PEER REVIEWED

Comparison of Serum Steroidal Hormone Concentrations in Buller Steers, Riders, and Uninterested Penmates. Investigation of Sickness, Body Weight, Feed Bunk Status, and Implant Condition During Buller Occurrence.

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Abstract

Body weight, day 1 and day 3 rectal temperature, implant condition, feed bunk condition, and serum hormone concentrations of trenbolone, trenbolone acetate, testosterone, progesterone, and estradiol 17β on days one and three were measured in rider steers (n = 17), buller steers (n = 6) and control steers (n = 18) at the time of bulling activity. Day 1 was considered the day of initial bulling activity.

Body weight at the time of bulling did not differ between groups ($p = 0.99$), nor did rectal temperature at the time of bulling or the rectal temperature on day 3 post-bulling ($p = 0.93$, $p = 0.80$). There was a significant relationship between body weight at the time of bulling activity and day 1 rectal temperature ($p = 0.002$), however the relationship between body weight at the time of bulling and day 3 rectal temperature was not significant ($p = 0.31$). The condition of growth hormone implants at the time of bulling did not differ between groups ($p = 0.27$).

Day 1 serum estradiol 17β concentration was significantly different between groups ($p = 0.05$). The four steers that had detected-quantified levels of estradiol 17β on day 1 were riders. One buller and one control steer had detected-not quantified levels of estradiol 17β on day 1. The available data suggest rider steers may have elevated levels of estradiol 17β as compared to bullers and non-involved penmates at the time of bulling activity. Results of this study suggest that the rider steer should be scrutinized as closely as the buller steer in future studies.

Résumé

La masse corporelle, la température rectale au jours 1 et 3, l'état de l'implant, l'état de la mangeoire et la concentration hormonale sérique de la trenbolone, de l'acétate de trenbolone, de la testostérone, de la progestérone et de l'estradiol 17β aux jours 1 et 3 ont été mesurés chez des bouvillons actifs à la monte (*rider*; n = 18), des bouvillons qui se laissent monter (*buller*; n = 6) et des bouvillons témoins (n = 18) au moment des activités de monte en parc d'engraissement. Le jour 1 était considéré comme le jour initial des activités de monte.

Ni la masse corporelle (p = 0.99) ni la température rectale au moment de la monte (p = 0.93) ou au jour 3 suivant le début des activités de monte (p = 0.80) n'étaient différentes entre les groupes. Il y avait une relation significative entre la masse corporelle au moment de la monte et la température rectale au jour 1 (p

= 0.002) alors que la même relation avec la température rectale au jour 3 n'était pas significative (p = 0.31). L'état des implants de croissance au moment des activités de monte n'était pas différent entre les groupes (p = 0.27).

La concentration sérique d'estradiol 17β au jour 1 variait selon les groupes (p = 0.05). Les quatre bouvillons avec des quantités détectées et estimées d'estradiol 17β au jour 1 étaient des bouvillons actifs à la monte. Un bouvillon qui se laissait monter et un bouvillon témoin avaient des niveaux détectables mais non-estimés d'estradiol 17β au jour 1. Les données recueillies jusqu'à présent suggèrent que les bouvillons actifs à la monte auraient un niveau d'estradiol 17β plus élevé que les bouvillons qui se laissent monter et que les bouvillons du même enclos qui ne sont pas impliqués dans les activités de monte. Les résultats de cette étude suggèrent que les bouvillons actifs à la monte (*rider*) devraient recevoir une attention aussi particulière que les bouvillons qui se laissent monter (*buller*) dans les travaux futurs.

