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Study Of The Influence Of Beef With An Improved Fatty Acid Composition On The Development Of Atherosclerosis In Animal Experiments.

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ABSTRACT

This article presents the results of a study of the effect of modified beef fat on the development of atherosclerosis, deliberately induced in white mice. Using 2 different diets of mice feeding, the ability of modified beef fat to cause a slowdown in development and regression of atherosclerosis is evaluated. Based on the analysis of blood serum lipoproteins and fatty acid composition of the liver of experimental mice, a conclusion was made about the influence of beef of one or another fattening on the development of atherosclerosis.
Keywords: beef, fatty acid composition, atherosclerosis, polyunsaturated fatty acids

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INTRODUCTION

The fatty acid composition of beef, at least in part, depends on the composition of the feeds fed to cattle. Grass and clover contain a large amount of α-linolenic acid, while grains are usually rich in linoleic acid. While most unsaturated fatty acids are biohydrogenated in the rumen, significant amounts avoid this process and enter the animal's tissues. These fatty acids can also be further elongated and become unsaturated as derivatives for a number of other fatty acids. In the case of α-linolenic acid, this can include both EPA and DHA. The purpose of this study was to investigate whether the difference in the fatty acid composition of herb / clover fattening meat is compared with the feed (from grain) fattening of animals sufficient to affect plasma lipids and the development of atherosclerosis in the mouse model.

The initial tasks were to investigate whether enriched beef n-3 PUFAs (1) exert positive effects, slow the progression of atherosclerosis, and (2) regress atherosclerosis. However, after initial research on the effect of modified beef on the progression of atherosclerosis, it was decided to concentrate on establishing the type and amount of PUFAs that would be required to overcome the potentially pro-atherosclerotic effect of SFA in beef and to assess whether n-3 PUFAs had any particular advantage over compared with n-6 PUFAs. In total, within the framework of this work program, three types of feeding have been studied.

MATERIAL AND METHODS

The beef used in this experiment was obtained from steers at the age of 22 weeks fed by one of two diets: 1) forage (grass / white clover grass during grazing, followed by grass silage in winter), or 2) limited barley straw and mixed fodder (40:60 based on DM). After slaughter animals selected samples of the internal oblique abdominal muscles. Samples were thawed, crushed, freeze-dried and ground to a powder. Samples from each group were thoroughly mixed before freeze-drying to ensure uniformity of the collective samples.

Mice were randomly assigned to one of two nutritional groups (n = 10) with an average age for each group of 12 weeks. Both groups received a semi-synthetic diet containing 36% (w / w) of lyophilized beef from cattle, a forage diet (FB), or a mixed fodder (CB) diet, and both diets also contained 0.25% cholesterol. Feeding was conducted for a 12-week period, and the animals were given fresh feed every morning, weighing the remains of the previous dose, so the daily intake of food could be controlled throughout the study. At the end of the study, the mice were selected and the blood serum frozen for subsequent lipid / lipoprotein analysis. The liver was collected to determine the fatty acid composition and gene expression studies. The fatty acid composition of diets and liver was determined by FAME gas chromatography. The heart and the aorta were removed and frozen before the aorta was divided at the point of its attachment to the heart. Then, every third part was stained with hematoxylin and Oil Red O, and the staining area of the latter was quantified to determine the extent of atherosclerosis. The aorta site, in which three tricuspid leaflets first appeared, was nominally designated and atherosclerosis was defined in this and five other sections.

RESULTS AND DISCUSSION

Table 1 shows the composition of the fatty acids of beef included in diets and the composition of total liver lipid in mice. Both sources of beef contained similar amounts of SFA. FB was relatively enriched with oleic acid, α-linolenic acid and EPA compared to CB, but contained significantly less linoleic acid. The liver of mice receiving FB contained significantly more α-linolenic acid, EPA and DHA than in animals receiving CB. The presence of a higher concentration of DHA indicates a significant elongation and desaturation of dietary α-linolenic acid.

Table 1: Fatty acid composition of beef and mouse liver lipids

% total FAME	Fatty acid composition of beef (n=6 replicates)		Fatty acid composition of mice liver	
	Forage	Concentrate	Forage	Concentrate
16:0 palmitic	30,60	32,25	17,37	15,48
18:0 stearic	14,04	13,35	6,85	4,98
18:1 n-9 oleic	39,99	36,70	43,56	44,92

18:1 trans11	1,71	2,40	0,21	0,55
18:2 n-6 linoleic	0,96	2,68	6,06	5,72
CLA c9,t11	0,41	0,25	0,29	0,08
18:3n-3 α-linolenic	0,78	0,23	1,10	0,92
20:4n-6 arachidonic	0,42	1,08	4,11	4,27
20:5n-3 eicosapentaenoic	0,22	0,06	0,23	0,00
22:5n-3 docosapentaenoic	0,41	0,25	0,37	0,08
22:6n-3 docosahexaenoic	0,05	0,03	4,70	2,37
Sum SFA	50,17	51,14	25,58	21,24
Sum n-3	1,45	0,58	6,41	3,36
Sum n-6	1,43	4,16	10,17	9,98

Table 2 presents plasma lipids and lipoproteins from mice that feed on two sources of beef. Those animals fed FB had a significantly lower plasma triacylglycerin and HDL cholesterol level than those that received CB.

Table 2: Plasma lipids and lipoproteins in mice fed two sources of beef

mMol/l	FB	CB
Total Cholestero	10,99	11,84
HDL Cholestero	1,18	1,48
Non HDL Cholestero	9,77	10,36
Non HDL/HDL ratio	8,60	7,58
Total Triacylglyerol	2,66	3,32

Studies of the aortic site by staining with red assessed lipid deposition in atherosclerotic lesions. As a result, it was found that on both diets the lesion area was consistent along the length of the aorta under investigation, and there was no significant effect of the diet on the affected area.

CONCLUSION

Beef forage diet showed significant differences in the composition of fatty acids than those fed a mixed fodder diet, the first being relatively enriched with n-3 PUFAs. This was reflected in the accumulation of n-3 PUFAs in the liver of mice receiving FB, and further elongation and desaturation of α-linolenic acid was also demonstrated in order to increase the concentration of DHA. Mice receiving FB had a lower serum triglyceride level and HDL cholesterol compared to those that received CB. Perhaps they can have an opposite effect on the development of atherosclerosis, which may explain why there was no significant difference in atherosclerosis between the two groups of mice.

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