balchem

ReaShure®-XC

Precision Release Choline

Balchem Research Summary

Meta-analysis of Transition Cow Studies Examining the Effects of Supplementing Rumen-protected Choline to Transition Dairy Cows.

Ric R. Grummer, Ph.D. Ruminant Technical Director, Balchem Corp.

Introduction

Meta-analysis is a statistical approach to combine the results of several studies that had a common research objective. Pooling data across studies allows for wider inference for conclusions and may increase the statistical power for determining treatment effects. In theory, individual research studies should have sufficient replication and statistical power to adequately test a hypothesis. However, in reality, replication often is not adequate yet the research survives peer-review and is published. Transition cow studies are notorious for insufficient replication. This often occurs because university research herds are not of adequate size to provide sufficient animal numbers during the period of time allotted for the study. Often times, multiple studies are summarized by simply reporting a mean response across studies. This is too simplistic and can lead to erroneous conclusions. An appropriate meta-analysis should account for variation among studies, include variables that may explain variation, and weight studies according to size and amount of variation among experimental units (studies with more replication and less variation are more influential than studies with less replication and more variation).

A meta-analysis of studies examining the effects of rumen-protected choline (RPC) on milk production recently was published in the Journal of Dairy Science (93:3746; Sales et al., 2010). There were some problems with the methodology used in this paper and the authors included studies that utilized cows that were beyond the transition period. Since that analysis, more studies have been conducted and we now have a reasonably large number of studies in which RPC was fed to transition cows. The objective of the current meta-analysis was to restrict the study selection to those in which RPC was fed during times that are most consistent with our feeding recommendations, i.e., the transition period.

Methodology

For meta-analysis, criteria for study selection are extremely important and must be clearly defined. For studies to be included in this analysis, RPC had to be fed *prior* to calving. Studies were *not* restricted to those supplementing ReaShure®, however the majority of studies did use ReaShure. Feed stability or evidence of bioavailability of choline source was not a criterion for study selection. For example, the study of Hartwell et al. (2001; utilizing Capshure. Balchem Corp) was included even though the RPC source is known to be inferior to ReaShure. Studies were not screened for "soundness" of research. To qualify, studies had to report treatment means and a measure of variation that accounted for sample size (standard error of the mean).

For some studies, this eliminated response variables that were presented in graphic form. Ten of the thirteen trials were published in peer-reviewed journals. One trial from Oelrichs et al. and two studies of Lima et al. (Table 1) were used because we have copies of unpublished manuscripts corresponding to those trials.

Table 1. Studies used in the Meta-Analysis. Studies shaded have not been published in a peer-reviewed journal.

Study	Choline Dose, g/d	Product	Duration	Exp. Units	Parity
Hartwell	0,6,12	Capshure	-21 to 120	24	M
Zom et al.	0,15	ReaShure	-21 to 42	19	M
Lima et al. #1	0,15	ReaShure	-25 to 80	4 (pen)	M,P.
Lima et al. #2	0,15	ReaShure	-22 to 0	5 (pen)	P
Oelrichs et al.	0,15	ReaShure	-28 to 100	32	M,P.
Zahra et al.	0,14	ReaShure	-25 to 28	91	M,P.
Piepenbrink et al.	0,11,15,19	ReaShure	-21 to 63	12	M
Janovick et al.	0,15	ReaShure	-21 to -21	21	M
Eleket al.	0, 25/50 pre/post	Norcol-25	-25 to 60	16	M,P.
Ardalan et al.	0,14	Col 24	-28-70	20	M,P.
Pinotte et al.	0,20	Overcholine 45%	-14 to 30	13	M
Xu et al. #1	0,7.5	Not reported	-7 to21	7	M
Xu et al. #2	0,11,22,33	Not reported	-15 to 15	9	M,P.

Time when RPC supplementation was started varied between 28 to 7 days prior to expected calving. RPC supplementation was terminated anywhere from the day of calving to 120 days in milk.

Response variables included DMI, milk yield, energy corrected milk yield, fat %, protein %, and fat and protein yield. Insufficient data was available for analysis of liver fat or energy-related blood parameters.

