

## Comparison of commercially available rumen-stable choline products

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### Abstract

The objectives of this experiment were to determine the ruminal dry matter and choline stability of five commercially available rumen-stable choline products and to determine differences in qualitative evaluation of rumen-stable nutrients between measuring ruminal dry matter and nutrient disappearance of the products. Products evaluated were Reashure® (25% choline; Balchem Encapsulates, New Hampton, NY), product A (13% choline; USA manufactured and distributed) product B (40% choline; Italian manufactured, North American distributed), product C (40% choline, Italian manufactured, Asian distributed), product D (25% choline; Canadian manufactured, North American distributed). All products used in the experiment were obtained through commercial distributors, and were stored at ambient temperature prior to the initiation of the experiment. Stability was evaluated for total product dry matter (DM) and for the choline fraction of the products at 0.5, 6, 12 and 24 hours of incubation using an Ankom Dairy II Incubator. Triplicate samples were used for each time point for each product. Corn silage was used as an internal standard. Each sample was corrected using a blank to adjust for any DM infiltration into the sample bags. Following incubation, each sample bag was dried for 24 hr at 65 C. Residues were then analyzed for choline content using a choline oxidase based detection system. Rumen-stability for each sample was then calculated by subtracting the recovered DM or choline from the amount of DM or choline added to the bag originally. All products had reasonable ruminal DM stability, with products ranging from 63 to 98% stable on a DM basis at the 12 hr time point. However, choline stability varied considerably, with only one product (Reashure) having appreciable choline stability after 12 hr of incubation. In conclusion, considerable differences exist between commercially available rumen-stable choline products. Measuring dry matter disappearance is not an acceptable method for accessing the quality of rumen-stable products.

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### Introduction

Rumen-stable choline is receiving increased attention in the dairy industry as a feed additive for transition and early lactation dairy cows. Choline is a nutrient widely used in a variety of species as an essential or conditionally essential nutrient. Little attention was given to choline's role until a series of experiments at the University of Maryland pointed to an opportunity to improve productivity of lactating dairy cattle if choline could be successfully delivered postruminally. In that research, it was clearly shown that any choline that was not protected from ruminal degradation and delivered to the small intestine for absorption, was of no usefulness to ruminant animals.<sup>4</sup> However, the same lab showed that Reashure could effectively deliver bioavailable choline to dairy cows.<sup>1</sup>

Recently, research at Cornell University<sup>2</sup>, clearly showed that supplementing transition dairy cows with an effective source of rumen-stable choline, reduced storage of fat in the liver, improving stores of liver glycogen as a result. These changes in liver physiology of transition dairy cows is consistent with reducing the risk of these animals for clinical and subclinical ketosis, setting the stage for improved milk production in early lactation. Recent research at the University of Missouri<sup>3</sup> showed that transition cows supplemented with an effective form of rumen-stable choline had higher dry matter intakes, and an improved milk yield over the first 50 days of lactation. Consistent with this, university and field research<sup>5</sup> has shown approximately a six pound increase in early lactation, leading to over 600 lb. improvements in projected 305 ME milk yield.

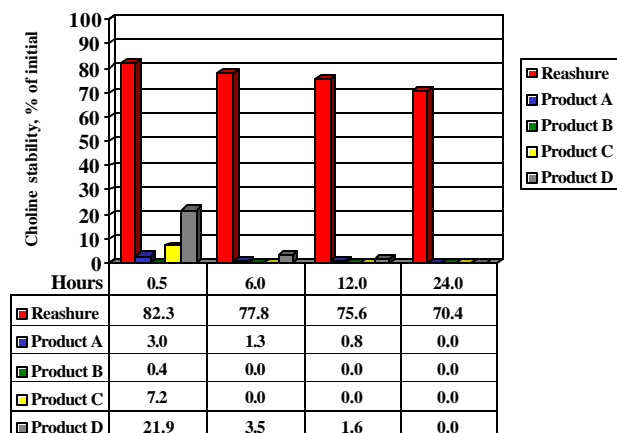
Rumen-stable choline products are not easy to manufacture, nor inexpensive to purchase and use. However, as this market has grown, so has the number of products available to try and meet this market demand. Like many other rumen-stable products and technologies, considerable qualitative differences can exist between rumen-stable choline products. This research was designed to evaluate the quality of the rumen-stable products known to be commercially available at this time. Specifically, rumen-stable choline products were tested for rumen-stability using modified in situ incubation methodologies.

