

PALATABILITY TRAITS OF MEAT FROM NELLORE HEIFERS FED ZILPATEROL HYDROCHLORIDE

N. R. B. Consolo, M. O. Frassetto, R. S. Goulart, V. B. Ferrari, L. F. P. Silva

Department of Animal Science, USP, Duque de Caxias Norte, 225, 13635-900, Pirassununga, SP, Brazil

Abstract – Nowadays, among palatability traits, meat tenderness is the primary determinant of consumer satisfaction. However, the use of additives like beta-adrenergic agonists in order to increase muscle mass deposition can lead to damage of meat palatability traits, especially tenderness. Therefore, the objective of this study was to evaluate the effects of zilpaterol hydrochloride and postmortem aging in the palatability traits of meat from Nelore heifers. Seventy-two Nelore heifers were fed in a feedlot system during 135 days. Heifers were divided into two treatment groups: Control (C) and Zilpaterol (Z) in a randomized block design. Zilpaterol was administrated during the last 30 days of feeding, allowing 3 days of withdraw before slaughter. Twenty-four hours after slaughter, four steaks from each animal from *Longissimus* muscle, after the 12th rib, was collected, vacuum packed and aged for 0, 7, 14 or 21 days to texture, juiciness, aroma, beef flavor and off-flavor analysis by a trained panel. Zilpaterol did not change beef flavor, off-flavor nor aroma; however the meat from animals fed zilpaterol had lower tenderness score in all aging times ($P < 0.05$). Zilpaterol decreased ($P < 0.05$) juiciness after 0 and 14 days of aging. In conclusion, zilpaterol decreases the meat tenderness and juiciness depending on the aging time on the sensorial test.

Key Words – beta-adrenergic agonists, beef cattle, tenderness.

I. INTRODUCTION

In recent years, meat palatability has become important to consumer satisfaction. Meat palatability is defined as the tenderness, juiciness and flavor of cooked meat products [1]. The growth promoters, such as beta-agonist, has been use in beef cattle to increase the muscle mass deposition and consequently improve the cattle performance. Zilpaterol hydrochloride (ZH) is a beta-agonist largely use in USA to improve muscle growth and subprimal yield. The effect ZH on meat quality and palatability has been documented in *Bos taurus* cattle [2, 3, 4, 5]. However, there is no data shown the effect of this product on meat quality from

Nellore cattle. There is several differences on growth and growth composition between the genetic groups, Nelore reaches the point of slaughter later than breeds such as Angus and Hereford, with low degree of fat thickness, and marbling [6, 7], a common situation in Brazilian herds. Therefore, the aim of this study was to evaluate the effects of zilpaterol hydrochloride (ZH - MSD Brazil) and postmortem aging on palatability traits of meat from Nelore heifers.

II. MATERIALS AND METHODS

Seventy-two Nelore heifers, with 267 kg of BW and 18 months were fed in a feedlot system during 135 days. Heifers were divided into two treatment groups: Control (C) and Zilpaterol (ZH), which received the same diet containing 14% crude protein, and formulated with corn silage, ground corn, soybean meal and mineral premix. The ZH group received zilpaterol hydrochloride (Zilmax®) at 8.3 mg/kg dry matter. Heifers were allotted to 18 pens and assigned to a randomized block design. Zilmax was administrated during the last 30 days of feeding, allowing 3 days of withdraw before slaughter. All animals were slaughtered in a commercial plant, according to proper welfare guidelines. After twenty-four hours, four steaks from each animal from *Longissimus* muscle was sampled, vacuum packed and aged for 0, 7, 14 or 21 days to sensorial texture, juiciness, aroma, beef flavor and off-flavor analysis by trained panel. The sensorial analysis were performed using a panellist score by a trained eight-member sensory panel [8]. Eight sessions were performed, including four training sessions, one blank test and analysis of the samples in the three last sessions, previously described by Cõnsolo et al. [9]. Steaks were thawed (4 °C), roasted in an oven equipped (F01; Flexa de Ouro Industry, São Paulo, Brazil) with a thermostat adjusted to 170 °C and their internal temperature was monitored individually. Roasted steaks were cut immediately into 1-cm cubes which were

