

Blood parameters of lambs fed diets with vegetable oil supplements

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ABSTRACT

The effect of different types of dietary fat on rumen parameters was assessed on four lambs with rumen cannulae in a 4×4 Latin square design. The basic ration for the control group consisting of meadow hay and concentrate (40:60) was supplemented for the experimental groups with 5% of rapeseed, sunflower or linseed oil. Volatile fatty acids, ammonia concentration and pH in rumen fluid, and glucose, free fatty acids, cholesterol and triglycerides in blood were determined. The propionic acid level was lower ($P<0.05$) in rumen fluid when 5% of rapeseed oil was added to the ration. Addition of rapeseed oil or linseed oil decreased blood glucose level.

KEY WORDS: oils, blood parameters, lipid metabolism, VFA, lambs

INTRODUCTION

Fats rich in chemopreventive agents, conjugated linoleic acid (CLA) and *trans* C 18:1 fatty acids may affect lipid and glucose metabolism (Selberg et al., 2004), improve the metabolic efficiency of some organs and the health of the animal (Hocquette and Bauchart, 1999). However, a number of studies reported that diets high in fat, especially in saturated fatty acids, increase the level of cholesterol and free fatty acids in blood. This study was carried out to assess the effect of vegetable oils in lamb rations on the blood metabolites and rumen parameters describing lipid metabolism.

MATERIAL AND METHODS

The experiment was carried out in a 4×4 Latin square design on 4 Whitehead meat type lambs fitted with permanent rumen cannulae. The basic diet (1.07 UFM, 105 g

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PDIN and 106 g PDIE) for the control group comprised hay and concentrate (40:60%), supplemented for the experimental groups with 5% (DM basis) of rapeseed, sunflower or linseed oil. The animals were adapted to the diet for 14 days and during the next 2 days of each period samples of blood and rumen fluid were collected.

Samples of rumen fluid were collected before the morning feeding and 3 and 6 h after feeding. The samples were analysed for pH, ammonia (modified Nessler's method) and volatile fatty acids (VFA) according to Tangerman and Nagengast (1996). Blood samples were obtained from the jugular vein at the same time as the rumen fluid and were analysed for free fatty acids (colorimetric methods by Dancomba), glucose (GOD-PAP, method; Polfam Dialab[®]), triglycerides (GOD-PAP method; Polfam Dialab[®]) and cholesterol (ChOD-PAP method; Polfam Dialab[®]).

Data were analysed by the ANOVA software programme for a Latin square design by using the General Linear Models procedure of SAS (1996).

RESULTS

Supplementing vegetable oil to the diets significantly ($P < 0.05$) influenced only the glucose concentrations in the blood samples collected before feeding, which were higher in the control (85.8 mg/dL) and SFO (82.3 mg/dL) groups than in groups RSO and LSO (68.2 and 68.6 mg/dL). Differences between the effect of the oils on the concentrations of triglycerides, cholesterol and free fatty acids and time after feeding did not reach statistical significance ($P > 0.05$).

Supplementation of diets with 5% of RSO decreased ($P \leq 0.05$) the level of propionic acid, whereas SFO and LSO did not cause such an effect (Table 1). An increasing tendency in acetic, propionic and butyric acid levels in the rumen 3 and 6 h after feeding was found compared with samples taken before feeding.

Vegetable oils, especially 5% of rapeseed oil, decreased the level of rumen ammonia but the differences were not statistically significant (Figure 1). Rumen pH remained stable regardless of the added fat and time after feeding (Figure 1).

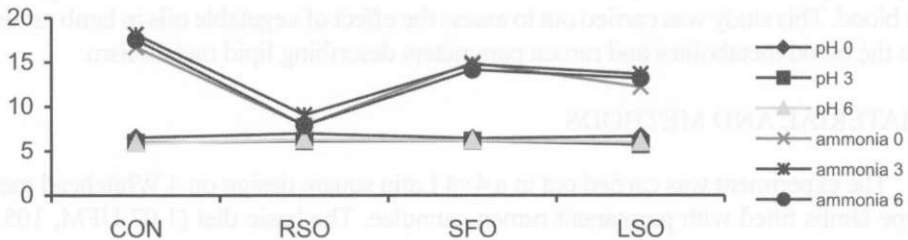


Figure 1. Effect of supplementing different oils to lamb rations on the concentration of rumen ammonia (mmol/L) and pH

TABLE 1

Effect of vegetable oils on the concentration of individual VFA in the rumen of sheep, mmol/L.

