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Comparison of ivermectin and extended-release eprinomectin deworming treatment on stocker and subsequent feedlot performance and carcass characteristics of fall-born Angus heifers

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Abstract

The effect of deworming beef heifers with either ivermectin or extended-release eprinomectin on performance and carcass characteristics of stocker and feedlot cattle was assessed. Sixty Angus heifers (610 ± 50 lb initial body weight; 277 ± 23 kg) were blocked by body condition score and body weight, and allotted to 1 of 2 injectable deworming treatments after grazing summer pasture for 35 days: 1) ivermectin (IVM) or 2) extended-release eprinomectin (ERE). After 63 days grazing, heifers were placed in a feedlot and fed a finishing ration for 150 days. Heifers were stratified by BW within grazing treatment and allotted to receive ivermectin (dewormed; DWRM) or no treatment during processing (NO) at feedlot entry. Although fecal egg counts did not differ at treatment initiation, egg counts were greater in the IVM group (5.138 eggs per gram) than in the ERE group (0.073 EPG) at the end of the grazing period ($P < 0.01$). Heifers in the ERE group had greater average daily gain and greater body weight change ($P = 0.01$) during the grazing period. There were no differences in feedlot performance or carcass characteristics ($P \geq 0.09$) between treatment groups. Based on this study, there may be no benefit to deworming at feedlot arrival when cattle are effectively managed to minimize internal parasite infection during the grazing period. However, even at extremely low levels of infection during grazing, parasites can significantly impact performance.

Key words: cattle, fecal egg count, grazing, ostertagia, parasite, deworming

Résumé

L'effet du déparasitage de taures de boucherie avec soit de l'ivermectine ou soit de l'éprinomectine avec libération prolongée sur la performance et les caractéristiques de la carcasse a été examiné chez des bovins en parc d'engraissement. Un total de 60 taures Angus (610 ± 50 lb masse corporelle initiale; 277 ± 23 kg) ont été stratifiées selon l'indice de condition corporelle et la masse corporelle et allouées à l'un des deux traitements de déparasitage suivants après une période de 35 en pâturage estival: 1) ivermectine (IVM), 2) éprinomectine à libération prolongée (ERE). Après 63 jours au pâturage, les taures ont été placées dans le parc et nourries avec une ration de finition pendant 150 jours. Les taures ont été stratifiées selon la masse corporelle à l'intérieur de chaque traitement au pâturage et ont reçu de l'ivermectine (déparasité) ou aucun traitement à leur entrée dans le parc. Les comptes d'œufs dans les fèces n'étaient pas différents au début du traitement mais étaient plus élevés dans le groupe IVM (5.138 œufs par g) que dans le groupe ERE (0.073 œufs par g) à la fin de la période au pâturage ($P < 0.01$). Durant cette période, les taures dans le groupe ERE avaient un gain moyen quotidien plus élevé et un plus grand changement de masse corporelle ($P = 0.01$). Il n'y avait pas de différence entre les deux traitements au niveau de la performance au parc ou des caractéristiques de la carcasse ($P \geq 0.09$). Selon cette étude, le déparasitage à l'entrée au parc ne serait pas bénéfique si les bovins avaient déjà reçu un traitement efficace pour minimiser l'infection par les parasites internes au pâturage. Toutefois, même à des niveaux d'infection très peu élevés au pâturage, les parasites peuvent avoir un impact important sur la performance.

Introduction

Internal parasite infections of cattle are often associated with decreased growth, anorexia, diarrhea, and weight loss. Ostertagia infections may cause immunosuppression and increased levels of circulating stress hormones, potentially impairing host health and productivity.[4] Cattle on pasture are exposed to many parasites, and appropriate deworming strategies can be used to treat, control, and prevent gastrointestinal nematode infections. It is widely recognized that strategic deworming cow-calf and stocker cattle on pasture can improve performance, resulting in greater body weight (BW) and improved body condition. Compared to untreated controls, beef calves on pasture treated for internal parasites had greater BW gain, average daily gain (ADG), and weaning weight.[11] Strategic deworming of beef cow-calf herds on pasture may improve performance, even in the absence of clinical disease associated with severe parasite infections.[11]

