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Linseed-based diets for sheep. 2. Performance and chemical composition of meat and liver*

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ABSTRACT

The effects of dietary linseed cultivars, traditional (Opal, Omega) or the new Linola cultivar with an increased content of linoleic acid, on the performance and chemical composition of lamb meat and liver were investigated. The animals were fed meadow hay and concentrate. The control group received no linseed in concentrate, whereas the experimental groups received 10% crushed linseed of different cultivars. There was no significant effect of linseed, irrespective of cultivar, on daily weight gains of the lambs, feed conversion, dressing percentage and chemical composition of leg muscle and liver. However, significant ($P<0.05$) changes were shown in the fatty acid profile of meat and liver.

KEY WORDS: linseed, lambs, meat, liver, chemical composition

INTRODUCTION

Fat in linseed is characterized by a high content of unsaturated fatty acids, which may adversely affect microorganism growth and nutrient utilization in the rumen (Jenkins, 1993). Market varieties of linseed vary in their fatty acid composition, which may positively affect the performance of lambs and the dietary value of their meat. Traditional cultivars have a high content of $C_{18:3}$, while the new cultivar Linola is higher in $C_{18:2}$ and lower in $C_{18:3}$ acid (Borowiec et al., 2001). The aim of the present study was to determine the effects of dietary linseed cultivars (traditional ones and Linola) on performance as well as on the chemical composition of meat and liver of lambs.

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MATERIAL AND METHODS

The lambs were fattened for 55 days from about 20 to 31 kg body weight. The animals were assigned to 4 groups of 10 animals and were fed meadow hay (0.5-0.7 kg/head) and concentrate (0.4-0.65 kg/head). The control group (I_K) received no supplemental linseed in concentrate, whereas groups II_{OP}, III_{OM} and IV_{LI} received 10% crushed linseed of cultivars Opal, Omega, or Linola™947, respectively. All diets were isonitrogenous and only slightly differed in energy value. At the end of fattening, 4 animals from each group were slaughtered and representative samples of leg muscle and liver were taken for analyses. The chemical composition of feeds, meat and liver was determined according to AOAC (1995) methods. The fatty acid profile was analysed by gas chromatography (Varian Star 3400 CX; detector FID). The data were subjected to one-way analysis of variance using the GLM procedure of SAS (1995). The individual means were compared by the Scheffe test (SAS, 1995).

RESULTS

Compared with the control diet, traditional linseed cultivars (Opal and Omega) caused an increase in the content of $C_{18:3}$, while the Linola cultivar supplement increased the content of $C_{18:2}$ in the fatty acid profile of the diets.

There was no statistically significant effect of feeding linseed concentrate on daily weight gains of the lambs, feed conversion or dressing percentage (Table 1)

TABLE 1

Performance of lambs

Item	Group				P	SEM
	I_K	II_{OP}	III_{OM}	IV_{LI}		
Daily weight gain, g	178.9	174.2	168.0	172.0	0.9828	9.34
Energy and protein conversion, per kg of gain						
UFV	4.97	5.22	5.40	5.29	-	-
PDIN, g	498.6	512.6	532.7	522.7	-	-
PDIE, g	531.4	552.1	552.6	539.8	-	-
Hot carcass yield, %	42.9	43.8	42.5	44.1	0.5668	0.53
Cold carcass yield, %	40.9	42.0	40.8	42.2	0.6587	0.54

as well as on the chemical composition of meat and liver (Table 2). In these tissues, the cholesterol content was increased in each experimental group (P>0.05). Moreover, significant changes were noted in the fatty acid profile of meat and liver. There was an increase in the sum of unsaturated fatty acids (mainly $C_{18:1}$ and $C_{18:3}$ in groups II_{OP} and III_{OM}, and $C_{18:2}$ in group IV_{LI} as well as CLA in all experimental

groups) which was accompanied by a decrease in the saturated fatty acid content (mainly palmitic acid in meat and stearic acid in liver).

