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Estimation the grass feeding influence on cattle productivity and meat quality.

Ruslan Saferbegovich Omarov[1]*, Evgeny Ivanovich Rastovarov[1], Tatiana Sergeevna Alexandrova[1], Anton Alekseyevich Nesterenko[2], and Sergei Nikolayevich Shlykov[1].

[1]Stavropol State Agrarian University, Technological Management Department, Zootekhnicheskiy lane 12, Stavropol 355017, Russia.
[2]Kuban State Agrarian University, Faculty of Processing Technologies, Kalinina St., 13, Krasnodar 350044, Russia.

ABSTRACT

This article presents the results of ongoing research into the feasibility of an intravital modification of the fatty acid composition of beef. The influence of introducing different doses of vegetable oils rich in PUFA on the productivity of animals and the quality of the beef obtained is considered in the ration of cattle. Particular attention is paid to the study of fatty acid composition of meat and its organoleptic characteristics.
Keywords: beef, grass feeding, polyunsaturated fatty acids, meat quality.

Corresponding author

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INTRODUCTION

The quality of nutrition is becoming increasingly important in the modern world and directly depends on the quality of food [1]. Much attention is paid to increasing the content of n-3 PUFAs in food products, since the increased consumption of long-chain PUFA n-3 has a beneficial effect on human health and will reduce the incidence rate [6-12]. Green fodder, rich in C18: 3n-3, is an important tool to increase the delivery of n-3 PUFAs through ruminants to meat (and milk). Because C18: 3n-3 are building blocks of long chains-3 PUFAs (EPA and DHA). However, the levels of n-3 PUFA, C18: 3n-3, EPA and DHA achieved by the basic diets of feeding are below the level necessary to state that beef is either a "source" or has a "high content" of n-3 PUFA and increase them possibly by reducing lipolysis and / or biohydrogenation in the rumen by secondary compounds such as polyphenidoxidase, saponins, tannins and catecholamines. These methods will make it possible to obtain beef enriched with PUFA [2-5].

At this stage of the study, the effect of introducing vegetable oils rich in C18: 4n-3 PUFAs (Echium spp.) on the productive qualities of animals, fatty acid composition and quality of beef was assessed.

MATERIAL AND METHODS

Thirty-two bulls of the Kalmyk breed were distributed to one of four diets (8 animals / diet): 1) the grass silage (GS) according to the adlibitum system (control), 2) the grass silage GS plus 1.5% Echiumoil oil (Northstar Lipids Ltd.)., UK) / taken dry matter (DMI) (Echium 1.5%), 3) grass silage plus 3.0% Echiumoil / DMI (Echium 3%) and 4) grass silage plus 3.0% linseed oil / DMI Linseed 3%). The oils were mixed with sugar beets (1 kg) before feeding. The live weight was measured every 14 days, and the average number of days on the experimental diets was 95 ± 8 days. Slaughter of animals was carried out at the attainment of the fatness class 3L. To analyze the fatty acid composition and sensory evaluation, the longest muscle of M. longissimus back was selected.

RESULTS AND DISCUSSION

Feed intake from forage was the same for all diets, however, as expected, there was a significant change in oil consumption (Table 1).

Table 1: Productive indices of animals depending on diet

	Diet				*P*
	Control	Echium 1.5%	Echium 3%	Linseed oil 3%	
Consumed forage	7.68	7.76	7.79	7.69	0.983
Consumed oil	-	117	234	231	<0.001
Growth of live weight (kg / day)	0.71	0.79ab	0.91	0.81	0.033
Age of slaughter (day)	777	777	776	782	0.936
Weight of the chilled side (kg)	194.4	194.6	197.2	192.8	0.925
Body structure	92.5	77.5	77.5	77.5	0.263
Fatness	89.4	83.1	95.6	83.8	0.439

The increase in the live weight of animals receiving 3% of Echium oil was greater than in control animals (oil-free diet), but the slaughter age (which was carried out when animals reached the 3L fatness class), the mass of the chilled carcass, body structure and fatness were the same for all diets, which indicates that any changes in the fatty acid composition of muscle tissue do not affect the fatness of the carcass or age.

The next step in the experiment was to evaluate the effect of Echium spp. (bruise) of a rich 18: 4 n-3 PUFA for the fatty acid composition and the quality of the resulting beef. The introduction of this oil was expected to increase the C18: 3n-3 and long-chain fatty acids C20 and C22, eicosapentaenoic acid (EPA), docosapentaenoic acid (DPA) and docosahexaenoic acid (DHA) in muscle lipids.

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The results obtained indicate that the addition of Echiumspp oil or linseed oil did not affect the total content of lipids, neutral lipids, phospholipids, saturated fatty acids, fatty acids, fatty acids, or PUFA as compared to forage fattening alone (Table 2).