Item	Type of added oil				SEM ¹
	control	RSO [*]	SFO ^{**}	LSO ^{***}	
Acetate					
before feeding	44.64	32.77	34.48	33.59	15.42
3 h after feeding	55.06	47.16	45.07	44.83	20.16
6 h after feeding	54.23	46.93	47.41	46.84	21.20
Propionate					
before feeding	15.89	11.81	13.88	14.02	6.21
3 h after feeding	24.87 ^{aa}	17.01 ^{bb}	21.41 ^{ab}	25.81 ^{aa}	9.58
6 h after feeding	26.36	17.65	22.92	25.60	10.25
Iso-butyrate					
before feeding	1.77	1.38	1.45	1.40	0.65
3 h after feeding	1.92	1.34	1.24	1.39	0.56
6 h after feeding	1.87	1.23	1.13	1.10	0.50
Butyrate					
before feeding	11.64	7.04	9.38	10.14	4.19
3 h after feeding	14.57	10.13	13.13	15.93	5.87
6 h after feeding	15.05	10.51	12.21	18.35	5.46
Iso-valerate					
before feeding	0.86	0.79	0.67	0.64	0.30
3 h after feeding	0.87	0.71	0.62	0.75	0.28
6 h after feeding	0.94	0.74	0.61	0.66	0.27
Valerate					
before feeding	1.34	1.04	0.90	1.21	0.40
3 h after feeding	1.57	1.22	1.57	2.23	0.70
6 h after feeding	2.07	1.37	1.43	2.18	0.64

¹SEM - mean standard error; means in rows with the same letter are not significantly different^{a,b}- P₂≤0.05, ^{*}RSO - rapeseed oil, ^{**}SFO - sunflower oil, ^{***}LSO - linseed oil

DISCUSSION

The effect of supplementing fat to ruminants' rations depends on the level supplementation and the oil's fatty acid composition. Dietary fats undergo biohydrogenation. The degree of saturation of dietary fat influences digestion and absorption of fat (Oldick et al., 1997), and hence rumen and blood parameters. Saturated fatty acids seem to have a more detrimental effect on lipid metabolism parameters than unsaturated ones, and usually have resulted in increased blood levels of metabolites (e.g., cholesterol, free fatty acids) and changed proportions of individual fatty acids in the rumen. This hypothesis may explain the results of our research, in which different vegetable oils, sources of unsaturated fatty acids, C 18:1, C 18:2 and C 18:3, generally had no effect on basic blood and rumen parameters, except on glucose when RSO and LSO were added, and on propionic

acid with RSO. Similarly, according to Petit et al. (2002) and Rigout et al. (2003), fluctuations in the glucose level did not reflect the quantity and proportions of VFA. The observed decreased level of ammonia can be explained according to Doreau and Ferlay (1995) by the detrimental effect of fat supplements, especially RSO, on microbial synthesis in the rumen. Addition of 5% rapeseed, sunflower or linseed oils to lambs rations as energy supplements and meat fatty acid composition modifiers seems to be a safe quantity.

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STRESZCZENIE

Poziom wskaźników w krwi jagniąt żywionych paszami z dodatkiem olejów roślinnych

Doświadczenie przeprowadzono w układzie kwadratu łacińskiego 4×4 na czterech jagniętach typu mięsnego z kaniulami do żwacza. Podstawowa dawka pokarmowa składała się z paszy treściwej i objętościowej w stosunku 60:40 (kontrolna), z dodatkiem 5% oleju rzepakowego, słonecznikowego lub lnianego w suchej masie dawki w grupach kontrolnych. Dodatek 5% oleju rzepakowego oraz lnianego statystycznie istotnie ($P<0,05$) obniżył poziom glukozy we krwi, natomiast 5% oleju rzepakowego obniżył poziom kwasu propionowego ($P<0,05$) w treści żwacza. Nie stwierdzono istotnych zmian poziomu pH oraz stężenia amoniaku w żwaczu jagniąt żywionych dawką z dodatkiem badanych olejów.