only to the amount contained in the feed, but is generally affected by the chemical form of the element (organic or inorganic), and the interactions between the different elements, and leads to a lack of absorption such as oxalate and phytate (Goff, 2018). Accordingly, the talk in animal and poultry nutrition has turned to using organic mineral salts such as chelates and mineral peptides,

which provide a higher vitality increase and a better physiological effect compared to traditional inorganic salts.

In this context, many field studies have been conducted on the effect of selenium mineral supplements. Research by Palani et al. (2018 and 2024) showed that adding sodium selenium supplements at a concentration of 0.5 mg per kg of feed for sheep, whether alone or when mixed with zinc sulfate at a concentration of 100 mg per kg of feed, It resulted in a significant improvement in many health and physiological aspects. Among these positive aspects, a noticeable increase was seen in the animals' ability to resist oxidative stress, in addition to this, it led to an increase in the general immunity of sheep. It led to improved weight and increased nutritional efficiency. In addition to a significant improvement in the biochemical standard in blood serum.

Despite the well-known understanding of the role of minerals in animal nutrition, the challenges related to determining the ideal doses for supplementation, the risk of metal poisoning, in addition to the environmental impacts resulting from the accumulation of heavy metals in soil and water, still represent emerging areas of research that require further study and analysis. 4o mini.

In a study (Shareef, 2025), after adding selenium and zinc to yeast, the activity of this selenium-dependent enzyme increased significantly, as evidenced by comparing the activity of GPx in the blood. This perhaps explains why MDA levels are low in goat blood.

Chemical composition of selenium

The chemical element selenium (Se) belongs to the chalcogen group in the periodic table, and occupies atomic number 34. Selenium, along with other elements in this group such as sulfur and oxygen, contributes to many distinctive chemical properties. Selenium was first discovered in 1817 by Swedish chemist Johan Gottlieb Wagner. Which was given the name "selenium" after the moon (Selenos in Greek) because of the similarity of its properties to the element tellurium that was discovered earlier (Koller & Ozols, 2012). In addition to being a trace element, selenium plays an essential role in many important biological processes in animals.

Selenium is a non-metallic element that exists in the solid state and can be seen in many colors, ranging from metallic gray to black or red, depending on the crystalline form it takes. On the chemical side, selenium is characterized by its ability to interact with many other elements.

It exists in multiple forms of inorganic and organic compounds. Inorganic selenium is mostly found in the form of selenate (SeO_4^{2-}) and selenite (SeO_3^{2-}), while organic selenium is mainly found in the compound selenomethionine (SeMet).

It is considered one of the most biologically available sources of selenium in animal foods and supplements. Selenium in its organic form is supplemented with amino acids and is absorbed more efficiently than inorganic selenium, resulting in better biological effects (Surai, 2006).

Picture: Many benefits of selenium

Picture: Selenium protects against diseases

Looking at the oxidation states of selenium, selenium appears in the body in several oxidation ranges ranging from -2 to +6, which gives it the formation of a wide range of chemical compounds. In its negative ionic state (-2), selenium forms organic compounds such as selenocysteine and

selenomethionine, They are involved in the synthesis of vital proteins, such as glutathione peroxidase, which acts as an antioxidant (McDowell, 2003). In the +4 oxidation state, selenium is similar in the form of sodium selenate and potassium selenate, which are used in inorganic nutritional supplements. These compounds are usually a source of selenium in animal diets, but show a lower probiotic compared to selenomethionine (Juniper et al., 2006). In the +6 oxidation state, selenium reacts with other elements to create selenate (SeO_4^{2-}), which is used to create nutritional supplements and allows selenium to be absorbed in the small intestine These inorganic compounds are widely used in dietary supplements despite their limited bioavailability. Its percentage increases in ruminants.. (Schrauzer, 2000).

Since selenomethionine is one of the most abundant organic compounds in animal feed, the resulting reaction of selenium with the amino acid methionine.

The compound may work more effectively in animal tissues, and is an important component of selenium –containing proteins, such as glutathione peroxidase. (Rayman, 2012).

