Journal of Biodiversity and Environmental Sciences (JBES)
ISSN: 2220-6663 (Print), 2222-3045 (Online)
http://www.innspub.net
Vol. 6, No. 1, p. 183-186, 2015

RESEARCH PAPER OPEN ACCESS

Effects of feeding monensin on fatty acid profile of holstein dairy cows

Peyman Eyvazi*, **Mahtab Jalili, Sattar Nurmohammadi**

Department of Agriculture, Parsabad Moghan Branch, Islamic Azad University, Parsabad Moghan, Iran

Article published on January 12, 2015

Key words: Monensin, dairy cow and CLA.

Abstract

This study was conducted to investigate the efficacy of monensin on milk fatty acid profile in Holstein dairy cows. For this study 12 cows with initial weight 625 ± 48 kg were allocated to control group and monensin group, with 6 replication in each group using completely randomized design (CRD). The experiment was accomplished during 21 days including pre trial period (14d) and feedlot period (7d). Diet was given twice daily to each group. The conjugated linoleic acid content of diets with monensin was higher than other and there were significant differences ($P < 0.05$).

***Corresponding Author:** Peyman Eyvazi ✉ peyman697@yahoo.com

Introduction

In previous years, eating only vegetarian food experts emphasized. Until about two decades ago scientists found that a substance found in animal fat, which is an anti-jump. During the subsequent investigation, it was found that the properties of the isomers of linoleic acid, which are known as Conjugated Linoleic Acid (Boman, 2004).

Conjugated linoleic acid (CLA) is a term representing a mixture of positional and geometric isomers of octadecadienoic acid with a conjugated double bond system. Conjugated linoleic acid has been shown to possess a number of health benefits based on biomedical studies across a variety of animal models. These include anticarcinogenic, anti-atherogenic, anti-obesity, anti-diabetic and immune system enhancement (McGuire, 2000, Belury, 2002). Conjugated linoleic acid originates from either incomplete biohydrogenation of linoleic or linolenic acid to stearic acid in the rumen (Fellner *et al.*, 1995) or from endogenous synthesis in the mammary gland or adipose tissue. Endogenously, cis-9, trans-11 CLA (the primary isomer found in milk) is synthesized from trans vaccenic acid, another intermediate of ruminal biohydrogenation, via Δ9-desaturase in tissues (Corl *et al.,* 2001). The CLA content of milk and meat is affected by several factors including the animals breed, age, and diet.

Monensin sodium is an ionophore approved for use in lactating dairy cows in several countries including Australia, Argentina, Brazil, New Zealand, South Africa, and recently the United States. A major benefit of feeding ionophores to lactating dairy cows is the shift in the acetate-to-propionate ratio toward more propionate and the associated decrease in methanogenesis (Russell and Houlihan, 2003). Based on the potential of ionophores to increase the supply of glucogenic precursors such as propionate, the administration of monensin to dairy cows may increase the hepatic synthesis of glucose and, therefore, improve the energy balance (Ipharraguerre and Clark, 2003). Benefits of feeding monensin to lactating dairy cows include increased milk production (McGuffey *et al.,* 2001), antiketogenic effects, improved BCS (Sauer *et al.*, 1989; Duffield *et al.*, 1998), prevention of ruminal acidosis (McGuffey *et al.*, 2001), and legume bloat control (Maas *et al.,* 2002).

Monensin is a carboxylic polyether ionophore antibiotic produced by fermentation of Streptomyces cinnamonensis (Russell, 2002) and has been used extensively in the diet of dairy cows (Da Silva *et al.,* 2007; Odongo *et al.,* 2007; Alzahal *et al.,* 2008). The benefits of feeding monensin to dairy cattle include increased milk production and improved energy balance associated with reduced incidence of subclinical ketosis, clinical acidosis, and displaced abomasums (Duffield and Bagg, 2000). Monensin inhibits the growth of gram-positive bacteria.

Ionophores disrupt ruminal biohydrogenation similar to unsaturated fat supplements. Higher concentrations of linoleic acid, trans C18:1, and CLA were maintained in continuous cultures of ruminal bacteria following infusion of monensin, nigericin, or tetronasin (Fellner *et al.,* 1997). Feeding monensin had similar effects on enhancing linoleic acid and trans FA in milk of lactating cows, and also caused a reduction in milk fat percentage (Sauer *et al.,* 1998). According to Van Nevel and Demeyer (1995), ionophores and other antimicrobials act primarily to inhibit lipolysis, thus reducing the formation of a free carboxyl group that is a requirement for subsequent hydrogenation of double bonds.

Materials and methods

Animals and feeding

Twelve lactating Holstein dairy cows (625 ± 48 kg of BW) housed in a tie-stall facility at the Parsabad Moghan, were used in the study. The cows were milked in their stalls twice daily at 0800 and 1800 h. All cows were fed an identical TMR (Table 1) formulated to meet or exceed nutrient requirements (NRC, 2001). Experimental period was 28 days, includes 7 day adaptation period, 14 days before and 7 days sampling period. During the sampling period, samples were taken from milk of dairy cows. And obtained samples transported to the laboratory to determination of fatty acid profile and CLA.

Calculations and statistical analysis

Data were analyzed as a completely randomized design using a general linear model (GLM) procedure of SAS (1999), with Duncan's multiple range test used for the comparison of means.

