Contrasted status in B vitamins between dairy cows and goats fed various lipid supplements

Benoit Graulet, Laurence Bernard, Sophie Laverroux, Milka Popova, Hélène Fougere, Christiane Girard, Christiane Girard

Contrasted status in B vitamins between dairy cows and goats fed various lipid supplements

Graulet B[1]., Fougère H[1]., Girard C.L. [2], Laverroux S[1]., Popova M[1]. and Bernard L[1].
[1] Université d'Auvergne, INRA, Vetagro Sup, UMR12133 Herbivores, 63122 St-Genes-Champanelle, France
[2]Agriculture Agri-Food Canada, Sherbrooke Research and Development Centre, Sherbrooke, J1M 0C8, Canada

B vitamin status and metabolism are still known in ruminants in spite of their importance for the nutritional value of dairy products (Coudray et al., 2011), productive performance (Girard & Matte, 2005) and apparent link to feed efficiency (Meale et al., 2017, Li & Guan, 2017). In ruminants, B vitamins are from dietary and ruminal origins except B_{12}, exclusively synthesized by rumen bacteria (Graulet, 2014). A better understanding of the factors modulating B-vitamin status in ruminants would help to improve performance of livestock systems. We compared the B-vitamin status in 12 Holstein dairy cows and 12 Alpine dairy goats receiving the same diets supplemented or not with lipids for 28 d-periods in 2 species distinct (4 × 4) Latin square designs. Diets were based on hay (45 %) plus concentrates (55%) containing no additional lipid (CTL), or supplemented with corn oil and wheat starch (COS), marine algae powder (MAP), or hydrogenated palm oil (HPO) (Fougère et al., 2018). Vitamins were analyzed by liquid chromatography for B_2 and B_6 (Meale et al., 2017 ; Laverroux et al., unpublished) and radioassay for B_9 and B_{12} (Duplessis et al. 2015) in plasma and milk at the end of each period.
Cows had higher B_2 (x2), B_6 (x2 to 3) and B_9 (x5) plasma concentrations than goats ($p<0.001$) whereas B_{12} concentration was 3.4-fold higher in goats ($p<0.001$). In milk, B_6 concentrations were higher in goats (+21%, $p<0.001$) than in cows. Riboflavin (B_2) concentration was similar between the 2 species whereas folates (B_9) and vitamin B_{12} concentrations were 10- and 16-fold higher in cow milk, respectively. The COS diet increased plasma B-vitamin concentrations in both species ($p<0.001$), and cow milk concentration of B_2 and B_9 ($p<0.001$). The MAP diet also induced significant increases in plasma B vitamin concentrations, especially B_2 in goats and B_6 and B_9 in cows. Milk B_6 concentrations were lightly reduced and B_9 was increased in cows fed MAP diet. The HPO diet slightly increased vitamin B_{12} secretion in cow milk. This original study compared plasma and milk B vitamins in dairy cows and goats fed the same diets. Species-specific responses observed in ruminants fed COS or MAP diets *vs* CTL suggest distinct mechanisms acting on B-vitamin supply, likely their dietary intake and the modulation of rumen bacterial activities. Discrepancies in the pattern of response between plasma and milk also suggest the existence of regulatory mechanisms of vitamin B mammary uptake and milk secretion.

Coudray B, 2011. The contribution of dairy products to micronutrient intakes in France. J. Amer. Coll. Nutr. 30, 410S-414S.
Duplessis M, Mann S, Nydam DV, Girard CL, Pellerin D, Overton TR, 2015. Short communication: Folates and vitamin B12 in colostrum and milk from dairy cows fed different energy levels during the dry period. J. Dairy Sci. 98:5454-5459. doi:10.3168/jds.2015-9507
Fougere H, Delavaud C, Bernard L, 2018. Diets supplemented with starch and corn oil, marine algae or hydrogenated palm oil differentially modulate milk fat secretion and composition in cows and goats: A comparative study. J. Dairy Sci. 101, 8429–8445. DOI : 10.3168/jds.2018-14483
Girard CL, Matte JJ, 2005. Folic acid and vitamin B12 requirements of dairy cows : a concept to be revised. Liv. Prod. Sci., 98, 123-133
Graulet B, 2014. Ruminant milk : a source of vitamins in human nutrition. Animal Frontiers, 4, 24-30. DOI : 10.2527/af.2014-0011
Laverroux S, Picard F, Andueza D, Graulet B. The yellow color of cow milk is more dependent from riboflavin than carotenoids content. (in preparation)
Li F, Guan LL, 2017. Metatranscriptomic profiling reveals linkages between the active rumen microbiome and feed efficiency in beef cattle. Appl. Environ. Microbiol. 83:e00061-17. https://doi.org/10.1128/AEM.00061-17.
Meale SJ, Morgavi DP, Cassar-Malek I, Andueza D, Ortigues-Marty I, Robins RJ, Schiphorst A-M, Laverroux S, Graulet B, Boudra H, Cantalapiedra-Hijar G, 2017. Exploration of Biological Markers of Feed Efficiency in Young Bulls. J. Agr. Food Chem., 65, 9817-9827.