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INVESTIGATIONS ON THE INFLUENCE OF HIGH FATTY ACIDS DIETS ON FATTENING STEERS MEAT PRODUCTION AND MEAT QUALITY

CERCETĂRI PRIVIND INFLUENŢA UTILIZĂRII UNOR NUTREŢURI BOGATE ÎN ACIZI GRAŞI ASUPRA INDICILOR CANTITATIVI ŞI CALITATIVI AI CARNII LA TAURINE

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The effects of using high fatty acids forages on Maramures Brown fattening steer performance were studied on 30 finishing steers assigned uniformly to 3 groups: control group (no fatty acids-rich feed), E1 (24% full fat soybean in the compound feed) and E2 (32% rapeseeds in the compound feed). The diets consisted of Sudan grass as bulk forage (free access) and of limited amounts of compound feeds. The use of fatty acids-rich forages did not influence the ingesta of compound feeds and of the complete diet. Weight gain in the experimental groups were higher than in the control group (1393 and 1113 g/steer/day in groups E1 and E2, respectively, compared to 1053 g/steer/day in group C) a significant difference being noticed between groups C and E1 ($P \leq 0.05$). The meat of steers from the experimental groups had a higher level of crude fat (18 and 24 g in groups E1 and E2, respectively, versus 13 g in group C), while meat protein was lower in group E1 (211 g), intermediary in group C (226 g) and higher in group E2 (240 g). Crude fat linoleic acid (C18:2) level increased from 8.33% (group C) to 9.46% (group E1), which is beneficial to human health. A higher level of saturated fatty acids was noticed in the meat of animals from group E2, a higher level of monounsaturated and polyunsaturated fatty acids was noticed in the meat of animals from group E1, as well as a higher level of medium-chain fatty acids to the detriment of long-chain fatty acids.

Keywords: diets, fatty acids, steers, meat quality

Introduction

Knowing cattle meat fat content and structure of fatty acids is required due to technical, qualitative and sanitary reasons. Fatty acids composition influences the technological properties of the fats by their fusion point, which is the result of a combination of factors that involve fatty acids chain length, their degree of saturation and geometric isometry (*cis* or *trans* bonds). All fats, irrespective of their origin, contain saturated or unsaturated fatty acids with chains of 14-18 carbon atoms (National Cattlemen's Beef Association, 1997) which, normally are produced in enough amounts by the microbial fermentation (Ferrell, 2004).

The handiest natural and economic mean to modulate meat fatty acids is fattening steers feeding, although dietary fatty acids biohydrogenation in the rumen makes it more difficult to manipulate the tissue fatty acids profile in this species (Wood and Enser, 1997). Cattle feeding monitors the effects of fresh grass diets (Enser M. et al., 1999; Alessandro Priolo et al., 2001; Pitchford et al., 2002), of some novel combinations of raw materials such as those from the compound feeds (Fernanda Barros Moreira, 2003; Mach et al., 2006; Maddock et al., 2006; Akraim Fowad et al., 2006), fish oil (Raes et al., 2004) or broiler fat (Hutchison et al., 2006). There are concerns over the extent to which the different diet formulations or lipid supplements influence meat quality (Nelson M. L. et al., 2004).

One of the main means to influence meat production and to modulate meat fatty acids composition is feeding high fatty acids diets. Our paper quantifies the effects of two forages used as sources of fatty acids on the qualitative and quantitative traits of cattle meat.

Materials and Methods

Thirty Maramures Brown steers were used for 62 days in an experiment that was conducted by the Laboratory of Animal Nutrition of IBNA Balotesti. The animals were assigned to 3 groups of 10 steers each: a control group, C fed on diets without fatty acids-rich forages, an experimental group E1 fed on diets with 24% full fat soybean included in the compound feed formulation and an experimental group, E2 fed on diets with 32% rapeseeds in the compound feed formulation.

The basic diets consisted of Sudan grass silage (free access to the only bulk feed) and of three types of compound feeds given in limited amounts so that the joint supply of nutrients meets the requirements of fattening steers.

Results and Discussions

Feed and nutrients intake

Table 1 shows the feed intake of the three groups of animals. The average intake of the complete diet, expressed in kg DM/day, is quite similar among the experimental groups: 10.14 in E1 and 10.37 in E2, being slightly lower in C, 9.44, but the values were not significantly different (P>0.05) (Sandu, 1995).

It is noteworthy, however, to observe that the compound feeds intake was similar in all groups (6.05 kg, 6.24 kg and 6.27 kg DM/steer/day), which means that the use of dietary fatty acids-rich forages did not affect diet palatability or the digestive processes, as shown by the normal passage observed in the experimental animals. The intake of Sudan grass silage differed among the groups: 3.39 kg in group C, 3.90 kg and 4.10 kg DM/steer/day in the experimental groups.