Cattle are typically dewormed within a few days of feedlot arrival and have minimal chance of reinfection in a feedlot environment. As a result, a single deworming at feedlot arrival is generally effective at ridding cattle internal parasites and optimizing feedlot performance. In an earlier report, naturally infected feedlot heifers treated for internal parasites at initial processing had 4% greater ADG than non-treated counterparts during the feeding period.[12] It has also been reported that unexposed or non-infected cattle gained more than their infected-control and infected-medicated cohorts, suggesting that prevention of nematode infections of feeder cattle may be the best means of avoiding associated production loss during the feeding phase.[1] Furthermore, a 2007 report described that of available pharmaceutical technologies, anthelmintics had the largest estimated impact on production efficiency and cost of production.[7]

Extended-release eprinomectin was approved in 2012, and the product label describes persistent parasite control for 100 to 150 days following a single subcutaneous injection. In contrast, the label for injectable ivermectin states there is effective control to prevent reinfection with gastrointestinal nematodes for 14 to 21 days following treatment, depending on the specific parasite. The objective of this study was to compare the relative effects of injectable ivermectin and extended-release eprinomectin on stocker gain, feedlot performance, and carcass characteristics. It was hypothesized that extended-release eprinomectin would minimize the internal parasite burden of grazing cattle, improve stocker performance, and eliminate the need for deworming at feedlot arrival when administered less than 100 days prior to feedlot entry.

Materials and Methods

Stocker Phase

Sixty purebred, fall-born Angus heifers were obtained from the Iowa State University Angus herd housed at the McNay Research Farm near Chariton, IA. Heifers were born in the fall of 2012, early-weaned at approximately 120 days of age, and dewormed with ivermectin prior to transport to the Armstrong Research Farm. They arrived at the Armstrong Research Farm on February 13, 2013 where they were housed in a dry-lot until turn-out on pasture. Heifers were then turned-out on pasture and grazed for 35 days to allow exposure to parasites prior to initiation of the study.

Following the 35-day grazing period to allow natural parasite infection, the heifers were weighed (610 ± 50 lb; 277 ± 23 kg) and scored for body condition (BCS 4.90 ± 0.34). Study heifers were blocked by BCS, stratified by BW within BCS, and allotted to 1 of 2 injectable deworming treatments: 1) ivermectin[a] (IVM) or 2) extended-release eprinomectin[b] (ERE). Anthelmintic solutions were administered according to label dosages, 90.7 mcg of ivermectin/lb (200 mg/kg) and 0.45 mg eprinomectin/lb (1 mg/kg) or 1 ml/110 lb (50 kg) for each. Injection volumes were based on individual animal weight and were approximated based on 1 ml/110 lb as typically done in most working livestock operations. Products were administered subcutaneously in the neck according to BQA guidelines. Fecal samples were collected and submitted for quantitative fecal analysis using the Modified Wisconsin Sugar Flotation technique.[2]

Heifers were commingled and placed back on the same pasture at the Armstrong Research Farm during the stocker phase until the pasture was no longer suitable for grazing (total of 63 days). The pasture (~37 acres (15 hectares)) consisted primarily of smooth brome grass and alfalfa. The pasture was divided into 2 paddocks and cattle were rotated at the discretion of the cattle manager. Early-season rainfall was abundant, but drought conditions developed later and it was unusually dry during much of the grazing season. Interim BW and BCS were taken 27 days after treatment initiation. At the end of the stocker phase, fecal samples were collected, cattle were weighed, and body condition was scored.