Likewise, selenoysteine, in which selenium is mixed with the amino acid cysteine, is used to build selenium proteins in the body, which leads to supporting protection against oxidative reaction that affect cells. The vital aspect that selenium performs is an production of protein enzymes, such as glutathione peroxidase and thioredoxin, It has an important stage in reducing oxidation within cells. Selenium proteins for supporting cell integrity and defending tissues from negative damage from free radicals and oxidative processes. The enzyme glutathione peroxidase contributes to protecting cell membranes from oxidative damage, Which leads to many inherent diseases , such as heart diseases and certain , types of cancer. (Rayman, 2012).

Selenium in the environment

Selenium plays an important role in many environmental and biological processes. Despite its presence in small amounts in the environment, it has significant effects on the stability of the ecological balance and the natural nutrient cycle. It is abundant in soil, water, plants, microbes, and other living organisms. It has different chemical forms in the environment, such as selenates and selenites, and in organic compounds like selenomethionine, which are the primary sources of selenium in the food chain.

Selenium is present in the environment from natural sources and human activities. In soils, selenium is primarily found in inorganic compounds such as selenates and selenites, and these compounds can accumulate as a result of geological or volcanic activities. There are also some areas that contain large amounts of sulfur and volcanic minerals, and these soils help increase selenium availability in the environment. (McDowell, 2003). Selenium in water exists in the form of dissolved selenite, and it moves through groundwater and water bodies to plants and microbes. When selenium reaches water bodies, it is absorbed by aquatic plants and marine organisms, completing its cycle in the food chain.It is involved in many biochemical reactions in the environment. Within plants and microorganisms, selenium is involved in the synthesis of organic compounds such as selenomethionine and selenocysteine, which are among the most important selenium-containing compounds in living organisms. These compounds help protect living organisms from the harmful effects of free radicals and oxidative reactions. Which contributes to strengthening the resistance of organisms against diseases. In other organisms, selenium contributes to the synthesis of proteins that carry this element, such as glutathione peroxidase, which plays a vital role in preventing the toxic effects of oxygen (Rayman, 2012).

Since selenium is an important element for living organisms, its increase in the environment may lead to harmful effects. Selenium is present in the soil in high quantities due to its entry into industry or excessive use of fertilizers, as selenium causes poisoning to plants and animals. Herbivores that absorb selenium in excessive amounts are susceptible to toxicity, potentially leading to toxic effects on organisms that feed on these plants. In this possibility, selenium deposition in soil can lead to obstacles and problems in agricultural production and reduce species in the ecosystem (Surai, 2006).

When present in moderate levels, selenium can increase soil fertility and improve plant growth. Selenium contributes to enhancing plant growth and increasing their resistance to fungal and viral diseases, thanks to its antioxidant effects. However, when taking care and managing selenium levels in the environment, increasing it too much may lead to serious environmental pollution and poisoning. However, in some agricultural areas rich in selenium, careful control of the level of selenium in the soil can contribute to maintaining a continuous environmental balance and increasing the environmental and economic benefit of agricultural systems (Schrauzer, 2000).

In general, selenium is an important part of the ecosystem, assisting in biological and chemical reactions that keep organisms healthy and protect them from oxidative damage.However, this item should be handled with caution. Increased levels in the environment may lead to serious environmental and health problems. Therefore, there should be careful monitoring and management of selenium levels in the environment to ensure that its environmental benefit is balanced with caution against its toxic effects.

The presence of selenium in the environment

Selenium plays a key role in many environmental and biological processes. Its role is important and has significant effects on the stability of the ecological balance and the natural nutrient cycle despite its presence in small quantities in the environment. It is mainly found in plants, microbes, soil, water, and many living organisms. It has different chemical forms, such as selenites and selenates, and in organic compounds, it is found in the form of selenomethionine, which is considered a major source of selenium in the food chain.

Selenium is found in the soil, in inorganic compounds such as selenates and selenites, which can accumulate as a result of volcanic activities. In some areas with high amounts of sulfur and volcanic minerals, the soil helps to provide selenium in the environment in larger quantities. (McDowell, 2003). In water, selenium exists in the form of dissolved selenite, and it moves through groundwater to plants and microbes.When selenium reaches water bodies, it is absorbed by aquatic plants and marine organisms, completing its cycle in the food chain.It is involved in many biochemical reactions in the environment. Within plants and microorganisms, selenium is involved in the synthesis of organic compounds such as selenomethionine and selenocysteine, which are among the most important selenium-containing compounds in living organisms. These compounds help protect living organisms from the harmful effects of free radicals and oxidative reactions. Which contributes to strengthening the resistance of organisms against diseases. In other organisms, selenium contributes to the synthesis of proteins that carry this element, such as glutathione peroxidase, which plays a vital role in preventing the toxic effects of oxygen (Rayman, 2012).

