aJava

Asian Journal of Animal and Veterinary Advances

Academic
Journals Inc.

www.academicjournals.com

Asian Journal of Animal and Veterinary Advances 9 (5): 312-320, 2014
ISSN 1683-9919 / DOI: 10.3923/ajava.2014.312.320

Effect of Zilpaterol Hydrochloride on Feedlot Performance and Carcass Characteristics in Weaner Steers

[1]C.W. Mantiziba, [2]K.J. Leeuw, [2]P.E. Strydom and [1]O. Acheampong-Boateng
[1]Department of Agriculture and Animal Health, College of Agriculture and Environmental Sciences, University of South Africa, Florida 1710, Johannesburg, South Africa
[2]Agricultural Research Council, Animal Production Institute, Private Bag X2, Irene, 0062, South Africa

Corresponding Author: O. Acheampong-Boateng, Department of Agriculture and Animal Health, College of Agriculture and Environmental Sciences, University of South Africa, Private Bag X6, Florida 1710, Johannesburg, South Africa

ABSTRACT

An experiment was conducted using forty one Bonsmara steers (age ± 7 months) to determine the effect of Zilpaterol Hydrochloride (ZH) on the growth performance and carcass characteristics. The trial was structured using a completely randomized design with two treatments, control and ZH group. The steers were fed ZH for 28 consecutive days at the end of the finishing period and ZH was withdrawn from the diet 2 days prior to slaughter of the animals. The steers were placed in individual pens and weighed every fortnightly throughout the 4 months trial. Zilpaterol Hydrochloride (ZH) was included in the diet at a rate of 8.3 mg kg^{-1} of DM. Feeding of ZH increased ($p<0.05$) Body Weight (BW) gain and ADG (1.102 vs. 1.444) and tended to increase ($p = 0.067$) feed efficiency (F:G) during the last month of the finishing period. There were no significant differences ($p>0.05$) in daily Dry Matter Intakes (DMI). For the control group, high treatment weight gains were significantly associated with high initial weight ($r = 0.424$, $p = 0.049$) and also high pre-treatment body weight ($r = 0.678$, $p= 0.001$). Treatment weight gain increased as the initial and pre-treatment weight gain increased in the control group. For the steers that were fed ZH, there was no significant correlation between the treatment body weight gain with initial weight ($r = 0.097$, $p = 0.694$) and also pre-treatment live weight ($r = 0.393$, $p = 0.096$). Supplementation of ZH significantly increased ($p<0.0001$) the dressing percentage (56.4% vs. 58.4%) and had no significant ($p>0.05$) effect on the carcass weight. Zilpaterol hydrochloride supplementation resulted in an increase in gross profit margins by 37.7%. The outcome of the study suggest that supplementation of ZH to the diet during the last month of the finishing period enhances growth performance and shows the repartitioning capacity of the feed additive as a beta-agonist.

Key words: B-adrenergic agonist, zilmax, growth performance, beef cattle, carcass characteristics

INTRODUCTION

Market cattle become inefficient during the last month of the finishing period, because they start depositing less muscle and more fat (Radunz, 2011). The use of growth promoting agents such as Beta Adrenergic Agonists (βAA) has been studied since the 1980s to improve growth performance, feed efficiency and final Body Weight (BW) (Ricks *et al*., 1984; Plascencia *et al*., 1999; Montgomery *et al*., 2009a, b). In addition to the improved cattle performance these βAA also increase the carcass weight, lean muscle and decrease fat deposition (Moloney *et al*., 1990; Chikhou *et al*., 1993; Hilton *et al*., 2009).

Zilpaterol Hydrochloride (ZH) is a βAA that has been made commercially available in Mexico, South Africa and the United States of America (USA) as Zilmax (MSD) for use in feedlot cattle during the last 20 to 40 days. Dietary inclusion of ZH in cattle results in an increase in Average Daily Gain (ADG), improved feed efficiency (G: F) (Montgomery *et al*., 2009a; Avendano-Reyes *et al*., 2006) increased hot carcass weight, dressing percentage (Montgomery *et al*., 2009a; Chikhou *et al*., 1993; Fiems *et al*., 1993) and Longissimus Muscle area (LM) area (Plascencia *et al*., 1999).

