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Effect of Organic and Inorganic Selenium Supplementation on Weight Performance of Ewes and Lambs

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Abstract: Two selenium sources (organic and inorganic) were evaluated using 28 Multiparous (M) and 18 Uniparous (U) ewes, of 54.8±9.4 and 39.7±5.6 kg live weight, respectively. They were randomly assigned to 2 treatments: Basal diet plus Inorganic Selenium (IS) and basal diet plus Organic Selenium, Sel-Plex 50® (OS). A split plot design in time was used; the animal was the main plot and time (lactation days) was considered as the subplot. The main plot had a 2×2 factorial structure, with 2 selenium sources (IS or OS) and 2 maturities of ewes (M or U). The subplot also had 2 levels (from birth to weaning and from lambing to 22 days after weaning). The variables were analyzed using PROC MIXED of SAS. Results showed no difference ($p>0.05$) of the main effects: Selenium source (treatment), maturity and the weight of lambs in time (lactation days), however the treatment × time interaction showed statistical difference ($p<0.05$) with weights of 56.8 and 57.3 kg in IS and OS, respectively at 22 days post-weaning. The maturity × time interaction was different ($p<0.05$) with weights of 57.6 kg for M and 56.4 kg for U, respectively at 22 days post-weaning. The lamb weight was similar ($p>0.05$), although weights at weaning numerically values favored inorganic selenium. In conclusion, organic selenium could improve the weight of ewes after weaning, however lamb weight tended to be higher with inorganic selenium, however this effect may be related to more lambs per ewe in organic selenium group.

Key words: Organic selenium, inorganic selenium, weight-performance, sheep

INTRODUCTION

According with Edens (2002), there are 2 selenium sources for animal diets: Inorganic (sodium selenite and selenate) and organic (Sel-Plex 50®). Compared to inorganic sources, organic sources are potentially better for animals because of their higher bioavailability, (McDowell, 1997; Wolffram, 1999), since selenium's metabolic pathway in the animal body depends on its chemical structure (Cai *et al*., 1995).

The diet inclusion of vitamin E and Se in concentrations above of requirement is associated with improvements in animal performance and immune function (Finch and Turner, 1996). Nevertheless, in sheep these positive responses are variable depending upon species, physiological state, chemical form of vitamin E and Se (Rooke *et al*., 2004). It is reported in sheep by Elghany-Hefnawy *et al*. (2008) that prepartum sodium selenite (inorganic) supplementation maintains the maternal plasma Se level during gestation and the postpartum Se supplementation may improve the Se status in milk and plasma of the new born lambs, improving their weights at birth. However, in basis to Se bioavailability, it has been observed that feeding selenium from selenomethionine or selenized yeast (organic) results in higher tissue and milk selenium concentrations than those obtained with selenite (inorganic) (Spears, 2003). In agreement, Valle *et al*. (2003a) compared inorganic vs. organic Se supplementation in beef cows, they concluded that the yeast form of selenium provided continuous and highest levels of blood, liver and milk selenium concentrations. Similarly, Valle *et al*. (2003b) found that the control and the 2 inorganic treatments resulted in reduced calf plasma selenium concentrations with time and at no time were adequate. The organic selenium was adequate most of the time and most important, were adequate at the end of the experiment (180 days).

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In addition, to the positive Se stautus in the animal by organic selenium, it also may improve nutrient digestion in sheep, this sense, Arzola *et al*. (2008) found better ruminal parameters for organic than inorganic selenium that may improve productive efficiency in animals. Considering these aspects, we hypothesized that compared with inorganic, the organic Se supplementation will improve the weights of both, ewes and their lambs, from lambing to 22 days post-weaning. Because there is not information in this theme, the present study was conducted with the objective of comparing the effects of selenium sources (organic vs. inorganic) on weight gains of ewes and their lambs fed a typical diet used in sheep production for lactating animals.

