

CONTEMPORARY AGRICULTURE
SAVREMENA POLJOPRIVREDA

The Serbian Journal of Agricultural Sciences
Srpski časopis za poljoprivredne nauke

Vol. 64, No. 1 - 2, Pp. 1 - 119, 2015.

www:Contemporary Agriculture
ISSN: 0350-1205 UDC: 63(497.1)(051)-*540.2*

UNIVERSITAS STUDIORUM
NOVI SAD
University of Novi Sad, Serbia

Published by
Faculty of Agriculture,
Novi Sad

Original scientific paper

UDC: 636.2: 591.469 :612.664

INFLUENCE OF NIACIN ON LIPID METABOLISM IN DAIRY COWS DURING EARLY LACTATION*

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Summary: The aim of our study was to examine the influence of niacin administration on lipid metabolism in cows during early lactation. Thirty Holstein-Friesian cows were included in experiment and were divided into two groups: cows supplemented with niacin (15) and negative control nonsupplemented cows (15). Blood samples were taken by venepuncture of v.coccigea in vacutainers for serum separation. Sampling was performed at calving and in first and second weeks of lactation. Concentration of blood NEFA, BHB, cholesterol and triglycerides was determined. NEFA:cholesterol ratio was calculated as index of liver lipidosis. Cows that received niacin showed lower concentrations of NEFA and BHB and a higher concentration of triglycerides and cholesterol, also there is a significantly higher concentration of cholesterol per unit NEFA. Application of niacin in cows during periparturient period showed positive effects on lipid metabolism such as decreased lipid mobilization (decreased NEFA), ketogenesis (decreased BHB) and liver lipidosis (higher triglycerides and cholesterol in blood and higher concentration of cholesterol per NEFA unit) in early lactation.

Key words: cows, niacin, lipid metabolism, periparturient period.

INTRODUCTION

Metabolic changes in periparturient period sets metabolism of dairy cows to start with lactation. The most of important changes could be detected in lipid metabolism. In early lactation exists negative energy balance with insulin resistance and consequently lipid mobilization (with higher NEFA in blood) increases in order to use fat for energy purposes. This mechanism provides sparing of glucose for milk production. High lipid mobilization leads animals to higher ketogenesis in liver with increase of BHB. They are deposited in hepatocytes in the form of

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*This research was a part of project TR31062 funded by the Serbian Ministry of Science.

triglycerides (TGC), forming fatty liver. Fat accumulation in liver decreased transport form of cholesterol. Consequently concentration of TGC and CHOL decrease in early lactation (Đoković et al., 2015; Cincović, 2014; Đoković et al., 2014).

Niacin is a water-soluble vitamin, also known as vitamin B3. Niacin is the generic term for nicotinic acid (pyridine 3-carboxylic acid) and nicotinamide (nicotinic acid amide) and the coenzyme forms of the vitamin. Nicotinamide is the active form, which functions as a constituent of two coenzymes, namely, nicotinamide adenine dinucleotide (NAD) and nicotinamide adenine dinucleotide phosphate (NADP). NAD is included in next metabolic pathway: glycolysis, gluconeogenesis, fatty acid degradation and ketogenesis. NADP is included in fatty acid synthesis and cholesterol synthesis (Kutas, 1994). Niacin stabilizes and balances lipid metabolism through different way in liver, lipid tissue and inflammatory response (Kamanna and Kashyap, 2008).

The aim of our study was to examine the influence of niacin administration on lipid metabolism in cows during early lactation.

MATERIAL AND METHODS

Thirty Holstein-Friesian cows were included in experiment and were divided into two groups: cows supplemented with niacin (15) and negative control nonsupplemented cows (15). Niacin was administered in a dose of 60-80 g / day in the period before parturition (2 weeks) and early lactation (1 week).

Blood samples were taken by venepuncture of *v.coccigea* in vacutainers for serum separation. Sampling was performed at calving and in first and second weeks of lactation. Concentration of blood NEFA, BHB, cholesterol and triglycerides was determined by standard colorimetric kit (Randox, UK) on Rayto spectrophotometric device. NEFA:cholesterol ratio was calculated as index of liver lipodosis.

Statistic: Difference between concentration of lipid metabolites and NEFA:cholesterol ratio were calculated for each week by t-test.