Although previous research studies conducted have shown other βAA such as cimaterol, clenbuterol, $L_{644,969}$ and ractopamine to increase growth performance and several carcass characteristics (Ricks *et al*., 1984; Moloney *et al*., 1990; Chikhou *et al*., 1993). There is still limited data on the effects of ZH and results are contradictory. Feeding of ZH has been recently linked to lameness and heat stress in feedlot cattle in the USA. These reports are contradictory to previous research studies where feeding of ZH has been shown not to affect morbidity in cattle fed in large commercial pens (Van Donkersgoed *et al*., 2011; Montgomery *et al*., 2009b). Therefore, more experiments need to be conducted on the effects of ZH feeding in order to determine potential reasons for the inconsistent response. The objective of this study is to evaluate the effects of feeding ZH to Bonsmara weaner steers on growth performance and carcass characteristics.

MATERIALS AND METHODS

The study was conducted at the Agricultural Research Council-Animal Production Institute (ARC-API), cattle feedlot and abattoir in Irene, Gauteng Province, South Africa. Animal ethical approvals were obtained from the ARC-API and University of South Africa (UNISA) Animal Ethics Committee.

Animal management: Forty one Bonsmara steers (age±7 months, Mean BW±220 kg) were used for the experiment in 2012. For the first five days, the steers were maintained in holding pens with fresh water and fed hay *ad libitum*. The steers were subsequently processed on day five after arrival which included the following: Weighing, vaccination against botulism and anthrax (Botuthrax, MSD), clostridial organisms (Covexin, Coopers) and Infectious Bovine Rhinotracheitis (IBR) and other respiratory diseases (Bovishield Gold 5, Pfizer), deworming (Lintex-1, Bayer), treated for external parasites, eartaged, implanted with revalor S growth promoter (MSD). The steers were then placed in individual pens and weighed every two weeks throughout the four month trial. The steers were randomly allocated to the two treatments which consisted of ZH (22 steers) and control (without ZH) (19 steers).

Diets and treatments: During the first 18 days the steers were gradually adapted to a high concentrate diet (95%) using four transitional diets. The ingredient and nutrient composition of the final concentrate diet fed is shown in the Table 1. Zilpaterol hydrochloride was included in one of the treatment diets for 28 consecutive days from day 89 and was withdrawn from the diet two days prior to slaughter of the animals. Feed bunks were evaluated visually in the morning to determine the quantity of feed remaining from the previous day. Daily feed allotment to each pen was adjusted to allow (< 5%) feed accumulation in the feed bunk. Contaminants in feed bunks were

Table 1: Feed ingredients (%) and nutrient composition (g kg^{-1} DM unless stated otherwise) of the finishing diet[1]

Item	Control[2]	Zilpaterol[3]
Ingredient		
Hominy chop	62.00	62.00
Wheat bran	15.00	15.00
Molasses meal	10.00	10.00
Cotton OCM	5.00	5.00
Grass hay	4.50	4.50
Feedlime	1.60	1.60
Urea	1.30	1.30
Salt	0.50	0.50
Premix*	0.10	0.10
Zilpaterol HCl mg kg^{-1}	0.00	8.30
Nutrient composition (g kg^{-1} DM, unless states otherwise)		
Dry matter	873.30	873.30
Crude protein	149.20	149.20
Fat	63.40	63.40
NDF	444.80	444.80
Crude fibre	95.80	95.80
ME (MJ kg^{-1} DM)[4]	11.41	11.41
Starch	278.40	278.40
Calcium	7.30	7.30
P	5.20	5.20

[1]Finishing diet for the last 30 on feed, from start of Zilpaterol Hydrochloride (ZH) supplementation until slaughter, [2]Treatment without ZH in diet, [3]Treatment with ZH in diet, [4]Metabolizable energy, estimated from gross energy (NRC, 1996), *Containing : 6×106 IU vit A, 3 g vit B1, 3.5 g, 30 g iron, 12 g Cu, 50 g, Monensin included at 33 mg kg^{-1} feed

removed on a daily basis and orts were removed on a weekly basis. Feed refusal was measured and Dry Matter Intake was (DMI) calculated. Feed ration samples were taken to the ARC-API commercial laboratory for nutrient analysis.

