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ASSESSMENT OF THE EFFECT OF THE INCREASED CONTENT OF VEGETABLE OILS RICH IN PUFAS ON THE FATTY ACID COMPOSITION AND QUALITY OF BEEF

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Abstract:

The article presents the results of an assessment of the effect of making oil (Echium vulgare) rich in 18: 4 n-3 PUFAs on the fatty acid composition and qualitative indicators of beef. The introduction of this oil suggested an increase in the deposition of C18: 3n-3 and the long chain fatty acids C20 and C22, eicosapentaenoic acid (EPA), docosapentaenoic acid (DPA) and docosahexaenoic acid (DHA) in muscle lipids. It was found that the introduction of echium oil or linseed oil in the diet of cattle contributed to the improvement of the profile of long-chain C20 fatty acids in beef, but had a negligible effect on its quality indicators.

Keywords: *polyunsaturated fatty acids, beef, echium vulgare oil, linseed oil.*

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INTRODUCTION:

Food quality is becoming increasingly important in the modern world and is directly dependent on the quality of food. Much attention is paid to increasing the content of n-3 PUFAs in foods, since increased consumption of long-chain n-3 PUFAs has a beneficial effect on human health and reduces the incidence rate. C18: 3n-3 rich green fodder is an important tool to increase the delivery of n-3 PUFAs through ruminants to meat (and milk).

Our previous studies have established that seasonal and environmental factors play a significant role in the phenotypic variation in the content of fatty acids, which in turn will require adjustment of the fatty acid composition of the feed during the growing process. However, the instability of the fatty acid composition of forage grasses requires studying the possibility of additional enrichment of the cattle diet with PUFA sources.

A study of the effect of grass-fed fattening on the productivity and quality of meat of beef cattle has shown the effectiveness of using alfalfa extract in diets for feeding cattle to enrich PUFA meat. An assessment of the formation of organoleptic characteristics of beef showed that the least effect on the taste of beef has the use of a diet based on straw, feed containing 25% alfalfa extract and vitamin E (~ 300 mg / kg) significantly improves the fatty acid composition of meat.

The next stage of the experiment was to assess the effect of adding echium oil rich in 18: 4 n-3 PUFAs on the fatty acid composition and qualitative indicators of beef. The introduction of this oil suggested an increase in the deposition of C18: 3n-3 and the long chain fatty acids C20 and C22, eicosapentaenoic acid (EPA), docosapentaenoic acid (DPA) and docosahexaenoic acid (DHA) in muscle lipids.

RESULTS AND DISCUSSION:

The results obtained indicate that the addition of echium oil or linseed oil did not affect the total content of lipids, neutral lipids, phospholipids, saturated fatty acids, MUFAs or PUFAs compared to grass-fed fattening only (table 1).

Table 1: Fatty acid composition of M. Longissimus from experimental animals

Indicators	Diet			
	Control	Echium oil 1.5%	Echium oil 3%	Linseed oil 3%
Mg / 100 g muscle concentration				
Total lipids	3138.0	4034.4	3964.3	3378.4
The total number of neutral lipids	2678.4	3553.8	3495.8	2912.3
The total amount of phospholipids	459.6	480.6	468.4	466.1
Saturated Fatty Acids [A]	1328.4	1785.5	1717.9	1454.4
MUFA[B]	1311.6	1648.8	1643.8	1359.4
PUFA[C]	164.7	175.3	173.3	175.3
Amount n-6[D]	78.2	85.5	85.3	83.7
Amount n-3[E]	86.5	89.7	88.0	91.6
Health indicators				
P:S[F]	0.06	0.06	0.06	0.07
n-6:n-3	0.91	0.95	0.97	0.92
EPA+DHAG	23.4	23.1	20.8	24.6

[A] Saturated Fatty Acids, (12:0 + 14:0 + 16:0 + 18:0).
[B] MUFA, (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 muscle.

In addition, the ratio of fatty acids n-6: n-3, and polyunsaturated to saturated (P: S) was also not dependent on the diet, as well as the concentration of EPA + DHA in total lipids of M. longissiumus (table 1).

The diet with added oils also slightly affected fractionated lipid components. Adding 3% echium oil to the diet improved the deposition of C18: 1 trans and cis-9, trans-11 CLA in both neutral and phospholipid fractions, and also increased C18: 4n-3

in the neutral lipid fraction (table 2).

Table 2: The concentration of fatty acids (mg / 100 g muscle) in the lipid fractions of M. Longissimus