Table 2: Fatty acid composition of M. longissimus from experimental animals

	Diet				SED	P
	Control	Echium spp 1.5%	Echium spp 3%	Linseed oil 3%		
Concentration of mg / 100 g of muscle						
Total amount of lipids	3138.0	4034.4	3964.3	3378.4	572.3	0.334
Total amount of neutral lipids	2678.4	3553.8	3495.8	2912.3	566.2	0.340
Total amount of phospholipids	459.6	480.6	468.4	466.1	19.25	0.742
Saturated fatty acids[A]	1328.4	1785.5	1717.9	1454.4	267.6	0.293
MNFA[B]	1311.6	1648.8	1643.8	1359.4	253.7	0.402
PUFA[C]	164.7	175.3	173.3	175.3	9.09	0.613
Sum of n-6[D]	78.2	85.5	85.3	83.7	4.40	0.330
Sum of n-3[E]	86.5	89.7	88.0	91.6	5.05	0.767
Health indicators						
P:S[F]	0.06	0.06	0.06	0.07	0.009	0.755
n-6:n-3	0.91	0.95	0.97	0.92	0.029	0.154
EPA+DHAG	23.4	23.1	20.8	24.6	1.645	0.116

[A] Saturated fatty acids, (12:0 + 14:0 + 16:0 + 18:0).
[B]MNFA, (16:1 + t18:1 + 9c18:1 + 11c18:1 + 20:1).
[C]PUFA, (18:2n-6 + 18:3n-3 + 18:4n-3 + 20:3n-6 + 20:4n-6 + 20:4n-3 + 20:5n-3 +22:4n-6 + 22:5n-3 + 22:6n-3).
[D] n-6 PUFA (18:2n-6 + 20:3n-6 + 20:4n-6 + 22:4n-6).
[E] n-3 PUFA (18:3n-3 + 18:4n-3 + 20:4n-3 + 20:5n-3 + 22:5n-3 + 22:6n-3).
[F] P:S, (18:2n-6 + 18:3n-3)/(12:0 + 14:0 + 16:0 + 18:0).
[G]mg / 100 g of muscle.

In addition, the ratio of fatty acids n-6: n-3, and P: S was also independent of the diet, as was the concentration of EPA + DHA in total lipids. longissiumus (Table 2).

The diet with added oils also had a slight effect on the fractionated lipid components. The addition of 3% Echium spp.oil to the diet improved C18: 1 trans and cis-9 deposition, trans-11 CLA in both neutral and phospholipid fractions, and also increased C18: 4n-3 in the neutral lipid fraction (Table 3).

Table 3: Concentration of fatty acids (mg / 100 g of muscle) in lipid fractions of M. longissimus

	Diet				SED	P
	Control	Echium spp 1.5%	Echium spp 3%	Linseed oil 3%		
Neutral lipids						
C14:0	86.8	130.3	127.0	104.8	24.0	0.253
C16:0	761.1	1030.4	1003.3	818.5	167.7	0.304
C16:1	120.0	164.1	158.4	127.3	28.3	0.324
C18:0	375.5	514.8	480.6	428.0	77.9	0.318
C18:1*trans*	37.9a	71.7ab	112.4c	73.7b	13.0	<0.001
C18:1*cis-9*	993.8	1237.2	1203.9	1002.6	207.3	0.517
C18:2n-6	18.6	23.6	22.9	20.1	3.3	0.388
C18:3n-3	13.2	16.0	15.3	14.1	2.2	0.591
CLA[A]	9.2a	14.8a	23.1b	14.3a	3.0	<0.001
C18:4n-3	1.1a	1.6ab	2.3b	1.9ab	0.4	0.026
Phospholipids						
C14:0	0.889	0.993	1.110	0.834	0.324	0.838

C16:0	60.899	63.302	60.824	57.610	3.59	0.479
C16:1	11.732	13.318	12.155	10.849	0.975	0.108
C18:0	41.298	42.832	42.206	42.308	1.878	0.874
C18:1*trans*	1.880a	2.782b	4.572c	2.972b	0.326	<0.001
C18:1n-9	106.095	114.144	106.280	102.652	6.24	0.323
C18:2n-6	32.383	34.357	36.250	35.496	1.844	0.197
C18:3n-3	18.069	18.927	19.688	20.440	1.113	0.196
CLAA	0.770a	1.091a	1.642b	1.081a	0.118	<0.001
C18:4n-3	0.244	0.226	0.225	0.219	0.036	0.910
C20:3n-6	4.519	4.342	4.382	4.425	0.313	0.949
C20:4n-6	19.978	20.118	18.602	20.880	1.142	0.269
C20:4n-3	3.822	3.526	3.918	3.639	0.337	0.652
C20:5n-3	18.979	18.410	16.899	19.806	1.306	0.178
C22:4n-6	1.215	1.278	1.342	1.149	0.107	0.322
C22:5n-3	23.346	22.358	21.898	23.069	1.321	0.685
C22:6n-3	3.664	3.747	3.110	3.757	0.369	0.263

[A] CLA, 18:2*cis-9*, *trans-11* CLA.

