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BLOOD CONCENTRATIONS OF THYROID HORMONES AND LIPIDS AND HISTOLOGICAL CHANGES IN THE LIVER IN DAIRY COWS IN POSTPARTURIENT PERIOD*

KONCENTRACIJE HORMONA TIROIDNE ŽLEZDE I LIPIDA U KRVI I HISTOLOŠKE PROMENE U JETRI KOD MLEČNIH KRAVA U POSTPARTALNOM PERIODU

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The triiodthyronine (T_3), thyroxine (T_4), glucose, free fatty acids (FFA), triacylglycerols (TAG) and total cholesterol concentrations were estimated in the blood serum and content of lipids in the liver in healthy (n=10) and ketotic (n=10) dairy cows in the postparturient period. Samples of liver and blood tissues were taken from all the cows. Pathohistoligical examination of liver tissues showed statistically significant higher ($p<0.01$) lipid infiltration in ketotic cows compared to healthy ones. Biochemical examination of blood serum showed significantly higher values ($p<0.01$) of free fatty acids in ketotic cows such as significantly lower concentrations of glucose ($p<0.01$), triacylglycerols ($p<0.01$), total cholesterol ($p<0.05$), triiodthyronine ($p<0.05$) and thyroxine ($p<0.05$) compared to values of these parameters in the blood serum in healthy cows. Significant increase of concentration of free fatty acids, such as positive correlation ($r=0.51$; $p<0.05$) between the free fatty acids in blood and the content of lipids in liver in ketotic cows compared to healthy ones, as well as pathohistological report, shows that during intensive lipomobilisation newly synthetized triacylglycerols accumulated in the hepatocytes.In ketotic cows hypothyroidal status is established and it can be a significant factor in the development of fatty liver.

Key words: cows, fatty liver, ketosis, lipids, triiodthyronine, thyroxine

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Introduction / *Uvod*

Most metabolic disorders develop during the postparturient period. Fatty liver and ketosis present the most frequent disturbances occuring in dairy cows, resulting in significant economical losses due to a decrease in milk production (10-15%) high expenses of therapeutic treatment, emergency slaughter and deaths. Fatty liver develops during the periparturient period, when mobilization of lipids from bodily fat reserves are elevated and the rate of triglicerides accumulation in the liver is particularly high (Veenhuizen *et al*., 1991; Vazquez-anon *et al*., 1994; Reist *et al*., 2002).

Lipomobilisation characterised by high concentrated free fatty acids in blood starts within high pregnancy, reaching its maximum at early lactation. Free fatty acids are re-esterified and accumulated in the form of triacylglycerols in the liver, primarily due to a decreased capacity of hepatocytes for transport of lipids by very low density lipoproteins (VLDL). As a result, lipomobilisation intense ketogenosis and lipogenesis in the liver and as a consequence, lower concentrations of glucose, triacylglycerol and total cholesterol in blood were manifested (Herdt *et al*., 1983; Holtenius, 1989; Veenhuizen *et al*., 1991; Grummer, 1993; Vazguez-anon *et al*., 1994; Sevinc *et al*., 2003).

The hormonal activity of the thyroid gland has an important role in early lactation for determining cell metabolism intensity, energy metabolism and the lactation course itself by its thyroid hormones (Nikolić *et al*., 1997). A positive correlation was established between thyroid hormones in blood and energy balance (Reist *et al*., 2002) and a negative one between concentrations of triiodthyronine and thyroxine in blood and milk production (Nixon *et al*., 1988). Under the conditions of a negative energy balance and of high lipomobilisation, the concentrations of thyroid hormones were reduced in blood of dairy cows in the postparturient period, with pronouncedly declined triiodthyronine in blood shortly before and after calving (Blum *et al*., 1983; Gerloff *et al*., 1986; Nikolić *et al*., 1997; Reist *et al*., 2002; Pezzzy *et al*., 2003).

