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Selenium supplementation to Awassi lambs did not improve their growth performance

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Abstract

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This study was conducted to evaluate the effects of selenium (Se) supplementation on growth performance of growing Awassi lambs. Twenty-five lambs were divided randomly into three groups. Lambs received the basal diet plus: no Se (CON; n = 8), 0.15 mg/lambs/day of supplemental Se to the diet as Se selenite (DSE; n = 8), or 0.5 mg/lamb of Se injection as Se selenite (ISE; n = 9). At the end of the study that lasted for 50 day, 3 lambs from each treatment randomly selected and individually housed in metabolism crates to evaluate nutrient digestibility. Nutrients (DM, OM, CP, NDF, ADF, and EE) intake of lambs and nutrient digestibility were not affected by Se supplementation. Growth performance (final body weight, average daily gain, and feed conversion ratio) of lambs were similar among treatment groups. Selenium supplementation (dietary or injection) failed to improve the performance of growing Awassi lambs fed high-concentrate diets containing 0.13 mg Se /kg of dry matter.

Keywords: Awassi lambs; Growth rate; Selenium; Trace mineral

Introduction

Selenium (Se) is a trace mineral that is essential for optimum health and, subsequently, production of lambs (Fairweather-Tait et al., 2010; Sushma et al., 2015). As an essential component of the glutathione peroxidase, Se is an important antioxidant (Awadeh et al., 1998). Selenium is also important in thyroid activity and the conversion of T_4 to biological active T_3 (Gartner et al., 2007; Schauberger et al., 2017). Selenium deficiency, by impacting immune system and thyroid functions (by which the general metabolism is controlled), can affect the health (i.e., immunity) and production efficiency (i.e., growth rate) of lambs (Hefnawy & Tórtora-Pérez, 2010). Thus, Se supplementation to growing lambs might indirectly improve their productive performance (Yue et al., 2009).

In late stage of pregnancy, supplementation ewes with 0.3 mg Se yeast/kg of feed significantly improved daily weight gain and total gain of body weight (Saba et al., 2019). In addition, providing grazing ewes with Se as sodium selenite injection along with vitamin E throughout the breeding season increased the viability of the offspring (Farahavar et al., 2020). Selenium supplementation along with vitamin E also enhanced growth performance and immune response, since they work as antioxidants (Soliman, 2015). In a study conducted on Tibetan sheep, intake and absorption of nitrogen (N), as well as their apparent ability to digest neutral detergent fiber (NDF), acid detergent fiber (ADF), and ether

extract (EE), were all improved by adding 0.4 mg Se/kg of DM (Wang et al., 2019).

Effects of Se supplementation on growth performance of sheep have been variable (Kumar et al., 2009; Vignola et al., 2009). Effects of Se supplementation on growth performance of Awassi lambs are not available.

The aim of this study was to evaluate the effects of Se supplementation (dietary or injection) on nutrients intake, digestibility, and growth performance of growing Awassi lambs.

Materials and Methods

This experiment was conducted in 2019, at the Agriculture Center for Research and Production, at Jordan University of Science and Technology (JUST). All procedures used in this study were approved by JUST Institutional Animal Care and Use Committee.

Growing and digestibility study procedures

Twenty-five Awassi lambs (average age 65 days of age and average body weight 20.8 kg) were randomly allocated into one of three groups in completely randomized design. Lambs received the basal diet plus: no Se (CON; n = 8), 0.15 mg/lambs/day of supplemental Se to the diet as Se selenite (DSE; n = 8), or 0.5 mg/lamb of Se injection as Se selenite (ISE; n = 9). Selenium in the DSE group was daily top-dressed (after mixing with 10 g of soybean meal) on the basal diet to ensure complete consumption of the allocated amount. Also, 10 grams of soybean meal were top-dressed on the diet for other groups. In ISE group, intramuscular injections of Se were given biweekly as recommended by manufacturer.

The basal diet (Table 1) was formulated to meet nutrient requirements of growing lambs (NRC, 2007) and Selenium content of the basal diet was 0.13 mg/kg of dry matter. Diets were mixed biweekly during the study and were sampled upon mixing. Diet was offered at *ad libitum* intake as a total mixed ration with free access to water. Feed refusals were weighed daily throughout the study and stored (-20°C) for future analysis.

