# MONENSIN, VIRGINIAMYCIN AND FUNCTIONAL OILS ON CARCASS CHARACTERISTICS AND MEAT QUALITY OF CATTLE ABRUPTLY FED HIGH CONCENTRATE DIETS

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**Abstract - To evaluate the effects of the supplementation of feed additives on carcass characteristics of cattle abruptly fed high concentrate diets, 48 Nellore bulls (322 ± 23 kg of BW) were submitted to a diet change, without adaptation, from grazing pasture to a 92% grains diet. The animals were fed four different additives: M30 (monensin at 30 mg/kg DM), M40 (monensin at 40 mg/kg DM), M+V (monensin at 30 mg/kg DM + virginiamycin at 25 mg/kg DM) and FO (functional oils from castor oil and cashew nut shell liquid at 400 mg/kg DM). Feed additives had no effect on hot carcass weight, dressing percentage, rib eye area, fat thickness and carcass pH. Animals receiving FO had heavier kidney, pelvic and heart fat. Color parameters, cooking loss and shear force were not affected by additives. Functional oils may substitute antibiotics without any harm to carcass traits.**

## I. INTRODUCTION

Feed additives are used to improve rumen fermentation and rumen health, and the ionophore monensin is widely used in feedlots. Ionophores are known as modifiers of the fatty acid profile in the rumen increasing the production of propionic acid and decreasing energy losses due to the decrease in methane production (1). Daenicke et al. (2) reported an increase in empty body fat content of 15.3%, and also in daily energy retention of 15.9%, when monensin was fed to the animals. For this reason, feed additives like monensin, indirectly affect carcass traits. The use of virginiamycin has increased in the last years and similar to ionophores the virginiamycin acts against gram-positive bacteria altering the rumen microbiota and, consequently, the rumen fermentation, decreasing ammonia and hydrogen production and increasing propionic acid (3).

Due to the prohibition of the use of antibiotic by the European Union, the research community has tested other natural products such as functional oils that have antimicrobial functions besides its energy content. Among those plant extracts, the cashew nut shell liquid and castor oil are used in ruminant diets as a substitute for ionophores and antibiotics, and have the same activities as a monovalent ionophore (4). This study evaluated the effect of monensin, virginiamycin and functional oils on carcass characteristics and meat quality of feedlot finished steers.

## II. MATERIAL AND METHODS

Forty-eight Nellore bulls (322 ± 23kg BW, 20 months old) were randomized in blocks. On d1, all animals were abruptly changed from grazing pastures to a high concentrate basal diet (82.02% cracked corn, 7.72% sugar cane bagasse, 6.83% soybean meal, 1.44% urea and 0.6% mineral mix) fed twice a day during 120 days. The treatments were the feed additives added to the basal diet in a DM basis: 1) monensin at 30 mg/kg (M30), 2) monensin at 40 mg/kg (M40), 3) monensin at 30 mg/kg + virginiamycin at 25 mg/kg (M+V) and 4) functional oils from a blend of castor oil and cashew nut shell liquid at 400 mg/kg (FO). After 14 days, the concentration of monensin in the M40 was decreased to 30 mg/kg. Animals were

slaughtered after 120 days of feeding, with no difference among treatments on final body weight (508 ± 45kg, data not shown). Weights of kidney, pelvic and heart fat (KPHF) were recorded. Carcass pH was measured at the first hour and twenty four hours after slaughtered. Rib eye area and fat thickness were measured at the *Longissimus dorsi* muscle between the 12th and the 13th ribs and a 2.5 cm thick steak was collected from this area for posterior analysis of Warner-Bratzler shear force values. The determination of meat color was performed using a Konico Minolta colorimeter (Model CMD2500d; Konica Minolta Sensing, Inc, Tokyo, Japan), evaluating the lightness (L*), redness (a*) and yellowness (b*). Data was analyzed using the GLM procedures (SAS®). Effects were considered significant when P value was <0.05. Means were obtained by LSMEANS procedures.

## III. RESULTS AND DISCUSSION

Carcass traits measured at slaughtering are shown on Table 1. No treatments effects (P>0.05) were observed on hot carcass weight (HCW) and dressing percentage (DP). Similar to these results Gastaldello Jr. et al. (5), observed no effects of monensin supplementation on HCW and DP of lambs receiving a 90% concentrate diet. In a 340 day feedlot trial with steers, Salinas-Chaviria et al. (6), evaluated the addition of monensin at 28 mg/kg DM and virginiamycin at 16 and 22.5 mg/kg DM, and did not verify differences among treatments for HCW and DP.

In accordance to the results of this trial, in the study conducted by Purevjav et al. (7), the use of monensin and cashew and castor oil or the combination of ionophore and the functional oil did not cause any effect on HCW. However for DP animal receiving FO in a dosage of 500 mg/kg of DMI had larger DP than animals receiving monensin (223 mg/day) or FO in a lower dosage (250 mg/kg of DM).