Kapp *et al*. (1979) noticed diffusal lipid infiltration of hepatocites, impairing most of them, took place due to a reduced mitochondria capacity to oxidize fatty acids at reduced levels of thyroid hormones in blood. Allowing for a role of thyroid hormones in the energy metabolism as well as in the milk production during lactation, the correlation between the concentrations of thyroid hormones, lipids and glucose in blood and histological changes in the liver tissue in the postparturient period was the subject of the current research.

Materials and methods / *Materijal i metode rada*

The high pregnant and calved cows (n=20) were chosen from a Holstein dairy herd and split up into two groups, the first one (C – control group)

(n=10) consisting of clinicaly healthy cows, the other (E-experimental group) (n=10) consisting of ketotic ones. The liver and blood samples were taken from all the cows. The cows were average on the 4-6 years old, 650 kg in weight, with 3 lactations and 7625 i milk of average milk production per 305 days of lactation. The diseased cows were those indicating clinical symptoms of ketosis (inappatence, rumen atony and behavioural changes) with urine of their ketotic bodies exceeding 17.20 mmol·l $^{-1}$ (Lastradet-Rosenberg test 1978). The trial cows were kept in tie-up stalls in a barn housing. Diet and feeds were in conformity with purpose and animal utilisation. The meal was prepared in the way to suit the energy needs of animals in early lactation.

The blood samples were collected by punction of the jugular vein (2 test tubes of blood taken per punction, around 20 ml blood) from 10 a.m. to noon or from 4 to 6 h after milking and feeding. The blood serum separation was aided at 3000 rotations/min. The blood serum samples were kept in a fridge at -18 ^{o}C before the investigation started.

Shortly after blood sampling the liver tissue was sampled through liver percutaneus biopsy using a biopsy instrument (Davieset and Jebbett, 1981; Gaál, 1995) following a modified method of Gaál after Hajovcava-Kacifirex (1967). The biopsy was performed at the right 11 th intercostal region, approximatelly 2 cm below the horizontal line through the tuber coxae, with a 3-5 cm long and 3-4 mm wide liver specimen.

Triiodthyronine (T_3) and thyroxine (T_4) concentrations in the blood serum samples were determined following the RIA method, using commercial test packages (INEP-Zemun) and those of free fatty acids (FFA) colorimetrically according to Ducombe (1966), with the colorimetric test No. 001 INEP Zemun being used. The determination of glucose contained in blood was made through GOD-PAP phenol method Dialab (Austria) cat. No. 760312, that of triacylglycerols (TAG) in blood serum through GPO-PAP method cat. No. A 40015 and total cholesterol in the blood serum CHOD-PAP method cat. No. 041015, reagens Serbolab (Serbia) by means of microtiter reader MULTISKAN MCC/340 (Helsinki, Finland). All biochemical parameters were assayed at the laboratory of the Institute for the Applicatin of Nuclear Energy (INEP) Zemun. Liver tissue was pathohistologicaly tested for lipid content at the Pathological Department of the Faculty of Veterinary Medicine in Belgrade. The liver specimens were fixed in neutral 10% formaldehyde solution. Cryostat sections were stained with hemotoxylin and eosin and Sudan-III in order to determine the degree of lipid infiltration.The amount of fats in the liver were determined stereometrically, computing volume density according to the formula:

$$Vvf = \frac{Pf}{Pt} \times 100$$

Vvf – volumen density of phase
Pf – points which follen on phase
Pt – points of test system

For determination of the amount of fats in the hepatocytes the net M 100 was used.

The significance of differences of thyroid hormones, lipids and glucose concentrations in the blood serum and the content of lipids in the liver between the animal groups used in the experiment were determined by the ANOVA procedure. Data are expressed as means ± standard deviation (x ± SD). Correlation coefficients were obtained using linear regression models. Differences with $p<0.05$ and $p<0.01$ were considered statistically significant (microsoft STATISTICA ver.5.0, Stat. Soft. Inc.1995).

This experiment has been aproved by the veterinary inspection at Novi Sad.

