Effects of selenium and vitamin E administration on breeding of replacement beef heifers

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Original article

Effects of selenium and vitamin E administration on breeding of replacement beef heifers*

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Summary – Forty-eight heifers were given selenium and/or vitamin E or no supplementation from age of weaning (8 months) for 6 months prior to breeding. Blood plasma levels were monitored and some reproductive traits were assessed. The overall pregnancy rate (33 %) in the control group was significantly ($P < 0.05$) lower than in the vitamin E-supplemented groups (58–83 %). Age of first heat, breeding and calving were unaffected by vitamin E and/or selenium supplementation.

selenium / vitamin E / reproduction / cattle

Résumé – Effets de l'administration de sélénium et de vitamine E sur la reproduction des génisses de remplacement. *Quarante-huit génisses ont reçu du sélénium et/ou de la vitamine E ou n'ont reçu aucun traitement durant les 6 mois précédant la période des saillies. La teneur de ces élements dans le plasma et certains paramètres de la reproduction ont été mesurés. Le taux de conception du groupe témoin (33 %) était significativement ($P < 0.05$) plus bas que celui des groupes recevant de la vitamine E (58-83 %). L'âge aux premières chaleurs, à l'accouplement et au vêlage n'étaient pas modifiés par l'apport de sélénium et/ou de la vitamine E.*

sélénium / vitamine E / reproduction / génisse

INTRODUCTION

Selenium and vitamin E are closely related metabolically. Many health conditions, for example white muscle disease, may respond to supplementation by either nutrient (Muth *et al,* 1958; Proctor *et al,* 1958) and their minimal requirements depend on the amount of each in the diet (Scott, 1978).

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Hartley *et al* (1960) have reported some beneficial effects of selenium in correcting certain cases of poor reproductive performance in New Zealand. Oral supplementation with 5 mg of selenium per ewe at monthly intervals resulted in improved lambing percentage from 62 to 94 (Hartley and Grant, 1961). Andrews *et al* (1968) reported the role of selenium in the reproductive process, including that in cattle. Buck *et al* (1981) noted and accumulation of selenium in the corpus luteum, pituitary and adrenal glands of the cow; these organs are important in pregnancy and in the initiation of parturition. Vitamin E has been referred to as the anti-sterility vitamin considering its important role in the regulation of the development and function of reproductive organs, the establishment and maintenance of pregnancy and the regulation of hormone metabolism through the anterior lobe of the pituitary gland (Gallo-Torres, 1980). An increase in twinning (Hill *et al,* 1969), a decrease in stillbirths (Whanger *et al,* 1978) and an increase in the number of weaned lambs (Kott *et al,* 1983) have been reported in vitamin E and/or selenium-supplemented ewes. However, no report is available on the sparing effect of these nutrients on reproduction in heifers. The goal of this experiment was to investigate the effects of selenium and/or vitamin E on overall pregnancy rate and age at onset of breeding, at first heat, at first breeding, gestation length and days from calving to rebreeding of young replacement beef heifers.

MATERIALS AND METHODS

Animals

Twenty-four weaned (at 8 months of age) replacement beef heifers averaging 230 kg body weight were allotted for each year of this 2-yr study. They were housed indoors and individually fed an average quality grass hay plus 2 kg per day of a barley-based ration containing respectively 0.025 and 0.21 mg/kg dry matter of selenium and < 1 and 18.5 mg/kg dry matter of vitamin E.

Experimental procedures

Each year the heifers were randomly allocated to 4 treatment groups of 6 heifers and each group was assigned to one treatment consisting of : i), 1 mg selenium plus 1 g vitamin E per day; ii), 1 g vitamin E per day; iii), 1 mg selenium per day; and iv), no supplementation. Selenium was supplemented as sodium selenite (Colborn-Dawes Canada Ltd, Cambridge, Ont), and vitamin E was given as d α-tocopherol acetate (Colborn-Dawes Canada Limited, Cambridge, Ont). The heifers were fed these rations for 6 months from weaning at 8 months until the start of the 45-d breeding season with natural service.

Throughout the trial, and in both years, the heifers were observed daily (sunrise, sunset) for any signs of heat until breeding time. Once breeding started, heifers were observed 3 times a day (sunrise, noon, sunset) and the bull was equipped with a chin pad marker. Records were kept on breeding date and a rectal examination for pregnancy diagnosis was carried out 60 days after the end of the breeding period. These data were used to determine the overall pregnancy rate. Following calving, the heifers were maintained together and the length of time between calving and rebreeding was calculated when the subsequent rectal pregnancy check was performed.

