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O14 Hepatic energy reserves and carnitine palmitoyltransferase activity in grazing dairy cows of two pasture-based systems during lactation

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Keywords: Energy metabolism; Liver; Fatty acid oxidation

Introduction
Mitochondrial fatty acid (FA) oxidation is a major source of energy, providing substrates for oxidative phosphorylation and ketogenesis. Entrance of long chain FA to these pathways relies on the carnitine palmitoyltransferase (CPT) system composed of two acyltransferases, CPT1 and CPT2, and carnitine-acylcarnitine translocase which all increase in liver of postpartum dairy cows (Han van der Kolk et al., 2017). Hepatic abundance of CPT1 and CPT2 mRNA and its protein concentrations are decreased in ketotic vs. non-ketotic cows (Li et al., 2012). As the inclusion of grazing in dairy cow systems may imply insufficient energy intake (Chilibroste, et al., 2005) our aim was to evaluate energy reserves and CPT activity in liver biopsies of dairy cows in two pasture-based systems during the prepartum and early to mid-lactation.

Material and Methods
Forty-eight multiparous Holstein cows (562 ± 64 live weight and 3.1 ± 0.3 body condition score at calving; autumn calving), were managed similarly during the prepartum (40% of offered dry matter (DM) as grazed Medicago sativa and Dactylis glomerata and supplemented with total mixed ration (TMR), 16 g/kgDM crude protein (CP) and 10.3 MJ of metabolizable energy (ME) per kgDM) and assigned at calving to two feeding strategies: maximum pasture (MaxP) treatment, forage represented 67% of offered intake (70:30 direct grazing to conserved forage ratio) and the remaining 33% was a commercial concentrate offered in the milking parlor and fixed pasture (FixP) treatment, grazing represented 32% of offered intake and the remaining was a TMR (55:45 forage:concentrate DM basis) provided in an open lot. Average annual CP and ME values were 21 g/kgDM and 10.7 MJ ME/kgDM for MaxP and 20 g/kgDM and 11.6 MJ ME/kgDM for FixP. Liver biopsies were collected at - 45 ± 17, 21 ± 7, 100 ± 23 and 180 ± 23 days in milk (DIM), representative of the prepartum, early, mid and late mid-lactation. Free glucose, glycogen and triglyceride concentrations in liver were measured in homogenates using commercial kits and specific activity of CPT was measured by following the release of CoA-SH from palmitoyl-CoA at 412 nm. Data were analysed using a mixed model with repeated measures that included DIM, feeding strategy and their interaction as fixed effects.

Results and Discussion
Solids corrected milk peaked during early lactation and was greater for the MaxP treatment during early and mid-lactation (37.4 vs. 33.3 ± 0.79, 21.4 vs. 18.8 ± 0.79, 19.8 vs. 21.0 ± 0.79, for 21, 100 and 180 DIM, for MaxP and FixP, respectively, $P < 0.001$) Free liver glucose was greater during the prepartum ($P < 0.0001$, Figure 1A) while liver glycogen decreased during early lactation ($P < 0.0001$, Figure 1B) and the ratio between these two variables suggested that glucose reserves were depleted during early lactation ($P < 0.001$, Figure 1C). Regarding FA oxidation, liver triglyceride peaked ($P < 0.0001$, Figure 1D), greatly for MaxP cows ($P < 0.05$) and CPT activity decreased during early lactation ($P < 0.001$, Figure 1F), especially for MaxP cows ($P < 0.05$). Our results showed that although lipid reserves are mobilized during early lactation, entrance of FA for its oxidation was depressed, in accordance with previous studies performed in ketotic cows (Li et al., 2012). In addition, mobilization of lipid reserves was less dramatic ($P < 0.05$) in cows supplemented with TMR and CPT activity was greater ($P < 0.05$) compared to cows supplemented with concentrate.

Conclusion and Implications
Although mobilization of FA was exacerbated during early lactation, activity of CPT was impaired, impeding mitochondrial beta-oxidation and cows with a higher inclusion of grazed pastures and supplemented with concentrate maintained lower levels of CPT activity and higher concentrations of liver triglycerides than grazing cows with TMR supplementation.