Results / *Rezultati*

The results of selected metabolic parametars of the groups of healthy cows (C – control group) and ketotic cows (E – experimental group) are shown in Table 1.

Table 1. *Selected metabolic profile parameters (means ± standard deviation) of the groups of healthy (C – control group) and ketotic (E – experimental group) cows in the postparturient period* /
Tabela 1. Odabrani parametri metaboličkog profila (srednja vrednost ± standardna devijacija) grupa zdravih krava (C – kontrolna grupa) i ketoznih krava (E – eksperimentalna grupa) u postpartalnom periodu

	Ketotic cows / *Ketozne krave*	Healthy cows / *Zdrave krave*
Group / *Grupa* (n =10)	E	C
Glucose / *Glikoza* (mmol·l^{-1}*)*	1.80 ± 0.43	2.71 ± 0.35**
FFA (mmol·l^{-1})	0.74 ± 0.12	0.46 ± 0.10**
TAG (mmol·l^{-1})	0.27 ± 0.03	0.35 ± 0.04**
Total cholesterol / *Ukupni holesterol* (mmol·l^{-1})	1.39 ± 0.29	1.86 ± 0.62*
T_3 (nmol·l^{-1}*)*	1.58 ± 0.70	2.22 ± 0.74*
T_4 (nmol ·l^{-1})	35.06 ± 12.43	45.75 ± 14.27*
Content of lipids in the liver / *Sadržaj lipida u jetri* (%)	32.91± 13.23	8.37 ± 1.24**

Legend: *p<0.05 (between group E and C); **p<0.01 (beween group E and C) /
*Legenda: *p<0,05 (između grupe E i C); p<0.01 (između grupe E i C)*

From Table 1 it can be seen that there were significant changes of most parameters in blood in the group of ketotic i.e. the group of cows with fatty liver. Blood glucose concentration was significantly lower in ketotic cows than in control cows ($p<0.01$). Biochemical examination of lipids in the blood serum showed significantly higher values ($p<0.01$) of free fatty acids in ketotic cows such as significantly lower concentrations of triacylglycerols ($p<0.01$) and total

cholesterol ($P<0.05$), compared to the values of these lipids parameters in the blood serum in the groups of healthy cows.The results also showed that the concentration of both thyroid hormones was significantly lower in the blood serum of ketotic cows, than in the blood serum of normal, control cows ($p<0.05$).

In the group of ketotic cows, the content of lipids in the liver was 32.91 ± 13.23 % and it was higher ($p<0.01$) compared to the group of healthy cows (8.37 ± 1.24 %).

The results of single values of the content of the lipids in the liver in ketotic cows are shown in Table 2.

Table 2. *The content of the lipids (%) in the liver of ketotic cows* / *Tabela 2. Sadržaj lipida (%) u jetri ketoznih krava*

Ordinal number / *Redni broj*	1	2	3	4	5	6	7	8	9	10	x
% of lipids / *% lipida*	25. 44	23. 66	23. 98	61.15	44.82	42. 56	16. 04	31. 86	32. 98	26.62	32.91

According to the Gaál's (1993) proposal all cows can be divided into 3 groups on the basis of content of lipids in the liver: 1st group – mild degree of fatty liver (0-20 %), 2th group – moderate degree of fatty liver (20-40 %) and 3th group – severe degree of fatty liver (more than 40 %). The obtained results show that only one cow with ketosis had a mild degree of lipid infiltration of liver cells or 10 % of tested cows, in six cows there was a moderate degree of fatty liver (60 %) and in three cows (30 %) severe fatty liver had been determined.

