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Lipids and lipoproteins in blood serum of calves receiving Yea-Sacc[1026] dietary supplement

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ABSTRACT

The concentration of total lipids, lipid fractions and the quantitative and qualitative composition of plasma lipoproteins of calves fed a diet supplemented with the biopreparation Yea-Sacc[1026] were analyzed. Supplementation of the diet with yeast cultures from days 8 to 84 of life had a positive effect on lipid metabolism, especially when the calves received solid feeds. This was reflected not only by higher levels of triglycerides, cholesterol and non-esterified fatty acids (NEFA) in blood serum but also by lipoprotein fractions. The concentrations of very low density lipoproteins (VLDL) and triglycerides (TG) in this fraction were the lowest in calves aged 84 days. Higher values (8 vs 5%; 78 vs 70%, respectively) were, however, observed in group 2. The low density lipoprotein (LDL) concentrations were the highest in all animals on day 84 of life and constituted an average 25% of serum lipids. In experimental group 2, cholesterol represented 47% of LDL lipids and was higher (on average 11%) compared with the control group.

KEY WORDS: calves, yeast, blood serum, lipids, lipoproteins

INTRODUCTION

According to other authors, the lipid profile, secretion and composition of lipoproteins in calves are modified by the age of animals, amount and type of ingested fat and fodder additives (Jenkins et al., 1988; Auboiron et al., 1994, 1995; Leplaix-Charlat et al., 1996). The effect of biological supplements on the metabolism of lipids in calves has not been investigated to date. An example of such an additive is a yeast preparation, which was found to produce a beneficial effect on the development of the crop and fodder uptake in calves (Strzetelski et al., 1996).

The purpose of our study was to assess the effect of the preparation Yea-Sacc[1026] (containing a culture of *Saccharomyces cerevisiae* yeast) on the lipid profile, including the quantitative and qualitative composition of lipoproteins, in calves of different ages.

MATERIAL AND METHODS

The study was conducted on 20 Black-and-White Lowland calves from birth to day 84 of life. The animals, divided into two groups of 10, were housed and fed individually. After the first uptake of colostrum the calves were given whole milk to day 21, and a milk substitute from day 22 to 60 of life. Starting from day 7 of life the animals were given *ad libitum* access to solid feeds (compound mixture and hay). In group 2 (experimental) each calf aged 8 to 84 days received 2 g of Yea-Sacc[1026] (Alltech Biotechnology Center, USA) daily.

Blood samples were collected from the jugular vein immediately after birth (before the first colostrum feeding) and then on days 21, 60 and 84. Lipoprotein fractions (VLDL, very low density lipoproteins, d=0.96-1.006 g/ml; LDL, low density lipoproteins, d=1.006-1.063 g/ml; and HDL, high density lipoproteins, d=1.063-1.2010 g/ml) were separated by flotation in a potassium bromide gradient, using ultracentrifugation at 15°C (Beckman L 7, type 70.1 Ti-rotor) according to the method of Fontanais-Ferrer et al. (1988). VLDL and LDL were centrifuged for 18h and HDL for 48 h at 142000xg.

Analyses of the content of total lipids, triglycerides (TG), total cholesterol, phospholipids, and non-esterified fatty acids (NEFA) in the serum and VLDL, LDL and HDL fractions were determined using enzymatic methods.

The results were processed statistically using STATISTICA software.

RESULTS

The concentrations of total lipids, TG, cholesterol and phospholipids in the blood serum were the lowest in neonatal calves (Table 1). The levels of total lipids and TG, which were the highest in all calves aged 21 days, later tended to decline. However, the concentration of TG in group 2 was higher (by an average 15%) than in the control. The level of cholesterol began to increase starting from week 3 of life, with higher values (by 11% on average) found in group 2. The concentration of phospholipids was approximately the same throughout the whole experiment. The NEFA level was the highest at birth, decreasing afterwards, but maintaining higher values in group 2.

