Kansas Agricultural Experiment Station Research Reports

Volume 0
Issue 1 *Cattleman's Day (1993-2014)*

Article 212

2004

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Recommended Citation

Montgomery, Sean P.; Sindt, J.J.; Greenquist, M.A.; Miller, W.F.; Pike, J.N.; Good, E.J.; Loe, E.R.; Sulpizio, M.J.; Kessen, T.J.; and Drouillard, James S. (2004) "Plasma metabolites of receiving heifers and the relationship between bovine respiratory disease, weight gain, and carcass characteristics (2004)," *Kansas Agricultural Experiment Station Research Reports*: Vol. 0: Iss. 1. https://doi.org/10.4148/2378-5977.1615

Plasma metabolites of receiving heifers and the relationship between bovine respiratory disease, weight gain, and carcass characteristics (2004)

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PLASMA METABOLITES OF RECEIVING HEIFERS AND THE RELATIONSHIP BETWEEN BOVINE RESPIRATORY DISEASE, WEIGHT GAIN, AND CARCASS CHARACTERISTICS

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Summary

Six hundred sixty-five crossbred beef heifers initially weighing 495 lb were used to evaluate rectal temperature and plasma glucose, lactate, and urea nitrogen at initial processing as indicators of health status of newly arrived receiving cattle. We also evaluated the relationship between bovine respiratory disease (BRD), weight gain, and carcass characteristics. An increased number of treatments for BRD was associated with lower (linear, $P<0.01$) plasma glucose and lactate concentrations at initial processing. Elevated rectal temperatures at initial processing were associated with a greater number of treatments for BRD (linear, $P<0.03$). Initial body weight, final body weight, and average daily gain during the receiving period were progressively less (linear, $P<0.01$) as the number of treatments for BRD increased, whereas grazing-period gain was progressively greater with more frequent treatment for BRD during the receiving period (linear, $P<0.01$). Finishing-period gain, final body weight, hot carcass weight, fat thickness, and marbling score were linearly decreased ($P<0.05$) with increased treatment for BRD during the receiving period. These data suggest that initial plasma glucose and lactate concentrations might be associated with the health of newly arrived receiving cattle and that increased incidence of BRD in cattle is associated with lower weight gain and carcass quality.

Introduction

Bovine respiratory disease (BRD) continues to be a significant problem in receiving cattle. Stress associated with weaning, transport, commingling, processing, as well as feed and water deprivation, can compromise the immune system, thereby predisposing cattle to outbreaks of BRD. Antibiotic therapy is commonly employed to decrease the immediate impact of BRD on cattle performance; little is known, however, about the implications of BRD for subsequent growth performance and carcass values.

Current methods of BRD detection in receiving cattle consist of measuring rectal temperature and(or) visual appraisal of clinical symptoms. These methods are subjective and often lack the sensitivity necessary to detect BRD in its early stages of development. We theorized that the previously-mentioned stressors might affect plasma metabolites such as glucose, lactate, and urea nitrogen in newly arrived receiving cattle. The objectives of our study were to evaluate the association between rectal temperature, plasma glucose, lactate, and urea nitrogen measured at initial processing, and the incidence of BRD in newly arrived receiving cattle, as well as to evaluate the impact of BRD on subsequent growth performance and carcass characteristics of cattle.

Experimental Procedures

A total of 665 crossbred beef heifers initially weighing 495 lb was used in a completely randomized design. Heifers were processed within 24 hours of arrival, and processing included vaccination against common viral and clostridial diseases (Bovishield® 4 and Fortress® 7), recording of rectal temperature, treatment for internal and external parasites (Phoenectin®), and sampling of blood via jugular venipuncture for analysis of plasma glucose, lactate, and urea nitrogen concentrations.

Immediately after initial processing, heifers were assigned randomly to 28 pens, which contained 21 to 27 heifers depending upon pen size. Heifers were offered a diet containing 44% steam-flaked corn, 45% alfalfa hay, 6% corn steep liquor, 3.8% soybean meal, and 1.2% vitamins and minerals for ad libitum consumption. Heifers were subsequently monitored for clinical signs of BRD, including depression, lethargy, anorexia, coughing, rapid breathing, and nasal or ocular discharge. Heifers exhibiting signs of BRD received antibiotic therapy consisting of Micotil® as a first-time and second-time treatment for BRD, and Liquamycin® LA-200® and dexamethasone as a third-time treatment for BRD. The number of times a heifer was treated for BRD ranged between zero and three. After the 36-day receiving period, heifers were weighed, and six heifers identified as moribund were removed. The remaining heifers were implanted with Synovex C® and transported to native grass pastures for a 136-day grazing period. At the end of the grazing season, cattle were transported to a commercial feedyard, where they were implanted with Component TH® and offered a series of common diets for ad libitum consumption throughout a 124-day finishing period. At the end of the finishing period, heifers were transported to a commercial abattoir, where carcass data were collected. Final body weight was calculated by dividing hot-carcass weight by a common dressing percentage of 63.5%. These adjusted final weights were used to compute daily gains for each group of heifers.