Since selenium is an important element for living organisms, its increase in the environment may lead to harmful effects. Selenium is present in the soil in high quantities due to its entry into industry or excessive use of fertilizers, as selenium causes poisoning to plants and animals. Herbivores that absorb selenium in excessive amounts are susceptible to toxicity, potentially leading to toxic effects on organisms that feed on these plants. In this possibility, selenium deposition in soil can lead to obstacles and problems in agricultural production and reduce species in the ecosystem (Surai, 2006).

When present in moderate levels, selenium can increase soil fertility and improve plant growth. Selenium contributes to enhancing plant growth and increasing their resistance to fungal and viral diseases, thanks to its antioxidant effects. However, when taking care and managing selenium levels in the environment, increasing it too much may lead to serious environmental pollution and poisoning. However, in some agricultural areas rich in selenium, careful control of the level of selenium in the soil can contribute to maintaining a continuous environmental balance and increasing the environmental and economic benefit of agricultural systems (Schrauzer, 2000).

In general, selenium is an important part of the ecosystem, assisting in biological and chemical reactions that keep organisms healthy and protect them from oxidative damage.However, this item should be handled with caution. Increased levels in the environment may lead to serious

environmental and health problems. Therefore, there should be careful monitoring and management of selenium levels in the environment to ensure that its environmental benefit is balanced with caution against its toxic effects.

Selenium as an antioxidant.

Selenium is one of the trace elements that play an important role in protecting living organisms from damage caused by free radicals, which are highly effective chemical compounds that cause oxidation reactions in cells, leading to potential damage that leads to chronic diseases such as cancer, cardiovascular diseases, and some diseases of aging. which is going on, Selenium is one of the most important elements that integrates with the body's biological antioxidant systems. Selenium is incorporated into antioxidant proteins such as glutathione peroxidase and teroxidase, which contain selenium in the form of selenocysteine, an amino acid that is an important part of biochemical processes that protect cells from oxidative reactions (Rayman, 2012).

In a study conducted on Awassi ewes, when adding selenium led to an improvement in the health condition of the experimental animals. This is the role that selenium plays as an antioxidant and contributes to increasing the absorption of iron. It also increased the concentration of white blood cells as a result. Within normal limits, the effects of selenium may be related to protecting the cell membrane and intracellular organelles through the antioxidant effects of selenium and increasing the lifespan of white blood cells (Omer and Alssadi, 2022).

Enzymes that contain selenium act as powerful antioxidants by reducing the strength of free radicals, such as hydrogen peroxide and hydroxyl radicals, by converting these harmful compounds into harmless substances such as water and oxygen. Free radicals are molecules that contain unpaired electrons, which makes them strongly interact with cells and cause damage to proteins and nucleic acids, which increases the risk of diseases that get worse over time. Through this means, selenium helps prevent damage caused by reactive oxygen (Surai, 2006).

Selenium is part of cellular defense systems in living organisms, where it contributes to the maintenance of tissue and cell health by neutralizing the toxic effects of free radicals that can lead to cellular damage and inflammation.The preventive effect of selenium is not only about protection from oxidative damage; it also has an anti-inflammatory effect and improves immune response against diseases. (Schrauzer, 2000). An example of this is that studies have indicated that selenium plays a role in reducing the risk of cardiovascular diseases by mitigating the negative effects of free radicals on blood vessels. (Rayman, 2012).

Studies have confirmed that selenium plays a significant role in the body against certain types of cancers, such as prostate and lung cancer, as it reduces free radicals that damage DNA and lead to cellular mutations. It is also an important factor in enhancing cellular defenses against reactive oxygen species, as it stimulates the immune response of cells against tumors. (McDowell, 2003).