Table 1. Basal diet composition of fattening Awassi lambs fed diet supplemented with selenium

Item	
Ingredients (%, DM basis)	
Barley grain	62.5
Soybean meal	15
Wheat hay	20
Salt	1.5
Limestone	1
Nutrients (%, DM basis)	
Dry matter (DM)	89.8
Organic matter (OM)	91.9
Crude protein (CP)	17.0
Neutral detergent fiber (NDF)	31.8
Acid detergent fiber (ADF)	14.4
Ether extract (EE)	5.2

Lambs were individually housed in shaded pens (1.5 m × 0.75 m) and fed once daily at 0900. An adaptation period of one-week was allowed prior to the experimental period. The study lasted for 50 days. Lambs were weighed at the beginning of the experiment and subsequent weights were measured bi-weekly. On day 50 of the feeding trial, 3 lambs from each group were randomly selected and individually housed in metabolism crates (1.05 m × 0.80 m) to evaluate nutrient digestibility. Animals were allowed a period of 5 days to adapt the crates followed by a collection period of 4 days; where feed intake and refusals were recorded and sampled for further analysis. Daily fecal output was collected, weighed, recorded, and 10% sample was stored (-20°C) for analysis. Fecal, offered, and refused feed samples were dried at 55°C in a forced-air oven to reach a constant weight, air equilibrated, ground to pass through 1 mm sieve (Brabender, Duisburg, Germany) and stored (-20°C) for further analysis.

Laboratory analysis

Fecal, offered, and refused feed samples were analyzed following (A.O.A.C., 1990) procedures for DM (100°C in air-forced oven for 24 h; method 967.03), OM (550°C in ashing furnace for 6 hours; method 942.05), CP (Kjeldahl procedure; method 976.06) and EE (Soxtec procedure, Soxtec System HT 1043 Extraction Unit, Tecator, Box 70, Hoganäs, Sweden; method 920.29). Also, samples were analyzed for neutral detergent fiber (NDF) and acid detergent fiber (ADF) according to the procedure described by (Van-Soest et al., 1991) with modifications for use in the Ankom^{2000} fiber analyzer (Ankom Technology Cooperation, Fairport, NY, USA). Neutral detergent fiber analysis was performed using sodium sulfite and alpha amylase (heat stable) and expressed with residual ash content.

Statistical analysis

All data were analyzed using the MIXED procedure of SAS (S.A.S., 2002), where lamb was the random variable. Initial body weight was used as a covariate for analyzing differences in body weight gain. Least square means were used to further identify significant differences among means. Significant differences were considered at ($P < 0.05$).

Results and Discussion

The effects of Se supplementation on nutrient intake of growing Awassi lambs are presented in Table 2. No significant differences were observed in nutrient intake of DM, OM, CP, NDF, ADF, and EE among treatment groups. Same results were reported from many researches, dietary supplementation of Se had not effects on feed intake of lambs (Abdullah et al., 2019; Al-Taie & Almahdawi, 2021), steers (Lawler et al., 2004) or goats (Yue et al., 2009). In addition, (Vignola et al., 2009) suggested that neither the source nor the amount of supplemental Se affected feed intake and feed to gain ratio of lambs. In contrast, (Hernandez-Calva et al., 2013) found that DM intake improved by 13% when finishing lambs were dietary supplemented with Se selenite.

Growth performance (initial weight, final weight, average daily gain; ADG, and feed conversion ratio; FCR) of lambs was not affected by Se supplementation (Table 3). This is in agreement with previous studies on cattle and sheep (Dork & Loerch, 1989; Vignola et al., 2009; Al-Taie & Almahdawi, 2021). In contrast, ADG and FCR goats were improved by organic Se supplementation to the basal diet of 0.05 mg Se/kg of DM with no effects on feed intake (Yue et al., 2009; Abdullah et al., 2019).