Feedlot Phase

At conclusion of the stocker phase, heifers were transported to a feedlot where they remained commingled and were fed a finishing ration for 150 days. Upon feedlot arrival, heifers were stratified by BW within stocker phase treatment (IVM or ERE), and allotted to receive either a standard injectable deworming treatment during processing (ivermectin; DWRM), or no deworming treatment (NO). The ration consisted primarily of alfalfa/grass hay, dry corn, and a commercial pelleted protein supplement that contained melengestrol acetate[c] and lasalocid[d]. Cattle were fed once daily, and bunks were managed to be slick (either no feed or just crumbs remaining) just prior to feeding each day. Cattle were transitioned from a low-energy diet to a high-energy diet according to the feedlot's standard protocol. The final finishing diet was a 75% concentrate ration (NEg 0.58 Mcal/lb (1.28 Mcal/kg)) with 12% crude protein. Fecal samples were collected 4 days prior to transport to the packing house to determine final FEC. Preprandial weights were collected on days -4 and -3 prior to transport for slaughter; body weights were averaged for the final BW. For analysis of dressing percent, a 4% shrink was applied to the average final BW. Carcass data were collect by Tri-County Steer Carcass Futurity personnel.

Statistical Analysis

The animal was the experimental unit. During the stocker phase, the model consisted of the main effect of treatment. During the feedlot phase, data were analyzed as a 2x2 factorial with the model consisting of the main effects of stocker phase parasite treatment, feedlot phase parasite treatment, and the appropriate interaction. Throughout the analysis, binary and continuous data were analyzed using the GLIMMIX and MIXED procedures of SAS[e], respectively. Differences were considered to be significant when $P \leq 0.05$, and a tendency when $P > 0.05$ and ≤ 0.10.

Results and Discussion

Starting BW and BCS did not differ between treatments during the stocker phase ($P \geq 0.67$; Table 1). Average daily gain, BW change, BCS, and change in BCS did not differ between treatments ($P > 0.05$) during the first 27 days of grazing (data not shown). However, over the duration of the 63 day stocker phase, ERE heifers gained more total BW (88 lb (40 kg) vs 76 lb (34.5 kg); $P = 0.01$) and had greater ADG (1.40 lb (0.64 kg) vs 1.21 lb (0.55 kg); $P = 0.01$) compared to heifers in the IVM group. The greater ADG observed in this study is consistent with recent findings by DeDonder et al where stocker steers treated with a single injection of extended-release eprinomectin had greater ADG than stocker steers that received a single injection of doramectin.[3]

The difference in total weight gain and ADG during the grazing period is likely due to either differences in efficacy or duration of action provided by ERE. At the end of the grazing period, fecal egg counts in the ERE group were lower than those in the IVM group. Although statistically different than the ERE heifers, the FEC in the IVM group ($P < 0.001$; Table 1) was numerically low (5.138 EPG of feces) at the end of the stocker phase. This highlights the potential for minimal gastrointestinal nematode burdens to negatively impact performance of stocker cattle.

Parasiticides in the avermectin family are commonly used in the US beef cattle industry. According to the National Animal Health Monitoring System (NAHMS) Beef Cow-Calf Survey (2007-2008), 87.5% of operations that dewormed cattle or calves at least occasionally, used an avermectin.[8] Based on the life cycle of internal parasites, repeated doses of dewormers are sometimes necessary to achieve the desired level of parasite control during the grazing season. Williams et al reported that treating weanling-yearling beef cattle with ivermectin 3 times during year-long grazing was more effective than a single ivermectin treatment or 2 treatments with ivermectin or fenbendazole.[13] Extended-release eprinomectin offers the convenience of extended protection with 1 treatment, thus requiring less labor and less animal handling.

Interestingly, the NAHMS Beef Cow-Calf Survey (2007-2008) found 53.7% and 54.1% of cattle operations with unweaned calves and weaned stocker calves, respectively, dewormed their calves at least 1 time/year. Furthermore 22.6% of operations dewormed unweaned calves more than 1 time/year, and 25.2% dewormed weaned stocker calves more than 1 time/year.[8] Data from the current study suggest that cow-calf and stocker operations could benefit from improved performance through the use of a long-acting dewormer vs a conventional short-acting dewormer.

