Bulletin 1001 August 1993

Selenium Supplementation of Grazing Beef Cattle

MAFES
MSU
MISSISSIPPI AGRICULTURAL & FORESTRY EXPERIMENT STATION Verner G. Hurt, Director Mississippi State, MS 39762
Donald W. Zacharias, President Mississippi State University R. Rodney Foil, Vice President

Selenium Supplementation of Grazing Beef Cattle

H. W. Essig
Professor and Animal Scientist
Department of Animal and Dairy Sciences

K. P. Boykin
Research Assistant I
Department of Animal and Dairy Sciences

C. E. Cantrell
Instructor and Facilities Coordinator
Department of Animal and Dairy Sciences

F. T. Withers, Jr.
Superintendent
Leveck Animal Research Center

Published by the Office of Agricultural Communications, Division of Agriuclture, Forestry, and Veterinary Medicine, Mississippi State University. Edited by Keith H. Remy, Senior Publications Editor. Cover designed by Beth Carter, Graphic Artist.

Selenium Supplementation of Grazing Beef Cattle

Introduction

Prior to the discovery of the essentiality of selenium (Se) by Schwarz and Foltz (1957), the only nutritional significance of Se was thought to be related to toxicity in animals in the U.S. Central Plains.

Currently, Se is known to function as a component of the selenoenzyme glutathione peroxidase (Rotruck et al., 1973). According to the NRC (1983) publication, *Selenium in Nutrition*, Mississippi is a part of the United States where 80 percent of all forages and grains contain >0.1 part per million (ppm) Se.

Galphin (1980) sampled forages produced at the Mississippi State University Dairy Unit and reported that the Se content of forages ranged from 0.05 to 0.04 ppm. The National Research Council states that Se requirements for beef cattle range from 0.05 to 0.3 ppm with a suggested value of 0.2 ppm Se in the diet (NRC, 1984). The addition of sodium selenite, vitamin E, and zinc acetate to endophyte-infected fescue (EIF) hay did not improve gain or feed efficiency of growing beef steers (Essig and Armstrong, 1990).

Objectives of the studies summarized in this publication were to: (1) evaluate providing Se through a 120-day sustained-release bolus for growing steers grazing endophyte-free fescue (EFF) or EFF with bermudagrass; (2) evaluate using a 120-day sustained Se-release bolus for cows with calves grazing EFF or EIF forage systems or grazing a bermudagrass/ryegrass forage system; and (3) evaluate providing Se in a mineral mixture for replacement heifers grazing bermudagrass pastures.

Materials and Methods

This study used 155 Hereford x Angus crossbreed steers in three trials (Table 1), 88 cow/calf pairs in two trials (Tables 2 and 3), and 80 replacement heifers in a one-year trial (Table 4).

Trials 1 to 3

Steers used in the first three studies weighed between 425 and 495 pounds. In trial 1, an EFF/bermudagrass forage system was used in a 280-day grazing study (November to October). The forage system in trials 2 and 3 was EFF grazed for 196 days from November to July.

The forage systems used in trials 1 and 2 each consisted of twelve 2-acre paddocks (24 paddocks total), which were divided by electric fencing into 0.5-acre subplots for rotational grazing. A four-way rotational grazing system was used where each subplot was grazed for 7 days and allowed to accumulate forage for 21 days.

Both four-way rotational and continuous grazing systems were used in trial 3, where the 10 paddocks were 5 acres in size and seeded to endophyte-free Kentucky-31 fescue. Selenium was administered to steers in trials 1 to 3 through a sustained release bolus (Dura Se-120®, Schering Animal Health, Allentown, NJ), which had a delivery rate of 3 mg of Se daily. A second bolus was given after 140 days on study. Steers were weighed at 28-day intervals throughout the study.

Trials 4 and 5

Cows used in trial 4 of this study were grazed on replicated EIF or EFF forage systems. There were two 25-acre EIF and two 25-acre EFF pastures. One-half of the cows in each pasture were given a Se bolus every 120 days for one year (three times during the year). Cows were weighed in fall (beginning of study), winter (January before calving), spring (at breeding), summer (120 days post calving), and fall (at weaning). Blood samples were drawn from four cows on each treatment for selenium analysis. Blood Se analysis was done by Schering-Plough Animal Health, Elkhorn, NE. Pregnancy status was determined by rectal palpation in October.

Cows used in trial 5 of this study were grazed on a bermudagrass/ryegrass pasture system. One-half of the cows in each pasture were given a Se bolus at 120-day intervals and six pastures served as replications. Blood samples were drawn three times during the year (December, April, and November), from four animals (two no-Se and two Se) in each of the six pastures, for Se analysis. Cow management was the same as described in trial 4.