MATERIALS AND METHODS

The research was carried out at Facultad de Zootecnia de la Universidad Autonoma de Chihuahua, located in Chihuahua, Mexico. Forty-six pregnant Pelibuey × Blackbelly ewes were used; 18 were Uniparous (U) and 28 were Multiparous (M) with initial weights of 39.7±5.6 and 54.6±9.4 kg, respectively. Ewes were vaccinated against *Clostridium* sp. *Pasteurella haemolytica* A1 and *P. multocida* types A and D, using 2.5 mL animal^{-1} (TRIANGLE BAC 8V®) and the animals were treated against internal parasites using 1% moxidectin (0.2 mg kg^{-1} BW, CYDECTIN NR®).

The treatments considered 2 variables: selenium source: Inorganic Selenium (IS) or Organic Selenium (OS; SEL-PLEX50®) and maturity: Multiparous (M) or Uniparous (U) ewes. Based on these variables, ewes were randomly assigned to 4 groups: Uniparous Inorganic Selenium (UIS); Uniparous Organic Selenium (UOS), Multiparous Inorganic Selenium (MIS) and Multiparous Organic Selenium (MOS). All the animals received a basal diet, formulated according to their requirements (NRC, 1985) using ingredients available in the region (Table 1). The Se content in inorganic Se source was of 200 ppb and in the organic Se source of 1 mg of Se per gram.

Selenium supplementation started in gestation at 6 and 12 weeks of pre-lambing in multiparous and uniparous ewes, respectively and continued until 22 days after the end of lactation. Ewes were weighed individually at lambing and every 14 days until 112 days postpartum. Lambs were also individually weighed every 14 days until weaning (90 days). The weights were recorded in a digital balance (GALLAGHER 500®).

Data were analyzed in a split plot design; the animal was the main plot and time (lactation days) was considered as the subplot. The main plot had a 2×2 factorial structure. The subplot also had 2 levels: From 1-90 days in lambs (from birth to weaning) and from 1-112 days for the ewes (from lambing to 22 days after weaning), at 14 days intervals. The variables were analyzed using PROC MIXED of SAS (1998).

Table 1: Ingredients and proximate analyses (DM%) of a typical diet used in sheep production for lactation

	Stage			
	Gestation		Lactation	
Ingredients	IS	OS	IS	OS
Corn, rolled	21.34	21.34	18.15	18.15
Oat bran	17.37	17.37	18.48	18.48
Alfalfa hay	57.20	57.20	57.44	57.44
Soybean meal	---	---	3.03	3.03
Molasses	3.63	3.63	2.46	2.46
Common salt	0.12	0.12	0.10	0.10
Mineral premix	0.34	0.34	0.34	0.34
Sel-Plex 50	---	0.20	---	0.20
Proximate analyses				
DM	92.20	92.10	91.50	91.80
Ash	7.50	7.50	7.50	7.50
CP	13.30	12.80	15.30	14.60
ADF	33.60	30.70	28.30	28.30
NDF	63.80	64.20	58.90	62.80

IS = Mineral premix with inorganic selenium (Superbayphos®: P, Ca, Fe, Mg, Cu, Zn, Co, I, Se); OS = Mineral premix with organic selenium (Super-Min®: P, Ca, Cl, Mg, Na, S, K, Mn, Cu, Co, I + Sel-Plex 50: Organic selenium); DM: Dry Matter, CP: Crude Protein, ADF: Acid Detergent Fiber, NDF: Neutral Detergent Fiber

The statistical model was:

$$Y_{ijk} = \mu + S_i + F_{ij} + (SF)_{ij} + A\,(SF)_{k\,(ij)} + T_l + (FT)_{jl} + (ST)_{il} + (SFT)_{ijl}$$

Where:

- μ = Overall mean.
- Si = Selenium effect.
- Fi = Maturity.
- Sf_{ij} = Interaction effect of selenium with maturity.
- $A\,(SF)_{k(ij)}$ = Nested effect of animal in each selenium level and maturity effect corresponding to main plot error.
- T_l = Time effect.
- $(FT)_{jl}$ = Interaction effect of maturity and time.
- $(ST)_{il}$ = Interaction effect of selenium and time.
- $(SFT)_{ijl}$ = Interaction effect of selenium and maturity along time.