Heifers in the current study were only allowed to graze 63 days because of limited forage availability. The extended-release eprinomectin label describes that effective plasma levels persist for at least 100 days following treatment, and that there is an increase in plasma levels of eprinomectin at approximately 80 to 90 days post-injection. It is possible that IVM heifers could have acquired a greater parasite burden if climatic conditions had favored a longer grazing season, while ERE heifers could have been protected from reinfection for approximately 100 days post-injection. It is hypothesized that a longer grazing season would have resulted in a more significant difference in final FEC, and potentially an even greater difference in ADG.

Because of the 80 to 90 day post-injection release of eprinomectin mentioned above, heifers in the ERE-DWRM group would have experienced elevated plasma levels of eprinomectin again, approximately 20 to 25 days after

Table 1. Growth performance and fecal egg counts of fall-born Angus heifers grazing spring and summer pasture in SW Iowa after treatment with ivermectin (IVM) or extended release eprinomectin (ERE) injectable dewormer.*

	Treatment†			
Item	IVM	ERE	SEM‡	*P*-value
Body weight, lb				
Start	610	610	9.1	0.96
Final	686	698	9.9	0.38
Change	76	88	3.2	0.01
ADG, lb	1.21	1.40	0.05	0.01
BCS§				
Start	5.17	5.12	0.07	0.67
Final	4.92	4.90	0.06	0.80
Change	-0.24	-0.22	0.07	0.82
Fecal egg count, eggs/g				
Treatment initiation	0.897	0.629	0.413	0.65
End of grazing period	5.138	0.073	0.426	< 0.001
Change	4.229	-0.550	0.456	< 0.001

*Heifers were allowed 35 days on pasture to allow exposure to parasites prior to initiation of the study. The stocker period lasted 63 days.

†IVM = ivermectin injectable (Ivomec® 1% Injection, Merial, Duluth, GA); ERE = extended-release eprinomectin (LONGRANGE™, Merial, Duluth, GA)

‡n = 30/treatment

§BCS = body condition score measured on 1-9 scale (1 = emaciated, 9 = obese); as described by Wagner JJ, Lusby KS, Oltjen JW, Rakestraw J. Wettemann RP, Walters LE, Carcass composition in mature Hereford cows: estimation and effect on daily metabolizable energy requirements during winter. *J Anim Sci* 1988;66:603-612.

feedlot entry and arrival-treatment with ivermectin. Thus the ERE-DWRM heifers were essentially dewormed twice at feedlot entry.

Although stocker gain was improved in heifers in the ERE treatment group, they did not have increased ADG in the feedlot compared to heifers in the IVM group. At the end of the feeding period there were no differences in feedlot performance or carcass traits between stocker phase or feedlot phase treatment groups ($P \geq 0.10$; Table 2); additionally there were no interactions between the main effects ($P \geq 0.09$; Table 2).

Although FEC in IVM heifers was significantly higher than the FEC in ERE heifers at the end of the grazing period, the FEC in the IVM heifers was quite low. Fecal egg counts in cattle at the end of the feeding period were nearly undetectable, and did not differ between treatment groups (Table 2). It is hypothesized that the FEC at the end of the grazing period of this study (< 6 EPG) was not reflective of worm burdens severe enough to have detrimental effects on gain during the feedlot phase of production. In contrast, a low worm burden (based on FEC) in the current study led to a significant reduction in stocker gain. If climatic conditions had been more favorable for an extended grazing period, IVM heifers may have had an even greater FEC at feedlot arrival, which may or may not have caused differences in feedlot performance and carcass characteristics.