Introduction

A buller steer is defined as a steer that is relentlessly ridden and harassed by a group of pen mates. The average incidence of buller steers in a feedlot population is 2-3% (range 0-11.2%); the case fatality rate may exceed 1%.[1,2,5] Death loss, carcass condemnation, decreased live weight gain and treatment of injury cause economic loss.[5] A survey ranked the buller steer syndrome third behind bovine respiratory disease and foot rot as the most costly disease in North American feedlots.[5]

Buller steers have been classified as either type I or type II.[3] Type I buller steers are considered the "true buller." These steers assume a stance similar to pubertal heifers in estrus. It is not uncommon for these steers to be ridden and harassed to the point of collapse. Type II buller steers are considered steers of "unfair social circumstances," and these steers do not assume an estrus-like stance. The type II buller steer uses aggressive acts, such as head butting, to discourage riders. Eventually the type II buller steer succumbs to the harassment and lies down, although the rider steers often continue their aggression on the downed buller steer. Proposed factors related to the buller syndrome include, but are not limited to, season, pen size and density, group mixing, concurrent disease, pheromones, exogenous estrogens, serum steroidal hormone concentration, improper castration, growth hormone implant effect and social interactions.[1,4,5] These factors may influence bulling activity independently or in combination. To date, no specific causative factor has been implicated as the sole cause of the buller steer syndrome.

The objectives of this study were twofold. First, to determine if there were differences in serum concentrations of trenbolone, trenbolone acetate, testosterone, progesterone, and estradiol 17β between buller steers, riders, and uninterested pen mates on the day of bulling activity and three days subsequent to initiation of bulling. The second objective was to determine if there were differences in body weight, sickness, bunk score or implant condition at the time of buller activity.

Materials and Methods

A retrospective case-control observational study was performed from July 21, 1999 through November 30, 1999 at a 4000 head feedlot in southwest Iowa. Study animals were yearling steers originating from multiple sources in the midwest; 127 steers arrived on July 21, 1999 and 61 arrived on July 27, 1999. The average weight was 778 lb (354 kg) at processing. An additional 150 steers arrived on September 4, 1999, and weighed 851 lb (387 kg) at processing.

All steers were processed within 24 hr of arrival with modified live virus (MLV) infectious bovine rhinotracheitis virus (IBR), bovine viral diarrhea virus (BVDV), bovine respiratory syncytial virus (BRSV), parainfluenza-3 virus (PI3) vaccine;[a] *Haemophilus somnus* bacterin;[b] intranasal MLV IBR-PI3 vaccine;[c] injectable avermectin;[d] a multivalent clostridial bacterin-toxoid;[e] and a combination 120mg trenbolone acetate/24mg estradiol implant.[f]

The 188 steers that arrived on July 21 and 27 were penned together and allowed 450 square feet/head. The 150 steers received on September 4 were allowed 612 square feet/head. The steers were housed in open dirt lots with access to shade and were fed twice daily in fence line concrete bunks with an 8-foot apron. The feedlot manager was responsible for feed allocation. The ration consisted of corn gluten, whole shell corn, haylage, corn silage and a protein supplement.

Parameters investigated were weight at the time of bulling, rectal temperature on days one and three, bunk score at the time of bulling, condition of the growth hormone implant at the time of bulling, and serum hormone concentrations on days one and three. Day 1 was considered the day of initial bulling activity.

Pens were checked four times each day (7 am, 10 am, 1 pm and 4 pm) for buller activity. Tag numbers were recorded for the buller, three riders and three uninterested pen mates while bulling activity occurred. The identified steers were taken to the hospital facility for evaluation. The steers were weighed and the rectal temperature was recorded using a digital thermometer.[g] If the rectal temperature was 104°F (40°C) or higher, then other disease processes were noted and treated. The implant site was examined and the condition of the implant was recorded as good (implant maintained original pre-implant shape, and no swelling was evident);

missing (cattle known to be implanted, but no implant was present in the ear); or abscessed (evidence of swelling at the implant site). Twenty-four (24) ml of venous blood was collected from the jugular vein into 2-12 ml glass tubes, allowed to clot at room temperature, and then centrifuged for 10 minutes. The serum was poured into labeled plastic falcon tubes, frozen at -160°F (-106°C), and stored for future laboratory analysis.

After examination, the buller steer was separated from the rider steers and uninterested pen mates. All steers were kept in hospital pens until re-evaluation on day 3. The study steers were not mixed with cattle diagnosed with respiratory disease or lameness. The same procedures performed on day 1 were repeated on day 3. All steers were returned to the home pen following examination and sample collection on day 3.