A sigmoid growth model was applied for lamb weights:

$$Y_t = \frac{\alpha}{1+\beta e^{-kt}}$$

Where:

- Y_t = Weight at time t.
- α = Asymptotic adult weight.
- β = Parameter related with birth weight (birth weight = $\alpha/(1+\beta)$).
- k = Growth rate.
- t = Time.

RESULTS AND DISCUSSION

Ewes' weights from lambing 1-22 days of post-weaning (112 days) were similar ($p>0.05$) for the main effects (treatment, maturity and time). However, treatment × time interactions showed differences ($p<0.05$) among treatments (Fig. 1); lambing weight was lower for ewes fed organic selenium, but both sources produced similar weights at 28 days, after which OS was more variable than IS and at 112 days OS ewes showed higher weights.

The lamb weights were similar ($p>0.05$) for the main effects (selenium source and maturity). The only difference ($p<0.05$) was for selenium source × L size interaction, because the ewes suckled 1, 2 or 3 lambs, however data on parameters a, b and k (growth model) were similar ($p>0.05$) in weights of single and twin lambs (33.7 vs. 33.1 kg, respectively), however there were differences ($p<0.05$) between single and twin compared to triple lambs (33.4 vs. 27.3 kg, respectively).

Considering this effect, the selenium source × maturity × L size interaction was analyzed (Table 2).

The comparison of organic vs. inorganic selenium in uniparous ewes nursing 1 or 2 lambs showed no difference ($p>0.05$) in weaning weight or growth rate. However, they are favourable in UIS, maybe because most ewes of this group were suckling single lambs, while over 50% of the ewes in UOS had 2 lambs (11 vs. 14).

Weaning weights for lambs of mature ewes were 33.02 and 30.81 kg for MIS and MOS, respectively ($p>0.05$); their growth performance was similar to that observed in UIS and UOS, where weights favored MIS. Growth rate (k) was similar; this could have the same explanation with respect to the number on suckling lambs, since ewes in MOS were suckling 28 lambs versus 24 lambs in MIS; because of this, the amount of milk per lamb was lower, which is indispensable in first weeks of life, because it is the main nutrient source for proper growth, development and health (Godfrey *et al.*, 1997). Parameters a and k were similar ($p>0.05$) among the four treatments for ewes nursing 1 or 2 lambs, although weaning weights favored UIS and MIS, maybe because of the L size.

In the case of the ewes suckling 3 lambs, the weights in MIS and MOS were 29.58 and 25.74 kg, respectively (Table 2), without difference ($p>0.05$) between both groups, with numerical values higher for weights in MIS after showing the same growth rate (0.032) in both treatments. In MIS, there was no difference ($p>0.05$) between 3 vs. 1 and 2 lambs. However, the parameters in MOS for ewes suckling 3 lambs were different ($p<0.05$) from UIS and MOS for 1 and 2 lambs, but were similar ($p>0.05$) to UOS, maybe because of the milk productive capacity in each ewe and its ability to suckle 1, 2 or 3 lambs and to the feed conversion of the lamb; in agreement with this, Godfrey *et al.* (1997) pointed that several factors could influence lamb growth, such as: Milk production, environment, nutrition, parturition and the number of suckling lambs.

