Available online at www.sciencedirect.com
ScienceDirect
Livestock Science 119 (2008) 107–115
LIVESTOCK SCIENCE
www.elsevier.com/locate/livsci

Effect of virginiamycin and monensin supplementation on performance of multiparous Holstein cows

L.J. Erasmus [a,*], C. Muya [a], S. Erasmus [b], R.F. Coertze [b], D.G. Catton [c]

[a] Department of Animal and Wildlife Sciences, University of Pretoria, Pretoria 0002, South Africa
[b] Agricultural Research Council, Livestock Business Division, Irene 0062, South Africa
[c] D. G. Catton Consultants, Irene 0062, South Africa

Received 2 November 2007; received in revised form 29 February 2008; accepted 14 March 2008

Abstract

This study was conducted to determine the effects of monensin or virginiamycin, or both on the performance of and some energy balance parameters in Holstein cows. Forty multiparous Holstein cows were used in a randomized complete block design experiment. The basal diet was a total mixed ration based on lucerne hay (38% of DM) and ground maize (34% of DM). The experimental treatments were (1) control diet (C); (2) control diet plus 15 ppm of monensin (M); (3) control diet plus 20 ppm of virginiamycin (V), and control plus M (15 ppm) plus V (20 ppm). Cows received 8 kg/d (as fed) of the experimental diets plus *ad libitum Eragrostis curvula* hay from 3 weeks prepartum and only the experimental diets from calving until 60 days postpartum. Cows were milked twice daily. Dry matter intake did not differ between treatments, but energy corrected milk production was increased ($P<0.10$) by supplementing V+M (43.3 kg/d) when compared to treatments M (36.9 kg/d) and V (37.9 kg/d). Change in body weight tended ($P=0.11$) to be lower for cows supplemented with V+M (−8.1 kg/60 d) when compared to cows receiving the control diet (−34.2 kg/60 d). Both treatments M and V respectively, decreased blood BHBA and treatment M increased blood glucose when compared to the control diet ($P<0.10$). Results suggest a complimentary effect between the two additives monensin and virginiamycin when supplemented to early lactation cows.

Keywords: Lactating dairy cow; Virginiamycin; Monensin; Energy balance parameters

1. Introduction

Ionophores are feed additives that alter rumen microbial populations through ion transfer across cell membranes and have been used extensively in the beef and poultry industries since the 1970s (McGuffey et al., 2001). A controlled release capsule containing monensin was approved in Canada in 1997 for prevention of subclinical ketosis in dairy cows. Subsequently, in 2004, both Canada and the USA received approvals for the use of monensin in lactating cow diets for improving milk production efficiency (Duffield, 2005).

The mode of action of ionophores and its effectiveness in beef cattle have been presented in several reviews (Bergen and Bates, 1984; Corah, 1991; Nagaraja et al.,

* Corresponding author. Tel.: +27 12 4204947; fax: +27 12 4203290.
E-mail address: lourens.erasmus@up.ac.za (L.J. Erasmus).

1871-1413/$ - see front matter © 2008 Elsevier B.V. All rights reserved.
doi:10.1016/j.livsci.2008.03.005

1997). Recently, McGuffey et al. (2001) and Ipharraguerre and Clark (2003) reviewed the usefulness of ionophores for lactating dairy cows. Many of the benefits of ionophores are due to the improved energy status through increased propionic acid production and a reduction in methane production. This generally results in less mobilization of body fat, lower levels of blood NEFA and ketones, such as BHBA and increased glucose production. Dairy cattle responses include lower incidence of ketosis and displaced abomasum, lower loss of body condition, increased milk production and improved milk production efficiency (McGuffey et al., 2001).

Virginiamycin, a non-ionophore antibiotic, has been used for many years as a performance enhancer for poultry and swine. Some studies have indicated a growth promoting effect of virginiamycin in ruminants through improved weight gain and feed efficiency and decreased incidence of liver abscesses and acidosis in grain fed cattle (Hedde, 1984; Rogers et al., 1995). The effect of virginiamycin on gram-positive bacteria is similar to that of monensin, although the modes of action differ (Nagaraja et al., 1987). Virginiamycin supplementation, therefore, could potentially result in the same benefits for dairy cows as described above for monensin.