Analytical Methods

Serum hormones were extracted using previously published methods.[6] Ten milligrams (mg) of testosterone, trenbolone, trenbolone acetate, progesterone and estradiol 17β were weighed individually using an analytical balance and placed into separate labeled 10 ml volumetric flasks. Ten ml of reagent grade acetone was added, the flask was vortexed for 10 seconds, and then the 10 ml solution was placed into a 15 ml glass screw cap tube, capped, and labeled with the hormone identification, date and concentration (1mg/ml).

A stock solution was prepared for use as the standard for steroid hormone analysis. Twenty microliters (µl) of each steroid hormone solution was placed into a 10 ml volumetric flask. Ten ml of reagent grade acetone was then added to the flask, capped and vortexed for 10 seconds. The solution from the flask was removed and placed into a 15 ml glass screw cap tube. The tube was capped and labeled with the names of the standards in the mix and the date completed. The standards were placed into a freezer and maintained at -13°F (-25°C) for later analysis as a batch.

For analysis, serum samples were removed from the freezer and allowed to thaw at room temperature. Serum samples were vortexed for 10 seconds, and 0.5 ml aliquots of serum from sampling days 1 and 3 were placed into individually labeled 15 ml glass screw cap tubes. One hundred microliters of the standard hormone stock solution was added to the 0.5 ml test sample, and was considered the spiked control. Five ml of diethyl ether was added to each tube and centrifuged for 20 minutes at 2000 RPM. Samples were removed from the centrifuge, and the diethyl ether fraction was removed by passing it through a sodium sulfate column into a two-dram glass vial.

The diethyl ether solution contained in the two-dram glass vials was desiccated using nitrogen gas effusion. One-hundred µl of a 60:40 methanol:milipore water solution was added to the glass vials to re-solvate the hormone content, and these solutions were vortexed for 10 seconds. The samples (4 per steer) were analyzed using high performance liquid chromatography (HPLC) with a 5-micron YMC C18 reverse phase, 4.6 mm x 150 mm column. The mobile phase was 55% acetonitrile and 45% water at 1 ml/min. All steroids were detected using 991 photodiode array detector and monitoring at 200, 243, and 345 nm in tandem with a SF-749 fluorescence detector with HAS assembly Ex 280 nm Em 295 nm filter for estradiol. The HPLC operator was blinded to steer classification.

The levels of detection (LOD) and levels of quantification (LOQ) are listed in Table 1.

Statistical Methods

Data from steers in buller (n = 6), rider (n = 17), and control (n = 18) groups were evaluated. Day 1 weight, and day 1 and day 3 rectal temperature were analyzed as continuous variables. The continuous variables were analyzed using the general linear model procedure[h] due to the uneven distribution of steer classification.

Serum hormone concentration and implant condition were analyzed as categorical variables. The condition of the growth hormone implant at the time of bulling activity was classified as good, abscessed or missing. The serum hormone concentrations on day 1 and day 3 were categorized as non-detected, detected-not quantified, and detected-quantified variables. Serum hormone concentrations were analyzed as categorical variables because very few samples (7/350) had detected quantified hormone concentrations; therefore, analysis of variance would not be adequate because of the high number of "zero" values.

Trenbolone acetate and progesterone hormone concentrations on day 1 and day 3 in all steer groups were non-detected; therefore, those hormones were not included in the analysis. Those steers with inadequate serum volume were also not included in the categorical variable analysis. The hormone classes used in the statistical analysis were day 1 and day 3 trenbolone, day 1 and day 3 testosterone, and day 1 and day 3 estradiol 17β.

Table 1. Level of detection and quantification of serum hormones in study.

Hormone	Level of detection (ppb)	Level of quantification (ppb)
Testosterone	0.2	2
Trenbolone	0.2	2
Trenbolone acetate	0.5	5
Progesterone	1	10
Estradiol	1	10

For analysis of categorical variables the Fishers Exact Test[i] was applied. The Fishers Exact Test was applied instead of the Chi-square test because expected frequencies were less than five in any one cell. A significance level of 5% was used in the analysis for both continuous variables and categorical variables.