TABLE 1

Concentrations of total lipids and lipid classes in calves blood serum

Specification		Groups							
		1				2			
		age of calves, days							
		newborn	21	60	84	newborn	21	60	84
Total lipids,	g/l	1.01^{A}	3.04^{C}	2.49^{B}	2.26^{B}	1.06^{A}	3.20^{C}	2.64^{B}	2.44^{B}
		0.30	0.38	0.36	0.37	0.28	0.29	0.33	0.28
Triglycerides,	mmol/l	0.24^{A}	0.66^{C}	0.38^{B}	0.38^{B}	0.20^{A}	0.55^{C}	0.45^{B}	0.44^{B}
		0.08	0.11	0.06	0.07	0.06	0.12	0.08	0.09
Total cholesterol,	mmol/l	0.63^{A}	2.20^{Ba}	2.18^{Ba}	2.52^{Ba}	0.70^{A}	2.52^{Ba}	2.33^{Ba}	2.92^{Bb}
		0.09	0.43	0.26	0.37	0.11	0.33	0.35	0.37
Phospholipids,	mmol/l	0.50^{A}	1.55^{B}	1.36^{B}	1.41^{B}	0.42^{A}	1.40^{B}	1.40^{B}	1.42^{B}
		0.04	0.36	0.25	0.28	0.08	0.27	0.26	0.22
NEFA[1],	mmol/l	0.76^{A}	0.35^{B}	0.22^{B}	0.20^{B}	0.88^{A}	0.44^{B}	0.50^{BC}	0.37^{B}
		0.15	0.13	0.06	0.05	0.17	0.10	0.09	0.09

[1] non-esterified fatty acids

^{A,B,C} $P<0.01$; ^{a,b} $P<0.05$

Irrespective of the group or age of animals, HDL constituted about 70% of the serum lipids (Figure 1). The concentration of VLDL was the highest in week 3 of life and the lowest in week 12. A slightly higher percentage of this fraction was determined in group 2. The level of LDL in both groups was the lowest in week 3 of life, increasing afterwards.

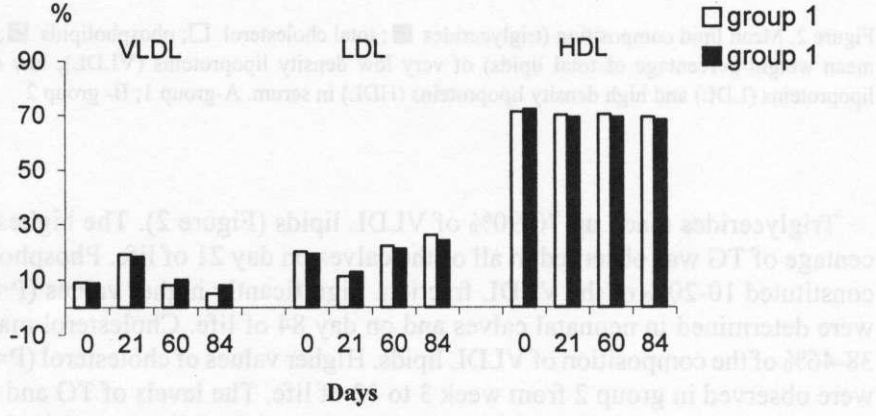

Figure 1. Average relative percent of very low density lipoproteins (VLDL), low density lipoproteins (LDL) and high density lipoproteins (HDL) in serum