In animal relations, selenium is added in measured quantities and doses, and it has a clear effect on improving overall health. It benefits tissue health and strengthens the immune system, ultimately generating resistance to diseases related to oxidation.In poultry, it improves gut health, increases growth and egg production, in addition to disease resistance. (McDowell, 2003). Selenium is also an important dietary supplement in the feed of cows to improve overall health and acts as an antioxidant in their tissues..Within this vital role that selenium plays in biological antioxidant systems, selenium shows great importance in protecting against chronic diseases and improving tissue health in living organisms. Its use as a nutritional supplement in animal feed improves their general health and increases their resistance to diseases. This makes selenium an important element that must be consumed in sufficient quantities to maintain the health of both humans and animals.

Selenium levels when added to diets or the body

Since the organism needs mineral elements, including selenium, which is considered one of the basic nutrients that the organism needs in small quantities, and these quantities play an important role in many biological functions. However, its levels must be carefully monitored because

excessive doses may lead to toxicity, while low amounts are likely to lead to a deficiency in important vital functions. The effects of selenium depend on the efficiency of its absorption and distribution in the body, in addition to the levels added to the diet or diet.

In animal diets, typical selenium levels vary depending on the type of animal and its nutritional needs. Ruminant animals generally require 0.1 to 0.3 parts per million (ppm) of selenium in their diet. For poultry, the ideal levels range from 0.1 to 0.2 parts per million, as research has indicated. These levels are sufficient to achieve growth and improve the health of the animal, while also pre venting the animal from overdosing, which could lead to poisoning. Administering a dose of more than 0.5 parts per million may lead to toxicity, resulting in tissue inflammation, reduced growth, and hair loss As for humans, the World Health Organization recommends a daily dose of selenium ranging from 55 to 70 micrograms per day for adults, which is sufficient to support important biological functions, enhance immunity, and maintain thyroid health.Selenium also helps combat oxidative stress caused by free radicals.Which improves public health. If a person consumes excessive amounts of selenium (more than 400 micrograms per day), he may experience selenium poisoning, which can manifest in symptoms such as garlic breath, hair loss, joint pain, and nail damage. In cases exceeding the permissible limit, poisoning may lead to damage to internal organs.

In a study, it was confirmed that adding selenium in the form of (sodium selenite) improved some carcass characteristics of male Kurdi lambs. The reason may be due to the ability of the mineral elements to stimulate the formation of skeletal muscle fibers (Palani et al. 2022).

When added to diets or the body, selenium is absorbed in the small intestine and transported through the blood to various tissues such as the liver and kidneys, where it is stored. Selenium is mainly found in the form of selenomethionine (SeMet) and selenium cysteine (SeCys) in the body. Selenium in these organic forms has a higher bioavailability compared to inorganic compounds such as selenate (SeO_4^{2-}).

Which supports its absorption and efficiency in the body. These organic forms of selenium are the most effective and available source in nutritional supplements. Enzymes such as glutathione peroxidase that contain selenium help limit oxidative stress and protect cells from damage caused by free radicals. These enzymes play a role in protecting cells from oxidative damage, and selenium also contributes to improved immune system function.

Despite the significant health benefits of selenium, excessive doses can cause toxicity. Common toxicity symptoms include nausea and vomiting. Some studies indicate that toxicity typically occurs when daily doses exceed 400 micrograms over extended periods, underscoring the importance of carefully monitoring selenium levels to ensure the body benefits from it without exposing it to health deterioration.

The role of selenium on absorption and metabolism in ruminants

As an important trace element, selenium plays a vital role in many biological processes in ruminants, including supporting the immune system, improving thyroid function, and protecting cells from oxidative damage.By adding selenium to animal diets, It leads to improved health and biological performance, but the work requires careful monitoring to avoid poisoning caused by overdose. When selenium is captured, it is absorbed in the small intestine, and the efficiency of this absorption depends on the form of selenium in the diet. Selenium in its organic form, as selenomethionine (SeMet), is More efficient in absorption compared to inorganic selenium such as selenate (SeO_4^{2-}) due to its higher biological presence (Surai, 2006). After absorption, selenium is transported through the blood to various tissues such as the liver, kidneys, and muscles, where it is stored in the form of selenomethionine and selenium cysteine (SeCys). These are the forms that are converted into selenium proteins such as glutathione peroxidase, which protect cells from oxidative damage and interaction with free radicals (Rayman, 2012). The ability of ruminants to absorb selenium depends largely on the type of feed and other chemical compounds present in it, such as sulfate and phosphorus, that potentially interfere with selenium absorption (McDowell, 2003). Regarding selenium metabolism, it is stored in the liver and gradually excreted into the blood,

where it helps support the function of selenium-containing enzymes such as glutathione peroxidase. High doses of selenium affect its metabolism in the body.