transferred to glass flasks with metal lids. A yogurt maker equipped with a thermostat adjusted to 40 °C was used to keep the samples warm until the time for analysis. The samples were analyzed in individual booths under controlled conditions of light and temperature. A ranking test was used for tenderness, juiciness, beef aroma, beef flavor and off-flavour of the samples on an 8-point scale, where 8 = extremely tender, juicy and intense, and 1 = extremely tough, dry and absent [8]. The statistical analyses were conducted using SAS, version 9.1.2 for Windows. Scores obtained were compared by Mann-Whitney test within PROC NPAR1WAY.

III. RESULTS AND DISCUSSION

There were no differences between steaks from heifers fed C and ZH diets for aroma, beef flavor, and off-flavor ($P > 0.05$, Table 1). Other data suggest that ZH affect largely tenderness and juiciness, with no changes on beef aroma or flavor [10, 11].

Table 1. Effects of zilpaterol hydrochloride (ZH, mg/kg DM) on sensorial analysis

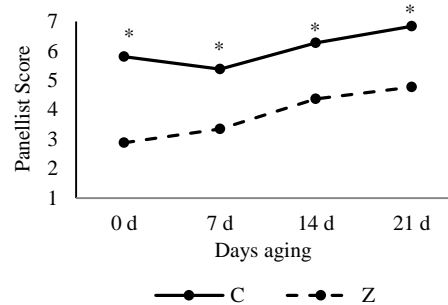
Trait	Diets		SEM	P-Value
	C	ZH		
Aging 0 d				
Aroma	5.77	5.88	0.10	0.677
Beef flavor	5.77	5.94	0.08	0.362
Off-Flavor	1.55	1.38	0.12	0.603
Aging 7 d				
Aroma	5.88	5.88	0.07	1.000
Beef flavor	5.94	5.77	0.10	0.408
Off-Flavor	1.55	1.50	0.10	0.796
Aging 14 d				
Aroma	6.22	5.87	0.08	0.096
Beef flavor	5.88	5.87	0.14	0.967
Off-Flavor	1.72	1.5	0.14	0.529
Aging 21 d				
Aroma	6.05	6	0.10	0.831
Beef flavor	5.72	6	0.07	0.159
Off-Flavor	2.11	1.5	0.15	0.143

For tenderness trait, the ZH decreased 36% of steak tenderness compared to control diet (6.07 and 3.84 panellist score average for C and ZH respectively,

Fig. 1). The lower tenderness for animals fed ZH can be due to the beta-agonist effect in increasing muscle hypertrophy by reducing protein degradation [12]. The decreased protein degradation is likely modulated by elevation of calpastatin, suppressing m-calpain, resulting in greater muscle growth and consequently decrease on meat tenderness [12].

The postmortem aging is considered an important technology to increase tenderness. Panellist tenderness scores were significantly improved with the use of postmortem aging independently of the treatment (Fig. 1). However, in all aging times, tenderness scores were lower for ZH than for C steaks. Several studies report a lower tenderness in steak from animals fed ZH compared to control diet measured by Warner Bratzler Shear Force (WBSF) or sensory panel [13, 14]. Some authors reported that postmortem aging >14 days decreases tenderness disparities between steaks from cattle fed ZH and control [15, 16]; however, these results are inconsistent for cattle fed ZH [17, 18, 19], and was not observed in this trial.

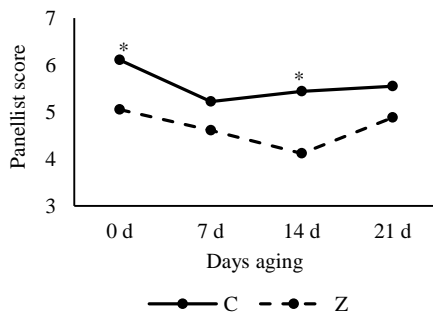
Figure 1. Effect of zilpaterol hydrochloride and aging times on meat texture.