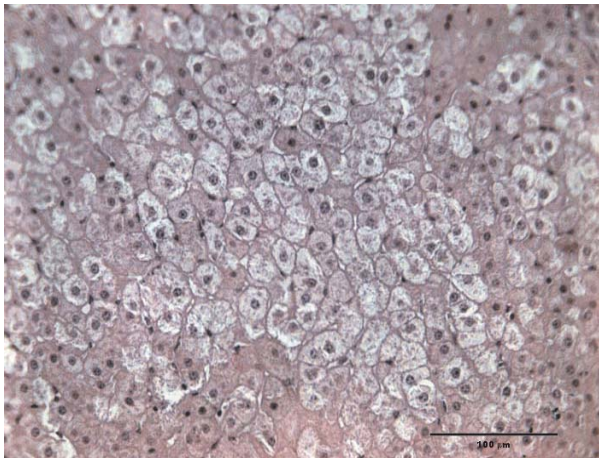

Figure 1. *Hepatocytes with light, fine granulated cytoplasm in the liver of a puerperal healthy cow (HE, 270x)* /
Slika 1. Hepatociti sa svetlom, fino granuliranom citoplazmom u jetri postpartalne zdrave krave (HE, 270x)

Significant content of lipids in hepatocytes has not been determined in healthy cows after calving. In histological preparations hepatocytes were normal by size, shape and order. In some of them lighter fine granulated cytoplasm was noted, while nuclei in some of those hepatocytes were masked (Figure 1).

Histological examination of liver of cows with a mild degree of fat infiltration in hepatocytes has been determined in the presence of intracytoplasmatic single tiny fat droplets placed centrolobularily. The shape and size of hepatocytes remained unchanged and such was the relation between hepatocytes and sinu-

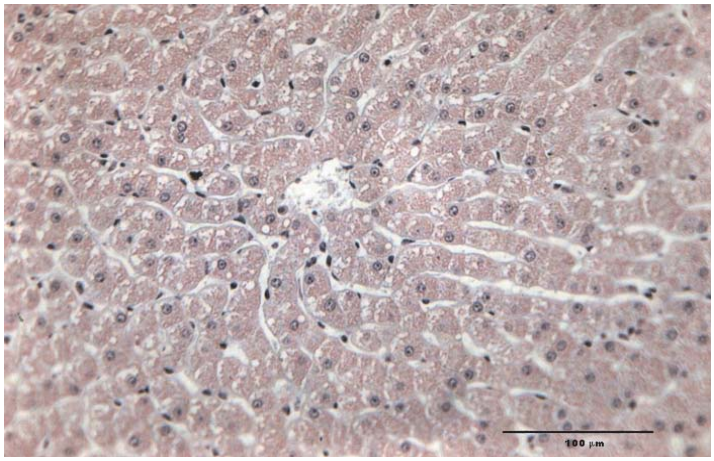

Figure 2. *Fatty changes of low intensity (16.04 %) in the liver of a ketotic cow (HE, 270x) /*
Slika 2. Masne promene niskog intenziteta (16,04%) u jetri ketozne krave (HE, 270x)

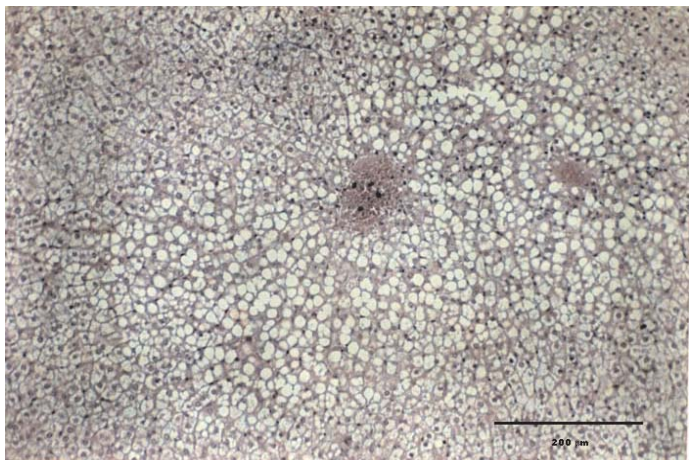

Figure 3. *Fatty changes of medium to high intensity (32.96%) in the liver of a ketotic cow (HE, 130x) /*
Slika 3. Masne promene srednjeg do visokog intenziteta (32,96%) u jetri ketozne krave (HE, 130x)