Other basic fatty acids, including long-chain fatty acids C20 phospholipids, were not dependent on the diet. Study of individual CLAM isomers. longissiumus revealed an increased content of 6 of the 13 CLA isomers detected, including cis-9, trans-11 CLA, which had a healing effect on human health (Belury, 2002), when 3% of Echium spp. oil was applied compared to the control. Addition of 1.5% oil Echium spp. or linseed oil increased deposition of trans-7, trans-9 CLA and trans-11, trans-13CLA. For all other CLA isomers, 1.5% of Echium spp. or linseed oil had an intermediate effect on their concentration compared with the application of 3% Echium spp. oil or control. It is suggested that a higher concentration of C18: 1 trans and CLA in muscles may indicate that the fatty acids of both Echium spp. Oil and linseed oil are prone to severe bio-hydrogenation in the rumen.

Shelf life, sensory characteristics, color saturation of meat from all animals, as expected, declined over time. There was no effect of rations on the saturation of the color of meat, nor the interaction between diet and time. All diets maintained a color saturation level above the threshold for acceptable meat color for at least 15 days on the Simulated retail display unit, but by the 18th day beef from all the groups had a color saturation <18. There was no effect from rations for oxidative stability in TBARS, chromaticity on day 10 on the Simulated retail display unit or vitamin E content in muscles (Table 4).

Table 4: Oxidative stability of M. longissimus steaks depending on rations

	Diet				SED	P
	Control	Echium spp 1.5%	Echium spp 3%	Linseed oil 3%		
TBARS, day 10[A,B]	0.62	0.52	0.44	0.46	0.075	0.213
Chroma, day 10	22.1	22.7	22.4	22.2	0.562	0.663
Vitamin E[C]	5.88	6.18	5.92	6.03	0.460	0.914

[A] mg madonnaaldehyde / kg of meat.

[B] The values are geometric values from the reverse transformations of the ERMS from Log10 (Log10 conversions used for analysis).

[C] mg / kg of muscle.

The diets used also had insignificant influence on the taste indicators, significant differences were noted only in terms of "vegetable / herbal" and "milky" flavor. The ration of cattle on the basis of linen intensified the manifestation of "vegetable / herbal" aftertaste, and a diet based on 3% of Echium spp oil increased the attribute of "milk" taste (Table 5). However, the overall taste values were similar between the rations used.

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Table 5: Taste of fried steaks from experimental animals, with a final temperature of 74 ° C

Attribute	Diet				P
	Control	Echium spp 1.5%	Echium spp 3%	Linseed oil 3%	
8 point scale					
Texture	5.14	4.77	4.75	5.22	0.0809
Juiciness	5.41	5.42	5.42	5.34	0.9620
Intensity of beef flavor	5.23	5.05	5.19	5.20	0.5185
Abnormal flavor intensity	2.47	2.69	2.47	2.80	0.1125
Thickness 100 mm					
Greasiness	19.08	20.02	19.66	17.39	0.4223
Bloodiness	15.05	14.39	14.08	14.13	0.9703
Hepatic smack	11.25	11.64	13.14	12.08	0.7005
Metallic taste	15.58	14.59	16.30	17.48	0.4794
Astringency	7.73	7.02	6.77	9.00	0.5938
Sweetness	16.09	13.55	16.73	14.77	0.3302
Rancidity	0.75	0.86	0.44	0.55	0.4076
Fish taste	2.92	3.19	2.69	2.97	0.6640
Acidity	9.84	11.09	10.11	11.38	0.7270
Cardboard	11.89	13.11	13.45	14.39	0.2863
Vegetable / mint flavor	12.47b	13.63ab	13.11b	15.81a	0.0440
Milk aftertaste	26.72ab	23.55b	29.86a	25.02b	0.0228
Hedonism					
General taste	57.59	55.00	58.02	54.58	0.5092

The introduction of Echium spp. Oil or linseed oil into the ration of cattle contributed to the improvement of the long-chain fatty acid profile of C20 in beef, but had a negligible effect on its quality.

The European Food Safety and Labeling Authority (EFSA) introduced a standard for the level of content in long-chain PUFA products that allows them to be labeled with n-3 PUFAs. They concluded that this standard should be based on the body's requirement of 250 mg per day EPA + DHA or 2g per day C18: 3n-3 to be labeled as "source" or "high content" the product should contain 40 or 80 mg EPA plus DHA per 100 g (European Food Safety Authority, 2009). The results obtained from these studies on directional modification of the fatty acid composition of beef indicate that the levels of EPA and DHA ranged from 11 to 25 mg / 100 g of muscle, with higher values in beef herbal fat supplemented with oils, but despite the increased content of PUFA this indicator is below the recommended level of 2 g 18: 3n-3 per 100 g of product.

CONCLUSION

Adding to the diet of flax meat and oil Echium spp. had an obvious effect on fatty acid composition of meat. The study of PUFA isomers revealed that a higher concentration of C18: 1 trans and CLA in muscles indicates that the fatty acids of both Echium spp. Oil and linseed oil were prone to severe bio-hydrogenation in the rumen. Assessment of the sensory characteristics of meat found that the taste, color indices and oxidative stability were similar between the rations used.

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