Trial 6

Eighty replacement heifers (24 Hereford, 20 Charolais, 12 Santa Gertrudis, 8 Angus, 8 Brahman, and 8 Hereford x Angus) were used to evaluate providing Se in a complete mineral mixture for one year prior to calving. Treatments consisted of a commercial mineral mixture (control) and the commercial mineral mixture with Se (0.00264%) to provide 3 mg Se when consumed at a rate of 3 to 4 ounces per head daily.

Heifers were divided into four groups. Two groups of heifers were fed the mineral mixture and two were fed the mineral mixture with Se. Heifers were maintained on bermudagrass pasture and were supplemented with hay and protein supplement when forage for grazing was not available. Heifer weights were taken in July (initial weight), October (after frost), December (at breeding), March (112 days after breeding), and July (ending weight and 7 months after breeding). Calf birth weights and birth dates were recorded.

Statistical analysis

Statistical analysis was conducted using the general linear model (GLM) procedure of SAS (1988) where treatment and replications were classes. When treatment effects were significant, means were separated using the Duncan range test.

Results and Discussion

Trial 1 was conducted from November to October using a EFF/bermudagrass forage system. Sixteen steers were given Se boluses in November and again in April; 12 were used as controls (Table 1). The first 140 days of the grazing period were on predominantly EFF forage whereas the last 140 days of the grazing period were on predominantly bermudagrass forage. There was no difference in gain between the control steers and those given a Se bolus for either the first 140-day or the second 140-day grazing periods. When gain was calculated for the 280-day grazing period, steers given the Se bolus gained more than the controls.

In trials 2 and 3, an EFF forage system was grazed from November to June. In trial 2, 22 steers served as controls, and 29 were given a Se bolus at the beginning of the study and again after 140 days on grazing (Table 1). There was no difference in gain at 140 days or at 196 days between the control steers and those given Se. In trial 3, 36 steers served as controls and 40 were given a Se bolus at the beginning and after 140 days of grazing the EFF forage (Table 1). There was no difference in gain between control steers and those given a Se bolus, either at 140 days or at 196 days of grazing.

In trials 1, 2, and 3, there was no difference in gain due to treatment with Se at 140 days on grazing and there was no difference in gain from day 140 to the end of the grazing period. The only difference in gain was when the gain of steers was combined for the 280-day period in trial 1. No explanation for these differences is apparent.

Trial 4 was a comparison of cow/calf performance when cows were given a Se bolus at 120-day intervals for 1 year while grazing either an EFF or EIF forage system. There no differences due to Se for any cow or calf trait within either the EFF or EIF forage system (Table 2). There were differences due to forage systems for cow and calf traits.

Cows grazing the EFF forage without Se (Controls) had more gain in the fall than control cows grazing EIF. Yearly weight change ranged from 57.4 pounds to -58 pounds with the only gain being in cows grazing EFF and given no Se.

Calf birth weight was not influenced by either forage system or Se treatment, which is in disagreement with research of Nelson and Miller (1987). Calf weaning weight and calf gain were greater for calves from cows grazing EFF than from cows grazing the EIF forage system.

Conception rate for cows grazing EFF was 92 per-

Table 1. Influence of sustained-release selenium bolus on performance of steers grazing EFF forage system.

Item	Treatment	
	Control*	Selenium*
EFF/BG forage system (Trial 1)		
Number animals	12	16
Init. Wt., lb	423.3	444.6
1st 140-d gain, lb	139.5a ± 14.8	178.6a ± 12.8
1st 140-d ADG, lb	.996	1.276
2nd 140-d gain, lb	101.0a ± 12.0	126.4a ± 10.4
2nd 140-d ADG, lb	.721	.903
280-d gain, lb	240.5b ± 18.8	305.0a ± 16.3
280-d ADG, lb	.859	1.089
EFF forage system (Trial 2)		
Number animals	22	29
Init. wt., lb	425.9	415.7
1st 140-d gain, lb	126.9a ± 8.2	121.9a ± 7.1
1st 140-d ADG, lb	.906	.871
2nd 56-d gain, lb	56.9a ± 4.4	55.1a ± 3.8
2nd 56-d ADG, lb	1.016	.984
196-d gain, lb	183.8a ± 10.4	177.0a ± 9.1
196-d ADG, lb	.938	.903
EFF forage system (Trial 3)		
Number animals	36	40
Init. wt., lb	492.2	495.1
1st 140-d gain, lb	156.9a ± 8.5	165.9a ± 8.0
1st 140-d ADG, lb	1.121	1.185
2nd 56-d gain, lb	68.6a ± 3.7	59.6a ± 3.5
2nd 56-d ADG, lb	1.225	1.064
196-d gain, lb	225.6a ± 8.4	225.4a ± 7.9
196-d ADG, lb	1.151	1.150

* Means within a row followed by a common letter aré not significantly different (P<.05).