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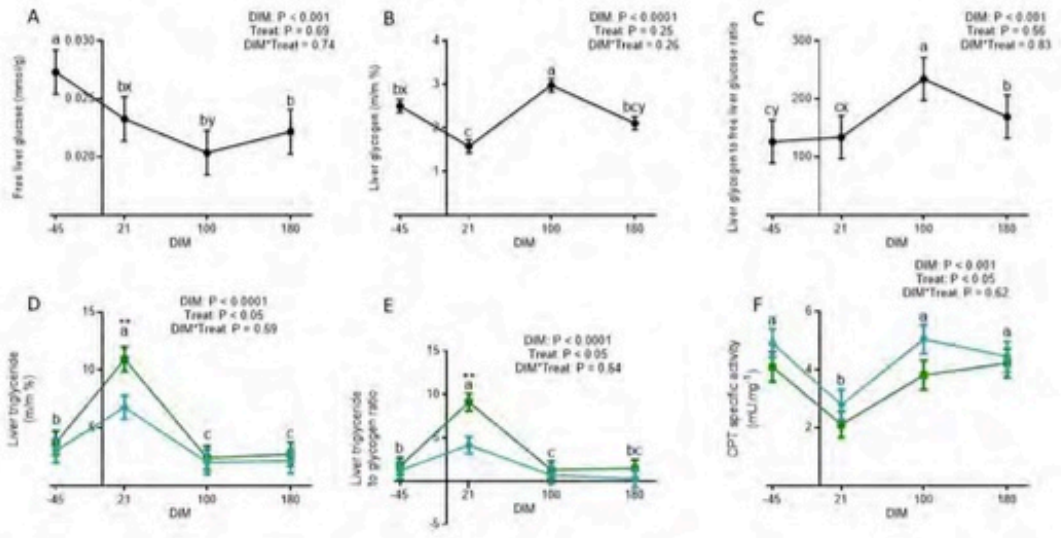

Figure 1. Hepatic energy reserves and CPT activity from pre-partum to mid lactation in cows from MaxP (green) and FixP (blue) (N = 24). Different letters (*a* and *b* for $P < 0.05$) and asterisks or numerals (** for $P < 0.01$) depict differences between means; letters for DIM effect and asterisks for treatment effect. Graphs show free liver glucose (A), liver glycogen (B), liver glycogen to glucose ratio (C), liver triglyceride (D), liver triglyceride to glycogen ratio (E) and CPT specific activity (F).

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O15 Hepatic amino acid catabolism and muscle protein degradation decrease in efficient young bulls

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Keywords: Residual feed intake; Protein turnover; Beef cattle

Introduction

The current economic and environmental context encourages the improvement of feed efficiency in beef cattle, which is lower than in other species. Residual feed intake (RFI) is one of the most widely used traits of feed efficiency in animal breeding. However, selection for RFI might entail the co-selection of undesirable characters such as lower immunity and reproductive performances. In addition, the RFI ranking seems to be dependent on the type of diet fed to animals. Understanding the biological mechanisms underlying RFI may help overcome these potential drawbacks. Protein metabolism has been proposed as a major determinant of RFI variations, given its role in both energy expenditure and N use efficiency (Guarnido-Lopez et al., 2021). The objective of this study was to evaluate one of the main pathway associated to protein degradation (ubiquitin pathway) in skeletal muscle and the hepatic amino acid catabolism of extreme RFI fattening beef cattle (the most vs least efficient) fed two contrasting fattening diets used in field conditions.

Material and Methods

A total of 100 Charolais bulls were evaluated for feed efficiency for 196 days and fed one of two diets, composed of 40 % concentrate and 60% forage (grass or corn silage). After the first 84 days on test, we chose the 32 most extreme RFI individuals (±1.08kg DMI/day). Before the slaughter at day 196 (12-14h), feed was removed. Then, 3h before slaughter the same amount of their respective concentrate (2.5kg) was