RESULTS AND DISCUSSION

Effect of niacin on lipid metabolism in cows in early lactation is multifaceted. Cows that received niacin showed lower concentrations of NEFA (graphic 1) and BHB (graphic 2) and a higher concentration of triglycerides (graphic 3) and cholesterol (graphic 4), there is also a significantly higher concentration of cholesterol per unit NEFA (graphic 5), so the risk of occurrence of fatty liver hepatocytes was lower. The concentration of the above parameters agrees with our previous studies of metabolism in cows during early lactation (Cincović et al., 2012)

Nicotinic acid in a very high dosage has the ability to suppress the release of fat. The pharmacological dose of nicotinic acid inhibits lipolysis in cattle. The concentration of NEFA in plasma was reduced in only one study of eleven studies when small dose of free niacin is given as a supplement in dairy cows. So nicotinic acid is a powerful antilipolytic agent in cattle that have a negative energy balance during food shortages and Sustainable decrease NEFA can be achieved as long as there is a supply of nicotinic acid in the lower part of the gastrointestinal tract where it is absorbed. Where it was used niacin protected in degradation in the rumen, the dose of 24 g encapsulated niacin (which provides bioavailability of 9.6 g per day) has been successful in the inhibition of lipolysis in postpartum cows. A dose of 12 g per day of encapsulated niacin provides bioavailability source of niacin, which modifies lipid metabolism (NRC, 2001; Pires et al., 2007a, 2007b; Niehoff et al., 2009; Morey et al., 2011; Yuan et al., 2012).

Studies have shown that niacin supplements reduce the concentration of BHB and NEFA in the blood plasma with increasing glucose concentration. Results were obtained with significant effects of niacin on BHB where the level of BHB concentration in plasma was lower in cows fed with niacin compared with the control group. Significant reduction of the BHB was obtained in cows fed with 12 grams of niacin per day, and reduction was lesser in cows that received 6 grams per cow per day compared with the control-group (Karkoodi and Tamizrad, 2009; Al-Abbasy, 2013; Pescara et al., 2010). There was a decreased concentration of triglycerides in the liver of cows fed with niacin. This occurs because the accumulation of triglycerides in liver directly related to the concentration of NEFA in the blood, and reduction of NEFA and lessens accumulation of triglycerides (Yuan et al., 2012)

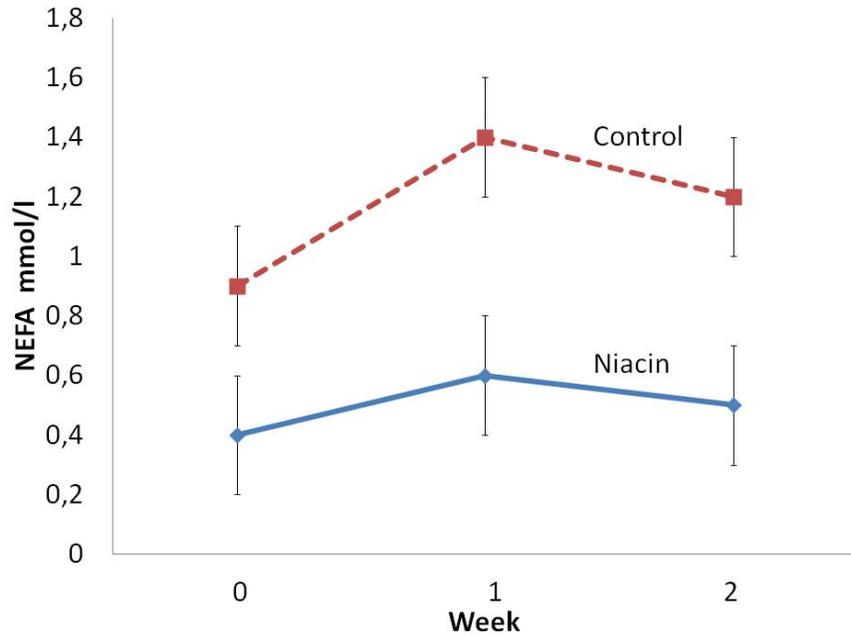


Figure 1. Concentration of NEFA in cows supplemented and non-supplemented (control) with niacin