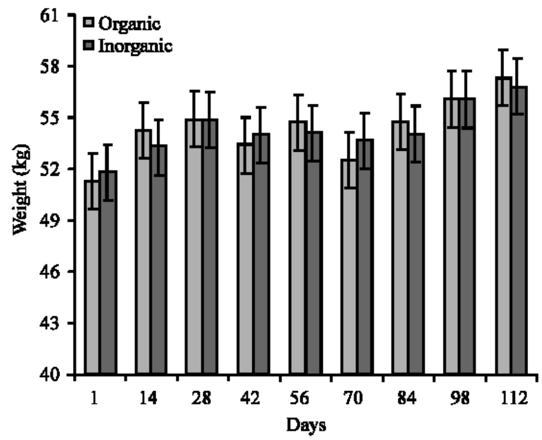

Fig. 1: Weight performance of ewes from lambing (1-22 days post-weaning (112 days) for the treatment × time interaction

Table 2: Weights of lambs, adjusted values

	Parameter			
	a		k	
	Litter		Litter	
Treatment	1 or 2	3	1 or 2	3
UIS	35.48±4.08[a]	---	0.036±0.005[a]	---
UOS	29.11±4.34[a]	---	0.033±0.006[a]	---
MIS	33.02±2.66[a]	29.58±8.03[ab]	0.033±0.003[a]	0.032±0.008[a]
MOS	30.81±1.76[a]	25.74±4.31[b]	0.035±0.002[a]	0.032±0.006[a]

UIS = Uniparous inorganic selenium; UOS = Uniparous organic selenium; MIS = Multiparus inorganic selenium; MOS = Multiparus organic selenium a = Asymptotic weight at weaning; k = Growth rate; [ab] Means within the same row or column showing different superscript are significantly different ($p<0.05$)

In the evaluation of weight gains, there are similar reports using selenium in 5-month-old grazing calves, with no significant effect (Lacetera *et al.*, 1996; Sweckert *et al.*, 1989; Ullrey *et al.*, 1977); however, others report favorable effects ($p<0.05$) in weight gain in calves (Wichtel *et al.*, 1996) and 10-months-old sheep supplemented with selenium (Sang-Hwan *et al.*, 1976).

In another study, Gunter *et al.* (2003) compared inorganic selenium (sodium selenite) vs. organic selenium (Sel-Plex) in 120 days pregnant cows fed alfalfa and they did not find effects ($p>0.05$) on body weight, body condition, daily weight gains or dry matter consumption.

CONCLUSION

The results of the present research show that organic selenium does not improve weight gains of ewes at lambing or during lactation, however, at 22 days post weaning the animals consuming organic selenium were heavier. This implicates that the organic form could propitiates faster recovery of the body condition after weaning. On the other hand, body weights tended to be lower in lambs from ewes supplemented with organic selenium, however this effect may be related to more lambs per ewe in organic selenium group.

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REFERENCES

Arzola, C., J. Segovia, O. Ruiz, J. Salinas-Chavira, C. Rodriguez-Muela and J. Jimenez, 2008. Influence of organic or inorganic selenium in diets on *in situ* dry matter degradability and ruminal kinetics in sheep. Arch. Latinoam. Prod. Anim., 16: 7-12.

Cai, X.J., E. Blok, P.C. Uden, X. Zhang, B.D. Quimby and J.J. Sullivan, 1995. Identification of selenoaminoacids in ordinary and selenium-enriched garlic, onion and broccoli using gas chromatography with atomic emission detection. J. Agric. Food Chem., 43: 1745-1750.

Edens, F.W., 2002. Practical Applications for Selenomethionine: Broiler Breeder Reproduction. Nutritional Biotechnology in the Feed and Food Industries. In: Lyons, T.P. and K.A. Jacques (Eds.). Nottingham University Press, pp: 29-42. ISBN: 978-1-904761-61-67.

Elghany-Hefnawy, A., R. Lopez-Arellano, A. Revilla-Vazquez, E. Ramirez-Bribiesca and J. Tortora-Perez, 2008. Effect of Pre- and Postpartum Selenium Supplementation in Sheep. J. Anim. Vet. Adv., 7: 61-67.