Table 1.

Average feed intake

Item	C	E1	E2
Sudan grass silage (kg)	13.57	15.59	16.39
Compound feed (kg)	6.77	6.91	6.95
Sudan grass silage (kg DM)	3.39	3.90	4.10
Compound feed (kg DM)	6.05	6.24	6.27
Total intake (kg DM)	9.44	10.14	10.37
Sudan grass silage out of total intake (%)	36	38	39
Compound feed out of total intake (%)	64	62	61

Body weight evolution and average daily weight gains

The average daily weight gain was higher in group E1 (1393 g), lower in group C (1053 g) and intermediary in group E2 (1113 g) (Table 2). This performance is due first of all to the dietary 24% full fat soybean given to E1 animals, which yielded significant differences as compared to C animals ($P \leq 0.05$). These results are in agreement with the findings of Sami et al., 2004 who fed Simmenthal steers on concentrates and corn silages. No significant differences from the control group ($P \geq 0.05$) were noticed for group E2 (32% rapeseeds), both groups having quite similar average daily gains.

Table 2.

Body weight evolution and average daily weight gains

Item	C	E1	E2
Initial average weight (kg)	421.60 ± 25.92	417.56 ± 31.18	419.90 ± 26.10
Final average weight (kg)*	$486.90^{a} \pm 27.7$	$503.89^{b} \pm 36.54$	$483.89^{a} \pm 21.90$
Total gain (g/steer)	65.30	86.33	63.99
ADG (g/steer)*	$1053^{a} \pm 227.42$	$1393^{b} \pm 216.25$	$1113^{a} \pm 232.97$

* same superscript shows not significant differences between groups ($P \geq 0.05$); different superscripts show significant differences between groups ($P \leq 0.05$)

Meat composition

Table 3 shows diet influence on meat protein and fat. A higher influence on meat crude fat level was noticed in groups E1 and E2 (18 and 24 g versus 13 g in group C), as supported by the work of Rodriguez et al., 2004. Meat crude protein level was lower in E1 (211g), intermediate in C (226g) and higher in E2 (240g). Meat cholesterol level was 0.1875 in group C, 0.1338 in E1 and 0.1750 g/100g crude fat in E2.

Table 3.

Chemical composition of the steer meat (g/kg meat)

Group	DM	CP	EE	Ash	Cholesterol (%g EE)
Control	250	226	13	11	0.1875
Experimental I	240	211	18	11	0.1338
Experimental II	274	240	24	11	0.1750

Dietary fatty acids level

The main purpose of the experiment was to determine the extent to which the dietary fatty levels are found in meat. Tables 4 and 5 show the dietary fatty acids levels related to the dietary crude fat level and to the dietary dry matter. The values are in agreement with the literature data (Sauvant et al., 2002).

Table 4.

Dietary fatty acids (% of CF)

Item	C14:0 myristic	C16:0 palmitic	C18:0 stearic	C18:1 oleic	C18:2 linoleic	C20:0 arachidonic	Other
Sudan grass silage	1.35	32.33	-	7.04	21.25	18.72	19.30
CF group M	-	15.68	-	26.27	56.84	1.21	-
CF group E1	-	11.80	2.39	22.84	57.63	5.34	-
CF group E2	-	6.79	1.35	57.44	27.16	6.76	0.51

Table 5.

Dietary fatty acids (g/kg feed/1000g DM)

Item	DM	C14:0 myristic	C16:0 palmitic	C18:0 stearic	C18:1 oleic	C18:2 linoleic	C20:0 arachidonic	Other
Sudan grass silage	207 1000	0.07 0.33	1.62 7.83	-	0.35 1.69	1.06 5.12	0.94 4.54	0.97 4.69
CF group M	887 1000	-	5.02 5.66	-	8.41 9.48	18.19 20.51	0.39 0.44	-
CF group E1	897 1000	-	7.55 8.42	1.53 1.71	14.62 16.30	36.88 41.11	3.42 3.81	-
CF group E2	908 1000	-	7.74 8.52	1.54 1.70	65.48 72.11	30.96 34.10	7.71 8.49	0.58 0.64

Tables 6 and 7 show the fatty acids profile of the steer meat and the proportion of the different groups of fatty acids within the total meat fatty acids. The two dietary sources of fatty acids influenced the level and proportion of meat fatty acids both according to chain length and according to their level of saturation, as also shown by Ishida et al., 2001. The rumen bacteria play a major role in these changes and in the transformation of the dietary lipids into new fatty acids (Sauvant et al., 2001).

