MEAT QUALITY OF FATTENING CATTLE FINISHED ON GRASS SILAGE DIET SUPPLEMENTED WITH RAPESEED OIL

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Introduction

Meat quality and its technological properties are influenced by the feeding system, feed quality and various feed additives and supplements. Because energy intake influences growth rate and carcass fatness: higher energy intake tends to increase the fatness of animal carcasses. Meat quality is a complex trait, referring to the compositional, visual and sensory traits of a carcass, or its retail cuts (Brzoska et al, 1999). Ruminant meats are generally low in polyunsaturated fatty ac ids (PUFA) and rich in saturated fatty acids (SFA). Lean beef has an intramuscular fat content of around 5 % or less with approximately 47, 42 and 4 % of total fatty acids as saturated fatty acids (SFA), monounsaturated fatty acids (MUFA) and polyunsaturated fatty acids (PUFA), respectively (Moloney et al., 2001). Following human health guidelines many studies have aimed at increasing the PUFA content. Enhancing the PUFA and decreasing the SFA content of beef could improve the healthful characteristics of the fat produced by ruminants (Scollan et al., 2003). Increasing the dietary supply of PUFA is one of the most important strategies allowing modification of beef fat composition. Hence, feeding diet rich of unsaturated acids (18:1, 18:2, 18:3) can increase the levels of these MUFA and PUFA in the meat (Felton and Kerley, 2004). Rapeseed oil may be an available fat source that contains large quantities of unsaturated fatty acids (FA). Thus, the objective of this study was to investigate the effects of feeding rapeseed oil in the diet of fattening bulls on animal performance, carcass characteristics and the FA composition of skeletal and cardiac muscles and adipose tissue.

Material and methods

Fourteen fattening young bulls of the Lithuanian Black-and-White breed with an initial mean live weight of 373 kg were randomly allocated to one of two dietary treatments, each consisting of seven animals. All animals were offered a first cut legume-grass silage *ad libitum* plus one of the two concentrates: RAP0 - barley (83%), soybean meal (15%), mineral-vitamin mixture (2%), or RAP1- barley (72%), soybean meal (15%), mineral-vitamin mixture (2%), rapeseed (canola) oil (11%). Canola oil has high content of unsaturated FA 18:1, 18:2 and 18:3 (59.5, 24.3 and 8.6% of total fat, respectively). The experiment was carried out according to the analogous design, consisting of 21 days of pre-experimental period and 168 days of the experimental period. Three animals from each group were slaughtered at the end of the experiment and blood and heart muscle samples were taken. The carcasses were held in chill for 48-h before butchering and sampling. Complete cross-sections of the *longissimus thoracis* muscle at the 10-12th rib level and depot fat (adipose tissue) samples from the left side of each carcass were taken and chemical composition analyzed. The composition of FA methyl esters were measured using gas-liquid chromatography. Samples of ruminal contents were taken. All the data were subjected to general one-way ANOVA (Genstat 5) with diets as main factor.

Results and Discussion

The average daily feed intake was 18.5 and 18.1 g DM/kg liveweight with a forage: concentrate ratio of 75:25 (DM basis), the average daily gain (ADG) was 1.1 and 1.2 kg/day and the average final weight 557 and 571 kg in RAP0 and RAP1 groups, respectively.

Table 1. Physicochemical indicators of M. *longissimus thoracis*

	RAP0	RAP1	$LSD_{0.05}$	$LSD_{0.01}$	$S_{\bar{x}}$
Meat pH	5.32	5.53	0.75	1.73	2.28
Water binding capacity %	61.23	63.6**	0.52	1.19	0.13
Cooking losses %	44.84	44.74	5.04	11.63	1.81
Tryptophan mg/ 100 g	338.64	338.63	90.16	207.97	4.37
Oxyprolin mg/100 g	84.01	72.04	43.38	100.07	9.14
Protein value index	4.20	4.70	3.11	7.19	11.51

In RAP1group, the pH-values of the *M. longissimus thoracis* was by 0.21 unit higher, water binding capacity by 2,37% (P<0,01) higher, cooking losses by 0.1% lower and protein value index by 0.5 unit higher in comparison with the RAP0 group (Table 1). Therefore, the nutritive value of these muscle was higher in RAP1 group compare to RAP0 group (Kim, 1994).