### Materials and methods

All products used in the experiment were obtained through commercial distributors for the products. Products evaluated were Reashure® (25% choline; Balchem Encapsulates, New Hampton, NY), product A (13% choline; USA manufactured and distributed) product B (40% choline; Italian manufactured, North American distributed), product C (40% choline, Italian manufactured, Asian distributed), product D (25% choline; Canadian manufactured, North American distributed). No special handling was applied, products were simply obtained from their standard packaging for use in the experiment. All products were stored at ambient temperature prior to the initiation of the experiment. Rumen stability was accessed using a modified in vitro ruminal fermentation.

Each product was evaluated for rumen-stability at 0.5, 6, 12 and

Figure 1. Ruminal choline stability



24 hours of incubation in an Ankom Dairy II Incubator. Triplicate samples were used for each time point for each product, and were weighed out into nylon bags. Corn silage was used as an internal standard. Each sample was corrected using a blank to adjust for any DM infiltration into the sample bags.

Following incubation, each sample bag was dried for 24 hr at 65 C. Residues were then analyzed for choline content using a choline oxidase based detection system. Rumens-stability for each sample was then calculated by subtracted the recovered choline from the amount of choline added to the bag originally.

### Results and discussion

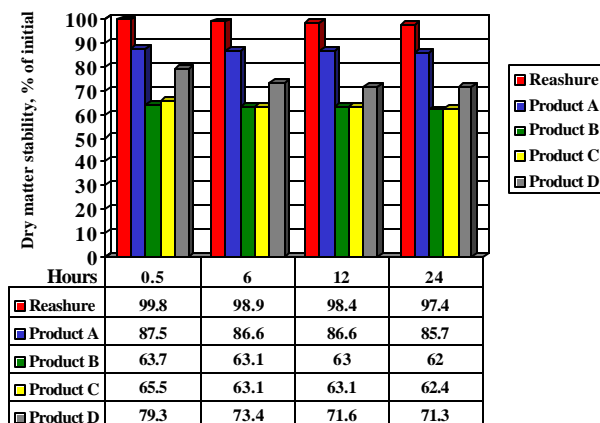
In testing the choline rumen-stability of the products, only one product was found to have any appreciable rumen-stability (Figure 1). Reashure exhibited considerable rumen-stability, whereas for all other products, essentially no choline was recovered after 6 hours of ruminal incubation. The rumen-stability of Reashure approximated 80% over the course of the incubation time points, and was consistent between replications and samples within replications.

Rumen dry matter stability varied between encapsulated products, ranging from 60 to 95% stability at the 12 hr time point (Figure 2). The differences in stability can be largely attributed to the relative disappearance rates of choline from the products and the differences in measured choline content prior to any ruminal incubation.

Rumen stability for encapsulated products can differ considerably for the nutrient being stabilized, and the inert material used to stabilize the nutrient. Thus, simply conducting a rumen DM disappearance measurement on products such as these can give extremely misleading results. Indeed, the differences between the ruminal choline stability versus the ruminal DM stability in most products is considerable (Figure 1 versus Figure 2). Ruminal DM disappearance measurement is not an appropriate test of ruminal stability for such products.

Choline is water soluble, and is rapidly degraded by ruminal bacteria. Research at the University of Maryland documented that no appreciable quantity of feed choline is delivered to the small intestine.<sup>4</sup> Furthermore, additional research documented that rumen-stable choline products can effectively supplement ruminant animals with choline, provided that they are of

Figure 2. Ruminal dry matter stability



sufficient quality so that the choline is protected from ruminal degradation.<sup>1</sup> The research conducted in this experiment shows that for all but one product available commercially, the protection is not sufficient to effectively supplement choline to ruminants. Furthermore, the complete lack of stability noted by all products, other than Reashure, indicates that no matter what price these products are offered at, their use will be completely ineffective, and therefore, not cost effective when used in ruminant applications.

### Summary

Considerable differences exist between commercially available rumen-stable choline supplements. In addition, proper analytical methodologies are required to accurately detect these differences. Specifically, studies on ruminal DM disappearance are of little benefit for evaluating such products. Reashure is the only commercially available choline product that effectively stabilizes choline from ruminal degradation.

### Literature cited

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