Fatty acid	Diet			
	Control	Echium oil 1.5%	Echium oil 3%	Linseed oil 3%
Neutral lipids				
C14:0	86.8	130.3	127.0	104.8
C16:0	761.1	1030.4	1003.3	818.5
C16:1	120.0	164.1	158.4	127.3
C18:0	375.5	514.8	480.6	428.0
C18:1 *trans*	37.9	71.7	112.4	73.7
C18:1 *cis-9*	993.8	1237.2	1203.9	1002.6
C18:2n-6	18.6	23.6	22.9	20.1
C18:3n-3	13.2	16.0	15.3	14.1
CLA[A]	9.2	14.8	23.1	14.3
C18:4n-3	1.1	1.6	2.3	1.9
Phospholipids				
C14:0	0.889	0.993	1.110	0.834
C16:0	60.899	63.302	60.824	57.610
C16:1	11.732	13.318	12.155	10.849
C18:0	41.298	42.832	42.206	42.308
C18:1*trans*	1.880a	2.782b	4.572c	2.972
C18:1n-9	106.095	114.144	106.280	102.652
C18:2n-6	32.383	34.357	36.250	35.496
C18:3n-3	18.069	18.927	19.688	20.440
CLA[A]	0.770	1.091	1.642b	1.081
C18:4n-3	0.244	0.226	0.225	0.219
C20:3n-6	4.519	4.342	4.382	4.425
C20:4n-6	19.978	20.118	18.602	20.880
C20:4n-3	3.822	3.526	3.918	3.639
C20:5n-3	18.979	18.410	16.899	19.806
C22:4n-6	1.215	1.278	1.342	1.149
C22:5n-3	23.346	22.358	21.898	23.069
C22:6n-3	3.664	3.747	3.110	3.757

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

Other major fatty acids, including long chain fatty acids of C20 phospholipids, were diet independent (Table 2). The study of individual CLA isomers of M. longissiumus revealed an increased content of 6 out of 13 detected CLA isomers, including cis-9, trans-11 CLA, when 3% echium oil was added compared to the control, which have a healing effect on human health. The addition of 1.5% echium oil or linseed oil increased the deposition of trans-7, trans-9 CLA and trans-11, trans-13 CLA. For all other CLA isomers, the addition of 1.5% echium oil or linseed oil had an intermediate effect on their concentration compared to adding 3% echium oil or control. It is suggested that a higher concentration of C18: 1 trans CLA in the muscles may indicate that the fatty acids of both echium and flaxseed oil were prone to strong biohydrogenation in the rumen.

Shelf life, sensory characteristics, color saturation of meat from all animals, as expected, decreased over time. In the course of the study, it was not possible to find any effect from the diets on the color saturation of the meat, nor the interaction between the diet and the shelf life. All diets maintained a color saturation level above the threshold for an acceptable meat color for at least 15 days, but by day 18, beef from all groups had a color saturation of <18. It was also not possible to establish the effect of diets on oxidative stability according to TBARS, color on the 10th day, or the content of vitamin E in the muscles (table 3).

Table 3: Oxidative stability of M. Longissimus steaks depending on rations

Indicators	Diet			
	Control	Echium oil 1.5%	Echium oil 3%	Linseed oil 3%
TBARS, days 10[A]	0.62	0.52	0.44	0.46
Chroma, days 10	22.1	22.7	22.4	22.2
Vitamin E[B]	5.88	6.18	5.92	6.03

[A] mg madonnaldehyde / kg meat.
[B] mg / kg muscle.

The diets used also had a slight effect on taste indices, significant differences were noted only in terms of "vegetable / herbal" and "milk" flavor. A flaxseed oil-based cattle diet intensified the manifestation of the "vegetable / herbal" flavor, and a diet based on 3% echium oil increased the "milk" flavor attribute (Table 4). However, the overall taste indices were similar between the diets used.

Table 4: Taste indices of fried steaks from experimental animals, with a final temperature in the thickness of 74 ° C

Indicators	Diet			
	Control	Echium oil 1.5%	Echium oil 3%	Linseed oil 3%
8 point scale				
Texture	5.14	4.77	4.75	5.22
Juiciness	5.41	5.42	5.42	5.34
Beef Flavor Intensity	5.23	5.05	5.19	5.20
Abnormal aroma intensity	2.47	2.69	2.47	2.80
Thickness 100 mm				
Greasiness	19.08	20.02	19.66	17.39
Bloodyness	15.05	14.39	14.08	14.13
Hepatic aftertaste	11.25	11.64	13.14	12.08
Metallic aftertaste	15.58	14.59	16.30	17.48
Astringency	7.73	7.02	6.77	9.00
Sweetness	16.09	13.55	16.73	14.77
Rancidity	0.75	0.86	0.44	0.55
Fish flavor	2.92	3.19	2.69	2.97
Acidity	9.84	11.09	10.11	11.38
Taste of paper	11.89	13.11	13.45	14.39
Vegetable / Herbal Flavor	12.47	13.63	13.11b	15.81
Milk flavor	26.72	23.55	29.86	25.02
Hedonism				
General taste	57.59	55.00	58.02	54.58

The introduction of echium oil or linseed oil into the diet of cattle helped to improve the profile of long-chain C20 fatty acids in beef, but had a negligible effect on its quality indicators.

CONCLUSION:

The European Food Safety and Labeling Authority (EFSA) has introduced a standard for levels of long-chain PUFAs in products that allows labeling them as a source of n-3 PUFAs. They concluded that this standard should be based on the needs of the body at the rate of 25 mg per day EPA + DHA or 2 g per day C18: 3n-3, in order to be labeled as "source" or "high content" the product should contain 25 to 40 mg EPA plus DHA per 100 g (European Food Safety Authority, 2009). The results obtained in the framework of research data aimed at modifying 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 observed in beef, supplemented with oils. The results obtained fit into the range of recommended parameters, which makes it possible to mark this product as a source of n3 PUFA.

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