Milk fatty acid profile from dairy cows fed increasing levels of soybean oil in diets based on tropical forage

F.C.F. Lopes[1], *C.G.S. Ribeiro*[2], *M.T. Ribeiro*[1], *N.M. Rodriguez*[2], *H.G.B. Filho*[1], *R.J.C. Castro*[1], *P.A.V. Barros*[1] *and M.A.S. Gama*[1]

[1]*National Dairy Cattle Research Centre, Embrapa, Juiz de Fora, MG, Brazil;* [2]*School of Veterinary Medicine, UFMG, Belo Horizonte, MG, Brazil; gama@cnpgl.embrapa.br*

Introduction

Due to health concerns, efforts have been done to decrease hypercholesterolemic saturated fatty acids (C12, C14 and C16:0) and increase *cis*-9 C18:1 and *cis*-9 *trans*-11 conjugated linoleic acid (CLA) in milk fat from dairy cows (Dewhurst *et al.*, 2006). Dietary supplementation with plant oils rich in linoleic and α-linolenic acids is a practical way to achieve this goal. However, most of these studies were conducted with temperate forage-based diets, usually conserved as silage or hay. During the conservation process, oxidative losses occur in the PUFA present in phospholipids (Dewhurst *et al.*, 2006). This can partially explain why milk fat from cows fed fresh green forage had higher unsaturated: saturated ratio and *cis*-9 *trans*-11 CLA than cows fed silage-based diets (Elgersma *et al.*, 2006). Therefore, the association of fresh tropical forage with plant oils seems to be an interesting dietary strategy for improving milk fatty acid profile of dairy cows. This study was designed to evaluate the effects of soybean oil levels on fatty acid profile from butter fat of dairy cows fed diets based on Elephant grass (*Pennisetum purpureum*) as tropical forage.

Material and methods

This study was conducted at the National Dairy Cattle Research Centre, Brazil. Twelve multiparous Holstein × Zebu dairy cows (90±25 DIM, initial milk yield and BW of 18.0±4.6 kg/d and 502.6±47.8 kg) were blocked according to milk yield and assigned to the following dietary treatments (DM basis): (1) Control: no soybean oil (SO); (2) T1: diets with 1.5% of SO; (3) T2: diets with 3.0% of SO and 4) T3: diets with 4.5% of SO. The experimental design was a 4×4 Latin square with 15-d treatment periods (10 d for adaptation and 5 d for data collection). Cows were allocated in free-stall barns and individual feed intake was recorded using the Calan headgate system (American Calan Inc., Northwood, NH, USA). Diets were fed once daily as a total mixed ration (TMR) and were composed of chopped Elephant grass and a concentrate mixture (50:50, on a DM basis). The Elephant grass was harvested daily at mid maturity stage and chopped immediately before TMR preparation. The basal concentrate was composed of ground corn, soybean meal, citrus pulp and a mineral-vitamin supplement. Soybean oil was mixed into the concentrate every 10 days throughout the study to prevent oxidative rancidity. Butter was prepared from milk produced by cows fed each dietary treatment at the first day of each collection period. Butter was stored at -20 °C degrees and subsequently analysed for fatty acid profile by gas chromatography using a CPSil-88 column as described by Destaillats *et al.* (2007). Treatment effects were determined by regression analysis using the GLM procedure of SAS® (2000) and declared significant at $P<0.05$.

Results

The concentration of selected FA identified in butter fat from cows fed each dietary treatment is presented in Table 1. Concentration of short and medium chain FA as well as odd chain FA were linearly decreased ($P<0.01$) in response to increasing levels of SO. In contrast, addition of SO to the diet linearly increased ($P<0.01$) the concentration of *trans*-C18:1 isomers in butter fat. The SO levels were also linearly and positively associated with *cis*-9 *trans*-11, *trans*-9 *cis*-11 and *trans*-10 *cis*-12 CLA in milk fat ($P<0.01$).

Table 1. Fatty acid concentration (g/100 g of total FA) in butter fat from dairy cows fed different levels of soybean oil (SO) in diets based on Elephant grass as tropical forage.

Fatty acids (g/100g of total FA)	Soybean oil levels (% DM)				Coefficient of variation (%)	Effect[1]	
	0	1.5	3.0	4.5		L	Q
C4:0 to C10:0	8.99	8.42	6.90	5.94	10.1	**	ns
C12:0 to C16:0	44.8	37.7	33.0	29.6	13.6	**	ns
Odd chain FA (except C19)	3.44	2.99	2.52	2.17	14.7	**	ns
C18:0	7.78	9.12	9.42	9.94	6.36	**	ns
C18:1 *trans-6 to 8*	0.23	0.51	0.66	0.88	15.7	**	ns
C18:1 *trans-9*	0.34	0.52	0.64	0.69	15.3	**	*
C18:1 *trans-10*	0.43	1.04	1.36	1.52	34.9	**	ns
C18:1 *trans-11*	2.00	4.24	6.44	9.35	21.0	**	ns
C18:1 *trans 12*	0.36	0.55	0.72	0.80	13.1	**	ns
C18:1 *trans-13 + trans-14*	0.50	0.66	0.75	1.18	37.7	**	ns
C18:1 *cis-9 + trans-15*	20.4	21.8	23.1	22.6	7.61	**	ns
C18:2 *cis-9 cis-12*	2.29	2.4	2.42	2.40	7.23	ns	ns
C18:3 *cis-9 cis-12 cis-15*	0.28	0.29	0.26	0.23	20.0	ns	ns
CLA *cis-9 trans-11*	1.28	2.47	3.74	4.59	18.0	**	ns
CLA *trans-9 cis-11*	0.02	0.04	0.06	0.08	15.1	**	ns
CLA *trans-10 cis-12*	<0.01	0.01	0.03	0.03	49.9	**	ns

[1] Probability of linear (L) or quadratic (Q) effect (*P<0.05, **P<0.01, ns: not significant).

Conclusion

Inclusion of soybean oil in Elephant grass-based diets positively affects milk fat composition of Holstein × Zebu lactating dairy cows.

Acknowledgement

The authors thank FAPEMIG and CNPQ for financial support as well as Rosimeire A.C. Dornelas and J.M. de Castilho for helping with butter production.

References

Destaillats, F., P.A. Golay, J. Joffre, M. Wispelaere, B. Hug, F. Giuffrida, L. Fauconnot and F. Dionisi, 2007. Comparison of available analytical methods to measure *trans*-octadecenoic acid isomeric profile and content by gas-liquid chromatography in milk fat. J. Chromat. A. 1145: 222-228.

Dewhurst, R.J., K.J. Shingfield, M.R.F. Lee and N.D. Scollan, 2006. Increasing the concentrations of beneficial polyunsaturated fatty acids in milk produced by dairy cows in high-forage systems. Anim. Feed Sci. Technol. 131: 168-206.

Elgersma, A., S. Tamminga and G. Ellen, 2006. Modifying milk composition through forage. Anim. Feed Sci. Technol. 131: 207-225.

SAS, 2000. Statistical analysis system, Release 8.02.2000. SAS Institute Inc. Cary, NC.

Ruminant physiology

Digestion, metabolism, and effects of nutrition on reproduction and welfare

edited by:
Y. Chilliard
F. Glasser
Y. Faulconnier
F. Bocquier
I. Veissier
M. Doreau

Proceedings of the XI[th] International Symposium on Ruminant Physiology

Wageningen Academic
Publishers