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Precision Release Choline

Balchem Research Summary

Effect of ReaShure® rumen-protected choline on performance, blood metabolites, and hepatic triacylglycerols of periparturient dairy cattle[1]

A summary of research conducted by R. L. G. Zom, J. van Baal, R. M. A. Goselink, J. A. Bakker, M. J. de Veth, and A. M. van Vuuren. Wageningen UR Livestock Research, Netherlands published in the August 2011 issue of the Journal of Dairy Science (Volume 94, pages 4016 – 4027).

Introduction

Fatty liver occurs in approximately 50-60% of dairy cows at orshortly after calving[2,3]. It occurs because the cow mobilizes energy from adipose tissue in response to hormonal changes at calving and negative energy balance immediately after calving when the cow cannot consume enough energy to support maintenance and milk production. However, it can also occur anytime the cow experiences negative energy balance from other factors such as sickness, suboptimal environment (overcrowding, heat stress, poor stall design) or poorly formulated diets. When cows mobilize fat from adipose tissue, the resulting nonesterified fatty acids (NEFA) enter into blood and may be taken up by the liver. Ideally, most of these fatty acids would be exported from the liver as a constituent of very low density lipoproteins (VLDL) so that they could be transported to the mammary gland where they can support lactation. Choline is required for VLDL synthesis and export, but unfortunately, very little dietary choline escapes degradation by microorganisms in the rumen. Therefore, ruminants are naturally prone to development of fatty liver when the liver is exposed to high levels of NEFA. Livers containing elevated fat levels have lower rates of ammonia detoxification (ureagenesis) and glucose synthesis and cows with fatty liver have lower milk production, greater susceptibility to infectious diseases, higher incidences of ketosis, and poor reproductive performance[4]. The only practical way to avoid fatty liver and its consequences is to supplement diets with choline that has been protected from ruminal degradation.

Balchem now manufactures a high-quality, ruminally protected choline product called ReaShure®-XC *Rumen Protected Choline,* the next generation of ReaShure which provides bioavailable choline in a more concentrated product. The choline is encapsulated by fat which allows it to bypass the rumen and enter the small intestine. The environment in the small intestine allows for the majority of choline to be released from encapsulation for absorption into the blood stream. The classic deficiency symptom for choline in nonruminant animals is fatty liver. Since dairy cows normally have very low amounts of choline absorbed from the small intestine, experience large quantities of NEFA being delivered to the liver at and shortly after calving, and suffer from high rates of fatty liver, it is highly likely they are choline-deficient and could benefit from supplementation of ReaShure-XC during the transition period.

Methodology

The effects of feeding ReaShure rumen-protected choline on liver fat (specifically triglyceride), blood metabolites, feed intake and milk production were published in the August 2011 issue of the Journal of Dairy Science (Volume 94, pages 4016-4027). Thirty-eight multiparous Holstein Friesian dairy cows in good body condition (mean = 3.25) and not experiencing subclinical ketosis from the herd at Wageningen University and Research Center, Netherlands, were fed 12,9 gr/day/cow of choline ion in a rumen protected form or a control diet from 3 weeks prior to calving until 6 weeks postcalving. Cows were housed in groups and transponder controlled feeders were used to dispense 582 g soybean meal and 18 g palm oil per day to control cows and 540 g soybean meal and 12,9 gr/day/cow of choline ion in a rumen protected form to treatment cows. In addition to these treatments, a dry cow feed mixture (grass silage/ corn silage/wheat straw/soybean meal/premix) was consumed ad libitum and cows were gradually increased up to 8.1 kg (17.9 lb) DM of additional concentrate per day prior to calving. After calving, treatments continued and cows consumed a lactating cow feed mixture (grass silage/corn silage/ grass seed straw/soybean meal/ premix) ad libitum and were gradually increased from 0.9 to 8.1 kg (2 to 17.9 lb) of additional concentrate per day. Dry matter intake and milk production were measured daily and milk was sampled from four consecutive milkings each week. Blood samples were obtained weekly with additional samples taken at 1 and 4 days postpartum. Liver biopsies were obtained at 3 wk prior to calving and at week 1, 4, and 6 postcalving from a subset of eight animals per treatment.

Results and Discussion

Immediately after calving, cows fed ReaShure consumed significantly more dry matter, 1.6 kg/day (3.6 lb), from the feed mixture fed (concentrate feeding from feeders was fixed). The advantage in dry matter intake remained for the entire trial; however, the difference for the 6 week postpartum period, 0.8 kg/day (1.8 lb), was not statistically significant *(Figure 1).* Feeding ReaShure increased milk protein yield immediately postpartum by 136 g/day. Body weight and body condition score of cows was not affected by treatment. Liver triglyceride concentration was significantly reduced by feeding ReaShure, primarily due to differences at 1 and 4 weeks after calving *(Figure 2)*.

The significant increase in milk protein yield was a reflection of greater milk yield, +2.0kg/day (4.4lbs) and milk protein percentage (+0.13 percentage units) when feeding ReaShure, although the differences in milk yield and milk protein percentage were not statistically significant. The greater milk protein yield may have been due to greater feed (i.e., nutrient) intake. Alternatively, it may have been a direct effect of feeding ruminally protected choline. Choline serves as a source of methyl groups for the resynthesis of methionine from homocysteine. Therefore, supplying more choline may spare methionine which is considered one of the most limiting amino acids for protein synthesis by early lactation dairy cows. The researchers who conducted this trial formulated the diets to be adequate in methionine, however, it is difficult to meet amino

acid requirements immediately after calving when feed intake is low. Not surprisingly, the greatest advantage in milk protein yield from feeding ReaShure was during the first 20 days postpartum *(Figure 3)*.