In a study conducted by (Kumar et al., 2009) the results showed that supplementation of 0.15 mg Se/kg DM as inorganic or organic form did not affect FCR of lambs. This is consistent with no effect of Se supplementation on DM intake and ADG observed in the current study. Furthermore, (Alimohamady et al., 2013) reported that FCR, ADG, and feed intake were not affected by different amount and sources (organic and inorganic) of Se offered to lambs fed a basal diet of 0.06 mg Se/kg DM. In addition, (Asadi et al., 2018) reported no effects on Dalagh Lambs performance when supplemented with Se orally nor injection. However, in a study on Tan sheep supplemented with Selenium yeast and published by Jia et al. (2022) FCR increased with the level of Se at 0.25 mg/kg and decreased as Se level increased to 2 mg/kg.

Table 3. Growth performance of fattening Awassi lambs fed diet supplemented with selenium

	Diets			SEM	P-value
Item	CON	DSE	ISE		
Initial body weight (Kg)	20.9	20.5	21.1	0.82	0.861
Final body weight (Kg)	30.7	29.7	30.1	1.38	0.808
Average daily gain (g/day)	197.8	184.0	180.0	27.67	0.808
Feed conversion ratio	4.5	4.2	4.2	0.56	0.874

Effects of Se supplementation on nutrient digestibility are shown in Table 4. Digestibility coefficients of DM, OM, CP, NDF, ADF, and EE were similar among treatment groups. Similar results were reported by (Serra et al., 1994; Kumar et al., 2008 Asadi et al., 2018) in sheep. On the other hand, intramuscular injection of Se decreased the digestibility of DM, OM, CP, and NFE as the Se level increased in pregnant Does (Abdou, 2021). However, (Liu et al., 2007; C. Wang et al., 2009) demonstrated that organic Se supplementation improved nutrients digestibility in cattle in dose-dependent by improving ruminal fermentation. Moreover, (Alimohamady et al., 2013) reported that nutrient digestibility's were improved in lambs supplemented with Se. Improved nutrient digestibility in response to Se supplementation was probably achieved by improving ruminal ecosystem and fermentation. In the current study, Se supplementation in the DSE did not affect nutrients digestibility and probably did not affect rumen ecology. It is not expected that Se injection would affect rumen environment.

Table 4. Nutrient digestibility of fattening Awassi lambs fed diet supplemented with selenium

	Diets			SEM	P-value
Item	CON	DSE	ISE		
Dry matter	81.7	82.1	85.6	1.84	0.302
Organic matter	83.5	84.4	87.4	1.54	0.233
Crude protein	77.7	76.6	81.5	2.95	0.259
Neutral detergent fiber	71.9	71.0	77.7	3.48	0.387
Acid detergent fiber	69.6	70.0	74.7	5.04	0.352
Ether extract	82.9	82.2	90.1	1.72	0.081

Table 2. Nutrient intakes of fattening Awassi lambs fed diet supplemented with selenium

	Diets			SEM	P-value
Item	CON	DSE	ISE		
Nutrient intake, g/d					
Dry matter	761.0	652.8	689.3	38.75	0.127
Organic matter	700.4	603.9	632.4	34.79	0.128
Crude protein	123.2	104.2	114.7	7.04	0.140
Neutral detergent fiber	244.6	213.2	226.4	12.10	0.204
Acid detergent fiber	108.3	94.8	100.9	5.69	0.244
Ether extract	39.9	34.3	36.0	2.03	0.124

The current dietary recommendation for growing lambs is 0.2–0.3 mg Se/kg of DM of feed (N.R.C., 2007) which is higher than earlier recommendation of 0.1–0.2 mg /kg (N.R.C., 1985). Our data suggest that supplemental Se to a basal diet of 0.1 mg/kg did not improve growth performance of growing lambs. This does not simply imply that 0.13 mg Se/kg DM was the optimal level. (Alimohamady et al., 2013) demonstrated that Se (organic or inorganic) supplementation to lambs fed a diet with 0.06 mg /kg had no effect on growth performance (ADG, DM intake, or FCR) but improved glutathione peroxidase activity and T3 levels. Thus, dietary Se level might be different for optimal performance vs. optimal physiological (thyroid functions and antioxidant status) performance. Indeed, improved physiological performance might not be always translated into improved production performance and this might be true in the current study that deserves further investigation.

Conclusion

Under condition of the current study, Se supplementation (dietary or injection) failed to improve the performance of growing Awassi lambs fed high-concentrate diet. This indicates that diets with 0.13 mg Se/kg DM are enough to support productivity of growing lambs.

