THE INFLUENCE OF FISH OIL SUPPLEMENTATION TO THE FEED RATION OF COWS ON THE LEVEL OF CHOLESTEROL AND ITS FRACTION IN THEIR BLOOD SERUM[3]

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SUMMARY

The aim of the searching was to define the influence of fish oil supplement to the feed ration of high producing cows on the level of cholesterol and its fraction in their blood serum. The research was carried out on primiparous cows (1 – without supplementation, 2 – fish oil supplementation) as well as on multiparous cows (3 – without supplementation, 4 – fish oil supplementation) in the period from the 10th day till the 8th week after calving. Cows were given, together with the feed ration (TMR system), fish oil in amount of 1% of daily ration of dry matter, during all the experiment period. At the first day of experiment and after 4, 6 and 8 weeks, level of cholesterol and its fraction in the blood serum of examined cows has been signified.

On the basis of received results an increase of total cholesterol by all examined individuals and what follows, increase of its fraction, has been stated. By the primiparous cows of control group the increase was highest at the end of the experiment – 130% in relation to the initial value and by the individuals receiving 1% of fish oil in the feed ration, only 18%. By multiparous cows, receiving the supplementation, twice as small increase of LDL fraction concentration in relation to the control individuals has been observed.

Keywords: cows, fish oil, cholesterol, HDL, LDL, blood serum

INTRODUCTION

Modification of fatty acids composition in the cow diet is one of few methods that enable gaining of milk with higher content of multiunsaturated fatty acids, important from dietary point of view [3, 10]. The content of individual fatty fractions in cow milk depends on feeding and ipso facto from fodders applied in food ration. Considering the fact, that in the case of high productive cows, TMR system is recommended, advisable would be modification of milk composition, which can be obtained applying fish oil, receiving from liquid productive raw materials form sea fish processing.

Separate problem are metabolic transformations, therein energetic, by milk cows. In the perinatal period and at the beginning of lactation it comes to violent increase of energetic demand and nutritional components requirements, which are necessary for milk production, with

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simultaneously hormonal changes assuring homeostatic subordinating of the organism to the lactation process [15]. The energetic demand, especially by high productive cows, exceeds usually in the beginning of lactation energy volume consumed from the feed. Then negative energy balance and over-lipolysis of spare fat occurs [2, 7]. In consequence it can come to expansion of sub clinical or clinical ketosis and liver lumbering [7, 15]. The energy volume in the dose, without proportions change of nutritive fodder to bulky feed, can be increased among other things through addition of fats. Great interest for this nutrient in the last year's results from difficulties in meeting energetic demands of high productive cows in the first lactation phase. Moreover, using of fodder fat in cow feeding causes improvement of ovaries operation, lesser mortality of embryos, influencing profitably on the reproduction rate [12]. According to Hagemeister and Voigt [8] the fodder fat is more effectively used to meet energetic demands, connected with milk production, than fat of the organism. As Goff and Horst [6] show, high energy consume and its optimal transformations by cows in initial lactation have essential influence on the health and productivity of high productive milk cows.

The aim of searching was application of fish oil by feeding of high productive cows as well as its influence on carbohydrate- and lipid transformations – level of total cholesterol and its fractions HDL and LDL.

MATERIAL AND METHODS

The investigation was conducted on dairy cows farm numbering 250 animals, crossbreeds cb x hf of more than 75% of hf breed genes, featuring milk yield for previous lactation 8500 kg. The cows were kept in loose barn and fed according to TMR system (total mixed rations). The fodders used for cow feeding (TMR components) were subjected to chemical analysis in Blattin Laboratory in Langenfeld to determine the content of dry mass, total protein, raw ash, raw fat, raw fiber and its fractions (ADF and NDF), as well as mineral components: calcium, phosphorus, magnesium and sodium [2]. On the basis of the analysis done, there were worked out food rations for cows according to DLG norms [5]. Quantitative composition and food value of the doses were shown in Table 1.