Results and Discussion

Plasma glucose and lactate concentrations at initial processing were greater ($P<0.01$) for heifers not treated for BRD than for heifers subsequently treated for BRD, and they became increasingly lower (linear, $P<0.01$) as the number of times heifers were treated for BRD increased (Table 1). Heifers subsequently treated for BRD had lower initial plasma glucose and lactate concentrations, suggesting that their energy stores might have been less than that of healthy heifers, thereby possibly preventing them from mounting an effective immune response. Rectal temperature at initial processing increased (linear, $P<0.03$) with the number of times heifers were subsequently treated for BRD, although the range among group averages was only 0.23°F. Initial plasma glucose and lactate concentrations were negatively correlated with morbidity ($r = -0.20$, $P<0.01$ for glucose, and $r = -0.14$, $P<0.01$ for lactate; Table 2), indicating that, as initial plasma glucose and lactate concentrations increased, subsequent morbidity decreased. Although rectal temperature at initial processing was not significantly correlated with morbidity ($r = 0.04$, $P>0.34$), it was positively correlated with death loss ($r = 0.12$, $P<0.01$).

An increased number of treatments for BRD during the receiving period was linearly related to lesser ($P<0.01$) initial body weight, final body weight, and daily gains during the receiving period (Table 3), suggesting that lighter heifers were more susceptible to BRD infection and that BRD decreased weight gain during the receiving period. Grazing-period daily gains (Table 3) were linearly increased ($P<0.01$) with increased number of treatments for BRD, possibly as a result of less gastrointestinal tract fill at the start of the grazing period because of reduced feed intake during the

receiving period. Finishing-period gain, final body weight (Table 3), hot-carcass weight, fat thickness, and marbling score (Table 4) were decreased linearly (P<0.05) with increased number of treatments for BRD during the receiving period. The percentage of USDA Yield Grade 1 carcasses increased linearly (P<0.04) with increased number of treatments for BRD, whereas the percentage of USDA Yield Grade 3 carcasses decreased (quadratic, P<0.04). Because all heifers were marketed on a pen basis, the effect of BRD on USDA Yield Grade 3 carcasses was the result of delaying the marketing of healthier heifers to allow heifers previously treated for BRD to reach a marketable endpoint. Marketing healthier cattle earlier might avoid possible discounts from less favorable USDA Yield Grades. Total weight gain during the entire 296-day experiment was linearly decreased (P<0.04) with increased number of treatments for BRD during the receiving period, demonstrating the long-lasting effects that BRD infection can have on subsequent cattle weight gain.

These data suggest that initial plasma glucose and lactate concentrations are correlated with the health status of newly arrived receiving cattle; because of their great variability, however, glucose and lactate concentrations were not very efficacious in identifying individual cattle at risk for BRD infection. These data also indicate that increased incidence of BRD in cattle decreases growth rate and carcass quality.

Table 1. Plasma Glucose, Lactate, and Urea Nitrogen Concentrations and Rectal Temperatures of Heifers at Initial Processing

	Number of Times Treated for Respiratory Disease					Contrast[a]		
Item	0	1	2	3	SEM[b]	0 vs. T	Linear	Quadratic
No. of heifers	268	247	78	72	-	-	-	-
Glucose, m*M*	5.3	5.0	5.1	4.8	0.08	<0.01	<0.01	0.99
Lactate, m*M*	6.5	5.8	5.2	4.3	0.35	<0.01	<0.01	0.82
Urea N, m*M*	4.1	4.3	4.2	4.5	0.11	0.08	0.11	0.76
Rectal temp., ºF	102.48	102.50	102.71	102.71	0.085	0.06	0.03	0.92

[a]Contrasts: 0 vs T = heifers never treated for respiratory disease vs. treated heifers; Linear = linear effect of number of treatments for respiratory disease; Quadratic = quadratic effect of number of treatments for respiratory disease.
[b]Average SEM among groups of heifers.