soids (Figure 2). In cows with a moderate degree of fatty liver pathohistological changes of the liver tissue were in correlation with the amount of lipids in the hepatocytes. In lighter forms single tiny fat droplets were noticed in centrolobularily placed hepatocytes. The nuclei of these cells were visible and without changes. With the increase of the amount of fat the number of infiltrated hepatocytes increases such as the number and size of fat droplets in them. Nuclei of the cell were peripherally dislocated and in the heavier forms they were becoming piknotic or were completely missing (Figure 3). In the severe degree of fatty liver, patohistological changes of liver tissue were the most visible, i.e. hepatocytes were almost completely filled by middle and large sized fat droplets, the size of hepatocytes was cosiderably increased, nuclei were damaged and peripheraly dislocated, piknotic or completely missing (Figure 4).

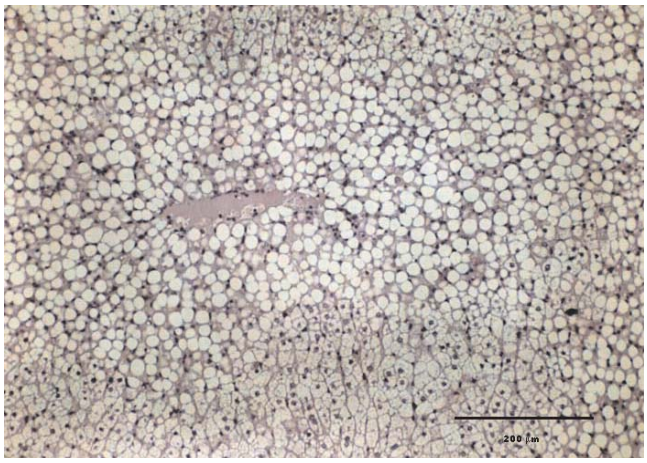

Figure 4. *Selection of fats in a major part of the liver lobule (42.56%) in a ketotic cow (HE,130x) /*
Slika 4. Nagomilane masti u većem delu jetrenog režnjića (42,56%) ketozne krave (HE, 130x)

Discussion / *Diskusija*

Primary homeoretic adaptation of the glucose metabolism in the early lactation leads to an increased gluconeogenesis in the liver to direct glucose to the mammary gland for lactose synthesis (Reynolds *et al*., 2003). If the degree of gluconeogenesis does not satisfy the increased needs in glucose of dairy cows in early lactation, hypoglycaemia, ketonemia and ketonuria likely occurs (Young, 1977).

In the group of ketotic cows, hypoglicaemia was determined which was significantly lower ($p<0.01$) compared to the groups of healthy cows. Similar

results were obtained by other authors (Veenhuizen *et al*., 1991; Vazquez-anon *et al*., 1994). Needs for glucose in early lactation in dairy cows are higher than the amount which the body can provide in the condition of high milk production and that is an important factor in the development of hypoglycaemia and ketosis.

In ketotic cows there is a decreased ability of hepatocytes to synthese glucose by gluconeogenesis and as a consquence fatty liver development (Gröhn, 1985; Veenhuizen *et al*., 1991; Codorniga-valino *et al*., 1997). In accordance with this, we have confirmed in our test the negative correlation ($r=-0.69$; $p<0.05$) between glucose concentration in blood and content of lipids in the liver in the group of ketotic cows.

In this experiment, pathohistoligical examination of liver tissues shows statistically significant higher ($p<0.01$) lipid infiltration in ketotic cows compared to healthy cows. In the ketotic cows, various degrees of fatty liver were estimated.

Similar results of the testing of structure of fatty liver in dairy cows using light or electron microscopy were also obtained by other authors (Kapp *et al*., 1979; Gröhn, 1985; Gröhn and Lindberg, 1985; Johannsen *et al*., 1993). These authors have determined an increase of the hepatocyte volume, compression and decrease of volume nuclei, glycogen, sinusoids, rough endoplasmic reticulum and other organelles in the hepatocytes, a decrease of the number with simultaneous increase in the size of mitochondria and mitochondrial damage such as increase in a smooth endoplasmic reticulum and the number and size of fat droplets.