Table 1. Content and nutritional composition of the cows' diets

Dose composition	Units		
Maize silage	kg	25,000	
Fresh pressed pulp		8,000	
Maize seed silage		5,500	
Barley		3,000	
Soybean		2,700	
Rapeseed		2,500	
Barley strain		2,000	
Sodium bicarbonate		0,200	
Premix		0,180	
Forage chalk		0,150	
Fat-mineral preparation*		1,126	
Nutritional composition		Control groups I and II – (primiparous and multiparous)	Experimental groups III i IV (primiparous and multiparous)
Dry mass	%	48,17	49,06
Raw fibre % dry mass	% s.m.	14,03	13,65
NEL	MJ/kg s.m.	6,87	8,24
Total protein	g/kg s.m.	3858,00	3864,59
Available total protein in small intensive	g/kg s.m.	3806,63	3813,19
Ca	g/kg s.m.	6,95	6,75
P	g/kg s.m.	4,36	4,35
Na	g/kg s.m.	1,40	1,35
Mg	g/kg s.m.	2,54	3,19

*preparation supplementation in experimental groups (III i IV)

40 clinically healthy cows were selected for strict examination and, following the analogy method, considering the sequence of lactation (primiparous and multiparous in 2 or 3 lactation, as well as milk yield for previous lactation); they were at random classified into 4 equipotent groups. The factor differentiating particular groups was fat-mineral preparation (F–M), additionally administered for 8 weeks twice a day in the dose of 563 g per head – fish oil amounted 1% of dry mass ration. The layout for this experiment was shown in Table 2.

Table 2. The scheme of the experiment

Cows	Feed groups			
	I – control	II control	III – experimental	IV – experimental
Primiparous	No supplement	–	supplement – fish oil (1% of dry DM)–	–
Multiparous	–	– No supplement	–	supplement – fish oil (1% of DM)

F-M preparation contained fish oil 22%, bentonite 33%, vermiculite 33% and humokarbowite 12%. F-M food value was determined according to the methods enforced [1]. Fatty acids composition in fish oil (herring-sprat) was examined using chromatographic method [14] – gas chromatograph coupled with mass spectrophotometer (GC/MS-mass spectrophotometer by Varian, Saturn 200). Purified and neutralized extracts were subjected to analysis according to

GC/MS technology with the se of capillary column Rt x MS of 30 m length. Fatty acid composition in fish oil was shown in other work [9].

Blood from examined cows was drawn from *vena exsterna jugularis*, at the first research day, after 2 weeks of preparation applying and in 4th and 8th experiment week. In blood serum there was determined total cholesterol level by enzymatic method as well as level of its fractions (HDL and LDL) by indirect method and using reagents of "Randox" firm house

The values obtained were statistically worked out using statistical program Statgraphics Version 5.0 and difference significance was estimated according to Duncan test.

RESULTS AND DISSCUSION

On the grounds of obtained results (Tab. 3) constant increase of total cholesterol level by all of examined groups was stated. During the whole period of experiment, the highest growth of cholesterol concentration in blood serum of examined cows was noted in the group of primiparous cows and multiparous, which didn't get the fish oil supplement to the fodder. This increase has amounted to adequately: 130% and 89% ($p \leq 0,01$) in relation to the level at the first day of experiment. In groups III and IV of experimental animals the increase was on the lowest level. By primiparous cows of III group it amounted to only 33% ($p \leq 0,05$). Loor et al. [11] have also noted in their studies an increase of cholesterol level in blood serum of cows of about 30%, after applying to the rumen 1% of fish oil in food ration. Such results confirm also other studies [4, 13]. Petit at all [13] applying cows 1,2% of fish oil, have noted increase of total cholesterol level in blood serum of examined cows of 36% in relation to the groups getting commercial preparation containing protected fat, what wasn't noted in own studies, where in the groups of control cows cholesterol concentration has risen more than by cows getting fish oil supplement to the food ration.