Results

One steer group from those that arrived on September 4 was identified 10 days following arrival. Five steer groups were identified from the group arriving July 21 and 27, and the average days on feed at the time of bulling activity was 67 (range 50-87 days; Figure 1).

Feed bunk scores were recorded at the time bullers were identified. Five of the six steer groups were identified when feed bunks were empty, and one group was identified when approximately one-fourth of ration remained in the bunk. The number of steers per classification, mean, range, and standard deviations of the body weight on day 1, and the rectal temperature on day 1 and day 3 are listed in Table 2. The raw data are included in Appendix A.

Body weight at the time of bulling activity did not differ between steer groups ($p = 0.99$). Rectal temperature on days one and three did not differ between steer groups ($p = 0.93$ for day 1, $p = 0.80$ for day 3). The difference between day 1 rectal temperature and day 3 rectal temperature was not significant ($p = 0.20$). Day 1 rectal temperature increased as body weight increased ($p = 0.002$).

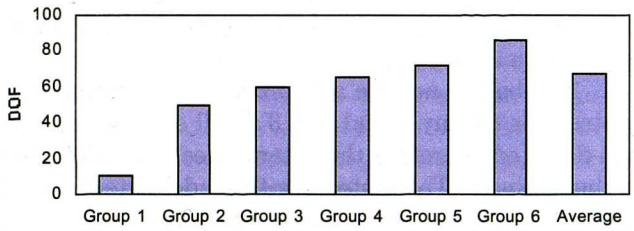

Figure 1. Buller group and corresponding days on feed (dof) to initial buller activity.

Thirty-eight steers were evaluated for day 1 serum trenbolone concentrations. Trenbolone concentrations in sera of one buller were detected-not quantified on day 1. The serum concentration of trenbolone on day 1 did not differ between steer groups ($p = 0.14$). Sera from 32 steers were evaluated for day 3 trenbolone levels; trenbolone concentrations in sera from two riders and one control steer were detected-not quantified on day 3. The serum concentration of trenbolone on day 3 did not differ between steer groups ($p = 0.45$).

The sera from 38 steers were evaluated for day 1 serum testosterone concentration. Testosterone concentrations in two riders and one control steer were detected-not quantified on day 1. The serum concentration of testosterone on day 3 did not differ between steer groups ($p = 0.74$).

Thirty-two steers were evaluated for day 3 serum testosterone concentrations; one rider steer had detected-not quantified levels of testosterone. The serum concentration of testosterone on day 3 did not differ between groups ($p = 1.0$).

Day 1 sera from 38 steers were evaluated for estradiol 17β concentrations. In one control steer and one buller, estradiol 17β levels were detected-not quantified on day 1, while estradiol 17β concentrations in four riders were detected-quantified on day 1. The serum concentration of estradiol 17β of rider steers on day 1 was significantly higher than control and buller steer groups ($p = 0.05$). Thirty-two steers were evaluated for day 3 serum estradiol 17β concentrations. Estradiol 17β concentrations in two riders and one buller steer were detected-quantified on day 3. The serum concentration of estradiol 17β on day 3 did not differ between steer groups ($p = 0.38$). The hormone concentration categories and the number of bullers, riders and control steers in each category are found in Figure 2.

Three control steers had missing growth hormone implants, and one rider steer had an abscessed growth hormone implant site. Steers with missing and abscessed growth hormone implants did not have detectable serum hormone concentrations. Examination of the implant site of remaining steers was normal. The

Table 2. Day 1 weight (lb), day 1 and day 3 rectal temperature (°F) of riders, bullers and control steers.