The energy metabolism in dairy cows in the transitional period is closely linked to lipid metabolism. The best indicator of negative energy balance and the degree of mobilisation of lipids from bodily fat reserves in the postpartal period is the increase of FFA concentrations in blood (Veenhuizen *et al*., 1991; Vazquez-anon *et al*., 1994; Reist *et al*., 2002; Overton and Waldron, 2004). There is an increase in blood FFA concentrations which are bound to albumin and transported to the liver. In the liver, they may be oxidized to CO_2 or ketone bodies or they are re-esterified to TAG. TAG are then combined with phospholipids, cholesterol and apoproteins, with the production of lipoproteins and mainly lipoproteins of very low density (VLDH) that carry TAG to varius tissues (Holtenius, 1989).

Significantly higher FFA concentrations have been determined in the blood ($p<0.01$) of ketotic cows than in healthy cows. This agrees with the studies of Veenhuizen *et al*. (1991), Reist *et al*. (2002) and Overton and Waldron (2004).

In accordance, in this experiment significant possitive correlation ($r=0.51$; $p<0.05$) was determined between the FFA in blood and the content of lipids in the liver such as a negative correlation ($r=-0.64$; $p<0.05$) between the FFA and TAG concentrations in blood in the group of ketotic cows. The obtained results unambigously show that the significant increase of FFA concentrations in blood causes an increase of the amount of lipids in the liver cells.

In cows with fatty liver the TAG and total cholesterol concentrations in the blood decline (Sevinc *et al*., 2003). In ruminants relatively low TAG concentra-

tions in the blood serum (2.6-5.2 mmol·l^{-1}, Jovanović, 1984) and the further decline of their concentrations could be a consequence of lipid infiltration of liver cells.

In this experiment significantly lower ($p<0.01$) TAG concentrations has been determined in blood in the group of ketotic cows than the values in the group of healthy cows, such as a significant negative correlation ($r=-0.55$; $p<0.05$) between the TAG concentrations in blood and the amount of lipids in the liver in the group of ketotic cows. The results unambigously indicated that the blood TAG concentrations decreased and proportionally their amount increased in the liver cells in which they accumulated. These results are in accordance with the observation by Holtenius (1989) and Sevinc *et al*. (2003).

Furthermore, the significant positive correlation ($r=0.54$; $p<0.05$) between glucose and TAG levels in blood clearly shows that during intensive lipomobilisation and accumulated TAG in the liver cells, their gluconeogenetic ability is decreased, which is probably one of the main causes of developing hypoglicaemia in the animals.

Contrary to this, in healthy cows in the puerperal period, a positive correlation ($r=0.70$; $p<0.05$) has been determined between the FFA and TAG concentrations in blood. This indicates that in the condition of lipomobilisation in blood of just calved healthy cows the increase of TAG concentrations in blood and unlike the ketotic cows TAG do not accumulate in the liver, but are transported by the blood to the tissues which use them for their purposes.

According to Gerloff *et al*. (1986) a low level of total cholesterol in blood has been observed in the cows which have damaged liver function.

In this study the total cholesterol concentrations in blood in the tested group of cows were within the lowest physiological limit (1.3-6.0 mmol·l^{-1}, Jovanović, 1984) and significantly lower ($p<0.05$) levels of the total cholesterol were determined in blood in ketotic cows than of healthy group of cows. These results were in accordance with the results of other authors (Gerloff *et al*., 1986; Holtenius, 1989; Sevinc *et al*., 2003) which indicate that in the condition of ketosis and fatty infiltration of liver cells in dairy cows, their ability to synthesize and transport cholesterol is decreased.

The decline of TAG and total cholesterol levels in the blood of ketotic cows is the consequence of decreased or insufficient synthesis of lipoprotein fractions. This is specially important from the aspect of synthetic activity of hepatocytes, because in the conditions of fatty infiltration their role is significantly decreased, so that concentration of all lipoprotein fractions in blood decreases (LDL,VLDL and HDL) and a specially of those which are responsible for transporting TAG from the liver (VLDL) (Herdth, 1983; Gerloff *et al*., 1986; Holtenius, 1989; Sevinc *et al*., 2003).

