Journal of Frontiers in Multidisciplinary Research

Current Research on The Effect of Selenium Supplementation in Animal Diet on The Meat Quality

Yunmei Lu [1], Huixia Dong [2*]
[1-2] Jingchu University of Technology, College of Food and Biology, 448000, Jingmen, Hubei, China

* Corresponding Author: **Huixia Dong**

Article Info

E-ISSN: 3050-9726
P-ISSN: 3050-9718
Volume: 07
Issue: 02
Received: 21-06-2026
Accepted: 19-07-2026
Published: 20-08-2026
Page No: 223-225

Abstract
Supplementation of selenium in animal diet is generally used in modern husbandry. Selenium can improve the quality and nutritive value of meat. The mechanism of selenium and the effect of selenium deficiency on meat quality were summarized. The efficacy of improving meat color pH water holding capacity, nutritional ingredients from supplying selenium in animal diet were also summarized.

DOI: https://doi.org/10.54660/.JFMR.2026.7.2.223-225

Keywords: selenium, meat quality, selenium concentration, selenium deficiency

1. Introduction

Meat quality has become a hot topic in current nutritional research. Numerous factors (genetics, nutrition, transportation, slaughter, etc.) can affect meat quality. There are many indicators for evaluating meat quality, mainly including meat color, pH, water-holding capacity, and tenderness, which reflect the freshness, nutritional quality and flavor of meat. The trace element selenium (Se) possesses a wide range of biological functions [1]. It not only regulates the synthesis of thyroid hormones and enhances body immunity, but also improves meat color and pH, and increases water-holding capacity through its antioxidant activity. Therefore, selenium is essential for maintaining normal muscle function. The shelf life of meat is affected by multiple factors such as temperature, light, exposure time to air, and microbial growth. Mitigating the adverse effects of these factors to extend meat shelf life has become a major concern in the meat industry [2]. Studies have demonstrated that dietary selenium supplementation can enhance the antioxidant capacity of animals, effectively preserve meat quality during storage, and thereby prolong meat shelf life. Lipid oxidation leads to meat discoloration and increased drip loss, which deteriorates meat quality and causes substantial economic losses to the meat industry. Accordingly, the addition of antioxidants (selenium, vitamin E, etc.) to animal diets is one of the common strategies to improve meat quality and extend meat shelf life.

2. Mechanism of Selenium in Improving Meat Quality

2.1. The Antioxidant Effects of Selenium and Related Enzymes

Studies suggest that lipid peroxidation triggered by free radical attack on polyunsaturated fatty acids in muscle is one of the primary causes of meat deterioration during refrigerated storage. Selenium improves meat quality by enhancing the antioxidant capacity of the organism to inhibit the deteriorative reactions arising from lipid peroxidation [3]. The glutathione peroxidase (GSH-Px or GPx) family plays a vital role in the body's antioxidant system. As an essential component of GSH-Px, selenium exerts remarkable effects on scavenging free radicals and maintaining the integrity of cell membranes. Similarly, this enzyme system may contribute substantially to the antioxidant defense of post-mortem muscle by decomposing hydrogen peroxide and lipid hydroperoxides. Malondialdehyde (MDA), a product of lipid peroxidation, serves as one of the sensitive indicators reflecting tissue antioxidant status [4]. Its concentration can be quantified by the thiobarbituric acid reactive substance (TBARS)

value; a lower TBARS value indicates stronger antioxidant capacity of the organism. Dietary selenium supplementation enhances tissue antioxidant capacity and accelerates the elimination of oxygen free radicals in tissues, thereby reducing TBARS values.

2.2. The Antioxidant Effects of Selenium and Vitamin E

Selenium can also exert its effects via synergistic interactions with vitamin E (V_E) to modulate non-enzymatic reactions. As antioxidants, selenium and VE share similar biological functions and serve as key components of the tissue and cellular antioxidant defense system. V_E constitutes the first line of antioxidant defense in the organism. It is localized on cell membranes and can block peroxides generated in the membrane. Selenium acts as the second line of antioxidant defense, eliminating intracellular peroxides through glutathione peroxidase. Therefore, they work synergistically to maintain the redox homeostasis of the body, thereby positively improving meat quality. Bai *et al*. reported that dietary supplementation with selenium and VE had no effect on the color of broiler thigh muscle, but reduced the TBARS values of thigh muscle [5]. Li *et al*. found that dietary yeast selenium and VE significantly increased the pH and meat color scores of pork at 45 min and 24 h post-mortem, which were 7.34%, 6.16%, and 23.14% higher than those of the control group, respectively. Meanwhile, drip loss was extremely significantly decreased by 16.37% compared with the control group.