	Rider (n=17)	Buller (n=6)	Control (n=18)	*p* value
WT-1 mean ± SD	1107 ± 178	1104± 128	1111 ± 168	0.99
WT-1 range	806-1404	924-1286	802-1406	
TP-1 mean ± SD	103.1 ± 1.1	103.3 ± 1.6	103.1 ± 0.9	0.93
TP-1 range	101.4-105.3	101.1-105.3	101.9-104.9	
TP-3 mean ± SD	102.6 ± 0.7	102.8 ± 1.3	102.6 ± 0.8	0.8
TP-3 range	101.2-103.9	101.6-105.1	101.0-104.0	

WT-1 = Day 1 weight, TP-1 = Day 1 rectal temperature, TP-3 = Day 3 rectal temperature, SD = standard deviation

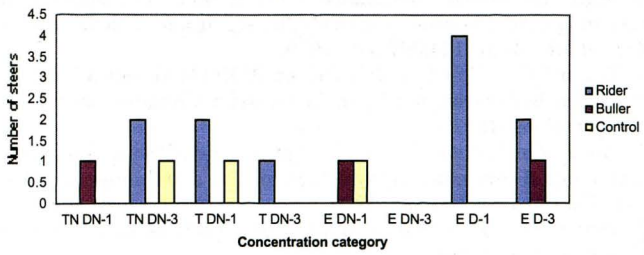

Figure 2. Number of steers per hormone concentration category.
TN DN-1 = trenbolone detected-not quantified on day 1; TN DN-3 = trenbolone detected-not quantified on day 3; T DN-1 = testosterone detected-not quantified on day 1; T DN-3 = testosterone detected-not quantified on day 3; E DN-1 = estradiol 17β detected-not quantified on day 1; E DN-3 = estradiol 17β detected-not quantified on day 3; E D-1 = estradiol 17β detected-quantified on day 1; E D-3 = estradiol 17β detected-quantified on day 3.

relationship between growth hormone implant condition and steer classification was not significant ($p = 0.27$). Buller steers (n = 6) were returned to their home pen after data collection, and none were repulled and reclassified as bullers during the 10-week study period because none exhibited signs of bulling activity. One rider steer was sampled later in another steer group as a rider, and two control steers were sampled later in other steer groups as control steers.

Bunk scores were recorded in pens with bulling activity, however, they were not recorded in pens without bullers. As a result, bunk score at the time of bulling activity was not analyzed for differences.

Discussion

Day 1 estradiol 17β was the only serum hormone significantly different among the steer groups ($p \leq 0.05$). The LOD and LOQ for estradiol 17β in this study were 1 ppb and 10 ppb, respectively, which is not as sensitive as previous serum hormone studies.[4] A lower LOQ was not achieved because of low serum sample volume.

In this study, 86% (6/7) of the steers that had detected-quantified concentrations (≥ 10 ppb) of estradiol 17β either on day 1 or 3 were riders. This is supported by previous work in which buller steers were found to have lower serum estradiol concentrations than normal steers.[7] If hormone concentrations in riders, bullers and control steers are normally distributed in a feedlot population, then one hypothesis is that rider steers may have elevated estradiol 17β concentrations as compared to bullers and controls.

One of the biological effects of stress is the release of steroids from either gonads or adrenal glands. This could result in elevated serum concentrations of glucocorticoids or steroid hormones (particularly estrogen), which may account for hormone variation in a pen of steers.[8] Therefore, stress management may be an important step to control buller activity. Minimizing overcrowding, providing adequate water and bunk space, and especially avoiding excessive commingling of steers either on arrival or during re-implantation, may help decrease the incidence of bullers.[9]

A positive relationship was found between day 1 rectal temperature and body weight at the time of bulling activity. This may be related to the effect of environmental temperature and physical activity (transport to hospital facility) on heavier cattle, therefore heavier cattle may have higher normal body temperatures. The cattle in each classification that had a rectal temperature of 104.0°F (40°C) or higher showed no evidence of clinical disease. These data suggest disease was not a cause of bulling activity in this study. Body weight at the time of bulling also had no relationship to the incidence of bulling.

This is the first study to examine serum hormone concentrations in riders as well as bullers and uninterested pen mates. Although the assay level of detection used was of low sensitivity, the results of this study suggest that the rider steer should be scrutinized as closely as the buller in future studies.

Conclusions

This study provides the groundwork for further investigation into serum hormone concentrations of rider steers and their contribution to the buller steer syndrome in North American feedlots. Significant differences ($p = 0.05$) were demonstrated in serum estradiol 17β concentrations at the time of bulling activity. The four steers that had serum concentrations of estradiol 17β above the assay level of quantification were all classified as riders. The level of quantification for estradiol 17β in this study was not as sensitive as other studies, but the available data support the hypothesis that the rider steer may have elevated estradiol 17β at the time of bulling activity, as compared to the buller and uninterested pen mates.