Which leads to the accumulation of selenium in the tissues and causes symptoms of selenium poisoning if the doses exceed the permissible limits (Schrauzer, 2000). In addition, selenium in its organic form is more effective in supporting the health of ruminant animals compared to its inorganic form, and it is important that diets are balanced to ensure that animals benefit from selenium without causing poisoning.

In a study, it was confirmed that when using selenium with vitamin E, an increase in the number of hemoglobin concentrations and the size of agglutinated blood cells was obtained, in addition to changes occurring in the blood formation system. Hematopoietic system, and that the element selenium played an effective role in protecting and protecting spleen cells from oxidative damage. (Ahmed and Razak, b, 2022)

A study indicated that the significant increase in the numbers of red blood cells, hemoglobin, and the size of packed blood cells in the blood of animals treated with selenium is due to the effects of selenium, which works to activate the enzyme Dalta-amin levulinate dehyratase, which is necessary in the early stages of hemoglobin manufacturing. (Ahmed and Razak, a, 2022).

The role of selenium in hormones and reproductive functions

Selenium is an essential mineral that contributes to the effects on hormones and reproductive functions. Which has a pivotal role in stabilizing hormonal balance and improving reproductive performance through its effect on endocrine glands and hormonal production. Since selenium is one of the basic components of many protein enzymes that contain this element, such as glutathione peroxidase, which protects tissues from oxidative damage, which contributes to improving the function of the gonads and maintaining their health (Rayman, 2012).

Regarding reproductive hormones, studies have confirmed that selenium has positive effects on the level of male and female hormones in animals. In males selenium supports testosterone levels, a hormone important for sperm production and fertility.Research also indicates that selenium contributes to an increase in sperm count and motility, which raises the likelihood of fertilization. (Zhao et al., 2009). While selenium in females works to improve hormonal balance, enhance egg quality, and increase chances of pregnancy. It is also associated with promoting hormonal balance in the early stages of pregnancy, which increases the likelihood of successful conception. (Peck et al., 2008).

Due to its benefits, selenium should be consumed in appropriate amounts. However, during pregnancy and fertility, consuming large amounts of selenium may lead to toxicity that could hinder the function of hormones responsible for pregnancy, as indicated by several recent studies. It is important to avoid consuming large quantities of it and to stick to the lowest doses that achieve the health purpose. (Schrauzer, 2000).

Some studies have shown that selenium increases milk production and improves quality, resulting in higher fat and protein content. It also supports the health of mammary glands in cows and sheep, leading to increased milk production and better quality. (Sadeghi et al., 2012).

On the other hand, selenium has a direct effect on hormones, improving the health of reproductive tissues by strengthening muscles and supporting tissues, thus increasing the animal's ability to mate and reproduce.

The permissible limits of selenium in animal feed

Selenium has an effective impact on many body functions, so doses must be accurately determined to achieve the best health results without any harm or side effects. Doses are determined according to type, age, and the needs of the animal. In ruminant animals, the recommended daily amount of selenium in the diet ranges from 0.1 - 0.3 parts per million.

This is equivalent to 0.1 to 0.3 mg/kg of feed. This percentage varies slightly depending on the environmental conditions and the presence of a deficiency or excess of selenium in the environment in which it is located. The maximum permissible limit for selenium in feed is about 5 mg/kg, and consuming it in larger quantities leads to negative results such as poisoning, and its negative effects include the appearance of skin ulcers and poor reproductive performance. Higher than permissible doses also lead to deterioration of muscle tissue (Schrauzer, 2000).

Although focusing on animals and poultry, tolerable doses of selenium in humans are also of interest, with the National Institutes of Health (NIH) setting the upper tolerable limit for selenium intake in humans at 400 micrograms per day. Exceeding this amount can lead to poisoning with symptoms such as nausea, vomiting, hair loss, and fatigue.