Health observations: Animals were observed daily for signs of morbidity and other health conditions and recorded where applicable.

Slaughter and carcass evaluation: The cattle were slaughtered at the ARC abattoir. Hot Carcass Weights (HCW) were recorded on the day of slaughter. After the carcasses were chilled for 48 h, the Cold Carcass Weight (CCW) was measured. The dressing percentages were calculated.

Statistical analysis: The data were analyzed using (SPSS, 2012). Pearson correlation coefficients between initial and pre-treatment weights with pre-treatment and treatment weight gains were computed. Independent samples t-tests were used to assess differences between means of the control steers and steers fed ZH on various growth performance indicators. Differences were regarded as significant at $p<0.05$.

RESULTS

No incidences of mortality or morbidity were observed and special attention was made to observe for lameness, but no symptoms were observed.

Effect of initial weight on last 30 days weight gain is shown in Fig. 1 whilst the effect of pre-treatment weight on last 30 days weight gain is shown in Fig. 2. Steers fed ZH gained more weight than the control during the treatment period. For the control steers, Pearson correlation analysis showed that there was significant positive correlation ($r = 0.424$, $p = 0.049$) between the initial weight and treatment weight gain and between the pre-treatment weight and treatment weight gain ($r = 0.678$, $p = 0.001$) during the last 30 days of the finishing period. High treatment weight gains are significantly associated with high initial weight and with high pre-treatment weights. Treatment weight gain increased as the initial and pre-treatment weight

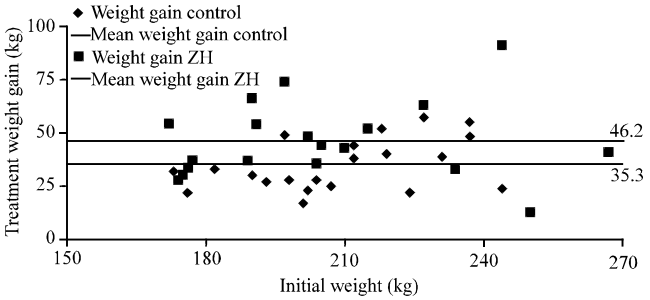

Fig. 1: Effect of initial weight on treatment weight gain during the last 30 days

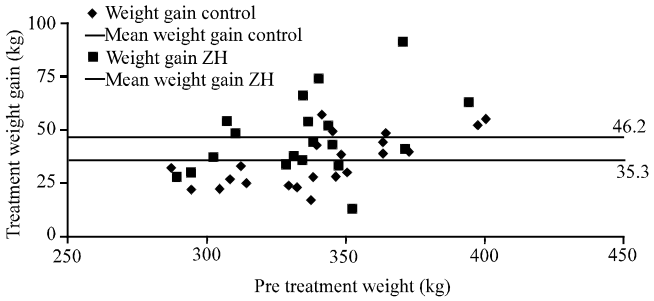

Fig. 2: Effect of pre-treatment weight on treatment weight gain during the last 30 days