These results suggest that different serum estrogen concentrations between steers in a pen may contribute to the buller steer syndrome. Prompt removal of the buller steer and minimizing stress are necessary to minimize buller steer occurrence and potential losses.

Footnotes

[a]Bovishield® 4, Pfizer Animal Health, Exton, PA
[b]Somubac®, Pfizer Animal Health, Exton, PA
[c]TSV-2®, Pfizer Animal Health, Exton, PA

[d]Dectomax®, Pfizer Animal Health, Exton, PA
[e]Fortress® 7, Pfizer Animal Health, Exton, PA
[f]Component™ TE-S, Vet Life, Winterset, IA
[g]GLA®, Agricultural Electronics, San Luis Obispo, CA
[h]JMP® 4.0.2, SAS Institute Inc., Cary, NC
[i]SAS®8.0, SAS Institute Inc., Cary, NC

References

1. Blackshaw JK, Blackshaw AW, McGlone JJ: Buller steer syndrome review. *Appl Anim Behav Sci* 54:97-108, 1997.
2. Brower GR, Kiracofe GH: Factors associated with the buller steer syndrome. *J Anim Sci* 46:26-31, 1978.
3. Edwards TA: Buller Syndrome: What's behind this abnormal sexual behavior. *Large Anim Vet* July/August 6-8, 1995.
4. Irwin MR, Melendy DR, Amoss MS, et al: Role of predisposing factors and gonadal hormones in the buller syndrome of feedlot steers. *J Am Vet Med Assoc* 174:367-370, 1979.
5. Taylor LF, Booker CW, Jim GK, et al: Epidemiological investigation of the buller steer syndrome in a western Canadian feedlot. *Aust Vet J* 75:45-51, 1997.
6. Wei J, Wei J, Zhou X, et al: Isocratic reversed phase high performance liquid chromatography determination and fluorescence detection. *Bio Chrom* 4:161-164, 1990.
7. Wettemann RP, Lehman F: Buller steers – causes and control. *OSU Imp Symp* P-957, 1997.
8. Kiracofe GH, Zimbelman R: Buller syndrome and the endocrinology of the feedlot steer. *Proc Acad of Vet Consult* Sept 2-62, 1978.
9. Apley M: Buller syndrome in feedlot steers. *Compend Contin Educ Pract Vet* 21:250-256, 1999.

Appendix A. Raw data; hormone concentration, body weight and rectal temperature of buller steers, riders and control steers.