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Ethics approval: The Institutional Animal Care and Use Committee at Jordan University of Science and Technology approved the techniques and procedures followed in this study.

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Consent for publish: The authors declare that this study has never been published anywhere else.

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Author contributions: FAAL: running the study, analyzing the collected samples, writing, reviewing, and editing. BSO: writing & editing, data curation; formal analysis, methodology, supervision. MSA: writing & editing, methodology. MAA: writing, reviewing, and editing. All authors read and approved the final manuscript.

References

Abdou, A. R. (2021). Effect of selenium and vitamin e injection on digestibility coefficients and nutritive value of Baladi Doe goats in Southern Sinai. *Egyptian Journal of Nutrition and Feeds*, *24*, 37–47.

Abdullah, M. N., Mohammed, O. D., Abbo, N. Y. & Yousef, S. I. (2019). Effect of partial replacement of barley grain with wheat bran in the ration and some feed additive on growth and some carcass traits of Awassi lambs. *Journal of Physics: Conference Series, 1294, 92027*.

Alimohamady, R., Aliarabi, H., Bahari, A. & Dezfoulian, A. H. (2013). Influence of different amounts and sources of selenium supplementation on performance, some blood parameters, and nutrient digestibility in lambs. *Biological Trace Element Research*, *154*, 45–54.

Al-Taie, Y. A. & Almahdawi, M. K. (2021). Effect of selenium and zinc doses and interaction between them on production performance and some carcass traits of Awassi lambs. *Annals of the Romanian Society for Cell Biology*, *25*, 2506–2520.

A.O.A.C. (1990). *Official Methods of Analysis* (15th ed.). Association of Official Analytical Chemists.

Asadi, M., Toghdory, A. & Ghoorchi, T. (2018). Effect of Oral Administration and injection of selenium and vitamin e on performance, blood metabolites and digestibility of nutrients in suckling Dalagh lambs. *Research On Animal Production (Scientific and Research*, *9*, 79–87.

Awadeh, F. T., Kincaid, R. L. & Johnson, K. A. (1998). Effect of level and sources of dietary selenium on concentrations of thyroid hormones and immunoglobulins in beef cows and calves. *Journal of Animal Science*, *76*, 1204–1215.

Dork, E. A. & Loerch, S. C. (1989). Effects on parenteral selenium and vitamin E on performance, health and humoral immune response of steers new to feedlot environment. *Journal of Animal Science*, *67*, 1350–1359.

Fairweather-Tait, S. J., Collings, R. & Hurst, R. (2010). Selenium Bioavailability: Current Knowledge and Future Research Requirements. *American Journal of Clinical Nutrition*, *9*, 1484–1491.

Farahavar, A., Rostami, Z., Alipour, D. & Ahmadi, A. (2020). The effect of pre-breeding vitamin E and selenium injection on reproductive performance, antioxidant status, and progesterone concentration in estrus-synchronized Mehraban ewes. *Tropical Animal Health and Production*, *52*(4), 1779–1786.

Gartner, R., Gasnier, B., Dietrich, J., Krebs, B. & Angstwurm, M. (2007). Selenium supplementation in patients with autoimmune thyroiditis decreases thyroid peroxidase antibodies concentrations. *The Journal of Clinical Endocrinology & Metabolism*, *87*, 1687–1691.

Hefnawy, A. & Tórtora-Pérez, J. L. (2010). The importance of selenium and the effects of its deficiency in animal health. *Small Ruminant Research*, *89*, 185–192.

Hernandez-Calva, L. M., Ramirez-Bribiesca, J. E., Guerrero-Legarreta, I., Hernandez-Cruz, L., Avendaño-Reyes, L., Dominguez Vara, I. & McDowell, L. R. (2013). Influence of dietary magnesium and selenium levels in finishing diets on growth performance and carcass meat quality of feedlot Pelibuey lambs. *Archives Animal Breeding*, *56*, 303–314.

Kumar, N., Garg, A. K., Dass, R. S., Chatuverdi, V. K., Mudgal, V. & Varshney, V. P. (2009). Selenium supplementation influences growth performance, antioxidant status and immune

response in lambs. *Animal Feed Science and Technology*, *153*, 77–87.