Blood samples were taken every month from weaning until breeding. A 10-ml portion of blood, collected in heparinized evacuated tubes, was used for the vitamin E assays by the method of McMur-

ray and Blanchflower (1979), while the remaining 20 ml was used for the selenium assays by the fluorometric method of Hoffman *et al* (1968). These samples were centrifuged shortly after collection and the plasma was stored at – 20°C until the analyses could be performed.

Statistical analysis

Analysis of variance by the least squares method was used to determine the significance of difference in all the different parameters studied (Steel and Torrie, 1980). Chi-square analysis was used to determine differences in overall pregnancy among the 4 treatment groups.

RESULTS

The plasma levels of both selenium and vitamin E are presented in table I. All heifers responded quickly to the supplementation program and different plasma levels of selenium and vitamin E were attained before 2 months following the initiation of the trial.

Data on the reproductive performances are presented in table II. No significant ($P > 0.05$) difference was observed among treatments for age

Table I. Serum levels of vitamin E and selenium in heifers over both years.

	Vitamin E and selenium	Vitamin E	Selenium	None	SE
Vitamin E (µg/ml)					
Initial level	3.66	3.59	3.31	4.02	1.2
2 months later	3.79[b]	3.29[ab]	1.94[a]	1.94[ab]	0.4
Average last 3 months	4.09 [b]	3.09[ab]	2.04[ab]	0.98[ab]	0.8
Selenium (µg/ml)					
Initial level	0.012	0.010	0.010	0.008	0.004
2 months later	0.057[ab]	0.032[a]	0.060[b]	0.037[a]	0.007
Average last 3 months	0.052[b]	0.038[ab]	0.051[b]	0.029[a]	0.006

[a,b] Means within the same row with different superscripts differ ($P < 0.05$).

Table II. Reproductive performances of heifers supplemented with selenium and vitamin E.

	Vitamin E and selenium	Vitamin E	Selenium	None	SE
Age of heifers (d) at :					
Start of breeding	405	408	406	410	16
First heat	395	407	404	416	18
Breeding	418	422	427	429	28
Calving	702	708	710	714	19
Length of gestation (days)	284	286	283	285	6
Time between calving to rebreeding (days)	55	60	63	58	5.2
Pregnancy rate (%)	83.3[a]	83.3[a]	58.3[ab]	33.3[b]	8.4

[a,b] Means within the same row with different superscripts differ ($P < 0.05$).

at first heat, age at the beginning of the breeding period, age at breeding or age at calving. The effects of supplementation on overall pregnancy rate were significant between those supplemented with vitamin E and the heifers with no vitamin E and selenium supplementation, while there was no significant ($P > 0.05$) difference due to selenium.

Our data showed no ($P > 0.05$) difference in age at first heat. The numbers of days between actual breeding and calving was not ($P > 0.05$) affected either by selenium or vitamin E for those heifers that calved, and the number of days between calving and rebreeding was also unaffected by the selenium–vitamin E treatment prior to their first breeding.

DISCUSSION

The plasma levels of both selenium and vitamin E rose quickly after initiation of supplementation and were similar to the published levels of 0.06 µg/ml of selenium (Hidiroglou *et al*, 1971; Hidiroglou *et al*, 1985) and 3 µg/ml of vitamin E (Bayfield and Mylrea, 1969; Hidiroglou *et al*, 1978) for supplemented heifers.

The data on the reproductive performances confirm the conclusions of Scott (1978) who reported a major effect of vitamin E on very few reproductive performances. He reported that certain forms of reproductive failure may respond primarily to selenium, but the classical embryonic death and resorption in rats is primarily a vitamin E-responsive deficiency disease. The supplementation did not reduce age at first heat, partly because breeding had started before the unsupplemented group had all reached a first heat. The lack of effect of selenium and vitamin E on the number of days between breeding and calving, and calving and rebreeding, suggests that there was no long-term effect on those heifers.

The results of this trial indicate that a lack of vitamin E will not delay breeding in replacement heifers. The effects of selenium were not conclusive and indicated no sparing effect in vitamin E-deficient heifers. The effects of vitamin E and/or selenium were not observed in any of the parameters measured except pregnancy rate. Our data suggested an increase in the overall pregnancy rate when vitamin E-deficient beef heifers are given vitamin E supplementation. Also, these data suggest that it would be of interest to design a large-scale experiment using identical treatments in order to confirm the previous conclusions gathered from a limited number of heifers.

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