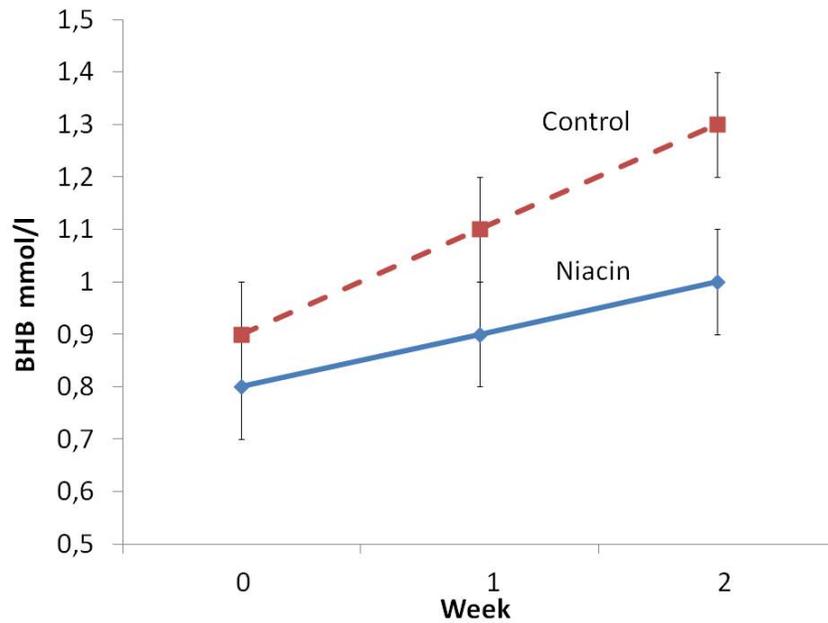


Figure 2. Concentration of BHB in cows supplemented and non-supplemented (control) with niacin

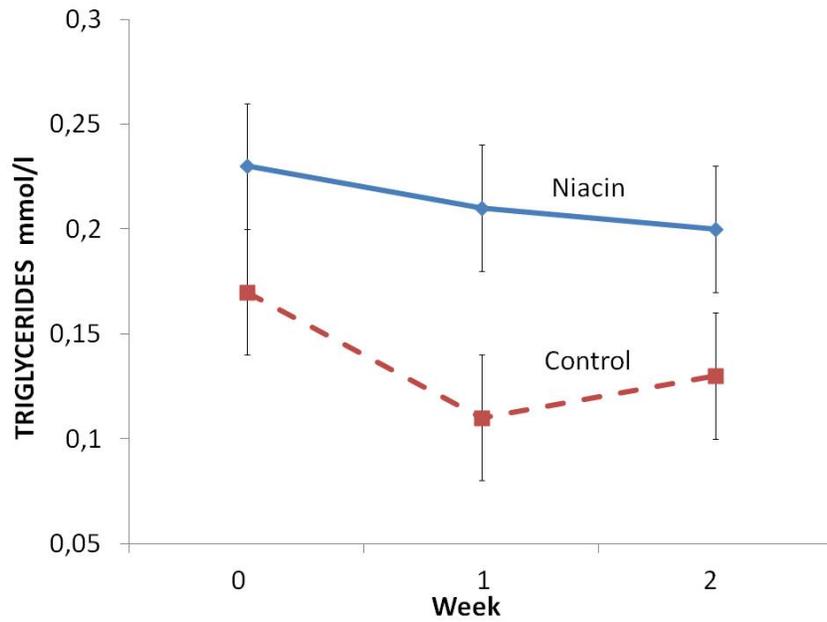


Figure 3. Concentration of triglycerides in cows supplemented and non-supplemented (control) with niacin

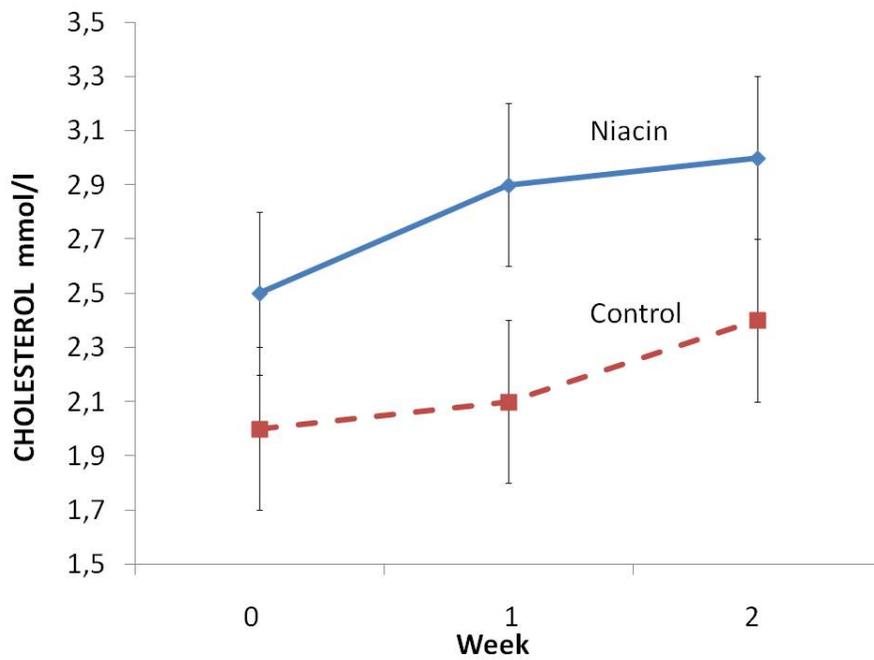


Figure 4. Concentration of cholesterol in cows supplemented and non-supplemented (control) with niacin