It is widely accepted that internal parasitism of feedlot cattle can reduce performance and impair immune function.[4,10] As such and because of a lack of treatment history, many feedlots routinely deworm cattle upon feedlot arrival. According to the NAHMS Beef Feedlot Survey (2011), greater than 80% of cattle placed in feedlots were processed as a group after feedlot arrival, regardless of feedlot size. Parasite treatment was 1 of the 2 most common management practices used during initial processing, and greater than 90% of large feedlots (over 1000 head) treated at least some cattle for parasites during initial processing.[9] Data from the present study brings into question the practice of routinely deworming cattle at feedlot arrival, especially for cattle that have been managed with a strategic parasite control program during the grazing phase of production. As described in the NAHMS survey, many feedlot operators still lack access to pre-arrival management information.[9] With improved pre-feedlot parasite management and with improved communication

Table 2. Feedlot performance and carcass characteristics of fall-born Angus heifers that were treated with a short- or long-lasting injectable dewormer prior to grazing on pasture for 63 days.

	Treatment*							
	IVM		ERE			*P*-value‡		
Item	NO	DWRM	NO	DWRM	SEM†	Stock	Feedlot	SxF
Final fecal egg count/g§	0.08	0.30	0.00	0.08	0.10	0.17	0.16	0.52
Body weight, lb								
Feedlot arrival	688	684	702	695	14.3	0.39	0.68	0.91
Feedlot exit	1163	1160	1175	1146	23.8	0.98	0.49	0.58
ADG, lb	3.17	3.17	3.16	3.01	0.10	0.38	0.47	0.43
HCW, lb	699	694	713	691	15.9	0.71	0.38	0.61
Dress, %	62.7	62.3	63.2	62.7	0.45	0.26	0.34	0.92
Backfat, in	0.5	0.49	0.51	0.53	0.03	0.37	0.86	0.51
KPH, %	2.27	2.30	2.30	2.47	0.06	0.10	0.10	0.27
Ribeye area, in^2	12.07	11.97	11.93	11.86	0.23	0.60	0.70	0.94
Yield grade	3.01	2.99	3.13	3.16	0.09	0.12	0.92	0.80
Marbling score‖	1206	1148	1176	1200	23.8	0.64	0.48	0.09
Quality grade¶	18.6	18.0	18.3	18.5	0.24	0.58	0.41	0.10
Choice or better, %	100	100	100	100		1.00	1.00	1.00
Certified Angus Beef, %	93.3	66.7	86.6	86.6		0.80	0.23	0.23
Prime, %	13.3	13.3	13.3	20.0		0.74	0.74	0.74

*IVM = treated with ivermectin injectable (Ivomec® 1% Injection, Merial, Duluth, GA) during stocker phase; ERE = treated with extended-release eprinomectin (LONGRANGE™, Merial, Duluth, GA) during stocker phase; NO = no deworming treatment at feedlot arrival processing; DWRM = dewormed with ivermectin injectable at feedlot arrival processing

† n = 15/treatment

‡*P*-values of main effects of stocker and feedlot treatment and stocker x feedlot interaction

§Fecal samples collected at the end of the feeding period

‖Marbling score: 1000 = small^0, 1100 = modest^0, 1200 = moderate^0

¶USDA quality grade: 17 = Choice$^-$, 18 = Choice^0, 19 = Choice$^+$

between feedlots and cattle sources, it may be possible to reduce unnecessary parasite treatments to arriving cattle.

It should be noted that there is growing concern worldwide about the development of parasite resistance to available anthelmintics. Although the degree and prevalence of anthelmintic resistance appears to be more severe in parasites of small ruminants, the problem exists and seems to be worsening in parasites that infect cattle.[6] Parasite control programs must be developed beyond the traditional to include strategic, appropriate, and judicious use of anthelmintics in conjunction with best pasture management practices, diagnostic testing (FEC), and other non-chemical approaches.[5,14] Long-term, continual release products such as extended-release eprinomectin can potentially increase selection pressure toward resistance and must be used appropriately to preserve efficacy.[14] Care must be taken to optimize the potential performance and economic benefits while preserving the long-term effectiveness of such products.

Conclusions

Based on results in this study, there may be no performance or carcass trait benefits to deworming at feedlot arrival if cattle have been effectively managed to reduce or eliminate internal parasite infection during the grazing period. However, even at surprisingly low levels of infection during the stocker phase, parasites can have a significant impact on weight gain. These data highlight the importance of parasite control during the stocker phase, even at subclinical levels of infection.