Table 6

Steer meat fatty acids (% of CF)

Fatty acids	C	E1	E2
myristic (C14:0)	3.03	3.18	3.92
myristoleic (C 14:1)	0.62	0.36	0.29
palmitic (C16:0)	28.07	38.04	32.77
palmitoleic (C 16:1)	3.93	2.89	1.29
stearic (C 18:0)	13.31	2.14	9.6
oleic (C 18:1)	42.33	43.93	44.29
linoleic (C 18:2)	8.33	9.46	7.03
Other fatty acids	0.39	-	0.80
Total fatty acids	100.01	100	99.99

An increased proportion of linoleic acid (C18:2) was noticed, from 8.33% in group C to 9.46% in E1 (full fat soybean). This is beneficial to human health, as supported by Raes et al., (2003, 2004). The proportion of saturated fatty acids also increased (46.29%) in E2 (rapeseeds), monounsaturated and polyunsaturated in E1 (full fat soybean) (47.18% and 9.46%, respectively). These values are in agreement with the observations of Graham et al., 2006, Sami et al., 2004, who worked on Simmental steers fed concentrates and corn silage; the proportion of the medium-chain fatty acids also increased to the detriment of long-chain fatty acids.

Table 7

Proportion of fatty acids groups in steer meat (% of total fatty acids)

Item	SCFA*	MCFA**	LCFA***	Saturated	Monoun saturated	Polyunsa turated	Other fatty acids
C	-	35.65	63.96	44.41	46.88	8.33	0.39
E1	-	44.47	55.53	43.36	47.18	9.46	-
E2	-	38.27	60.93	46.29	45.87	7.03	0.80

*) SCFA Short-chain fatty acids
**) MCFA Medium-chain fatty acids
***) LCFA Long-chain fatty acids

Conclusions

1. The intake of compound feed given in limited amounts was not influenced by the use of dietary fatty acids-rich forages. The total feed intake (compound feed + Sudan grass silage) was not influenced either.

2. The average daily gain increased from 1053 g/steer/day in group C to 1393 g/steer/day in group E1 (significant differences ($P<0.05$), and to 1113 /steer/day in group E2 (not significant differences $P>0.05$);

3. The dietary treatments had a higher influence on the meat crude fat level of the experimental groups E1 and E2 (18 and 24 g) versus 13 g in the control group, than on the meat crude protein level, which displayed lower values in E1 (211g), intermediate in C (226g) and higher in E2 (240g).

4. The most important results concern meat fatty acids profile, such as the increased proportion of linoleic acid (C18:2) from 8.33% in the control group to 9.46% in E1, which is beneficial to human health. A higher level of saturated fatty acids was noticed in the meat of animals from group E2 (rapeseeds), a higher level of monounsaturated and polyunsaturated fatty acids was noticed in the meat of animals from group E1 (full fat soybean), as well as a higher level of medium-chain fatty acids to the detriment of long-chain fatty acids

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Efectele folosirii unor nutreţuri bogate în acizi graşi asupra performanţelor taurinelor supuse îngrăşării din rasa Brună de Maramureş, au fost studiate pe 30 de animale în faza de finisare repartizate uniform în 3 loturi: lotul martor M (fără nutreţ bogat în acizi graşi), lotul experimental E1 (cu 24% full fat în nutreţul combinat) şi lotul experimental E2 (cu 32% rapiţă boabe în amestecul de NC). Raţiile au avut în componenţă siloz de iarbă de Sudan, ca furaj de volum, administrat la discreţie şi nutreţuri combinate complementare, administrate restricţionat. S-a observat că utilizarea nutreţurilor bogate în acizi graşi nu a influenţat ingesta nutreţurilor combinate şi nici a raţiei totale. Sporul de greutate la loturile experimentale (1393g la E1 şi 1113g/cap/zi la E2) a crescut faţă de lotul martor (1053g/cap/zi), înregistrându-se diferenţe semnificative doar între lotul M şi E1 (P ≤ 0,05). Sub aspectul compoziţiei chimice, s-a sesizat o influenţă mai mare asupra conţinutului în grăsime brută al cărnii la loturile experimentale E1 şi E2, de 18 g respectiv 24 g faţă de lotul M, 13 g, comparativ cu cel de proteină, care a avut valori mai mici la E1(211g), intermediare la M (226g) şi mai mari la E2 (240g). Privind spectrul acizilor graşi din grăsimea brută a cărnii, s- a observat creşterea ponderii acidului linoleic (C18:2) de la 8,33% la lotul M la 9,46% la lotul E1, fapt apreciat drept benefic pentru sănătatea umană; în acelaşi timp a crescut ponderea acizilor graşi saturaţi la lotul E2, mononesaturaţi şi polinesaturaţi la lotul E1, precum şi a acizilor graşi cu catenă medie, în detrimentul acizilor graşi cu catenă lungă.

Cuvinte cheie: raţii, acizi graşi, tăuraşi, calitatea cărnii