There were no differences among treatments for rib eye area and fat thickness (P>0.05). However, there were differences (P<0.01) for the weight of KPH. Animals receiving FO had heavier KPH than animals receiving treatments M30 and M+V, but without differences for animals receiving M40 diet. Fat deposition starts among organs, and goes external to tissues and finally inside muscles. Salinas-Chaviria et al. (6) did not find effect on rib eye area, fat thickness and KPH and Zawadzki et al. (8) did not find effect on fat thickness and rib eye area using the same functional oils as the present study.

Carcass pH measured 1 hour and 24 hours after slaughter were not statistically different among groups M30, M40, M+V and FO. According to Savell et al. (9) soon after slaughter the pH decreases from 7.0 to values between 5.3 and 5.8. The pH value for 24 hours of treatments M40 and OF are higher than 5.8. High carcass pH is related to premortem stress caused by transportation, fast and sexual behavior of non-castrated animals (10).

Color parameters and meat traits are shown on Table 2. Meat color is the first point to be affected by pH changes and as pH increases the color of the meat gets darker, resulting in a dark, firm and dry meat, known as DFD meat (11) and meat and fat color are the main characteristics affecting consumer preference (12). Color parameters (L*, a*, and b*) were not affected by additives supplementation (P>0.05).

According to Muchenje et al. (13) the average values reported on the literature for characteristics of meat color in bovines would be from 33 to 41 for L*, from 11.1 to 23.6 for a* and from 6.1 to 11.3 para b*, so according to the authors the values of L* and b* obtained in

Table 1. Carcass traits of Nellore bulls supplemented with different feed additives

| | Treatments | | | | | |
|---|---|---|---|---|---|---|
| Item | M30 | M40 | M+V | FO | MSE | P |
| Hot carcass weight, kg | 281.03 | 293.18 | 284.17 | 298.56 | 5.25 | 0.6205 |
| Dressing percentage, % | 57.86 | 57.31 | 55.75 | 57.27 | 0.74 | 0.1565 |
| Rib eye area, $cm^2$ | 64.33 | 65.08 | 66.75 | 68.42 | 2.00 | 0.4895 |
| Fat thickness, mm | 4.3 | 4.1 | 3.7 | 4.7 | 0.05 | 0.5430 |
| KPH, kg | 8.89b | 10.52ab | 9.44b | 11.04a | 0.45 | 0.0066 |
| pH 1h | 6.68 | 6.73 | 6.58 | 6.75 | 0.07 | 0.3489 |
| pH 24h | 5.79 | 5.84 | 5.79 | 5.93 | 0.08 | 0.5803 |

a,b Means within a row not sharing a common superscript differ significantly (P<0.05)

Table 2. Meat color and quality of Nellore bulls supplemented with different additives

| Item | Treatments | | | | MSE | P |
|---|---|---|---|---|---|---|
| | M30 | M40 | M+V | FO | | |
| Color | | | | | | |
| L* | 30.38 | 30.63 | 31.82 | 30.07 | 1.50 | 0.8524 |
| a* | 15.13 | 14.51 | 15.88 | 15.41 | 0.86 | 0.7528 |
| b* | 12.45 | 12.89 | 13.98 | 13.47 | 0.82 | 0.5764 |
| Meat Traits | | | | | | |
| Cooking loss, % | 6.68 | 6.73 | 6.58 | 6.75 | 0.07 | 0.8327 |
| Shear force, kgf/cm$^2$ | 6.61 | 6.12 | 5.88 | 6.86 | 0.45 | 0.4133 |

the study are in disagreement with the expected values. Gomes et al (14), evaluating the use of monensin and yeast for Nellore steers also found different values from the ones pointed by Muchenje et al. (13).

On the results of this study, the meat pH after 24 hours of slaughter was higher than expected for M40 and OF (above 5.8) and for M30 and M+V it was 5.79 almost reaching the limit value of 5.8. Possibly, this is the cause to the color variations. Meat with higher pH, is darker because there is less free water to reflect the light and also in a higher pH the enzymes that use oxygen are more actives, decreasing the oxygenation on the myoglobin surface resulting in a dark color (15).

Tenderness varies due to changes on the myofibrilar structure of proteins of muscle in the period of time between slaughter and the meat consumption (16). According to Lawrie et al. (17) values bellow 5.00 kgf/cm$^2$ indicate a tender meat. Therefore, the meat of all treatments would be considered not tender, characteristic of *Bos indicus* cattle.

Cooking loss was not affected by treatments ($P>0.05$). Similarly to the results obtained for shear force and cooking loss, other studies reported that the use of additives did not affected those two characteristics (14 and 17).

## CONCLUSION

In the conditions of the present study the feed additives tested had no effect on carcass and meat quality. For market places where the use of antibiotics is banned, the use of functional oils as feed additives will not depreciate carcass traits.