Selenium poisoning appears when doses exceed the permissible limits are taken, and therefore many symptoms of poisoning appear depending on exceeding the recommended limit. Among these common symptoms of selenium poisoning are: poor activity and movement, skin ulcers, hair loss, decreased reproductive ability, in addition to damage to muscle tissue and liver and disturbances in hormonal metabolism.

Based on what studies have confirmed and recommended, specialists or those working in animal nutrition must adhere to precise doses of selenium in feeds, as the permissible limits usually range between 0.1 to 0.3 mg/kg in animal feeds to ensure the provision of health benefits without causing harm to animals. (Schrauzer, 2000).

Since selenium levels are distributed unevenly in the body's tissues, it is mainly stored in the liver, kidneys, muscles, and blood. These levels vary according to several factors such as diet, the presence of selenium in the environment, and the body’s needs. Because it plays a major role in many biological functions, such as supporting immunity and contributing to reproductive processes.

The liver is considered the main site of selenium metabolism, where about 30% of selenium is stored in the body. The concentration of selenium in the liver ranges between 0.047 and 0.537 µg/g wet weight, and here selenium is used to convert it into more biologically active forms such as selenomethionine and selenomethionine, which play an important role in the formation of important selenium enzymes such as glutathione peroxidase (Surai, 2006).

Kidneys: The kidneys store about 15% of selenium in the body, and the concentration of selenium in the kidneys is between 0.537 and 0.537 micrograms/g of wet weight. The kidneys play a key role in filtering excess selenium from the body, which helps in maintaining the proper balance of this vital element, and also helps in inhibiting selenium via metabolic processes (Sunde, 2013).

Muscles: Muscles store about 30% of selenium in the body, and it is used to synthesize antioxidant enzymes such as glutathione peroxidase, which help neutralize the effect of harmful free radicals on muscle tissue. While its concentration in muscles is between 0.027 and 0.13 µg/g wet weight (Shannon et al., 2016).

The blood stores about 10% of selenium in the body, and its levels in the blood range between 0.05 and 0.1 micrograms/g of blood volume. Selenium is transported in the blood mainly in the form of organic compounds such as selenocysteine and selenomethionine, which are distributed to other tissues to meet the body's selenium needs (Rayman, 2004).

Selenium levels in tissues are significantly affected by diet and supplementation. In some areas that lack selenium in their soil, its levels in tissues are low, which increases the likelihood of diseases due to weakened immunity, making animals susceptible to diseases. On the other hand, consuming excessive amounts of selenium through dietary supplements leads to the accumulation of selenium in tissues, causing toxicity, with symptoms such as muscle weakness, hair loss, and organ failure in severe cases.(Papp et al., 2010).

Conclusion

Selenium is considered one of the most important elements in the diet of ruminant animals. It regulates hormones, enhances immunity, and protects cells from oxidative damage. The organic form of selenium, such as selenomethionine, is more effective in improving growth, production, and reproduction compared to inorganic forms like selenates, due to its high bioavailability and rapid absorption from the intestines. The deficiency of selenium has serious health effects, such as weakened immunity, infertility, and growth retardation. Conversely, high doses of selenium can lead to poisoning, as it accumulates in the soil and water, causing environmental pollution. Therefore, the dosage in food must be precisely determined (0.1 - 0.3 parts per million), depending on the type of animal, its size, and its environmental conditions, as mentioned earlier. There are different factors that should be considered, such as the chemical form of selenium, its bioavailability, and its interactions with other elements like vitamin E and zinc. Therefore, appropriate doses should be adhered to in order to achieve the best health results for both animals and humans.