Endnotes

[a]Ivomec® 1% Injection for Cattle and Swine, Merial, Duluth, GA
[b]LONGRANGE™, Merial, Duluth, GA
[c]MGA®, Zoetis Animal Health, Florham Park, NJ
[d]Bovatec®, Zoetis Animal Health, Florham Park, NJ
[e]SAS, Version 9.3, SAS Institute Inc., Cary, NC

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References

1. Ames ER, Rubin R, Matsushima JK. Effects of gastrointestinal nematode parasites on performance in feedlot cattle. *J Anim Sci* 1969; 28:698-704.
2. Bliss DH, Kvasnicka WG. The fecal examination: a missing link in food animal practice. *Compend Cont Ed Pract Vet (Beef Production Management)* 1997; 104-109.
3. DeDonder KD, Rezac, DJ, Lechtenberg K, Parimi S, Singu V. Comparison of the effects of LONGRANGE™ and DECTOMAX™ on grazing performance and parasite burden in stocker cattle. *Intern J Appl Res Vet Med* 2015; 13:150-157.
4. Gasbarre LC. Effects of gastrointestinal nematode infection on the ruminant immune system. *Vet Parasitol* 1997; 72:327-343. doi:10.1016/S0304-4017(97)00104-0.
5. Kaplan RM. Recommendations for control of gastrointestinal nematode parasites in small ruminants: These ain't your father's parasites. *Bov Pract* 2013; 47:97-109.
6. Kaplan RM, Vidyashankar AN. An inconvenient truth: global worming and anthelmintic resistance. *Vet Parasitol* 2012; 186:70-78.
7. Lawrence JD, Ibarburu MA. Economic analysis of pharmaceutical technologies in modern beef production. NCCC-134 meeting on Applied Commodity Price Analysis, Forecasting, and Market Risk Management, Chicago, IL. 2007. Available at: http://ageconsearch.umn.edu/bitstream/37560/2/confp05-07.pdf. Accessed: March 14, 2014.
8. NAHMS. 2007-08. Part IV: Reference of beef cow-calf management practices in the United States, 2007-08. Available at: http://www.aphis.usda.gov/animal_health/nahms/beefcowcalf/downloads/beef0708/Beef0708_dr_PartIV.pdf. Accessed: March 14, 2014.
9. NAHMS. 2011. Part III: Trends in health and management practices on US feedlots, 1994-2011. Available at: http://www.aphis.usda.gov/animal_health/nahms/feedlot/downloads/feedlot2011/Feed11_dr_Part%20III.pdf. Accessed: March 14, 2014.
10. Smith RA, Rogers KC, Huse S, Wray MI, Brandt Jr. RT, Hutcheson JP, Nichols WT, Taylor RF, Rains JR, McCauley CT. Pasture deworming and (or) subsequent feedlot deworming with fenbendazole. I. Effects on grazing performance, feedlot performance and carcass traits of yearling steers. *Bov Pract* 2000; 34:104-114.
11. Stromberg, BE, Vatthauer RJ, Schlotthauer JC, Myers GH, Haggard DL, King VL, Hanke H. Production responses following strategic parasite control in a beef cow/calf herd. *Vet Parasitol* 1997; 68:315-322. doi:10.1016/S0304-4017(96)01081-3.
12. Utley PR, Stewart TB, Ciordia H, McCormick WC. Effect of anthelmintic treatment on feedlot performance of growing and finishing heifers. *J Anim Sci* 1974; 38:984-990.
13. Williams JC, Knox JW, Marbury KS, Swalley RA, Willis RE. Three treatments with ivermectin in year-long control of gastrointestinal nematode parasites of weaner-yearling beef cattle. *Vet Parasitol* 1989; 33:265-281.
14. Yazwinski TA, Tucker CA, Powell J, Jones L, Wray E. Considerations for control of helminths in stocker cattle. *Bov Pract* 2013; 47:110-119.