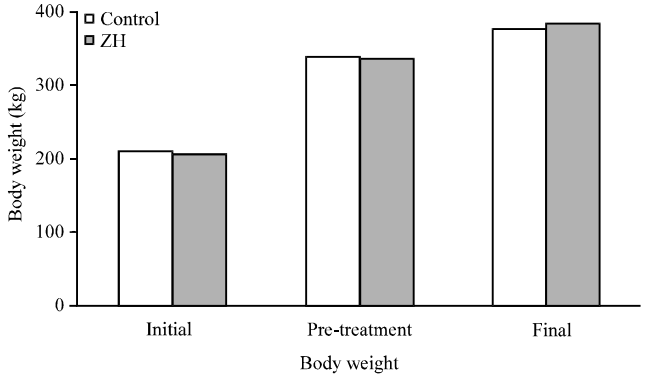

Fig. 3: Mean live body weight of the steers

gain increased in the control group. For the ZH group, treatment weight gains were not significantly associated with initial weight ($r = 0.097$, $p = 0.694$) and pre-treatment body weight ($r = 0.393$, $p = 0.096$).

The results of the effects of ZH on performance of the steers are presented in Table 2. There were no significant differences ($p>0.05$) on initial and pre-treatment live Body Weights (BW) between the control and ZH groups (Fig. 3). Zilpaterol hydrochloride supplementation had no significant ($p>0.05$) effect on the final BW of the steers (Fig. 3). No significant differences ($p>0.05$) on pre-treatment and overall BW gain were observed between the two groups (Fig. 4). Zilpaterol hydrochloride significantly ($p<0.05$) increased the live BW gain during the last 30 days of the finishing period (Fig. 4). Steers fed ZH had a significantly higher BW gain during the last 30 days of finishing period compared to the control steers ($p = 0.026$). The ZH group gained 10.9 kg more than the control group.

Supplementation of ZH to the feedlot steers significantly ($p<0.05$) influenced daily ADG (Fig. 5) and tended ($p = 0.067$) to improve feed to gain ratio (F: G) during the last 30 days of the finishing period. The mean ADG of the steers that were in the control group was 1.39 kg day^{-1} during the pre-treatment period and reduced to 1.102 kg day^{-1} during the last 30 days of fattening. However, the ADG of the steers fed ZH increased from

Table 2: Effect of Zilpaterol Hydrochloride (ZH) on feedlot cattle performance and carcass characteristics

Item	Control	ZH[1]	SEM	p-value
Number of steers	22	19		
Initial wt. (kg)	208.8	205.2	7.49	0.633
Pre-treatment wt. (kg)	340.1	335.0	8.92	0.568
Final wt. (kg)	375.4	381.2	12.03	0.632
BW gain (kg)				
Pre-treatment	131.3	129.8	6.90	0.826
Treatment	35.3	46.2	4.73	0.026*
Day 1-end	166.6	176.0	9.89	0.347
ADG (kg day^{-1})				
Pre-treatment	1.39	1.35	0.09	0.655
Treatment	1.10	1.44	0.15	0.026*
Day 1-end	1.32	1.38	0.09	0.580
DMI (kg day^{-1})				
Pre-treatment	6.568	6.471	0.30	0.747
Treatment	7.862	8.100	0.41	0.568
Day 1-end	6.876	6.853	0.31	0.942
F: G (kg kg^{-1})				
Pre-treatment	4.869	4.849	0.24	0.933
Treatment	7.693	6.354	0.71	0.067
Day 1-end	5.356	5.090	0.27	0.327
Warm carcass wt.	211.8	222.7	7.01	0.129
Cold carcass wt.	208.7	219.6	6.97	0.126
Dressing percentage	56.4	58.4	0.51	0.000*

*Means differ significantly at $p<0.05$, [1]ZH: Zilpaterol hydrochloride, BW: Body weight, ADG: Average daily gain, DMI: Daily dry matter intake, F:G: Feed to gain ratio, kg dry matter intake/kg gain, wt: Weight

1.352-1.444 kg day^{-1}. There were no significant differences ($p>0.05$) observed on the daily DMI for the two treatments throughout the whole trial.

Zilpaterol hydrochloride supplementation had no significant ($p>0.05$) influence on the warm and cold carcass weights but the carcasses of the treatment steers were 10.9 kg heavier than the control group (Fig. 6). The dressing percentage was significantly higher ($p<0.000$) for the steers fed ZH by 2% (Fig. 7). The effect of ZH supplementation resulted in an increase in gross profit margins by 37.7% (Table 3).

