Effects of Supplementing Ewes with d-á-Tocopherolon Serum and Colostrum Immunoglobulin G Titers and Preweaning Lamb Performance

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Abstract

Two experiments were conducted to examine effects of d-á-tocopherol (vitamin E) on colostrum immunoglobulin G (IgG) titers and preweaning lamb performance. Trial 1 consisted of 86 Suffolk ewes receiving either no vitamin E (control) or 1500 IU vitamin E on d-28 prepartum. From the 86 ewes, a subset of 25 ewes was randomly chosen for an intensive analysis of ewe serum and colostrum IgG and lamb serum IgG concentrations. Average daily gain was analyzed for lambs (n = 100) born to the 86 ewes as well as for lambs (n = 25) born to the subset of 25 ewes. Birth weights were also analyzed for the 25 lambs. Vitamin E supplementation had no effect on ewe serum (P = .16), lamb serum (P = .77) or ewe colostrum (P = .25) IgG concentrations. Of the intensively sampled lambs, those born to vitamin E-treated ewes had heavier (P = .08) birth weights and greater (P = .02) ADG than lambs born to control ewes. Average daily gain for lambs born to the 86 ewes was not affected by vitamin E (P = .97; n = 100). Trial 2 examined effects of vitamin E on lamb growth under range conditions. Two hundred whiteface, pregnant ewes were randomly sorted into four pastures with two pastures per treatment. Ewes received either no vitamin E (control) or 1500 IU vitamin E 40 d before the onset of lambing. Lambs from vitamin E-treated ewes showed higher weight gains at 30 d of age than lambs from control ewes (P = .03). However, weaning weights were similar (P > 0.10) for both treatment groups. Vitamin E does not appear to increase IgG concentrations in ewe and lamb serum or ewe colostrum. However, vitamin E showed positive effects on growth when lambs were under stress conditions during the first several weeks postpartum as indicated by intensively sampled lambs in Trial 1.

Introduction

Reproductive efficiency, or percentage lamb crop raised and marketed, is the key factor for profitability of sheep enterprises. Lambs weaned per ewe exposed ranges from 75% to 140% (SID, 1988). Survival of twin or triplet lambs is significantly reduced in comparison to single lamb survival when reared under range conditions (Thomas et al., 1995). Safford and Hoversland (1960) found a majority of lamb deaths occur in the first 3 wk of life. Survival of lambs following birth is primarily dependent on the supply of colostrum and its component immunoglobulins (IgG) received from the dam within the first 12 to 24 h after birth (Christley et al., 2003). Increasing colostrum intake by lambs increases serum IgG concentrations in the neonate (Mansur et al., 2002).

Vitamin E (d-á-tocopherol) supplementation has been shown to enhance immune function as well as reduce lamb morbidity and mortality. Gentry et al. (1991) reported lambs from ewes injected with 1500 IU vitamin E 21 d before parturition contained greater concentrations of serum immunoglobulin G (IgG) than lambs born to ewes receiving no vitamin E. Lamb weights at 90 d of age were also greater for vitamin E-treated lambs. Vitamin E injected on a monthly basis has also been shown to increase pre-weaning survival of lambs (Kott et al., 1983). In a more recent study, mortality was decreased for lambs born to vitamin E-treated ewes (Thomas et al., 1995). Williamson et al. (1996) reported that injecting ewes with 1200 IU vitamin E 2 wk before lambing and at lambing, resulted in lambs with more vigor and preweaning gain. However, weaning weights were similar to controls.

The objective of this study was to determine if d-á-tocopherol administration affects pre-weaning lamb performance in farm flock and range lambs by influencing IgG concentrations in ewe colostrum and lamb serum.

Materials and Methods

Trial 1

Eighty-six multiparous Suffolk ewes were randomly assigned to one of two treatments; no vitamin E (control) or 1500 IU vitamin E (s.c.; stuart products, Bedford, TX) 28 d prepartum. Ewes were mated to rams fitted with marking harnesses and estral activity was recorded daily to establish breeding dates. Pregnancy was determined via ultrasound (Aloka 500 fitted with 5 MHz flank probe, Corometrics Medical Systems, Inc., Wallingford, CT) at approximately 90 d following ram introduction. Ewes were maintained together in indoor-outdoor pens with free access to water and a salt-mineral block and fed 2.27 kg alfalfa hay and .45 kg-ewe'-d"1 ground corn. At parturition, a sub-sample of 25 twin-bearing ewes was randomly selected with 12 ewes from the control group and 13 from the vitamin E group to quantify colostral and serum IgG concentrations. At lambing, ewes were placed in individual pens and lambs were not allowed to nurse initially. Immediately following parturition, ewe serum and colostrum and lamb serum samples were taken, with blood collected via jugular venipuncture. Serum samples were then collected from lambs hourly through 12 h postpartum. Colostrum was collected from each ewe once an hour for a total of 12 h. Blood samples were cen-trifuged at 1500 x g at 4°C for 20 min. Serum and colostrum samples were stored at -20° C until later analysis of IgG. At birth, lambs were administered 60 mL colostrum via stomach tube to ensure all lambs received colostrum initially. Lambs were weighed at birth, 14, 28, 56 and 60 d to measure preweaning growth performance. Lambs were docked between 7 and 14 d of age and male lambs were castrated at this time. Lambs were vaccinated (s.c.) against overeating and tetanus initially at docking with a booster given 14 d later. Weaning weights were collected at an average of 60 d of age. Lambs were offered a creep feed (Table 1) starting at 3 wk of age.