In early lactation, dairy cows are in a state of metabolic stress in order to satisfy the increased energy of the mammary gland and the adjusment of the neuro-endocrine system of dairy cows to the new metabolic needs of the body

(Bauman and Currie, 1980; Nikolić *et al*., 1997). One of the endocrine factors are the thyroid hormones. In this study significantly lower ($p<0.05$) T_3 and T_4 concentrations in blood have been determined in the group of ketotic cows compared to the values of these hormones in the blood in group of the healthy cows. There is also a significant positive correlation ($r=0.73$; $p<0.05$) between the T_3 and T_4 levels in blood. Similar results have been obtained by other authors (Gerloff *et al*., 1986; Nikolić *et al*., 1997; Stang *et al*., 1998b; Reist *et al*., 2002). It is considered that thyroid hormones, especially T_3 which is about four times more active than T_4, have an important role in the postparturient period in dairy cows, because in their very low concentrations in blood usage of bodily fat reserves are enabled as well as their transfer for high milk production. In accordance with this, Nixon *et al*. (1988) and Reist *et al*. (2002) have determined the negative correlation between T_3 and T_4 concentrations in blood and production of milk and the positive correlation with the energy balance.

Pezzy *et al*. (2003) consider that in dairy cows in early lactation, the state of hypothyroism is present and it is the cause of the liver's decreased 5'-deiodinase activity or the secretion of thyroid hormones in milk. Namely, the authors have determined the highest T_3 and T_4 concentrations in colostrum when the concentrations of these hormones in blood were the lowest.

The hepatic capacities for disposal of FFA through mithochondrial or peroxisomal B oxidation or export as TAG with VLDL are limited in ruminants compared with nonruminants (Grummer 1993; Palmquist 1994).

It is well known that the intensity of oxidation in mithochondria of cells is in strong correlaton with the functional state of the thyroid gland, so it is justifiably considered that the conditions of negative energy balance and the increased lipomobilisation from bodily fat reserves result in lipid infiltration of liver cells. The reason is the decreased capacity of mithochondria to oxidize fatty acids in the conditions of low concentrations of thyroid hormones in blood (Kapp *et al*., 1979; Stang *et al*., 1998b).

Romo *et al*. (1997) reported that as a consequence of liver steatosis, FFA accumulate in the liver parenchyma and it has been demonstated that some fatty acids inhibit type-I liver 5'–deiodinase activity.

These opinions are confirmed by these results, since significantly lower ($p<0.05$) values of T_3 and T_4 in blood of ketotic cows have been determined as compared to the healthy ones. Within all tested cows with ketosis, the fat infiltration of the liver has been determined, especially in cows with severe fatty liver (>40 %) the lowest values of the T_3 (<1.00 $nmol \cdot l^{-1}$) and those of T_4 (<15 $nmol \cdot l^{-1}$) were established (physiological range T_3: around 1,5 $nmol \cdot l^{-1}$; T_4: 40 – 80 $nmol \cdot l^{-1}$; Jovanović, 1984). That confirms the negative correlation ($r=0.50$; $p<0.05$) between the T_3 and FFA concentrations in blood in the ketotic cows.

Kapp *et al*. (1979), on the basis of the results of a pathological examination of the liver tissue taken by biopsy and the concentrations of thyroid hormones in blood, indicates that at their very low concentrations in blood, the most

noticeable is lesion of organelles of hepatocytes while the cytoplasm is completely filled with fat droplets. For this reason, the authors consider that diffuse infiltration of hepatocytes in ketotic cows occurs because of the decreased capacity of mithochondria to oxidize FFA in the conditions of decreased or discontinuited activity of thyroid hormones.

