The role of B-vitamins in dairy cow health and performance

Early research on ruminants' B-vitamins requirements during the 1950s concluded that ruminal synthesis was important and sufficient to recover animal needs. This subject was then quite forgotten by the scientific community.

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However, lactating cows continued to improve their performance. In particular, milk production increased by 18% between 2001 and 2011, leading to a rise in nutrient requirements, including vitamins.

That is why more recent research has focused on revising needs and has assumed that supplementation with B-vitamins may positively influence dairy cow performance.

The key role of B-vitamins

Each of the B-vitamins plays a key role, either as an enzymatic cofactor or metabolic constituent in many facets of intermediary metabolism (Fig. 1).

They are especially involved in the metabolism of energy and protein, providing these nutrients to the animal for improvement of welfare and performance.

- Pantothenic acid (B5) is linked to many reactions involved in the release of energy from carbohydrates, fatty acids and amino acids, thus providing more nutrients for milk production. It also plays a role in biosynthesis of haemoglobin and fatty acids.
- B6 vitamins complex (pyridoxal, pyrodoxamine and pyridoxine) takes part in DNA, RNA and protein synthesis. A study demonstrated that stress or 'moderate' injury may expand B6-vitamins requirements by eight, due to their role in cell transformation and proliferation during the immune response.
- Biotin (B8) is implied in neoglucogenesis of propionate into glucose, therefore unlocking energy supply for milk production. Biotin is also quite renowned for its effect on hoof quality. Indeed, keratinisation process reactions implicate biotin and supplementation allows greater resistance of the hoof.
- Folic acid (B9) has a single biochemical function in DNA synthesis and replication. It is then important for cell division, gene transcription and genetic stability allowing global cells and animal integrity. Moreover, B9 implication in mammary epithelial metabolism seems to be a critical regulatory point for synthesis of milk protein in the dairy cow's udder.
- Cobalamin (B12) plays a major role for entry of propionate in energy metabolism. Together with B9, they are involved in reactions for changing gene expression of differentiation of ovarian follicles, improving the number of large follicles and the size of the dominant follicle. Several studies with B9 and B12 demonstrated improvement of reproduction indicators of lactating cows.

Why supplementation of B-vitamins?

Already in 2001, the NRC (Nutrient Requirements of Dairy Cattle) projected that folic acid and pantothenic acid would be limiting nutrients for performance of dairy cows.

Later research on intestine flow of vitamins to the gut underlined a possible deficit of cobalamin, pantothenic acid and pyridoxine.

Numerous studies on supplementation to dairy cows have demonstrated improvement of cows' performance, either with single vitamin or with blends of different B-vitamins.

For example, cows fed folic acid produced more milk than unsupplemented cows: +6% during the 100 first days of lactation and +10% from 100-200 days of lactation.

Biotin and cobalamin supplementation demonstrated a similar response regarding milk production. Some blends of B-vitamins are commonly added to mineral and vitamins premixture for animals.

A study compared efficiency of a blend of B-vitamins to biotin supplementation alone

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Fig. 1. Role of B-vitamins in the cow's metabolism.

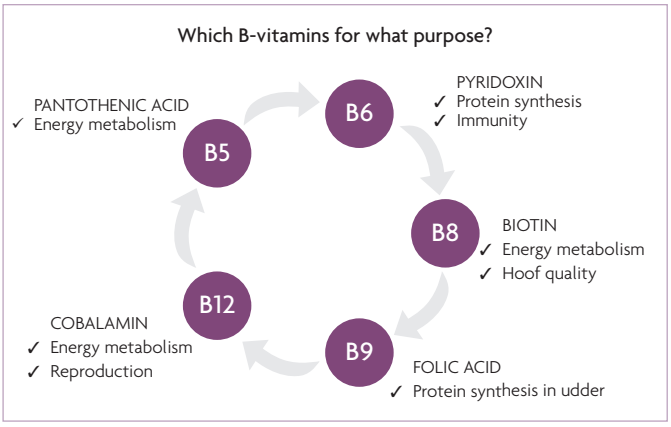
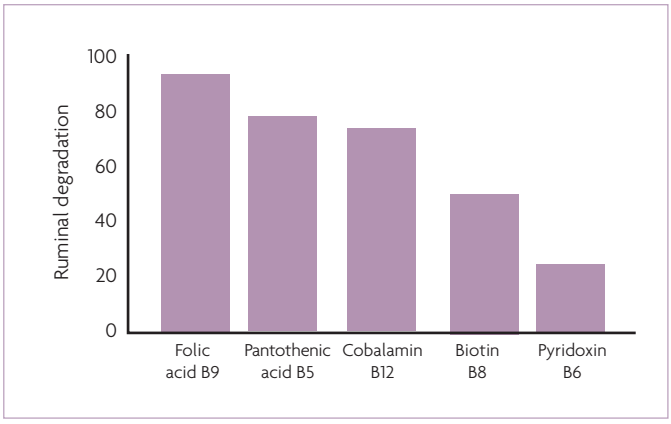