Serum IgG, ewe colostral IgG for the 25 intensively managed ewes and lamb weights were analyzed as a split-plot design with treatment in the main plot and time and treatment by time in the sub-plot. Animal within treatment was used to test the treatment effect and residual was used to test the time and treatment by time effects. When a treatment by time interaction was detected, data were analyzed within time. Data were analyzed with the General Linear Models Procedure of SAS (SAS Inst. Inc. Cary, NC).

Trial 2

Two hundred pregnant, western whiteface range ewes, at the Corona Range and Livestock Research Center, were randomly assigned to one of four pastures and pastures were randomly allotted to treatments. Ewes received either: no vitamin E (control) or 1500 IU vitamin E (s.c.). Treatments were administered at shearing, 40 d before the onset of lambing. This time was selected because it represents the last normally scheduled period in which animals are handled before onset of lambing for New Mexico sheep ranches. Number of feti per ewe was determined via ultrasound 45 d after removing rams from pastures and ewes with multiple feti were equally distributed among pastures. Onset of parturition was May 15. All lambs were weighed, tail-docked, eartagged and males castrated at 45 d following initiation of lambing season. Lambs were weaned and weighed in early October when lambs were 120 to 150 d of age. Lamb weights were analyzed as a complete randomized design with pasture as the experimental unit. Data were analyzed using the General Linear Models of SAS (SAS Inst. Inc. Cary, NC).

The study area is at an elevation of approximately 1,850 m. The predominant forages include blue and sideoats grama (Bouteloua pracilis and curtipendula, respectively, Renner, 1996). Grasses make up 95% of the forage cover with a combination of forbs, snakeweed and cactus making up the remainder (McFadin, 1997). The average annual precipitation is 350 mm.

Serum and Colostrum

Serum and colostrum IgG concentrations were measured using a previously described double-antibody radioimmunoassay (Richards et al., 1999). Within and between assay C.V. were 5% and 16%, respectively. Colostrum and lamb serum tocopherol concentrations were quantified using reversed-phase liquid chromatography (Hoehler et al., 1998). The CV for this assay was 4.5%.

Results

Trial 1

Ewe colostrum IgG concentrations were similar (P = .25) between treatments (Table 2). In addition, colostral IgG concentrations decreased (P < .0001) over the 12-h collection period. No treatment by time interaction was detected for ewe IgG concentration (P > 0.05). A treatment by time interaction occurred (P = 0.008) for serum IgG concentrations in lambs (Table 3). At birth and 1h postpartum, lambs born to ewes receiving vitamin E had higher serum IgG concentrations (Table 3). However, serum IgG concentrations were similar for all subsequent times. Waelchli et al. (1994) indicated that 19% of lambs had detectable levels of serum IgG before ingestion of colostrum. Also, Mazzone et al. (1999) reported 54% of lambs evaluated had serum IgG levels between 1.2 and 13.3 mg/mL before ingestion of colostrum. In the present study, 36% of the lambs had detectable levels before ingestion of colostrum ranging between 1.2 and 23.2 mg/mL. In three of the five lambs with >10 mg/mL, the values were below 1 mg/mL by 1 h postpartum. The other two lambs dropped to normal levels by 3 or 4 h postpartum. The reason for detectable pre-colostral IgG is not known. If the pre-colostral sample (0 h) is deleted, then a treatment by time interaction was not detected and the mean serum IgG concentrations are similar. Lamb serum á-toco-pherol concentrations were similar (P > .20) at birth (3.0 vs 2.0 ± .6 mg/mL) and 12 h postpartum (1.4 vs 2.6 ± .7 mg/mL) for control and vitamin E treatments, respectively. However, á-tocopherol concentrations in colostrum tended (P = .06) to be greater in ewes supplemented with vitamin E compared to controls (3.02 vs. .77 ± 1 mg/mL, vitamin E and control, respectively).