Table 3. Middle values of cholesterol level and its fraction in blood serum of examined cows

GROUPS	Samplings		Cholesterol [mmol/L]	HDL [mmol/L]	LDL [mmol/L]
I	Start	$\bar{x}$	**aA2,09**	**aA1,74**	**A0,32**
		SD	0,51	0,48	0,15
	2nd week	$\bar{x}$	**b3,02**	**bcA2,64**	**A0,27**
		SD	0,85	0,80	0,12
	4th week	$\bar{x}$	**aB3,61**	**aC2,99**	**a0,39**
		SD	0,84	0,76	0,17
	9th week	$\bar{x}$	**bB4,80**	**cBC4,03**	**Bb0,69**
		SD	1,17	0,96	0,37
II	Start	$\bar{x}$	**aA3,03**	**aA2,74**	**AC0,21**
		SD	0,89	0,84	0,10
	2nd week	$\bar{x}$	**bA4,02**	**b3,74**	**aC0,27**
		SD	0,88	0,90	0,08
	4th week	$\bar{x}$	**B5,35**	**B4,44**	**bBC0,59**
		SD	0,91	0,82	0,24
	9th week	$\bar{x}$	**B5,75**	**aB4,69**	**aB0,89**
		SD	1,18	1,10	0,43

Table 3. Continuation

GROUPS	Samplings		Cholesterol [mmol/L]	HDL [mmol/L]	LDL [mmol/L]
III	Start	$\bar{x}$	**a3,54**	**a2,07**	**A0,87**
		SD	1,32	0,54	0,58
	2nd week	$\bar{x}$	**a3,62**	**2,36**	**a1,21**
		SD	0,56	0,39	0,63
	4th week	$\bar{x}$	**4,19**	**b2,56**	**1,59**
		SD	0,89	0,46	0,71
	9th week	$\bar{x}$	**b4,74**	**2,47**	**bB 2,21**
		SD	0,99	0,36	0,97
IV	Start	$\bar{x}$	**A3,95**	**A2,10**	**AC1,28**
		SD	0,83	0,65	0,92
	2nd week	$\bar{x}$	**a4,69**	**aB2,75**	**C1,85**
		SD	0,62	0,70	0,47
	4th week	$\bar{x}$	**bB5,63**	**B2,90**	**aBC2,67**
		SD	0,83	0,52	0,75
	9th week	$\bar{x}$	**bB5,92**	**bA2,26**	**bB3,59**
		SD	1,29	0,41	1,33

Significance of differences between samplings in the given group at $p \leq 0.01$ – A, B, by $p \leq 0.05$ – a, b.

Result of transformations in total cholesterol level in blood serum of examined cows was also changes in the level of cholesterol fractions HDL and LDL. The greatest cholesterol concentration increase of HDL fraction, during the whole period of experiment was noted by cows of the control groups: I of 131% ($p \leq 0,01$) and II of 71% ($p \leq 0,01$). By animals getting in the food ration 1% fish oil supplement the increase was lower. In group of primiparous cows the growth amounted to 19% in the period of 8 weeks and wasn't statistically confirmed whereas in the IV group, after 2 weeks of applying fish fat there was noted growth of 38% ($p \leq 0,01$) and during next 6 weeks decrease of its concentration, what caused, that all the experiment long its increase was statistically unimportant and amounted to 7%. That tendency is confirmed by the studies of Petit at all [13], but not on such low level as in own studies. These authors have noted, after applying of fish oil supplement, an increase of fraction HDL concentration of 36% in relation to the cows getting protected fat in form of commercial preparation.

Identical tendency was observed in case of transformations by the cholesterol level of fraction LDL. By primiparous cows from control and experimental groups during 8 weeks of experiment there was observed cholesterol concentration increase of this fraction on similar level. In both cases it amounted to over 100% ($p \leq 0,01$). It's important to mention here, that by multiparous cows the changes were more distinct. By cows from IV group, getting fish oil supplement to the daily feed ration, cholesterol level increase of LDL fraction of 180% ($p \leq 0,01$) all the experiment long was noted. In analogous control group the increase amounted already 323% ($p \leq 0,01$). Such high rise wasn't noted by Petit at all [13] in their studies. After applying of fish oil in amount of 1,5% food ration they have noted an increase of cholesterol LDL fraction of 25% in relation to standard ration.

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