On the basis of the obtained results and the pathohistological report, it can be concluded that the significantly decreased concentrations of thyroid hormones in blood in ketotic cows is the key mechanism in the peripheral tissues adaptation during the decreased energy turnover which is used for the mammary gland requirements. Such conditions of metabolism regulation and energy insufficiency (considerable increase of the levels of FFA and hypoglycaemia) and very low concentrations of thyroid hormones in blood decrease the intensity of oxidation processes in the body tissues, as well as liver cells and that creates the conditions for fatty liver development in these animals.

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SRPSKI

KONCENTRACIJE HORMONA TIROIDNE ŽLEZDE I LIPIDA U KRVI I HISTOLOŠKE PROMENE U JETRI KOD MLEČNIH KRAVA U POSTPARTALNOM PERIODU

R. Đoković

Određivane su koncentracije trijodtironina, tiroksina, glukoze, slobodnih masnih kiselina, triglicerida i ukupnog holesterola u krvnom serumu i histološke promene u jetri kod 10 zdravih i 10 ketoznih mlečnih krava u postpartalnom peroidu.

Patohistološkim ispitivanjima tkiva jetre utvrđena je statistički značajno veća ($p<0,01$) masna infiltracija hepatocita kod ketoznih krava u odnosu na zdrave krave. Biohemijskim ispitivanjima krvnog seruma utvrđene su značajno veće vrednosti slobodnih masnih kiselina ($p<0,01$) i značajno niže vrednosti trijodtironina ($p<0,05$), tiroksina ($p<0,05$), glukoze ($p<0,01$), triglicerida ($p<0,01$) i ukupnog holesterola ($p<0,05$) u krvnom serumu ketoznih krava u odnosu na zdrave krave.

Kod grupe ketoznih krava utvrdjena je pozitivna korelacija ($r=0,51$; $p<0,05$) između sadržaja masti u jetri i koncentracije slobodnih masnih kiselina u krvnom serumu, što ukazuje da se slobodne masne kiseline zadržavaju u jetri u obliku triglicerida. Kod krava obolelih od ketoze utvrdjen je hipotiroidni status, što može biti značajan činilac u razvoju masne jetre kod mlečnih krava.

Ključne reči: krave, masna jetra, ketoza, lipidi, trijodtironin, tiroksin

РУССКИЙ

КОНЦЕНТРАЦИЯ ГОРМОНОВ ЩИТОВИДНОЙ ЖЕЛЕЗЫ И ЛИПИДОВ В КРОВИ И ГИСТОЛОГИЧЕСКИЕ ИЗМЕНЕНИЯ В ПЕЧЕНИ У МОЛОЧНЫХ КОРОВ В ПОСЛЕРОДОВОМ ПЕРИОДЕ

Р. Джокович

Определены концентрации триодтиронина, тироксина, глюкозы, свободных жирных кислот, триглицеридов и совокупного холестерина в кровяном серуме и гистологические изменения в печени у 10 кетозных молочных коров в послеродовом периоде.

Патогистологическими испытаниями тканей печени утверждена статистически значительно бóлше ($p<0,01$) жирная инфильтация гепатоцитов у кетозных коров в отношении здоровых коров. Биохимическими испытаниями кровяного серума утверждены значительно более большие стоимости свободных жирных кислот ($p<0,01$) и значительно более низкие стоимости триодтиронина ($p<0,05$), тироксина ($p<0,05$), глюкозы ($p<0,01$), тригицеридов ($p<0,01$) и совокупного холестерина ($p<0,05$) в кровяном серуме кетозных коров в отношении здоровых коров.

У групп кетозных коров утверждена положительная корреляция ($r=0,51$; $p<0,05$) между содержанием жира в печени и концентрации свободных жирных кислот в кровяном серуме, что указывает, что свободные жирные кислоты задерживаются в печени в порме триглицеридов. У коров заболевших кетозом утверждёногипотироидный статс,что может быть значительный фактор в резвитии жирной печени у молочных коров.

Ключевые слова: коровы, жирная печень, кетоз, липиды, триодтиронин, тироксин