Fig. 2. Degradation rates in rumen conditions of B-vitamins.



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and found no additional effect on performance. This result is not surprising and can be explained by the large susceptibility of main B-vitamins to rumen degradability or destruction (Fig. 2). To ensure maximum efficiency of supplementation, protection from ruminal degradation is necessary for most of the B-vitamins. To enhance this thesis, studies with protected vitamins have induced better results than with unprotected forms. For example, a supplementation with a rumen protected pyridoxine resulted in an increase of 2kg in milk production where unprotected pyridoxine established no significant difference compared to the control.

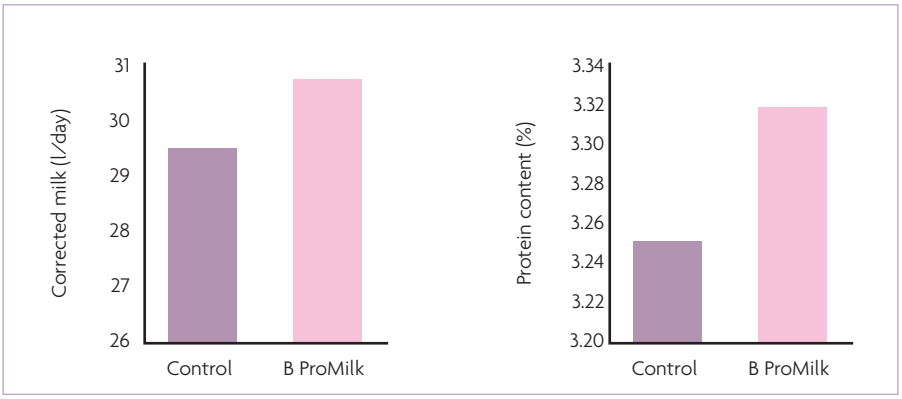

Fig. 3. Results on milk production and milk protein content from B ProMilk (blend of B-vitamins) supplementation during a four month period.

Trial with a blend of B-vitamins

Within MiXscience, a specific blend (B ProMilk) has been developed with adequate protection of the B-vitamins against ruminal degradation, to ensure bioavailability of the actives in the intestinal tract. B ProMilk was lately the object of a field test that took place on 14 different farms (representing approximately 1,000 lactating Holstein cows), with different types of diets and level of production. B ProMilk was supplemented at 15g/head/day, and results are from a four months supplementation after a month of pre-experiment period (Fig. 3).

Supplementation with B ProMilk resulted in an improvement of 1.4 L of milk (from 29.4 L to 30.8 L during the pre-experiment and experimental period, respectively) and 0.07% of milk protein content (from 3.25% to 3.32%). At least one of the performance indicators (milk production or protein content) was improved in six farms out of 14; both indicators in seven out of 14 and only in one farm none of the two indicators showed significant improvement.

That can be explained by the variation on experimental conditions: the test farms were located in different regions of France, and based either on corn silage, grass or on a mix between corn and grass silage. Based on French context of milk price and bonuses for quality, the average return of investment for that trial was €6 returned for €1 invested.

Conclusion

In conclusion, supplementation with B-vitamins to improve the performance of dairy cows is of interest. However, the right protection against ruminal degradation is necessary. With their action on hoof quality and overall metabolism, animal welfare can also be improved by the use of a B-vitamins blend. With such kind of supplementation, farmers can improve their herd performance as well as the sustainability and durability of their farms. ■

References are available from the author on request

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