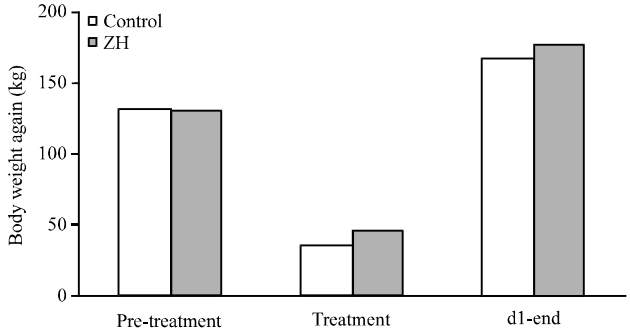

Fig. 4: Mean live body weight gains of the steers

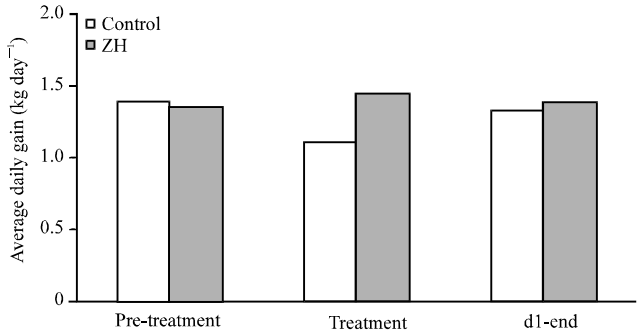

Fig. 5: Mean average daily gains of the steers

Table 3: Gross profit margins for cattle fed with or without ZH supplementation

Parameter	Control	ZH
Mean initial wt. (kg)	208.8	205.2
Mean final wt. (kg)	375.4	381.2
Initial liveweight value (R kg^{-1})	19.1	19.1
Mean purchase price (R)	3988.08	3919.32
No of days on feed	119	119
Mean DMI (kg day^{-1})	6.876	6.853
Total feed intake (kg)	818.244	815.507
Feed cost (R kg^{-1})	1.99	1.99
Total feed cost (R)	1628.31	1622.86
Zilpaterol cost (R)	0	56.7
Mean carcass wt. (kg)	208.7	219.6
Selling price of carcass (R kg^{-1})	31.50	31.50
Average income per carcass (R)	6574.05	6917.40
Gross profit	957.66	1318.52

It was assumed non-feed costs were the same for both treatments and were excluded in calculating gross profit

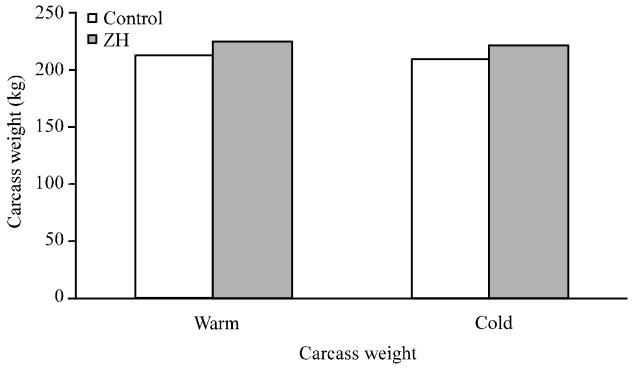

Fig. 6: Effect of ZH on carcass weights of the steers

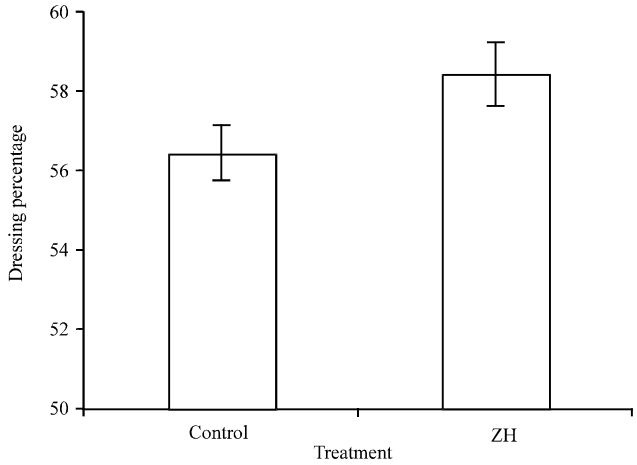

Fig. 7: Mean of dressing percentages (Bars: SE)