ID	TN-1	TN-3	T-1	T-3	TA-1	TA-3	P-1	P-3	E-1	E-3	Class	WT	TP-1	TP-3	IC
128-23	N	T	N	T	N	N	N	N	N	N	R	832	102.4	103.3	G
128-49	N	N	N	N	N	N	N	N	N	N	R	806	102.3	103.9	G
128-39	N	N	N	N	N	N	N	N	N	N	C	920	102	101.5	G
128-72	N	N	N	N	N	N	N	N	N	N	C	924	102.4	102.1	G
128-125	N	N	N	N	N	N	N	N	N	N	C	802	102.3	101	G
128-136	N	N	N	N	N	N	N	N	N	N	B	924	101.1	101.6	G
126-10	N		N		N		N		N		C	996	102	103	G
126-22	N		N		N		N		N		C	1084	101.9	102.3	G
126-5	N		N		N		N		56		R	1062	102.2	102.6	G
126-1	N		N		N		N		28		R	1124	102	102.3	G
126-186	N		N		N		N		N		C	1066	103.2	103.3	G
126-45	N		N		N		N		N		R	930	103.2	101.2	G
126-168											B	1046	101.8	103.6	G
126-22	N	N	N	N	N	N	N	N	N	N	C	1110	102.4	102.6	G
126-30	N	N	N	N	N	N	N	N	N	N	C	896	103	101.4	G
126-54	N	N	N	N	N	N	N	N	N	N	C	1084	103.3	102.7	G
126-116	N	N	N	N	N	N	N	N	N	N	R	918	101.4	102	G
126-68	N	N	T	N	N	N	N	N	N	N	R	1166	102.9	102.9	G
126-148	N	N	N	N	N	N	N	N	10	18	R	1060	102.1	102.4	G
126-8	N	N	N	N	N	N	N	N	N	23	B	1036	104.2	102.6	G
126-118	N	N	T	N	N	N	N	N	N	N	R	934	104.1	102.5	G
126-187	N	N	N	N	N	N	N	N	N	N	C	1138	104.1	103.4	G
126-125	N	N	N	N	N	N	N	N	17	10	R	1202	104.4	102.2	G
126-157	T	N	N	N	N	N	N	N	N	N	B	1186	103.9	102	G
126-27	N	T	N	N	N	N	N	N	N	N	R	1252	105.3	102.7	G
126-9	N	N	N	N	N	N	N	N	N	N	C	1284	104.9	103.8	G
126-179	N	N	T	N	N	N	N	N	N	N	C	1208	103.4	102.4	G
126-160	N	N	N	N	N	N	N	N	N	N	R	1248	103.2	101.6	G
126-49	N	N	N	N	N	N	N	N	N	N	C	1184	103.5	101.9	M
126-96	N	N	N	N	N	N	N	N	N	N	C	1276	103.7	102.7	G
126-120	N	N	N	N	N	N	N	N	T	N	C	1010	103.1	103.1	M
126-90	N	N	N	N	N	N	N	N	N	N	R	1050	103.9	102.2	A
126-27	N	N	N	N	N	N	N	N	N	N	R	1288	102.6	102.3	G
126-134	N	N	N	N	N	N	N	N	N	N	B	1150	103.5	102	G
126-166	N	N	N	N	N	N	N	N	N	N	C	1406	102.9	102.4	G
126-164	N	N	N	N	N	N	N	N	T	N	B	1286	105.3	105.1	G
126-28	N	N	N	N	N	N	N	N	N	N	C	1332	104.4	102.9	M
126-86											R	1342	105	103.4	G
126-187											C	1282	104	104	G
126-103	N	N	N	N	N	N	N	N	N	N	R	1404	103	103.1	G
126-15	N	N	N	N	N	N	N	N	N	N	R	1204	102.8	102.8	G

TN-1 = Day 1 trenbolone; TN-3 = Day 3 trenbolone; T-1 = Day 1 testosterone; T-3 = Day 3 testosterone; TA-1 = Day 1 trenbolone acetate; TA-3 = Day 3 trenbolone acetate; P-1 = Day 1 progesterone; P-3 = Day 3 progesterone; E-1 = Day 1 estradiol 17β; E-3 = Day 3 estradiol 17β; N = not detected; T = detected-not quantified; Class = buller (B), rider (R), control (C); WT = body weight (lb); (TP-1 = Day 1 rectal temperature; TP-3 = Day 3 rectal temperature; IC = implant condition; M = missing implant; A = abscessed implant; G = good implant; R = rider; B = buller; C = control.

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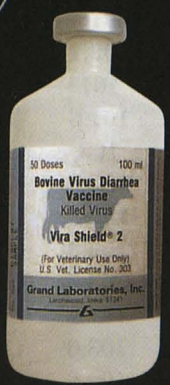

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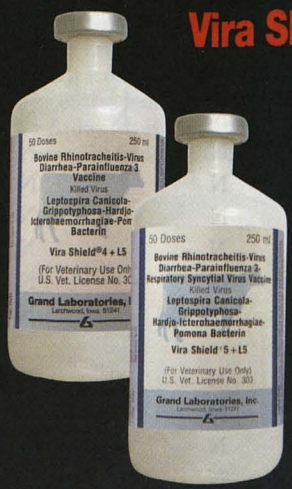
Vira Shield 3 gives the best defense possible against IBR as well as both Type 1 and Type 2 BVD.