TABLE 2

Chemical composition and fatty acid profile of leg muscle, %

Item	Group				P	SE
	I_K	II_{OP}	III_{OM}	IV_{LI}		
Dry matter, %	22.66	23.11	23.55	24.27	0.4860	0.36
Crude ash, %	1.16	1.20	1.15	1.18	0.4437	0.01
Crude protein, %	20.35	20.58	20.24	20.15	0.9570	0.26
Ether extract, %	2.14	2.01	2.40	2.72	0.6747	0.21
Total cholesterol, mg%	92.10	103.75	102.48	105.63	0.5059	3.28
Fatty acids						
$C_{14:0}$	2.02	1.97	1.94	2.07	0.9807	0.11
$C_{16:0}$	23.11^{a}	21.37^{ab}	21.09^{ab}	20.51^{b}	0.0374	0.36
$C_{16:1}$	0.93	1.01	1.28	0.91	0.3355	0.08
$C_{18:0}$	21.11	21.40	19.78	21.94	0.3281	0.42
$C_{18:1}$	35.55^{B}	38.38^{A}	39.49^{A}	35.47^{B}	0.0001	0.49
$C_{18:2}$	11.29	10.02	10.35	12.66	0.2355	0.49
$C_{18:3}$	1.02^{b}	1.85^{a}	2.23^{a}	1.08^{b}	0.0261	0.18
$C_{20:0}$	0.37	0.38	0.38	0.49	0.3940	0.03
$C_{20:1}$	0.13	0.20	0.28	0.13	0.6015	0.04
$C_{20:3}$	0.50	0.29	0.43	0.32	0.1642	0.04
$C_{20:4}$	2.83	2.18	1.78	2.23	0.1512	0.16
CLA	0.19^{b}	0.35^{ab}	0.49^{a}	0.29^{ab}	0.0125	0.04
others	0.95	0.60	0.48	1.90	0.3096	0.29
Sum of unsaturated acids	52.44	54.28	56.33	53.09	0.0606	0.57
n-6 : n-3 ratio	14.33^{A}:1	6.75^{B}:1	5.63^{B}:1	14.08^{A}:1	0.0016	1.33

$^{A, B}$ $P<0.01$; $^{a, b}$ $P<0.05$

TABLE 3

Chemical composition of liver and content of some fatty acids in fat, % of total FA

Item	Group				P	SE
	I_K	II_{OP}	III_{OM}	IV_{LI}		
Dry matter, %	29.02	30.06	31.47	30.45	0.1280	0.37
Crude protein, %	20.18	20.66	21.32	21.25	0.2667	0.23
Ether extract, %	2.56	3.22	3.75	3.14	0.5189	0.27
Total cholesterol, mg%	378.43	412.55	428.45	433.03	0.6624	16.01
Fatty acids						
C18:0	28.81	25.30	25.02	26.76	0.0545	0.57
C18:1	27.62^{b}	30.35^{a}	30.15^{a}	28.55^{b}	0.0393	0.42
C18:2	10.30^{b}	11.07^{ab}	11.41^{ab}	11.96^{a}	0.0139	0.21
C18:3	2.47	4.24	3.92	2.79	0.2177	0.35
CLA	0.16^{B}	0.35^{A}	0.35^{A}	0.33^{A}	0.0003	0.02

DISCUSSION

The supplementation of concentrate with linseed (10%) caused not only an increase in the contents of fat and energy in diets but also changed their fatty acid profile. Linseed did not disturb rumen function (Micek et al., 2004). Probably for this reason no significant effect of linseed was found on the performance of animals and chemical composition of their products. On the other hand, the increased content of polyunsaturated fatty acids, including CLA in meat and liver, increased their health value because of their hypocholesterolemic and anticarcinogenic properties (Bartnikowska and Kulasek, 1994). Supplementation also results in a more desirable ratio of n-6 to n-3 unsaturated fatty acids (groups II_{OP} and III_{OM}).

CONCLUSIONS

The 10% supplement of linseed to concentrate mixtures for fattened lambs had no negative effect on the performance of the animals and had no effect on the chemical composition of their meat and liver.

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STRESZCZENIE

Wpływ nasion lnu w dawkach pokarmowych dla owiec. 2. Wyniki produkcyjne oraz skład chemiczny mięsa i wątroby

Badano wpływ nasion lnu odmian o tradycyjnym (Opal, Omega) lub zmodyfikowanym profilu kwasów tłuszczowych (Linola) na efekty produkcyjne oraz skład chemiczny mięsa i wątroby tuczonych jagniąt. Zwierzęta żywiono sianem łąkowym oraz mieszanką treściwą bez dodatku nasion lnu (grupa kontrolna) lub z 10% udziałem nasion lnu różnych odmian (grupy doświadczalne). Nie stwierdzono statystycznie istotnego wpływu skarmiania mieszanek z dodatkiem lnu na przyrosty masy ciała jagniąt, wykorzystanie paszy, wydajność rzeźną i skład chemiczny produktów. Stwierdzono natomiast statystycznie istotne zmiany w składzie kwasów tłuszczowych mięsa i wątroby, zwłaszcza zwiększenie udziału kwasów $C_{18:1}$, $C_{18:2}$, $C_{18:3}$ i CLA.