As well as tenderness, juiciness is also an attribute valued by most consumers. The present study reports a decrease on juiciness trait depending on aging time, because only at 0 and 14 days of aging, ZH decreased juiciness compared with control (Fig. 2). There is a contradictory result in the literature about juiciness correlated with animals fed ZH, because this attribute depends on aging time, meat fat content, physiological, and psychological factors inherent to individual tasters. Hilton et al. [13] reported that trained panellists rated steaks from

cattle fed ZH lower for tenderness and juiciness. Brooks et al. [3] reported a tended to decrease juiciness and decreased tenderness scores when animals were fed ZH compared to control. Similarly, Garmyn et al. [10] found that overall tenderness and sustained juiciness scores were reduced due to ZH supplementation. In the other hand, Mehaffey et al. [14] reported no impact on consumer scores for juiciness of meat from beef animals fed 20 d ZH treated and aged for 21 d postmortem.

Figure 2. Effect of zilpaterol hydrochloride and days aging on meat juiciness.



IV. CONCLUSION

Nellore heifers fed zilpaterol hydrochloride had decreased on meat tenderness regardless of aging, and decreased on juiciness at 0 and 14 days of postmortem.

ACKNOWLEDGEMENTS

The author thanks the FAPESP for providing the author financial support, MSD-Animal Health by financial support for the trial and the team LPGC for al help to conduce the trial

REFERENCES

1. Miller, R. K. (2004). Chemical and physical characteristics of meat: Palatability. In: Encyclopedia of Meat Sciences. W. Jensen, C. Devine, and M. Dikemann, ed. Elsevier Science Publ., Oxford, OX, UK.

2. McEvers, T. J., Nichols, W. T., Hutcheson, J. P., Edmonds M. D., & Lawrence, T. E. (2012). Feeding performance, carcass characteristics, and tenderness attributes of steers sorted by the Igenity tenderness panel and fed zilpaterol hydrochloride. *Journal of Animal Science* 90: 4140-4147.

3. Brooks, J. C., Claus, H. C., Dikeman, M. E., Shook, J., Hilton, G. G., Lawrence, T. E., Mehaffey, J. M., Johnson, B. J., & Allen, D. M. (2009). Effects of zilpaterol hydrochloride feeding duration and postmortem aging on Warner-Bratzler shear force of three muscles from beef steers and heifers. *Journal Animal Science* 87: 3764-3769.

4. Garmyn, A. J., & Miller, M. F. (2014). Meat science and muscle biology symposium--Implant and beta agonist impacts on beef palatability. *Journal Animal Science* 92: 10-20.

5. Leheska, J. M., Montgomery, J. L., Krehbiel, C. L., Yates, D. A., Hutcheson, J. P., Nichols, M., Streefer, W. T., Blanton, J. R., & Miller, M. F. (2009). Dietary zilpaterol hydrochloride. II. Carcass composition and meat palatability of beef, *Journal Animal Science* 87: 1384-1393.

6. Scramlin, S. M., Platter, W. J., Gomez, R. A., Choat, W. T., McKeith, F. K., & Killefer, J. (2010). Comparative effects of ractopamine hydrochloride and zilpaterol hydrochloride on growth performance, carcass traits, and longissimus tenderness of finishing steers. *Journal Animal Science* 88: 1823-1829.

7. Vasconcelos, J. T., Rathmann, R. J., Reuter, R. R. Leibovich, J., Mcmeniman, J. P., Hales, K. E., Covey, T. L., Miller, M. F., Nichols, W. T. E., & Galyean, M. L. (2008). Effects of duration of zilpaterol hydrochloride feeding and days on the finishing diet on feedlot cattle performance and carcass traits. *Journal Animal Science* 86: 2005-2015.

8. American Meat Science Association (1995). Research Guidelines for Cookery, Sensory Evaluation and Instrumental Tenderness Measurements of Fresh Meat. AMSA, Chicago, IL, USA.