Table 2. Selenium bolus influence on performance traits for cows/calves grazing fescue pastures (Trial 4).

	Forage System			
	EFF Treatment		EIF Treatment	
Item	Control*	Selenium*	Control*	Selenium*
Number animals	13	11	7	9
Init. wt., lb	1,203.7	1,187.8	1,130.3	1,123.1
Winter cow wt., lb	1,249.1	1,234.9	1,204.0	1,202.4
Spring cow wt., lb	1,090.8	1,053.6	1,051.7	981.3
Summer cow wt., lb	1,091.1	1,104.2	1,054.9	1,033.8
Fall cow wt., lb	1,146.3	1,152.4	1,072.3	1,069.1
Cow winter gain, lb	45.4a ± 11.7	47.1a ± 12.7	73.7a ± 15.9	79.3a ± 14.0
Cow spring gain, lb	-158.3a ± 23.5	-181.3a ± 25.6	-152.3a ± 32.1	-221.1a ± 8.3
Cow summer gain, lb	.3a ± 18.1	50.5a ± 19.7	3.1a ± 24.6	52.4a ± 21.7
Cow fall gain, lb	55.2a ± 9.8	48.2ab ± 10.7	17.4b ± 13.4	35.3ab ± 11.8
Yearly wt. change, lb	57.4a ± 29.0	-35.5a ± 31.5	-58.0a ± 39.5	-54a ± 34.9
Calf birth wt., lb	102.3a ± 4.6	96a ± 5.0	107.1a ± 6.2	92.7a ± 5.5
Calf weaning wt., lb	526.3a ± 17.4	486.7ab ± 18.9	432.3b ± 23.7	448.4b ± 20.9
Calf gain, lb	424.0a ± 17.1	390.7ab ± 18.6	325.1c ± 23.3	355.8bc ± 20.6
Pregnancy, %	92	92	43	33
Blood Se, ppm, Apr 90	0.07	0.15	0.08	0.15

* Means within a row followed by a common letter are not significantly different (P<.05).

cent whereas the conception rate of cows grazing EIF forage was 38 percent. This is in agreement with other research (Essig et al., 1993) comparing EFF and EIF forage systems.

Cows given Se boluses had a Se blood level of 0.15 ppm whereas the control cows had a Se blood level of 0.07 PPM suggesting that Se was being provided by the bolus.

Bermudagrass overseeded in the fall was the forage system used in trial 5. There were 24 cows that served as controls and 24 cows were given a Se bolus at 120-day intervals for a year; these cows were divided among six different pastures (four control cows and four Se-treated cows per pasture). There was no difference in any trait measured due to treatment (Table 3). An explanation for the low pregnancy rate in both treatments is that the cows in one pasture (replication) were not bred because of an infertile bull. Blood analysis for Se showed no difference at the beginning of the trial, but by the middle and at the end of the trial blood levels of Se were elevated for cows given a Se bolus.

In Trial 6, a mineral mixture was fed with or without Se to 80 replacement heifers for a year prior to calving. Heifers were maintained on a mixed bermudagrass pasture and were fed mixed grass hay and a protein supplement when forage was not available through the grazing system. Gain was calculated for the summer (July to October), fall (October to December), prior to breeding (July to December), gain after breeding (December to July), and gain for the year (Table 4). There were no differences between treatments due to Se supplementation for traits measured in this study.

Conclusions

Six trials were conducted and Se boluses increased gain of steers only in one trial. Steers grazing an EFF/bermudagrass forage system for 280 days gained

Table 3. Selenium boluses for cows/calves grazing bermudagrass ryegrass pastures (Trial 5).