Lamb Performance

Trials 1 and 2

In Trial 1, gain of intensively sampled lambs (n = 25) differed between treatments (P = .02). Lambs born to vitamin E-treat-ed ewes gained .08 kg more (P < 0.02) than lambs from control-treated ewes (.37 vs .29 ± .02 kg-head'-d"1, respectively). Birth weights also differed (P = .08) between treatment groups with lambs from vitamin E-treated ewes weighing .6 kg more than lambs from control ewes (5.8 vs. 6.4 ± .24 kg, control and vitamin E, respectively). Lambs from treated ewes maintained their heavier weights through weaning. Lamb mortality was relatively low, with one death of an intensively managed lamb occurring at 3 wk of age. However, when gain was evaluated in the lambs born to the original group of 86 ewes (including the 25 intensively sampled group), no differences were noted (.28 ± .01 kg-lamb'-d"1 for both control and vitamin E, n = 119).

Trial 2 consisted of 240 western whiteface range lambs born in mid May. Lamb weights at 40 d following onset of lambing differed among treatments (P = .03) with lambs from vitamin E-treated ewes weighing an average of 1.1 kg more than lambs from control ewes (19.4 vs 18.3 ± .38 kg/head, respectively, n = 119). Vitamin E did not affect lamb mortality for range lambs. Lamb crop percentages for all pastures averaged 120%. However, at weaning lamb weights were similar (44 ± 1.0 kg for both treatments).

Discussion

Immunoglobulin G

Lack of treatment effects on colostral IgG concentrations could be attributed to several factors. First, vitamin E status of our ewes may have been sufficient before treatments were administered. According to the NRC (1985), dietary levels of vitamin E for late gestation ewes are 28 to 30 IU/d. The diet provided approximately 50 IU/d to the ewes during pregnancy exceeding the daily-recommended requirements given by the NRC (1985). These data agree with Becker et al. (1994) who evaluated doses of 0, 1500, and 3000 IU of vitamin E in Suffolk and western white face ewes under conditions similar to Exp. 1. On the other hand, it is possible that supplementing with higher doses of vitamin E may enhance immunoglobulin concentrations. Gentry et al. (1991) gave two times the dose of vitamin E we administered and found serum IgG levels in lambs were greater for vitamin E-treated ewes than for lambs from control ewes. Lastly, stress factors were kept to a minimum. Environmental influences were minimized because ewes were able to lamb in a sheltered area. Adequate feed was always available for both ewes and lambs. Thomas et al. (1995) reported improved neonatal lamb survival when dams were supplemented with Vitamin E. This was particularly true in ewes lambing early when ambient temperatures were colder in Montana.

Lamb Performance

Weights for lambs born to all 86 ewes were unaffected by vitamin E. Ewes were allowed to lamb indoors away from environmental factors, such as extreme weather conditions. They were also provided with ad libitum access to alfalfa hay daily. It was ensured that lambs nursed, especially in the first 12 h of life. Becker et al. (1994) reported that vitamin E treatment to ewes did not influence subsequent lamb growth in Suffolk and western white face lambs. Absence of shelter and feed, could potentially be a sufficient stress to negatively affect growth responses in lambs. In that case, vitamin E may be essential to ensure a positive response in lamb performance. Because we were able to reduce the amount of stress a lamb endures in the first 24 h of life, supplementation with vitamin E may be unnecessary. However, when stress to newborn lambs cannot be reduced, vitamin E supplementation to the ewe may be beneficial.

Intensively sampled lambs in Trial 1 may have been stressed by the excessive handling. When body weights were analyzed, differences between treatment groups occurred, illustrating vitamin E could improve the lamb's ability to grow. Lambs born to ewes on the range can also be faced with stressful conditions, severe weather and inadequate nutrition being the primary stressors. Vitamin E induced positive effects on lamb growth when ewes were supplemented 40 d prepartum. However, the advantage was at marking (15 to 45 d of age) and not at weaning. The level of vitamin E available in the pastures was unknown. Vitamin E could have been below daily-recommended dietary requirements for late gestating ewes; therefore, addition of vitamin E may have been enough to protect lambs from any stressors that could cause decreased performance. Typically, marking occurs prior to the forage growing season as dictated by the start of our rainy season. Weaning occurs in late September or early October which is at the end of growing season. Ramsey et al. (1994) reported that as lambs got older and lactation advanced, the lambs relied more on forage than milk. These authors found that lamb dry matter intake was highly correlated with lamb growth.

Implications

Environmental conditions may dictate the efficacy of vitamin E supplementation. When environmental stressors or nutritional restriction, which may reduce colostrum consumption, exists, vitamin E supplementation may support faster growth and potentially healthier lambs. Conversely, farm flock systems where environmental conditions are less severe, supplementing with vitamin E may not improve lamb performance.

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