9. Cônsolo, N. R. B., Gardinal, R., Gandra, J. R., Freitas Junior, J. E., Rennó, F. P., Santana, M. H. A., Pflanzler Junior, S. B. & A. S. C. Pereira. (2015). High levels of whole raw soybean in diets for Nellore bulls in feedlot: effect on growth performance, carcass traits and meat quality. *Journal Animals Physiology and Animal Nutritional* 99: 201-209.

10. Garmyn, A. J., Shook, J. N., VanOverbeke, D. L., Beckett, J. L., Delmore, R. J., Yates, D. A., Allen, D. M. & Hilton, G. G. (2010). The effects of zilpaterol hydrochloride on carcass cutability and tenderness of calf-fed Holstein steers. *Journal Animal Science* 88: 2476–2485.
11. Arp, T. S., Howard, S. T., Woerner, D. R., Scanga, J. A., McKenna, D. R., Kolath, W. H., Chapman, P. L., Tatum, J. D., & Belk, K. E. (2013). Effects of ractopamine hydrochloride and zilpaterol hydrochloride supplementation on longissimus muscle shear force and sensory attributes of beef steers. *Journal Animal Science*. 91: 5989-5997.
12. Koohmaraie, M., Kent, P. M., Shackelford, S. D., Veiseth, E. & Wheeler, T. L. (2002). Meat tenderness and muscle growth: is there any relationship? *Meat Science* 62: 345–352.
13. Hilton, G. G., Montgomery, J. L., Krehbiel, C. R., Cranston, J., Yates, D. A., Hutcheson, J. P., Nichols, W. T., Streeter, M., Blanton, J. R. & Miller, M. F. (2009). Dietary zilpaterol hydrochloride. IV. Carcass cutability and meat palatability of beef cattle with and without monensin and tylosin. *Journal Animal Science* 87: 1394–1406.
14. Mehaffey, J. M., Brooks, J. C., Alsup, E., Hutcheson, J. P., Nichols, W. T., Streeter, M. N., Yates, D. A., Johnson, B. J., & Miller, M. F. (2009). Impact of feeding zilpaterol hydrochloride to beef and calf-fed Holstein cattle on consumer palatability ratings. *Journal Animal Science* 87: 3712–3721.
15. Boler, D. D., Shreck, A. L., Faulkner, D. B., Killefer, J., McKeith, F. K., Homm, J. W. & Scanga, J. A. (2012). Effect of ractopamine hydrochloride (Optaflexx) dose on live animal performance, carcass characteristics and tenderness in early weaned beef steers. *Meat Science* 92: 458-463.
16. Scramlin, S. M., Platter, W. J., Gomez, R. A., Choat, W. T., McKeith, F. K. & Killefer, J. (2010). Comparative effects of ractopamine hydrochloride and zilpaterol hydrochloride on growth performance, carcass traits, and longissimus tenderness of finishing steers. *Journal Animal Science* 88: 1823-1829.
17. Hilton, G. G., Montgomery, J. L., Krehbie, C. R., Yates, D. A., Hutcheson, J. P., Nichols, W. T., Streeter, M. N., Blanton J. R. & Miller, M. F. (2009). Effects of feeding zilpaterol hydrochloride with and without monensin and tylosin on carcass cutability and meat palatability of beef steers. *Journal Animal Science* 87: 1394–1406.
18. Kellermeier, J. D., Tittor, A. W., Brooks, J. C., Galyean, M. L., Yates D. A., Hutcheson, J. P., Nichols, W. T., Streeter, M. N., Johnson B. J. & M. F. Miller. (2009). Effects of zilpaterol hydrochloride with or without an estrogen-trenbolone acetate terminal implant on carcass traits, retail cutout, tenderness, and muscle fiber diameter in finishing steers. *Journal Animal Science* 87: 3702-3711.
19. Rathmann, R. J., Mehaffey, J. M., Baxa, T. J., Nichols, W. T., Yates, D. A., Hutcheson, J. P., Brooks, J. C., Johnson, B. J. & Miller, M. F. (2009). Effects of duration of zilpaterol hydrochloride and days on the finishing diet on carcass cutability, composition, tenderness, and skeletal muscle gene expression in feedlot steers. *Journal Animal Science* 87: 3686-3701.