DISCUSSION

In agreement with Holland *et al.* (2010), the present study showed that ZH supplementation had no effect on the final BW. The results of the present study reveal that higher live body weight gains during the last 30 days of fattening were positively associated with higher initial and pre-treatment Body Weights (BW) in the control group. However, for the steers fed ZH, they were no association between the treatment weight gain with the initial weight and pre-treatment weight. This suggests that ZH supplementation during the last 30 days of fattening enhances live body weight gain during that phase.

In the present study, ZH had a positive effect on the Average Daily Gain (ADG) during the last month of the fattening phase. The results from these data analysis are comparable to other reports where ZH improved ADG of the animals (Rathmann *et al.*, 2012; Montgomery *et al.*, 2009a). The improved feed efficiency observed in this study has also been described as the effects of ZH in previous research studies (Plascencia *et al.*, 1999; Beckett *et al.*, 2009; McEvers *et al.*, 2013). Steers used in this trial exhibited lower feed efficiency than those observed in other ZH studies.

The effect of feeding ZH on DMI is inconsistent and varies among the previous research trials. The outcome of this study is similar to a study by Avendano-Reyes *et al.* (2006) who reported no

significant differences in daily DMI when ZH was supplemented to the diet. However, the results are in contrast to those reported by Holland *et al.* (2010), who showed that ZH supplementation for 20 days decreased (p= 0.02) DMI at the end of the finishing period.

The higher dressing percentages of steers fed ZH in the present study, is comparable to previous reports of the effects of ZH on dressing percentage (Avendano-Reyes *et al.*, 2006; Montgomery *et al.*, 2009a; Chikhou *et al.*, 1993; Fiems *et al.*, 1993). In this study ZH tended to increase carcass weight. Montgomery *et al.* (2009b) reported that the HCW of steers fed ZH were 16.4 kg heavier and the dressing percentage also increased by 1.5% compared to the control. The steers fed ZH had higher gross profit margins than the control group due to an increased carcass weight. The results of this study suggest the repartitioning capacity of ZH as a beta-agonist. Feeding of βAA enhances muscling of the carcass and this can be shown by an increase in the carcass weight.

CONCLUSION

The outcome of the study demonstrates that ZH has the capacity to repartition tissue growth in steers to improve the carcass characteristics and yield. Zilpaterol hydrochloride significantly increased the rate of live BW gain during the last 30 day of fattening and also increased the muscle weight without causing any lameness or morbidity. Zilpaterol hydrochloride supplementation also improves profit margins in feedlot cattle.

ACKNOWLEDGMENT

The authors would like to thank Professor A.K. Amey, Botswana International University of Science and Technology, for the statistical analysis of the data and to also thank the abattoir, feedlot and laboratory personnel of Agricultural Research Council, Animal Production Institute.

REFERENCES

Avendano-Reyes, L., V. Torres-Rodriguez, F.J. Meraz-Murillo, C. Perez-Linares, F. Figueroa-Saavedra and P.H. Robinson, 2006. Effects of two b-adrenergic agonists on finishing perfomance, carcass characteristics and meat quality of feedlot steers. J. Anim. Sci., 64: 3259-3265.

Beckett, J.L., R.J. Delmore, G.C. Duff, D.A. Yates, D.M. Allen, T.E. Lawrence and N. Elam, 2009. Effects of zilpaterol hydrochloride on growth rates, feed conversion and carcass traits in calf-fed Holstein steers. J. Anim. Sci., 87: 4092-4100.