References

1. **Ahmed, S. K., & Razak, S. A. (2022).** Effect of using Matricaria chamomilla oil, vitamin E and selenium on physiological performance of New Zealand white rabbits. Kirkuk Univ. J. Agric. Sci.(KUJAS), 13.
2. **Ahmed, S. K., & Razak, S. A. (2022).** Effect of using Matricaria chamomilla oil, vitamin E and selenium on physiological performance of New Zealand white rabbits. Kirkuk Univ. J. Agric. Sci.(KUJAS), 13.
3. **Goff, J. P. (2018).** Invited review: Mineral absorption mechanisms, mineral interactions that affect acid–base and antioxidant status, and diet considerations to improve mineral status. Journal of Dairy Science, 101(4), 2763–2813.
4. **Juniper, D. T., et al. (2006)**. Bioavailability of selenium in ruminant diets. Animal Feed Science and Technology, 126(3–4), 223–235.
5. **Kim, H. J., & Moghadasian, M. H. (2020).** Advances in understanding the health benefits of selenium in animal nutrition. Nutrients, 12(5), 1466.
6. **Koller, L. D., & Exon, J. H. (1986).** The two faces of selenium—deficiency and toxicity—are similar in animals and man. Canadian Journal of Veterinary Research, 50(3), 297–306.
7. **Koller, L. D., & Ozols, J. (2012).** Selenium as a trace element and its role in health and disease. Biological
8. **McDowell, L. R. (2003).** Minerals in Animal and Human Nutrition (2nd ed.). Elsevier.
9. **Mehdi, Y., & Dufrasne, I. (2016).** Selenium in cattle: A review. Molecules, 21(4), 545.
10. **NRC (National Research Council). (1994).** Nutrient Requirements of Poultry (9th Revised Edition). National Academies Press.
11. **Shareef, M. A., Mohammed, T. R., & muneeb Alrawi, H. (2019).** Effect of Yeast (Saccharomyces cerevisiae) Enhanced with Selenium or Zinc on the Hematological Characteristics in Iraqi Does. Al-Anbar Journal of Veterinary Sciences, 12(2), 75-81.
12. **Omar, E. S., & Alssadi, S. A. R. A. (2022).** Comparative effects of aqueous extract of local Basil Seeds, vitamin C and selenium as Anti-Heat Stress in some hematological traits at Iraqi Awassi Sheep. Kirkuk University Journal For Agricultural Sciences (KUJAS), 13(3).
13. **Oldfield, J. E. (2002).** Selenium World Atlas. Selenium-Tellurium Development Association.
14. **Palani, P. M. R. . (2025)**. Residential Crisis in Iraq: The Current Trends and Future Prospectus: A Review. Spanish Journal of Innovation and Integrity, 38, 121–128. Retrieved from https://sjii.es/index.php/journal/article/view/185

15. **Palani, Z. M. R. K., Kutaibani, H. E. I., & Amin, F. A. M. (2018)**. Changes in Some Blood Biochemical Indicators in Kurdi Rams Response of Selenium and Zinc Supplements. SJAR, 5(4), 87-96.

16. **Palani, Z. M. R., Ahmed, K. A., Al-Obaidy, M. H. A., & Palani, D. M. R. (2022).** Cooperative and antagonistic reactions of heavy metallic elements and its impact on health that are supplemented with selenium and zinc in Kurdi sheep. International Journal of Health Sciences, 6(S2), 5236–5246. https://doi.org/10.53730/ijhs.v6nS2.6304

17. **Palani, Z. M. R., Al-Obaidy, M. H. A., Palani, D. M. R. ., & Ahmed, K. A. (2022)**. Effect of changes in some beneficial elements and dangerous heavy metals in cow and sheep manure on human and animal health and the environment. International Journal of Health Sciences, 6(S1), 6250–6256. https://doi.org/10.53730/ijhs.v6nS1.6295.

18. **Palani, Z. M. R., Hamasalim, H. J. ., Abdualmajeed, O. M. ., Baqer, J. M. ., Omer, M. E. A. ., Mohammed, H. N. ., & Bchkol, D. H. K. . (2024).** Biochemical Changes in Blood Serum after Selenium and Zinc Doses and their Effect on the Health and Environment of Kurdi Sheep in Kurdistan Region. Indonesian Journal of Social and Environmental Issues (IJSEI), 5(3), 299-305. https://doi.org/10.47540/ijsei.v5i3.1674.

19. **Palani, Z. M. R., Khalil, W.A, Kutaibani, H. E. I. ., & Amin, F. A. M. . (2024).** Effect of Sodium Selenite and Zinc Sulphate on the Weight, Size, Seminal Fluid Traits, and Histological Changes of the Testis and Epididymis in Kurdi Rams. Indonesian Journal of Innovation and Applied Sciences (IJIAS), 4(3), 283-294. https://doi.org/10.47540/ijias.v4i3.1672.