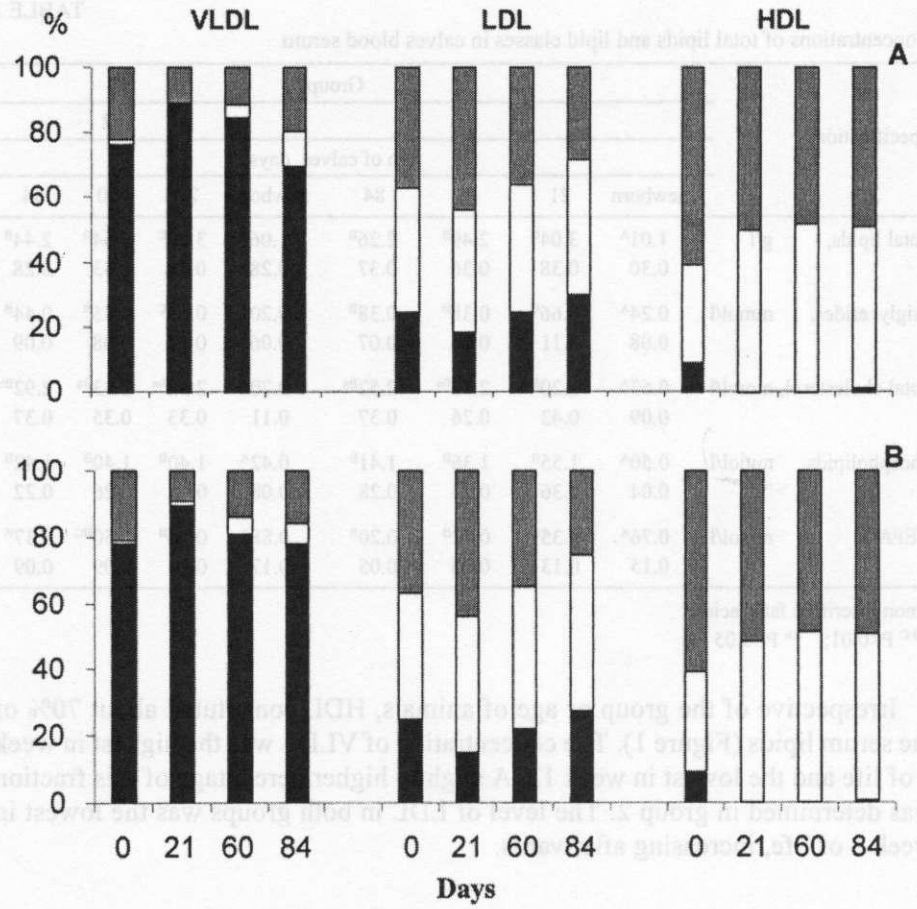

Figure 2. Mean lipid composition (triglycerides ■; total cholesterol □; phospholipids ▨; mean weight percentage of total lipids) of very low density lipoproteins (VLDL), low density lipoproteins (LDL) and high density lipoproteins (HDL) in serum. A-group 1; B- group 2

Triglycerides made up 70-90% of VLDL lipids (Figure 2). The highest percentage of TG was observed in all of the calves on day 21 of life. Phospholipids constituted 10-20% of the VLDL fraction. Significantly higher values ($P<0.05$) were determined in neonatal calves and on day 84 of life. Cholesterol made up 38-46% of the composition of VLDL lipids. Higher values of cholesterol ($P<0.05$) were observed in group 2 from week 3 to 12 of life. The levels of TG and phospholipids were similar in both groups, 15-30% and 28-44%, respectively. The lowest contribution of TG ($P<0.05$) was determined in week 3 of life, when the

level of phospholipids was the highest. In all neonatal calves the percentage of phospholipids in HDL was twice as high as that of cholesterol, with the levels of these two lipids attaining similar values of 48-51% later.

DISCUSSION

A three-fold increase in the concentration of lipids and their fractions observed in calves aged 21 days vs neonatal calves allows us to suggest that the period of colostrum and whole milk uptake plays a significant role in lipid metabolism in calves (Jenkins et al., 1998; Opałka, 2001). Although the profile of lipids changed when the animals' diet changed first to a milk replacer and then to solid feeds, group 2 calves had higher TG, cholesterol and NEFA levels in blood serum (by 15, 10 and 20%, respectively). The differences seem indicative of the effect produced by the Yea-Sacc^{1026} biopreparation. It may have caused some positive changes in ruminal fermentation and population of microorganisms (Strzetelski et al., 1996), which enhanced the activity of lipolytic enzymes and improved the utilization of dietary lipids.

Analysis of the quantitative and qualitative composition of the lipoprotein fraction proved that HDL is the most stable lipid fraction, regardless the age of calves or the type and level of nutrition. This is confirmed by other authors (Jenkins et al., 1988; Auboiron et al., 1994; Leplaix-Charlat et al., 1996). VLDL and LDL underwent more considerable changes. When the calves were fed colostrum and whole milk, VLDL was the main transporting fraction of TG, which explains why the level of VLDL was then the highest (Auboiron et al., 1994, 1995) and the concentrations of LDL and TG in this fraction, the lowest. When the diet was changed, the percentage of LDL increased in all of the calves, whereas that of VLDL declined, an observation that is confirmed by Jenkins et al. (1998). However, the application of the yeast supplement modified the lipid composition of the fraction, as the calves in group 2 had a higher TG percentage in VLDL and cholesterol in LDL (on average 11% higher) compared with the control group.