Finch, J.M. and R.J. Turner, 1996. Effects of selenium and vitamin E on the immune responses of domestic animals. Res. Vet. Sci., 60: 97-106.

Godfrey, R.W., M.L. Gray and J.R. Collins, 1997. Lamb growth and milk production of hair and wool sheep in a semi-arid tropical environment. Small Rum. Res., 24: 77-83.

Gunter, S.A., P.A. Beck, T.J. Wistuba, M.E. Davis and J.M. Phillips, 2003. Effects of Supplementary Selenium Source on Performance, Blood Measurements and Immune Function in Beef Cows and Calves. Nutritional Biotechnology in the Feed and Food Industries. In: Lyons, T.P. and K.A. Jacques (Eds.). Nottingham University Press, pp: 295-308. ISBN: 1-897676-40-9.

Lacetera, N., U. Bernabuci, B. Ronchi and A. Nardone, 1996. Effects of selenium and vitamin E administration during a late stage of pregnancy on colostrum and milk production in dairy cows and on passive immunity and growth of their offspring. Am. J. Vet. Res., 57: 1776-1784.

McDowell, L.R., 1997. Trace element supplementation in Latin America and the potential for organic selenium. Proc. Alltech's 13th Annual Biotechnology in the Feed Industry, pp: 389-417. ISBN: 1-897676-646.

NRC, 1985. Nutrient Requirements of Sheep. 6th Edn. National Academy Press, Washington DC., pp: 45-53. ISBN: 0-309-03596-1.

Rooke, J.A., J.J. Robinson and J.R. Arthur, 2004. Effects of vitamin E and selenium on the performance and immune status of ewes and lambs. J. Agric. Sci., 142: 253-262.

Sang-Hwan, O., A.L. Pope and W.G. Hoekstra, 1976. Dietary selenium requirements of sheep fed a practical-type diet as assessed by tissue glutathione peroxidase and other criteria. J. Anim. Sci., 42: 984-992.

SAS., 1998. User's Guide: Statistics, SAS Inst. Inc. Cary. North Carolina. U.S.A., pp: 558.

Spears, J.W., 2003. Trace mineral bioavailability in ruminants. J. Nutr., 133 (Suppl. 1): 1506S-1509S.

Swecker, W.S., D.E. Eversole, C.D. Thatcher, D.L. Blodgett, G.G. Schuring and J.B. Meldum, 1989. Influence of supplemental selenium on humoral responses in weaned beef calves. Am. J. Vet. Res., 50: 1760-1768.

Ullrey, D.E., P.S. Brandy, P.A. Whetter and P.K. Ku, 1977. Selenium supplementation of diets for sheep and beef cattle. J. Anim. Sci., 45: 559-565.

Valle, G.L., R., McDowell, D.L. Prichard, P.J. Chenoweth and D.L. Wright *et al*., 2003a. Effects of Supplementing Selenium to a Beef Cattle Cow-Calf Herd on Tissue Selenium Concentration. J. Anim. Vet. Adv., 2: 95-101.

Valle, G.L., R., McDowell, D.L. Prichard, P.J. Chenoweth, D.L. Wright, F.G. Martin, W.E. Kunkle and N.S. Wilkinson, 2003b. Selenium Status of Beef Calves from Dams Receiving Selenium Supplementation. J. Anim. Vet. Adv., 2: 338-342.

Wichtel, J.J., A.L. Craigie, D.A. Freeman, H. Varela-Alvarez and N.B. Williamson, 1996. Effect of selenium and iodine supplementation on growth rate and on thyroid and somatotropic function in dairy calves at pasture. J. Dairy Sci., 79: 1865-1872.

Wolffram, S., 1999. Absorption and Metabolism of Selenium: Differences Between Inorganic and Organic Sources: Biotechnology in the Feed Industry. Proceedings of Alltech's 15th Annual Symposium, pp: 547-560.