3. Effects of Selenium Supplementation on Selenium Content in Muscle

Recent reports indicate that 67.8% of the daily selenium intake of residents in Suzhou, China, originates from meat. Therefore, it is feasible to increase selenium concentration in muscle by selenium supplementation in animal diets and improve human selenium nutritional status through food consumption. Studies have shown that selenium utilization by animals varies with dietary selenium addition levels. Selenium deposition in muscle rises with increasing dietary selenium inclusion and then plateaus.

The amount of selenium deposited in muscle may be related to the metabolic pathways of different selenium sources. In the metabolic pathway of inorganic selenium, only a small fraction is incorporated into body proteins. Most selenium that is not used for selenoprotein synthesis is transported to the kidneys and ultimately excreted from the body. By contrast, selenium in organic selenium sources exhibits properties similar to sulfur-containing amino acids. During protein synthesis, selenoamino acids often replace sulfur-containing amino acids and integrate into proteins. Accordingly, organic selenium (such as selenium yeast and selenomethionine) can increase the total selenium reserve of the organism, serving as a selenium pool stored in tissues in an organic form. In addition, reasonable dosages should be adopted for animal selenium supplementation according to the selenium form applied.

Due to the uneven distribution of selenium, 40 countries around the world are in low-selenium or selenium-deficient status, and China is one of them. Countries with selenium-deficient soils, such as the United Kingdom and New Zealand, have adopted measures to increase selenium contents in human diets to prevent health problems caused by selenium deficiency. Governments worldwide are striving to develop strategies to raise human selenium intake, including direct selenium supplementation and selenium enrichment in soils or foods. Therefore, appropriately increasing selenium concentration in meat products can not only improve meat quality but also compensate for insufficient selenium intake in humans. In recent years, researchers have continuously explored various approaches to achieve meat quality improvement. For instance, functional ingredients such as selenium, VE, n-3 polyunsaturated fatty acids, and conjugated linoleic acid can be added to animal diets to modify animal products, carcass composition and meat quality.

4. Effects of Selenium on Meat Quality Improvement

4.1 Improvement of Meat Color

Consumers usually evaluate meat color by sensory assessment, which is also the most intuitive factor affecting consumers' purchase intention. Changes in meat color are closely associated with the natural oxidation of myoglobin (Mb), the pigment in muscle. Myoglobin consists of globin and heme, which contains an iron ion existing in the reduced state Fe^{2+} or oxidized state Fe^{3+}. Myoglobin itself is purplish-red. After binding with oxygen, it forms oxymyoglobin, presenting bright red color, which indicates fresh meat. Both Mb and oxymyoglobin can be oxidized to metmyoglobin with a brown color, which occurs when meat is stored for a long time. Therefore, maintaining heme iron in the reduced state and slowing the transition of meat color from bright red to brown are critical for preserving meat color stability. Regarding the effect of selenium on improving meat color, experimental results show that dietary selenium yeast significantly increased the a* value and decreased the b* value of breast muscle in male offspring of Langshan chickens, thereby improving meat color stability. Research by Jiang *et al*. also found that selenomethionine significantly increased the a* value of longissimus dorsi muscle in pigs at 24 h and 48 h post-mortem, significantly reduced the L* value at 12 h, 24 h and 48 h and the b* value at 12 h. Accordingly, selenomethionine plays a positive role in maintaining pork color stability and extending pork shelf life[6]. However, some reports indicated that dietary supplementation with sodium selenite (0.3 mg/kg) or selenium yeast (0.3, 0.45, 0.5, 3 mg/kg) had no effect on meat color of pigs, lambs and cattle. Further research is required to explore the underlying mechanism by which selenium improves meat color.

4.2 Improvement of Muscle pH

Muscle pH is also an important indicator reflecting meat quality. Studies have shown that lactic acid is produced via anaerobic glycolysis of glycogen by lactic acid bacteria in post-mortem muscle, so muscle pH declines over time after slaughter. However, a rapid drop in muscle pH readily leads to pale, soft, exudative (PSE) meat and deteriorates meat quality. Selenium can delay this pH decline by enhancing the capacity of muscle cells to clear lactic acid, a metabolic product. Reports have demonstrated that organic selenium is more efficient than inorganic selenium in reducing the incidence of PSE meat in breast muscle. Nevertheless, studies on other animal species have found no pH-improving effect of selenium. Different selenium sources (sodium selenite and selenium yeast) at the same inclusion level also exerted no significant influence on turkey breast muscle pH measured at 15 min, 1 h and 24 h post-mortem. Similarly, experimental results indicated that different selenium sources (sodium

selenite, selenium yeast) and inclusion levels (0.3, 0.45 mg/kg) had no effect on the pH of lamb longissimus dorsi muscle. This discrepancy may be related to animal species, and the underlying mechanisms require further investigation.