Kumar, N., Garg, A. K. & Mudgal, V. (2008). Effect of different levels of selenium supplementation on growth rate, nutrient utilization, blood metabolic profile, and immune response in lambs. *Biological Trace Element Research*, *126*, 44–56.

Lawler, T. L., Taylor, J. B., Finley, J. W. & Caton, J. S. (2004). Effect of supranutritional and organically bound selenium on performance, carcass characteristics, and selenium distribution in finishing beef steers. *Journal of Animal Science*, *82*, 1488–1493.

Liu, Q., Huang, Y. X., Wang, C., Dong, S. & Lin, W. A. (2007). Effects of selenium yeast on nutrient metabolism and serum physicochemical parameters in Simmental steer. *Chinese Journal of Animal Nutrition*, *19*, 379–385.

N.R.C. (1985). *Nutrient Requirements of Dairy Cattle* (7th ed.). National Academy Press.

N.R.C. (2007). *Nutrient Requirements of Sheep* (6th ed.). Natl. Acad. Press.

Saba, F. E., Saleh, A. A. K. & Al Moafy, A. A. (2019). Effect of supplementation with different types of selenium on lactation performance and some blood parameters of Farafra and Saidi ewes and performance of their lambs. *Egyptian Journal of Sheep and Goats Sciences*, *14*(2), 19–30.

S.A.S. (2002). *SAS user's guide: Statistics version* (9th ed.). SAS Institute, Inc.

Schauberger, B., Archotoulis, S., Arneth, A. B. J. C. P. D., Elliott, D. J. F. C. K. N. M., Pugh, C. A. A., Rolinski, S., Schaphoff, S., Scmid, E. W. & Schlenker, X. W. F. K. (2017). Consistent negative response of US crops to high temperatures in observations and crop models. *Nature Communications*, *8*(13931), 36.

Serra, A. B., Nakamura, K., Matsui, T., Harumoto, T. & Fujihara, R. I. (1994). Inorganic selenium for sheep: II. Its influence on rumen bacterial yield, volatile fatty acid production and total tract digestion of timothy hay. *Asian-Australasian Journal of Animal Science*, *7*, 91–96.

Soliman, E. B. (2015). Dose-response of vitamin E and selenium injection on growth performance, physiological and immune responses of Ossimi lambs. *Egyptian Journal of Sheep and Goats Sciences*, *10*(1), 1–14.

Sushma, K., Reddy, Y. R., Kumari, N. N., Reddy, P. B., Raghunandan, T. & Sridhar, K. (2015). Effect of selenium supplementation on performance, cost economics, and biochemical profile of Nellore ram lambs. *Veterinary World EISSN*, 2231–0916.

Van-Soest, P. J., Robertson, J. B. & Lewis, B. A. (1991). Methods for dietary fiber, neutral detergent fiber, and nonstarch polysaccharides in relation to animal nutrition. *Journal of Dairy Science*, *74*, 3583–3597.

Vignola, G., Lambertini, L., Mazzone, G., Giammarco, M., Tassinari, M., Martelli, G. & Bertin, G. (2009). Effects of selenium source and level of supplementation on the performance and meat quality of lambs. *Meat Science*, *81*, 678–685.

Wang, C., Liu, Q., Yang, W. Z., Dong, Q., Yang, X. M., He, D. C., Zhang, P., Dong, K. H. & Huang, Y. X. (2009). Effects of selenium yeast on rumen fermentation, lactation performance and feed digestibilities in lactating dairy cows. *Livestock Science*, *126*, 239–244.

Wang, Z., Tan, Y., Cui, X., Chang, S., Xiao, X., Yan, T., Wang, H. & Hou, F. (2019). Effect of different levels of selenium yeast on the antioxidant status, nutrient digestibility, selenium balances and nitrogen metabolism of Tibetan sheep in the Qinghai-Tibetan Plateau. *Small Ruminant Research*, *180*, 63–69.

Yue, W., Zhang, C., Shi, L., Ren, Y., Jiang, Y. & Kleemann, D. O. (2009). Effect of supplemental selenomethionine on growth performance and serum antioxidant status in Taihang Black goats. *Asian-Australasian Journal of Animal Science*, *22*, 365–370.

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