## ACKNOWLEDGEMENTS

The authors gratefully acknowledge Sao Paulo State Research Foundation (Fapesp) for the support of this project grant# 2011/19487-1 and scholarship grant# 2011/15818-3.

## REFERENCES

1. Russell, J. B., Strobel, H. J. (1989). Mini review: the effect of ionophores on ruminal fermentations. Applied and Environmental Microbiology 55: 1-6.
2. Daenicke, R., Rohr, K., Oslage, H. J. (1982). Effect of monensin on rumen fermentation, performance, and body composition of growing bulls. Livestock Production Science 8: 479-488.
3. Nagaraja, T. G., Taylor, M. B., Harmon, D.L., Boyer, J. E. (1987). In vitro lactic acid inhibition and alterations in volatile fatty acid production by antimicrobial feed additives. Journal of Animal Science 65:1064-1076.
4. Nagabhushana, K. S., Shobha, S. V., Ravindranath, B. (1995). Selective ionophoric properties of anacardic acid. Journal of Natural Products, 58 (5), 807-810.
5. Gastaldello Junior, A.L., Pires, A. V., Susin, I., Mendes, C. Q., Ferreira, E. M., Mourão, G. B. (2010) Desempenho e características de carcaça de cordeiros alimentados com dietas contendo alta proporção de concentrado adicionadas de agentes tamponantes. Revista Brasileira de Zootecnia, 39 (3), 556-562.
6. Salinas-Chavira, J., Lenin, J., Ponce, E., Sanchez, U., Torrentera, N., Zinn, R.A. (2009). Comparative effects of virginiamycin supplementation on characteristics of growth-performance, dietary energetics, and digestion of calf-fed

Holstein steers. Journal of Animal Science, 87: 4101-4108.

7. Purevjav, T., Hoffman, M. P., Ishdorj, A., Conover, A. J., Jedlicka, M. E., Prusa, K., Torrent, J. Pusillo, G. M. (2013). Effects of functional oils and monensin on cattle finishing programs. Professional Animal Scientist 29:426-434.
8. Zawadzki, F.; Valero, M.V.; Strack, M.G; Silva, R.R.; Moletta, J.L.; Prado, I.V. Glicerol e óleos essenciais na dieta de bovinos precoces da raça Purunã terminados em confinamento sobre as características da carcaça In: REUNIÃO ANNUAL DA SOCIEDADE BRASILEIRA DE ZOOTECNIA, 47., 2010, Salvador. **Anais…** Salvador: Sociedade Brasileira de Zootecnia, [2010] (CD-ROM).
9. Savell, J.W., Mueller, S.L., Bair, B.E. (2005) The chilling of carcasses. Meat Science 70:449-459.
10. Felício, P. E. Fatores que influenciam na qualidade da carne bovina. In FEALQ (Ed.), Produção de Novilho de Corte. , Vol. Único. (pp. 79–97). Piracicaba: FEALQ, 1997
11. Young, O.A., West, J., Hart, A.L.,Van Otterdijk, F.F.H. (2004). A method for early determination of meat ultimate pH. Meat Science 66 (2),493–498.
12. Cross, H.R., Durland, P.R., Seideman, S.C. Sensory Qualities of Meat. In: Betchel, P.J., Muscle as food. 3 ed. USA-ARS, US Meat Animal Research Center, Clay Center: Nebraska, 279-315, 1986
13. Muchenje, V., Dzama, K., Chimonyo, M., Strydom, P. E.; Hugo, A., Raats, J. G. (2009). Some biochemical aspects pertaining to beef eating quality and consumer health: A review. Food Chemistry 112 (2): 279–289.
14. Gomes, R.C., Leme,P.R, Silva, S.L., Antunes, M.T, Guedes, C.F. (2009) Carcass quality of feedlot finished steers fed yeast, monensin, and the association of both additives**.** Arquivo Brasileiro Medicina Veterinária Zootecnia 61 (3), p.648-654, 2009
15. Ledward, D. A., Johnston, D. E., Knight, M. K. (1992) The Chemistry of Muscle-Based Foods Thomas Graham House, Science Park, Cambridge, U.K.: The Royal Society of Chemistry, (pp. 128–139)
16. Muir, P. D., Wallace, G. J., Dobbie, P. M., Bown, M. D. (2000). A comparison of animal performance and carcass and meat quality characteristics in Hereford, Hereford x Friesian, and Friesian steers grazed together at pasture. New Zealand. Journal of Agricultural Research 43:193–205
17. Lawrie, R.A. (2004) Ciência da carne. 6.ed. Porto Alegre: Artmed 384p
18. Lage, J. F., Berchielli, T. T., San Vito, E., Silva, R. A., Ribeiro, A. F., Reis, R. A., Dallantonia, E. E., Simonetti, L.R., Delevatti, L. M., Machado, M. (2014) Fatty acid profile, carcass and meat quality traits of young Nellore bulls fed crude glycerin replacing energy sources in the concentrate. Meat Science 96:1158-1164.