Most individual saturated FA were not influenced by the rapeseed oil diet. Generally, differences between the two treatments in FA composition were greater in blood serum and heart muscle than in *longissimus thoracis* muscle (Table 2). Proportions of 18:1n-9 and 18:2n-6 were greater (P<0.05) or tended to be greater in blood serum, heart muscle and *longissimus thoracis* muscle from cattle fed rapeseed oil compared with the diet without oil. FA 20:4n-6 decreased significantly in blood serum but tended to increase in *longissimus thoracis* muscle and heart muscle. Contrasting with the higher 18:2n-6 acid content of the *longissimus thoracis* muscle and heart muscle due to rapeseed oil application, this effect was not observed for blood serum 18:2n-6 content. Oils containing high concentrations of C18 unsaturated FA have consistently decreased protozoal counts or activity (Oldick and Firkins, 2000). Our present data showed no significant difference in analysed rumen fluid infusoria count, however microbial protein synthesis significantly (P<0.05) decreased on the rapeseed oil diet.

Table2. Effect of rapeseed supplementation on FA composition of tissues in fattening bulls fed silage diet (% Total FA)

Individual fatty acids	Diets							
	RAP0				RAP1			
	LTM	BS	DF	HM	LTM	BS	DF	HM
18:1(n-9)	46.95	8.73	31.89	24.37	48.07	18.52*	37.66	23.06
18:2(n-6)	0.98	34.22	0.44	17.29	1.92*	31,16	0.42	24.43*
18:3(n-3)	0.52	9.88	0.30	1.92	0.58	10.70	0.36	2.82
20:4(n-6)	0.42	1.19		5.16	0.50	0.9		5.50
SFA	45.97	36.07	63.66	45.27	44.08	31.54	58.63	40.20
MUFA	51.65	17.62	34.48	28.47	52.44	25.00**	39.70	25.20
PUFA	2.38	46.31	1.86	26.26	3.49	43.46	1.67	34.60*

LTM - *longissimus thoracis* muscle; BS - blood serum; DF - depot fat; HM - heart muscle.
SFA - saturated FA (C14:0+C16:0+C18:0); MUFA - monounsaturated FA (C16:1+C18:1); PUFA - polyunsaturated FA (C18:2n-6+ C18:3n-3+C20:4-n-6+C20:5n-3+C22:4n-6+C225-n-3+C22:6n-3)

Conclusions

In the present experiment feeding canola oil to fattening bulls during finishing period suported higher level of growth by cattle and resulted in the higher nutritive value of the *longissimus thoracis* muscle. Were found a small decrease in SFA content and in higher (P<0.05) level of 18:2 n6 and PUFA in both beef and heart intramuscular fat. However, microbial protein synthesis decreased (P<0.05) on the rapeseed oil diet.

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References

1. Brzoska, F., Brejta, W. and Gasior, R. (1999). Fattening efficiency, carcass parameters and meat composition in bulls. *Polish Annals of Animal Science, 26, 1*, 141- 154.
2. Felton, E.E. and Kerley, M.S. (2004). Performance and carcass quality of steers fed different sources of dietary fat. *Journal of Animal Science, 82,* 1794-1805.
3. Kim, Y. S. (1994). Carcass characteristics and meat quality in forage-finished and grain-finished beef. *Proc. Hawaiian Home Lands Livestock Education and Assistance Symposium*, Hitahr, 121-125.
4. Moloney, A.P., Mooneu, M.T., Kerry, J.P. and Troy, D.J. (2001). Producing tender and flavoursome beef with enhanced nutritional characteristics. *Proceedings of the Nutrition Society, 60,* 221-229.
5. Oldick, B.S. and Firkins, J.L. (2000). Effects of degree of fat saturation on fiber digestion and microbial protein synthesis when diets are fed twelve times daily. *Journal of Animal Science, 78,* 2412-2420.
6. Scollan, N.D., Enser, M., Gulati, S.K., Richardson, I. and Wood, J.D. (2003). Effects of including a ruminally protected lipid supplement in the diet on the fatty acid composition of beef muscle. *British Journal of Nutrition, 90(3),* 709-716.