Table 2. Coefficients of Correlation (r) Among Plasma Metabolites, Rectal Temperature, and Morbidity and Death Loss of Heifers During the Receiving Period

	Morbidity		Death Loss	
Item	r	P-value[a]	r	P-value[a]
Plasma glucose	-0.20	<0.01	-0.04	0.36
Plasma lactate	-0.14	0.01	-0.02	0.72
Plasma urea nitrogen	0.06	0.11	0.03	0.61
Rectal temperature	0.04	0.34	0.12	0.01

[a]P-values less then 0.05 indicate significant linear relationships between the variable and either morbidity or death loss.

Table 3. Effects of Bovine Respiratory Disease on Growth and Death Loss of Heifers During a Receiving Period and Subsequent Grazing and Finishing Periods

	Number of Times Treated for Respiratory Disease					Contrast[a]		
Item	0	1	2	3	SEM[b]	0 vs. T	Linear	Quadratic
Receiving period								
No. of heifers	268	247	78	72	-	-	-	-
Initial wt, lb	504	491	485	479	4.7	<0.01	0.01	0.47
Final wt, lb	610	589	564	538	6.0	<0.01	<0.01	0.71
Daily gain, lb	3.10	2.86	2.25	1.70	0.096	<0.01	<0.01	0.13
Death loss, %	0.38	0.40	2.53	4.00	0.90	0.03	0.01	0.44
Grazing period								
No. of heifers	268	244	76	65	-	-	-	-
Initial wt, lb	610	591	564	547	6.0	<0.01	<0.01	0.84
Final wt, lb	729	725	710	702	6.5	0.01	0.01	0.76
Daily gain, lb	0.88	0.99	1.07	1.14	0.029	<0.01	<0.01	0.55
Finishing period								
No. of heifers	267	244	76	65	-	-	-	-
Initial wt, lb	729	725	710	702	6.5	0.01	0.01	0.76
Final wt, lb[c]	1225	1210	1184	1174	11.5	0.01	0.01	0.87
Daily gain, lb	4.00	3.91	3.80	3.80	0.066	0.02	0.03	0.51
Total								
No. of heifers	267	244	76	65	-	-	-	-
Daily gain, lb	2.44	2.44	2.38	2.35	0.033	0.06	0.04	0.92

[a]Contrasts: 0 vs T = heifers never treated for respiratory disease vs. treated heifers; Linear = linear effect of number of treatments for respiratory disease; Quadratic = quadratic effect of number of treatments for respiratory disease.
[b]Average SEM among groups of heifers.
[c]Calculated by dividing hot-carcass weight by a common dressing percentage of 63.5%.

Table 4. Effects of Bovine Respiratory Disease on Carcass Characteristics of Heifers

	Number of Times Treated for Respiratory Disease					Contrast[a]		
Item	0	1	2	3	SEM[b]	0 vs. T	Linear	Quadratic
Hot carcass wt, lb	778	769	752	746	7.3	0.01	0.01	0.87
Fat thickness, inches	0.53	0.47	0.45	0.41	0.019	0.01	0.01	0.56
Kidney, pelvic, and heart fat, %	1.8	1.8	1.8	1.8	0.03	0.73	0.88	0.77
Longissimus muscle area, sq. inch	14.4	14.4	14.1	14.0	0.18	0.13	0.06	0.74
Marbling score[c]	298	312	296	277	7.8	0.69	0.04	0.05
USDA Prime, %	1.6	2.5	2.7	0.0	1.3	0.88	0.46	0.17
USDA Choice, %	44.2	48.5	38.7	34.9	4.6	0.43	0.09	0.40
USDA Select, %	48.8	43.0	56.0	57.1	4.6	0.46	0.09	0.48
USDA Standard, %	5.4	6.0	2.6	8.0	2.0	0.87	0.85	0.57
USDA Yield Grade 1, %	9.3	14.3	10.7	20.6	3.0	0.04	0.04	0.44
USDA Yield Grade 2, %	35.7	32.9	37.3	39.7	4.4	0.82	0.44	0.59
USDA Yield Grade 3, %	35.7	42.0	44.0	28.6	4.5	0.57	0.38	0.03
USDA Yield Grade 4 & 5, %	19.3	10.8	8.0	11.1	3.0	0.06	0.27	0.24
Dark cutters, %	0.8	0.0	0.0	1.6	0.63	0.69	0.43	0.08
Liver abscesses, %	5.4	5.1	4.0	6.3	2.0	0.89	0.87	0.53

[a]Contrasts: 0 vs T = heifers never treated for respiratory disease vs. treated heifers; Linear = linear effect of number of treatments for respiratory disease; Quadratic = quadratic effect of number of treatments for respiratory disease.
[b]Average SEM among groups of heifers.
[c]250 to 300 = Select^{+}, 301 to 350 = Choice.