The reduction in liver triglyceride from feeding ReaShure is consistent with previous research[5], and solidifies the role of choline in facilitating VLDL triglyceride export from the liver and reducing the likelihood of fatty liver in postpartum dairy cows. The absence of treatment effects on blood metabolites (e.g., NEFA) reinforces that choline has a direct favorable effect on liver metabolism.

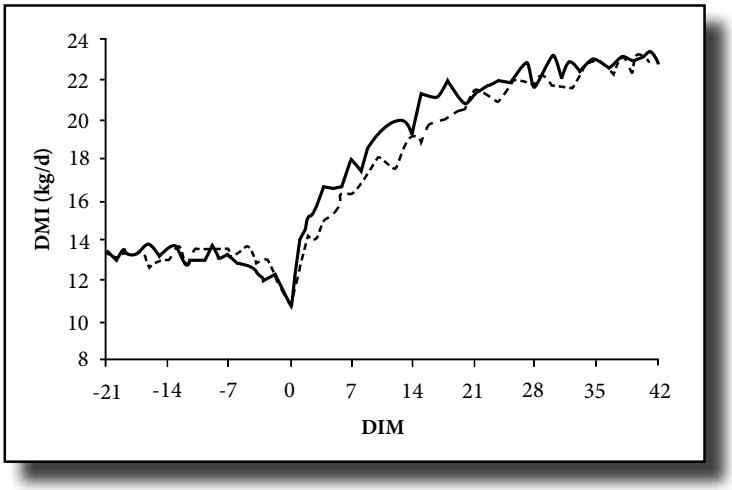
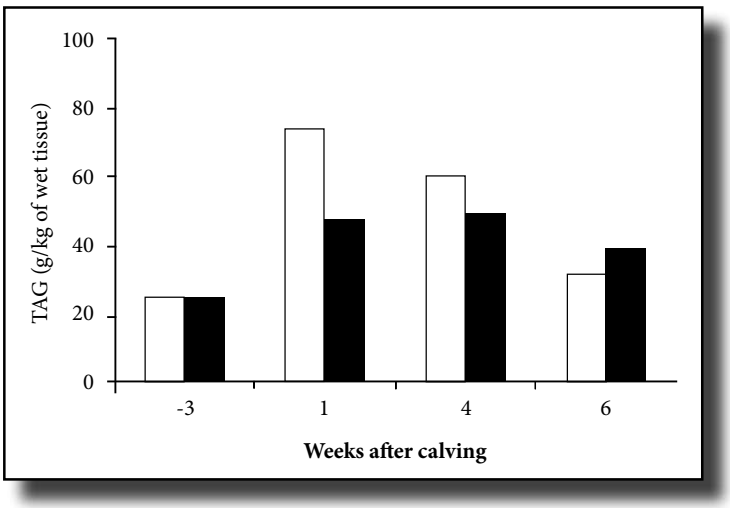


Figure 1. Dry matter intake (DMI) of cows fed diets with (solid line) or without (dashed line) ReaShure rumen-protected choline at various days in milk (DIM).

Figure 2. Liver triglyceride (TAG) in cows fed diets with (black bars) or without (white bars) ReaShure rumen-protected choline.



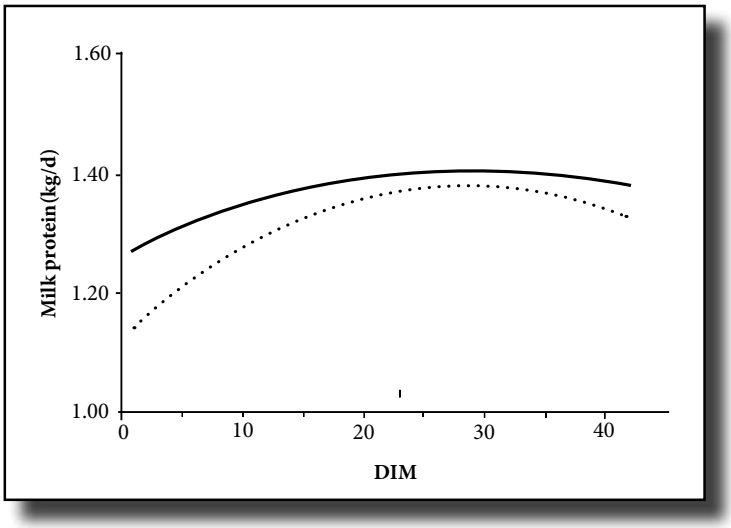


Figure 3. Milk protein yield of cows fed diets with (solid line) or without (dashed line) ReaShure rumen-protected choline at various days in milk (DIM).

Conclusion

The results of this Dutch study and previous studies conducted in other countries[5, 6, 7] indicates that feeding ReaShure rumen-protected choline reduces fat accumulation in the liver and improves production under a wide variety of feeding and management systems. To view the entire research go to: **http://www.journalofdairyscience.org/article/S0022-0302(11)00405-X/abstract.**

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