Vira Shield® 4

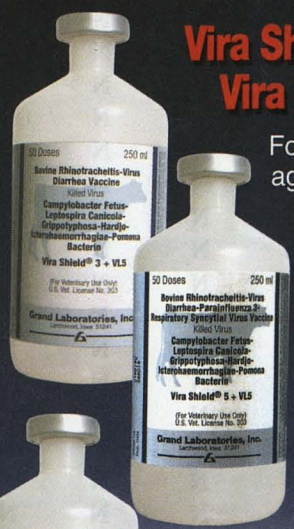
Vira Shield 4 provides the "base" coverage that most cattlemen request, with antigens against IBR, PI_3, and both Type 1 and Type 2 BVD.



Vira Shield® 4+L5
Vira Shield® 5+L5

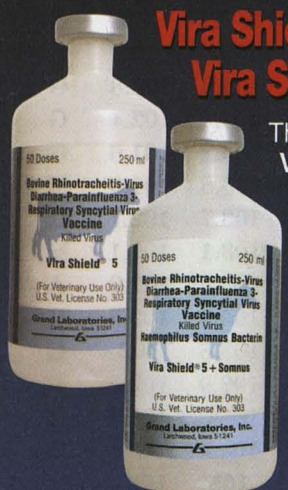
Vira Shield 4 + L5 or
Vira Shield 5 + L5 give the best in respiratory/reproductive combinations.

Vira Shield® 4 + L5 incorporates five strains of *Leptospira (L. canicola, L. grippotyphosa, L. hardjo, L. icterohaemorrhagiae* and *L. pomona)* along with IBR, PI_3 and both Type 1 and Type 2 BVD antigens. Vira Shield 5 + L5 adds in BRSV.



Vira Shield® 3+VL5
Vira Shield® 5+VL5

For those concerned with protection against Vibriosis *(Campylobacter fetus),* **Vira Shield 3+VL5** and **Vira Shield 5+VL5** provide coverage for both Type 1 and Type 2 BVD, IBR, *Campylobacter fetus* and five strains of *Leptospira.* Vira Shield 5+VL5 also includes PI_3 and BRSV.

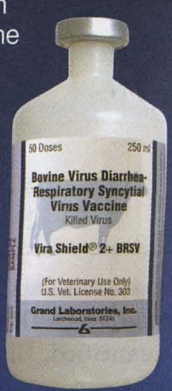


Vira Shield® 5
Vira Shield® 5+Somnus

The leading seller year after year is **Vira Shield 5.**

It provides broad-spectrum protection for the most common respiratory diseases — IBR, PI_3, and BRSV as well as both Type 1 and Type 2 BVD.

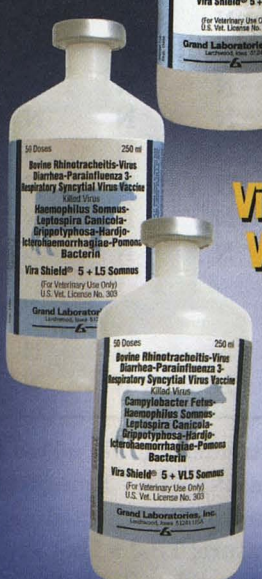
Vira Shield 5 + Somnus provides broad-spectrum protection by adding *H. somnus* to the IBR, PI_3, BRSV and BVD combination.



Vira Shield® 2+BRSV

Vira Shield 2+BRSV is the ideal companion vaccine to an intranasal IBR-PI_3 vaccine, since it provides both Type 1 and Type 2 BVD along with BRSV.

NEW!



Vira Shield® 5+L5 Somnus
Vira Shield® 5+VL5 Somnus

For those wanting the most comprehensive coverage available, **Vira Shield 5+L5 Somnus** includes BVD, IBR, PI_3, BRSV, five strains of *Leptospira* and *H. somnus.*

Vira Shield 5+VL5 Somnus incorporates *Campylobacter (Vibrio) Fetus* in addition to the above.

Grand Laboratories
Larchwood, Iowa 51241
www.grandlab.com

For more information contact Grand Laboratories at

800-843-3386

Our Vira Shield Products Require ONLY ONE Booster Dose Annually!