Results and discussion

The results of the fatty acid profile of milk were shown in Table 2. Fatty acids used in this study, including fatty acids, 10, 12, 13, 16, 18 carbons and conjugated linoleic acid (CLA), respectively. The obtained data showed that the untreated ration (without monensin) have higher C10, C13 and C18 profiles ($P<0.05$). Whereas monensin treating showed highest CLA composition ($P < 0.05$). Feeding monensin decreased the concentrations of short-chain fatty acids but increased the concentrations of long-chain fatty acids and CLA. In the study by Da Silva *et al.* (2007) feeding monensin at 20 mg/kg of DM had no effect on short-, medium- and long-chain fatty acids concentrations, but decreased saturated fatty acids concentrations in milk fat. Fatty acids in milk arise from two sources; uptake from circulation and the de novo synthesis within the mammary epithelial cells (Neville and Picciano, 1997).

Table 1. Ingredients and chemical composition (DM basis) of the basal diet.

Alfalfa	20
Corn silage	17
Barley	29
Cotton seed meal	6
Soybean meal	13
Wheat bran	6
Fish meal	3.5
Fat	2.5
Mineral and vitamin mixture	1.5
Salt	0.5
$CaCO_3$	1
NEL	1.58
CP	18

Table 2. The fatty acids in milk.

Ration	Fatty acids (grams per 100 grams of fatty acids)					
	C_{10}	C_{12}	C_{13}	C_{16}	C_{18}	CLA
without monensin	1.52^a	2.6	5.73^a	16.29^b	14.27^a	1.07^b
with monensin	1.46^b	2.47	4.38^b	17.88^a	14.03^b	1.16^a
SEM	0.0147	0.0434	0.0639	0.0319	0.0531	0.0147

Increasing dietary concentrations of unsaturated fatty acids decreases milk C14:0 and C16:0 levels (Palmquist *et al.,* 1993). Increasing specific unsaturated fatty acids such as conjugated linoleic acid (CLA), linoleic acid (C18:2) and linolenic acid (C18:3) in milk would increase consumer interest and acceptance of milk due to the health benefits associated with these fatty acids (Ramaswamy *et al.*, 2001). The fatty acid content of the lactating cow diet affects the type and the proportion of the fatty acids in the milk fat (Grummer, 1991). Conjugated linoleic acid is an intermediate product of biohydrogenation of linoleic acid by the rumen bacterium, Butyrivibrio fibrosolvens (Harfoot and Hazelwood, 1988).

Conclusion

Monensin increased the ratio of unsaturated to saturated fatty acids in milk fat. Therefore, monensin can be considered as an effective inhibitor of biohydrogenation of unsaturated fatty acids in the rumen, and consequently as a tool for increasing the supply of unsaturated fatty acids to the mammary gland for milk fat synthesis, thus enhancing the nutritional properties of the milk in terms of human health.

Acknowledgment

The researcher wishes to thank Mahtab Jalili and Sattar Nurmohammadi for their assistance.

References

Alzahal O, Odongo NE, Mutsvangwa T, Orrashid MM, Duffield TF, Bagg R, Dick P, Vessie G and McBride BW. 2008. Effects of monensin and dietary soybean oil on milk fat percentage and milk fatty acid profile in lactating dairy cows. Dairy Science Journal **91**, 1166-1174

Bauman D E. 2004. Conjugated Linoleic Acid (CLA) and Milk Fat: A Good News Story. Department of Animal Science, Cornell University, Ithaca, NY 14853-4801 USA.

Belury M A. 2002. Dietary conjugated linoleic acid in health: Physiological effects and mechanisms of action. Annual Review of Nutrition **22**, 505-31.

Da Silva DC, Santos GT, Branco AF, Damaseno JC, Kazama R, Matsushita M, Horst JA, Dos Santos BR and Petit HV. 2007. Production performance and milk composition of dairy cows fed whole or ground flaxseed with or without monensin. Dairy Science Journal **90**, 2928-2936.

Fellner V, Sauer F D, and Kramer J K G. 1997. Effect of nigericin, monensin, and tetronasin on biohydrogenation in continuous flow-through ruminal fermentors. Dairy Science Journal **80**, 921–928.

Grummer RR. 1991. Effect of feed on the composition of milk fat. Dairy Science Journal **74**, 3244-3257.

Harfoot C G and Hazelwood G P. 1988. Lipid metabolism in the rumen. In The Rumen Microbial Ecosystem. P. N. Hobson, ed. Elsevier Science Publishing, New York, NY. 285–322.

Ipharraguerre IR and Clark JH. 2003. Usefulness of ionophores for lactating dairy cows: a review. Animal Feed Science Technology **106**, 39-57.

Neville MC and Picciano MF. 1997. Regulation of milk lipid secretion and composition. Annual Review of Nutrition **17**, 159-184.

Odongo NE, Or-Rashid MM, Bagg R, Vessie G, Dick P, Kebreab E, France J and McBride BW. 2007. Long-term effects of feeding monensin on milk fatty acid composition in lactating dairy cows. Dairy Science Journal **90**, 5126-5133.

Palmquist D L, Beaulieu A D and Barbano D M. 1993. Feed and animal factors influencing milk fat composition. Dairy Science Journal **76**, 1753–1771.

Sauer F D, Fellner V, Kinsman R, Kramer J K G, Jackson H A, Lee A J and Chen S. 1998. Methane output and lactation response in Holstein cattle with monensin or unsaturated fat added to the diet. Animal Science Journal **76**, 906–914.

Van Nevel C and Demeyer D I. 1995. Lipolysis and biohydrogenation of soybean oil in the rumen in vitro: Inhibition by antimicrobials. Dairy Science Journal **78**, 2797–2806.