Chikhou, F.H., A.P. Moloney, P. Allen, J.F. Quirke, F.H. Austin and J.F. Roche, 1993. Long-term effects of cimaterol in Friesian steers: I. Growth, feed efficiency and selected carcass traits. J. Anim. Sci., 71: 906-913.

Fiems, L.O., C.V. Boucque and B.G. Cottyn, 1993. Effect of duration of a β-agonist treatment on growth, feed intake and carcass characteristics in finishing bulls. Arch. Tierernaehr., 45: 101-109.

Hilton, G.G., J.L. Montgomery, C.R. Krehbiel, D.A. Yates and J.P. Hutcheson *et al.*, 2009. Effects of feeding zilpaterol hydrochloride with and without monensin and tylosin on carcass cutability and meat palatability of beef steers. J. Anim. Sci., 87: 1394-1406.

Holland, B.P., C.R. Krehbiel, G.G. Hilton, M.N. Streeter and D.L. VanOverbeke *et al.*, 2010. Effect of extended withdrawal of zilpaterol hydrochloride on performance and carcass traits in finishing beef steers. J. Anim. Sci., 88: 338-348.

McEvers, T.J., L.C. Dorin, J.L. Berg, G.F. Royan and J.P. Hutcheson *et al.*, 2013. Effect of leptin genotype and zilpaterol hydrochloride supplementation on the growth rate and carcass characteristics of finishing steers. Can. J. Anim. Sci., 93: 199-204.

Moloney, A.P., P. Allen, D.B. Ross, G. Olson and E.M. Convey, 1990. Growth, feed efficiency and carcass composition of finishing Friesian steers fed the ß-adrenergic agonist L-644,969. J. Anim. Sci., 68: 1269-1277.

Montgomery, J.L., C.R. Krehbiel, J.J. Cranston, D.A. Yates and J.P. Hutcheson *et al.*, 2009a. Dietary zilpaterol hydrochloride. I. Feedlot performance and carcass traits of steers and heifers. J. Anim. Sci., 87: 1374-1383.

Montgomery, J.L., C.R. Krehbiel, J.J. Cranston, D.A. Yates and J.P. Hutchson *et al.*, 2009b. Effects of dietary zilpaterol hydrochloride on feedlot performance and carcass characteristics of beef steers fed with and without monensin and tylosin. J. Anim. Sci., 87: 1013-1023.

NRC, 1996. Nutrient Requirements of Beef Cattle. 7th Edn., National Academy Press, Washington, DC., USA.

Plascencia, A., N. Torrentera and R.A. Zinn, 1999. Influence of the ß-agonists, zilpaterol, on growth performance and carcass characteristics of feedlot steers. Proc. Western. Sect. Am. Soc. Anim. Sci., 50: 331-334.

Radunz, A.E., 2011. Use of ß-agonists as a growth promoting feed additive for finishing beef cattle. UW Extension Wisconsin Beef Information Center. http://fyi.uwex.edu/wbic/files/2010/11/Beta-Agonists-Factsheet.pdf.

Rathmann, R.J., B.C. Bernhard, R.S. Swingle, T.E. Lawrence and W.T. Nichols *et al.*, 2012. Effects of zilpaterol hydrochloride and days on the finishing diet on feedlot performance, carcass characteristics and tenderness in beef heifers. J. Anim. Sci., 90: 3301-3311.

Ricks, C.A., P.K. Baker and R.H. Dalrymple, 1984. Use of repartitioning agents to improve performance and body composition of meat animals. Proc. Reciprocal Meat Conf., 37: 5-11.

SPSS, 2012. SPSS Statistics for Windows. Version 21.0, IBM Corp, Armonk, NY.

Van Donkersgoed, J., G. Royan, J. Berg, J. Hutcheson and M. Brown, 2011. Comparative effects of zilpaterol hydrochloride and ractopamine on growth performance, carcass characteristics and longissimus tenderness of feedlot heifers fed barley-based diets. Prof. Anim. Sci., 27: 116-121.