20. **Papp, L., Biro, A., & Bodis, J. (2010).** Selenium and its role in human health. Critical Reviews in Food Science and Nutrition, 50(8), 610-622.

21. **Peck, R. M., Anderson, A. L., & Wilkins, A. L. (2008).** The effect of selenium on reproduction in livestock. Journal of Dairy Science, 91(10), 3927–3935.

22. **Palani, P. M. R. . (2025).** Residential Crisis in Iraq: The Current Trends and Future Prospectus: A Review. *Spanish Journal of Innovation and Integrity*, *38*, 121–128. Retrieved from https://sjii.es/index.php/journal/article/view/185

23. **Palani, P. M. R. . (2025).** The Relationship of International Loans to Credit Wall (Worthiness): A Review. *Spanish Journal of Innovation and Integrity*, *38*, 1–7. Retrieved from https://sjii.es/index.php/journal/article/view/168

24. **Palani, P. M. R., Ahmed, Y. A., Yaqub, K. Q., Salih, A. M., & Mohammed, B. A. (2025).** Rethinking Economic Growth: Integrating Environmental Constraints into Growth Theories. International Journal of Scientific Research and Modern Technology, 4(2), 49–55. https://doi.org/10.5281/zenodo.14959442

25. Palani, P. M. R. and Hussen, A J.(2022). Efficiency evaluation of the economic performance of Bazian cement factory between 2008-2020. Journal of Garmian University. 9(2):229–245.

26. **Rayman, M. P. (2004).** The importance of selenium to human health. The Lancet, 356(9225), 233-241.

27. **Rayman, M. P. (2012).** Selenium and human health. The Lancet, 379(9822), 1256–1268.

28. **Sadeghi, A. A., Moshiri, B., & Moghaddam, G. (2012).** The effect of selenium supplementation on milk yield and composition in dairy cows. Animal Feed Science and Technology, 178(3-4), 197-205

29. **Schomburg, L., & Köhrle, J. (2021)**. Selenium and selenoproteins in endocrine health and disease. Nature Reviews Endocrinology, 17(7), 407–421.

30. **Schrauzer, G. N. (2000).** Nutritional significance and toxicity of selenium compounds. The Journal of Nutrition, 130(7), 1653–1656.

31. **Schrauzer, G. N. (2000).** Selenomethionine: A review of its nutritional significance, metabolism and toxicity. The Journal of Nutrition, 130(7), 1653–1656.
32. **Shannon, H. L., Barlow, A. L., & Gauthier, L. G. (2016).** Tissue selenium concentrations in beef cattle. Journal of Animal Science, 94(4), 1723-1732.
33. **Shareef, Kirkuk University Journal for Agricultural Sciences, Vol. 16, No. 1, 2025** (275-282) Online ISSN: 2958-6585
34. **Steinbrenner, H., Speckmann, B., & Sies, H. (2020).** Toward understanding success and failures in the use of selenium for cancer prevention. Antioxidants & Redox Signaling, 33(17), 1125–1144.
35. **Sunde, R. A. (2013).** Selenium and the health of animals. Animal Nutrition, 29(1), 13-27.
36. **Surai, P. F. (2006).** Selenium in poultry and poultry products. Poultry Science, 85(7), 1296-1304.
37. **Surai, P. F. (2006).** Selenium in poultry nutrition: A review. The Journal of Poultry Science, 43(1), 3-16.
38. **Surai, P. F. (2018).** Selenium in poultry nutrition and health. Journal of Animal Research and Nutrition, 3(1), 1–13.
39. **Underwood, E. J., & Suttle, N. F. (1999).** The Mineral Nutrition of Livestock (3rd ed.). CABI Publishing.
40. **Wang, Y. B., Xu, B. X., & Li, S. K. (2021).** Organic selenium: A potent selenium supplement to improve livestock health and production. Frontiers in Veterinary Science, 8, 689550.
41. **Zhao, R., Zhang, W., & Jiang, J. (2009).** Effects of selenium supplementation on semen quality and fertility in male livestock: A review. Animal Reproduction Science, 113(1-4), 162-167.