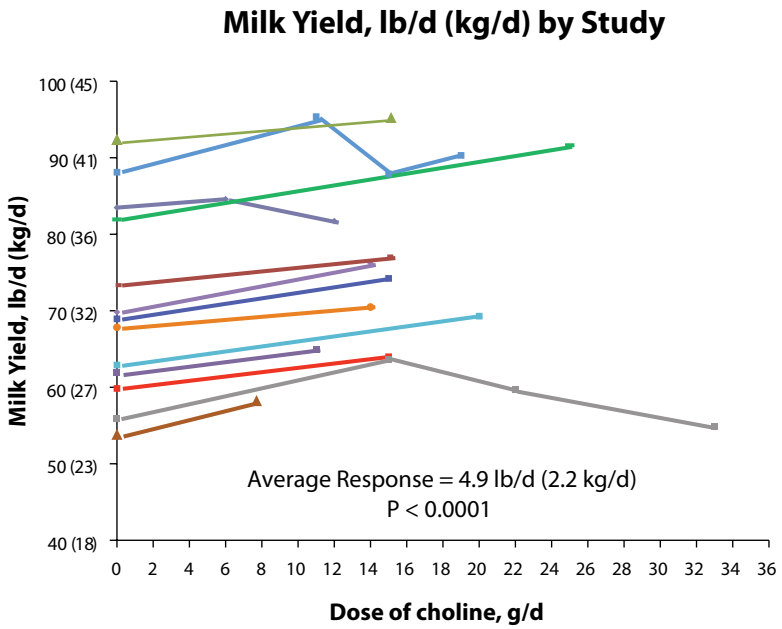
Results and Discussion

Feeding RPC to transition cows increased dry matter intake and milk, energy-corrected milk, protein and fat yield *(Table 2)*. Milk components (expressed as a percentage) were not affected by feeding RPC to transition dairy cows. Reasons for the increases in dry matter intake and milk yield are not known, but they may reflect cows with a healthier liver. For example, a liver with lower fat content may synthesize more glucose which is a precursor for lactose, the milk component that dictates milk yield. The consistency in responses across studies *(Figure 1)* supports the concept that choline is a limiting nutrient in transition cow diets. One would be hard pressed to find a more consistent response to a nutrient in the scientific literature.

Table 2. The effects of feeding RPC to transition cows on dry matter intake and milk.

	Control	RPC	SEd	P =
DMI, lb/d (kg/d)	39.98 (18.15)	41.60 (18.15)	.46 (.21)	.0042
Milk, lb/d (kg/d)	70.88 (32.18)	75.75 (34.39)	.75 (.34)	<.0001
ECM, lb/d (kg/d)	76.87 (34.9)	82.78 (37.58)	1.33 (.72)	.0038
Fat yield lb/d (kg/d)	2.788 (1.266)	3.042 (1.381)	.086 (.039)	.021
Protein yield, lb/d (kg/d)	2.300 (1.044)	2.467 (1.120)	.053 (.024)	.010

Figure 1. Milk responses to feeding RPC



(Since the studies of Oelrichs et al. and Lima et al. are not published, an additional analysis was conducted without them. This did not change the interpretation of the analysis. Attempts were made to see if conclusions could be made about duration of treatment or parity; however, more studies (i.e. replication) will be needed to draw conclusions regarding these parameters.)

References

Ardalan, M., M. Dehghan-banadaky, K. Rezayazdi, and N. Ghavi Hossein Zadeh. 2011. The effect of rumen-protected methionine and choline on plasma metabolites of Holstein dairy cows. J. Agric. Sci. doi:10.1017/S0021859610001292.

Elek, P., J. R. Newbold, T. Gaal, L. Wagner, and F. Husveth. 2008. Effects of rumen-protected choline supplementation on milk production and choline supply of periparturient dairy cows. Anim. 2:1595-1601.

Hartwell, J. R., M. J. Cecava, and S. S. Donkin. 2000. Impact of dietary rumen undegradable protein and rumen-protected choline on intake, peripartum liver triacylglyceride, plasma metabolites and milk production in transition dairy cows. J. Dairy Sci. 83:2907-2917.

Janovick Guretzky, N. A., D. B. Carlson, J. E. Garret, and J. K Drackley. 2006. Lipid metabolite profiles and milk production for Holstein and Jersey cows fed rumen-protected choline during the periparturient period.J. Dairy Sci. 89:188-200.

Lima, F. S., M. F. Sa Filho, L. F. Greco, F. Susca, V. M. Magalhaes, and J. E. P. Santos. Effects of feeding rumen-protected choline on metabolismand lactation of transition dairy cows. Manuscript prepared.

Oelrichs, W. A., M. C. Lucy, M. S. Kerley, and J. N. Spain. Production and reproduction of dairy cows fed rumen-protected choline during the periparturient period. Manuscript prepared. Piepenbrink, M. S., and T. R. Overton. 2003. Liver metabolism and production of cows fed increasing amounts of rumen-protected choline during the periparturient period. J. Dairy Sci. 86:1722-1733.

Pinotti, L., A. Baldi, I. Politis, R. Rebucci, L. Sangalli, and V. Dell'Orto. 2003. Rumen-protected choline administration to transition dairy cows: effects on milk production and vitamin E status. J. Vet. Med. A 50:18-21.

Sales, J., P. Homolka, and V. Koukolova. 2010. Effect of dietary choline on milk production of dairy cows: A meta-analysis. J. Dairy Sci. 93:3746-3754.

St-Pierre, N. R. 2001. Integrating quantitative findings from multiple studies using mixed model methodology. J. Dairy Sci. 84:741-755.

Xu, G., J. Ye, J. Liu, and Y. Yu. 2006. Effect of rumen-protected choline addition on milk performance and blood metabolic parameters in transition dairy cows. Asian-Aust. J. Anim. Sci. 19:390-395.

Zahra, L. C., T. F. Duffiled, K. E. Leslie, T. R. Overton, D. Putnam, and S. J. LeBlanc. 2006. Effects of rumen-protected choline and monensin on milk production and metabolism of periparturient cows. J. Dairy Sci. 89:4808-4818.

Zom, R. L. G., J. van Baal., R. M. A. Goselink, J. A. Bakker, M. J. de Veth, and A. M. van Vuuren. 2011. Effect of rumen-protected choline on performance, blood metabolites, and hepatic triacylglycerols of periparturient dairy cattle. J. Dairy Sci. 94:4016-4027.

Balchem Corporation
52 Sunrise Park Road, New Hampton, NY 10958 USA
Phone 845-326-5600
anh.marketing@balchem.com
BalchemANH.com

2008-008