CONCLUSIONS

The results seem to suggest that the Yea-Sacc^{1026} biopreparation used as a dietary supplement in calf nutrition improve the utilization of lipids and lipid metabolism, especially when the animals were fed on solid feeds. The positive effect is reflected in the level of some lipid fractions and the quantitative and qualitative composition of VLDL and LDL fractions.

REFERENCES

Auboiron S., Durand D., Bauchart D., Robert J.C., Chapman M.J., 1994. Lipoprotein metabolism in the preruminant calf: effect of a high fat diet supplemented with L-methionine. J. Dairy. Sci. 77, 1870-1881

Auboiron S., Durand D., Robert J.C., Chapman M.J., Bauchart D., 1995. Effects of dietary fat and L-methionine on the hepatic metabolism of very low density lipoproteins in the preruminant calf, *Bos* spp. Reprod. Nutr. Develop. 35, 167-178

Fontanais-Ferrer N., Serrat-Serrat J., Sorribas-Vivas A., Gonzalez-Garcia C., Gonzalez-Sastre F., Gomez-Gerique J., 1998. Quick method of determining lipoproteins, including those of intermediate density, in serum. Clin. Chem. 34, 1753-1757

Jenkins K.J., Griffith G., Kramer J.K.G., 1988. Plasma lipoproteins in neonatal, preruminant and weaned calf. J. Dairy. Sci 71, 3003-3012

Leplaix-Charlat L., Bauchart D., Durand D., Laplaud P.M., Chapman M.J., 1996. Plasma lipoproteins in preruminant calves fed diets containing tallow or soybean oil with and without cholesterol. J. Dairy. Sci. 79, 1267-1277

Opałka A., 2001. The effect of soybean protein concentrate and whey-lipid preparate in compound mixture CJ on lipid composition in blood serum and effects of calf production during the first 16 weeks of life (in Polish). Ann. Warsaw Agr. Univ., Anim. Sci. (in press)

Strzetelski J., Maciejewicz-Ryś J., Bilik K., Stasiniewicz T., Lipiarska E., Stecka K., 1996. Effect of new preparations on calf rearing, fermentation and protozoa count of bull rumen (in Polish). Rocz. Nauk. Zoot. 23, 123-141

STRESZCZENIE

Lipidy i lipoproteiny w surowicy krwi cieląt przy stosowaniu dodatku Yea-Sacc[1026]

Oznaczano stężenie całkowitych lipidów i poszczególnych ich klas oraz ilościowy i jakościowy skład lipoprotein w osoczu krwi cieląt, których dawkę pokarmową wzbogacono w biopreparat Yea-Sacc[1026].

Stwierdzono, że stosowanie od 8 do 84 dnia życia cieląt dodatku kultur drożdży miało korzystny wpływ na metabolizm lipidów, szczególnie w okresie żywienia paszami stałymi. Znalazło to odbicie nie tylko w wyższym poziomie triacyloglicerolu (TG), cholesterolu i wolnych kwasów tłuszczowych w surowicy krwi cieląt grupy 2 (doświadczalnej), lecz także we frakcjach lipoprotein. Stężenie lipoprotein o bardzo małej gęstości (VLDL) oraz udział triacyloglicerolu (TG) w tej frakcji były najniższe w 84 dniu życia cieląt, jednak wyższe wartości (odpowiednio 8 vs 5%; 78 vs 70%) stwierdzono w grupie 2. Stężenie lipoprotein o małej gęstości (LDL) było najwyższe u wszystkich cieląt w 84 dniu i stanowiło średnio 25% lipidów surowicy. W grupie 2 cholesterol stanowił 47% lipidów LDL i był wyższy (o 11%) niż w grupie kontrolnej.