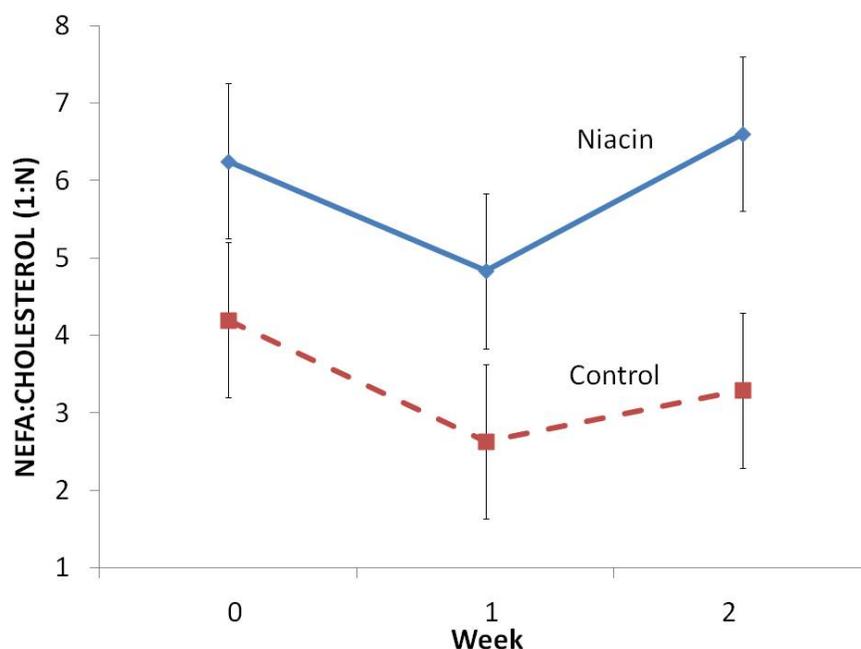


Figure 5. NEFA:cholesterol (1:n) ratio in cows supplemented and non-supplemented (control) with niacin

CONCLUSION

Application of niacin in cows during periparturient period showed positive effects on lipid metabolism such as decreased lipid mobilization (decreased NEFA), ketogenesis (decreased BHB) and liver lipidosis (higher triglycerides and cholesterol in blood and higher concentration of cholesterol per NEFA unit) in early lactation.

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UTICAJ NIACINA NA METABOLIZAM MASTI KOD KRAVA U RANOJ LAKTACIJI

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Izvod: Najvažnije metaboličke promene u ranoj laktaciji kod mlečnih krava nalaze se u okviru metabolizma masti. U ovom periodu postoji negativni energetska bilans krava sa insulinskom rezistencijom i posledičnim povećanom mobilizacijom lipida, ketogenezom i zamašćenjem jetre. Cilj ovog rada je da se ispita uticaj aplikacije niacina na metabolizam lipida kod krava u ranoj laktaciji. U ogled je uključeno 30 krava koje su podeljene u dve grupe: krave koje su primale niacin (15) i krave koje nisu primale niacin (15). Krv je uzeta venepunkcijom v.coccigea u vakutajnere za separaciju seruma u momentu teljenja i u prvoj i drugoj nedelji posle teljenja. Određena je koncentracija NEFA, BHB, holesterola i triglicerida, a izračunat je i odnos NEFA:holesterol. Aplikacija niacina pokazuje pozitivne efekte na metabolizam masti kod krava u ranoj laktaciji dovodeći do smanjene lipidne mobilizacije (niža koncentracija NEFA), smanjenje ketogenze (niža koncentracija BHB) i smanjenog stepena zamašćenja jetre (viša koncentracija holesterola i triglicerida u krvi i veća koncentracija holesterola po jedinici NEFA).

Ključne reči: krave, niacin, metabolizam lipida, peripartalni period.

Received / *Primljen*: 20.01.2015.

Accepted / *Prihvaćen*: 19.02.2015.