	Treatment	
Item	Control	Selenium
Number animals	24	24
Init. wt., lb	1,270.5	1,273.3
Winter cow wt., lb	1,289.4	1,312.0
Spring cow wt., lb	1,086.8	1,099.4
Summer cow wt., lb	1,107.6	1,117.9
Fall cow wt., lb	1,175.4	1,172.7
Cow winter gain, lb	25.3a ± 6.5	37.8a ± 6.5
Cow spring gain, lb	-202.6a ± 15.0	-212.6a ± 15.4
Cow summer gain, lb	20.8a ± 11.8	18.5a ± 12.0
Cow fall gain, lb	67.8a ± 4.9	54.8a ± 5.0
Yearly wt. change, lb	-93.5a ± 13.6	-100.7a ± 13.6
Calf birth wt., lb	86.2a ± 3.0	79.1a ± 3.1
Calf weaning wt., lb	524.8a ± 12.5	525.3a ± 12.8
Calf gain, lb	438.6a ± 12.7	446.3a ± 13.0
Pregnancy, %	76	68
Blood Se		
Dec 89	0.12	0.12
Apr 90	0.07	0.13
Nov 90	0.17	0.22

* Means within a row followed by a common letter are not significantly different (P<.05).

Table 4. Selenium supplementation of replacement heifers grazing bermudagrass pasture (Trial 6).

Item	Treatment[a]	
	Control	Selenium
Number animals	40	40
Initial wt., (July), lb	724.2	729.2
Oct. wt., (84 d), lb	812.2	828.5
Dec. wt., (56 d), lb	780.2	790.8
Mar. wt., (112 d), lb	791.1	806.0
July wt., (112 d), lb	918.3	916.9
Summer gain, lb	88.1	99.3
Fall gain, lb	-32.1	-37.7
Gain 4 mo post breeding, lb	11.0	15.2
Gain to breeding, lb	56.0	61.7
Gain after breeding, lb	109.1	117.5
Gain for 365 d, lb	162.6	173.3
Calf birth wt., lb	70.0	70.6
Heifers not bred	12b	7b
Calving % overall	65	78
Calving % exposed to bull	93	94
	(26/28)	(31/33)
Avg calf birth date	Oct 11	Oct 16

[a] No significant differences exist within variables due to treatment.
[b] 2 Hereford, 6 Santa Gertrudis, all 8 Brahman, 1 F1 (AxB), and 2 Charolais were not cycling and were not bred.

more than the control steers; however, there was no difference due to Se boluses when gain was calculated for each 140-day period of the trial. In two other trials, where a larger number of animals grazed forage systems for a 196-day period, there was no difference due to Se boluses. Cow and calf performance was not influenced when the cows were given a Se bolus and grazed on an EFF, EIF, or bermudagrass/ryegrass forage system. There was no influence on performance of replacement heifers given access to a mineral mixture containing Se for one year prior to calving.

These trials suggest that Se supplementation in bolus form or in a mineral mixture was not beneficial for grazing steers for less than 200 days; for cows with calves grazing EFF, EIF, or bermudagrass; or for heifers prior to their first calf.

Literature Cited

Essig, H.W., B. Aremu, C.E. Cantrell, M.E. Boyd, and F.T. Withers, Jr., 1993. Impacts of endophyte-infected fescue on cow/calf production. The Professional Anim. Scientist 9 (in press).

Essig, H.W., and T.A. Armstrong. 1990. Evaluation of additives to endophyte-infected fescue hay on growth performance and body temperature of steers. The Professional Anim. Scientist 6:11.

Galphin, S.P., 1980, Transfer of injectable and dietary selenium to serum colustrum and milk of dairy cattle. MS Thesis. Mississippi State Univ.

Nelson, A.O., and R.F. Miller. 1987. Responses to selenium in range beef herd. California Agri. March-April, 1987. p 4-5.

NRC. 1983. Selenium in Nutrition. rev. ed. Subcommittee on Selenium. Committee on Animal Nutrition, Board on Agriculture, National Academy of Sciences. Washington, DC.

NRC. 1984. Nutrient Requirements of Beef Cattle. 6th rev. ed. Subcommittee on Beef Cattle Nutrition, Committee on Animal Nutrition, Board on Agriculture, National Academy of Sciences. Washington, DC.

Rotuck, J.T., A.L.Pope, H. E. Ganther, A.B. Swanson, D.G. Hafeman, and W,G, Hoekstra. 1973. Selenium: Biochemical role as a component of glutathione peroxidase. Science 179:588.

SAS. 1988. SAS User's Guide: Statistics. SAS Inst. Inc. Cary, NC.

Schwarz, K. and C.M. Foltz. 1957. Selenium as an integral part of a factor 3 against dietary necrotic liver degeneration. J. Am. Chem. Soc. 79:3293.

Mississippi State
UNIVERSITY

Printed on Recycled Paper

Mention of a trademark or proprietary product does not constitute a guarantee or warranty of the product by the Mississippi Agricultural and Forestry Experiment Station and does not imply its approval to the exclusion of other products that also may be suitable.

56476/0.9M