Field observations from dairy herds in South Africa, showed positive responses when virginiamycin was supplemented together with monensin (K. Botha, personal communication). No literature could be found where virginiamycin and monensin were fed to lactating cows and the potential additive and/or complimentary effects of these additives have therefore not been described. The primary objective of this study was to evaluate the effects of virginiamycin, monensin and a combination thereof on milk production, milk composition and some blood metabolites, which are indicators of energy metabolism and subclinical ketosis in dairy cows.

2. Materials and methods

2.1. Cows, diets and experimental design

Forty multiparous Holstein cows were used in a randomized complete block design experiment. Three weeks prepartum cows were assigned to one of 10 blocks of four cows, based upon previous milk production and BW. The basal TMR, to which four different vitamin/mineral premixes were added, is shown in Table 1. The experimental treatments consisted of a control diet with no medication (C); control plus 20 ppm of virginiamycin (V); control plus 15 ppm of monensin (M) and control plus 20 ppm of V plus 15 ppm of M (V+M). The virginiamycin is commercially available as Stafac and monensin as Poulcox, both supplied by Phibro Animal Health, 623 Rubenstein Street, Moreletta Park 0044, South Africa.

Table 1
Ingredient and chemical composition of the basal TMR fed both prepartum and postpartum (DM basis)

Ingredients (%)	
Alfalfa hay	38.0
Ground corn	34.0
Cottonseed meal	3.0
Whole cottonseed (linted)	6.0
Sunflower meal	5.5
Soybeans roasted	4.0
Cane molasses	6.0
Brewers grains	2.0
Megalac [a]	0.79
Sodium chloride	0.40
Vitamin/mineral premix [b, c]	0.30
Chemical composition	
OM, % DM	92.3
Fat, % DM	5.5
CP, % DM	16.6
Soluble CP, % CP	27.8
RUP, % CP	41.2
NDF, % DM	29.1
ADF, % DM	21.9
NSC, % DM [d]	41.1
NE_L, MJ/kg DM [e]	7.51
Ca, % DM	0.81
P, % DM	0.39
K, % DM	1.52
Mg, % DM	0.29

[a] Arm & Hammer (Church & Dwight, Inc., Princetown, NJ).
[b] Contains per kg of premix: 7000 kIU of Vitamin A; 1500 kIU of Vitamin D_3; 1300 mg of Vitamin B_1; 4000 mg of Vit B_{12}; 15,000 mg of Vit E; 130,000 mg of niacin; 1000 mg of Co; 3000 mg of I; 375 mg of Se; 100,000 mg of Mn; 20,000 mg of Cu; 100,000 mg of Zn; 350,000 mg of S; 60,000 mg of Fe.
[c] There were four mineral/vitamin premixes, with the treatments being created by the addition of virginiamycin or monensin, or both, at a level to provide 20 ppm of virginiamycin or 15 ppm of monensin in the DM of the TMR.
[d] Non-structural carbohydrates (NFC) = 100 − (CP + Fat + Ash + NDF).
[e] Calculated as metabolizable energy (ME) using the database of Van der Merwe and Smith (1991) and converted to NEL as: ME × 0.67 (NRC, 1989).

Cows received 8 kg/d (as fed) of the experimental diets from 3 weeks prepartum. Additionally, cows had access to a good quality *Eragrostis curvula* hay (140 g/kg CP, 630 g/kg NDF (DM basis)). Cows received the experimental diets twice daily in equal allocations at 0700 and 1600 h. Cows were housed in individual pens measuring 10 m by 5 m and fresh water was continuously available.

After parturition the cows were moved to a semi-intensive housing unit equipped with Calan head gates (American Calan Inc., Northwood, NH, USA) for monitoring of DMI. Cows were fed their assigned experimental TMRs for *ad libitum* consumption in two equal allocations at 0700 and 1600 h. Water was added to the TMR at each feeding (300 g/kg of feed weight) to improve DMI and prevent feed selection. Feed allocations were monitored daily to ensure 50–100 g/kg