4.3 Improvement of Muscle Water-Holding Capacity

Muscle water-holding capacity (WHC) exerts a substantial impact on the economic value of the whole meat industry. It also affects meat flavor, color, nutritional composition and tenderness. pH is regarded as an important factor influencing water-holding capacity. A low pH causes myofibrillar shrinkage and reduces the ability of muscle proteins to bind water. Meanwhile, lipid oxidation may damage the integrity of muscle cell membranes and increase membrane permeability, which impairs membrane stability, resulting in greater exudative loss and elevated drip loss in meat. Selenium can ultimately improve muscle water-holding capacity by preserving cell membrane integrity.

4.4 Effects of Selenium on Nutritional Components of Muscle

The contents of nutritional components in muscle also affect certain meat quality traits, especially intramuscular fat content. The desirable intramuscular fat content in pork ranges from 2.0% to 3.0%. Within a certain range, higher fat content contributes to better juiciness and flavor, as well as finer and more tender mouthfeel of meat. However, most studies indicate that selenium has no effect on the nutritional components in muscle, including crude protein and crude fat contents. Nevertheless, some reports have shown that a high dosage (0.8 mg/kg) of sodium selenite increases the intramuscular fat content in the longissimus dorsi muscle of finishing pigs. Therefore, further research is required to explore the effects of selenium on crude protein and crude fat in muscle.

5. Effects of Selenium Deficiency on Meat Quality

Selenium deficiency can trigger a variety of diseases. Reports state that a region is considered selenium-deficient when selenium concentration in soil is less than 0.5 mg/kg or selenium concentration in plants is below 0.2 ng/kg. In addition, other elements such as calcium, sulfur, copper and arsenic can affect selenium uptake by plants, thereby inducing selenium deficiency. Selenium deficiency also severely impairs animal health and production performance, mainly manifested as slow body weight gain, reduced milk yield and wool production, decreased fertility, smaller litter size and increased mortality of newborn animals.

Dietary selenium deficiency can cause multiple muscular dystrophies, including exudative diathesis in chickens, mulberry heart disease in pigs, and white muscle disease in cattle and sheep. Moreover, selenium-deficiency-induced oxidative stress reduces the water-holding capacity of muscle. Reports from Australia indicated that white muscle disease was prevalent in animals due to selenium-deficient soil in this region. Therefore, meeting the body’s selenium requirement through various approaches can not only prevent the above diseases but also improve meat quality and raise economic benefits.

Funding

This work was supported by Research of Development of Regional Characteristic Selenium-Enriched Feed Resources and Integration of Key Technologies for Selenium Biofortification in Beef Cattle (HZ250148), Research and Development of Key Technologies for Improving Growth Performance and Meat Quality of Beef Cattle via Selenium-Enriched Nutritional Regulation (HZ260076).

References

1. Rederstorff M, Krol A, Lescure A. Understanding the importance of selenium and selenoproteins in muscle function. Cell Mol Life Sci. 2006;63:52-9.
2. Luciano G, Monahan FJ, Vasta V, *et al*. Lipid and colour stability of meat from lambs fed fresh herbage or concentrate. Meat Sci. 2009;82:193-9.
3. Ripoll G, Joy M, Muńoz F. Use of dietary vitamin E and selenium (Se) to increase the shelf life of modified atmosphere packaged light lamb meat. Meat Sci. 2011;87:88-93.
4. Chen JF, Xing Y, Nie M, *et al*. Comparative effects of various dietary selenium sources on growth performance, meat quality, essential trace elements content, and antioxidant capacity in broilers. Poult Sci. 2024;103(9):104057.
5. Bai X, Li F, Li FD, *et al*. Different dietary sources of selenium alter meat quality, shelf life, selenium deposition, and antioxidant status in Hu lambs. Meat Sci. 2022;194:108961.
6. Jiang DT, Phipps RH, Ramos-Morales E, *et al*. Effects of dietary supplementation with selenium-enriched yeast or sodium selenite on selenium tissue distribution and meat quality in lambs. Anim Feed Sci Technol. 2009;149:228-39.

How to Cite This Article

Lu Y, Dong H. Current research on the effect of selenium supplementation in animal diet on the meat quality. J Front Multidiscip Res. 2026;7(2):223-225.
doi:10.54660/.JFMR.2026.7.2.223-225.