

## Choline's Impact on Colostrum Quantity Multi-Study Research Summary

**Trial 1: Effects of supplementation with ruminally protected choline on performance of multiparous Holstein cows did not depend upon prepartum intake of calories**

Zenobi, M. G., R. Gardinal, J. E. Zuniga, A. L. G. Dias, C. D. Nelson, J. P. Driver, B. A. Barton, J. E. P. Santos, and C. R. Staples. 2018a. *J. Dairy Sci.* 101:1088–1110.

**Trial 2: Timing of initiation and duration of feeding rumen-protected choline affects performance of lactating Holstein cows**

Bollatti, J. M., M. G. Zenobi, N. A. Artusso, G. F. Alfaro, A. M. Lopez, B. A. Barton, C. R. Staples, and J. E. P. Santos. 2020b. *J. Dairy Sci.* 103:4174–4191.

**Trial 3: Effects of dietary rumen-protected choline supplementation on colostrum yields, quality, and choline metabolites from dairy cattle**

Swartz, T. H., B. J. Bradford, O. Malysheva, M. A. Caudill, L. K. Mamedova, and K. A. Estes. 2022. *JDS Comm.* 3:296–300.

**Trial 4: Increasing the prepartum dose of rumen-protected choline: Effects on milk production and metabolism in high-producing Holstein dairy cows**

Holdorf, H. T., S. J. Kendall, K. E. Ruh, M. J. Caputo, G. J. Combs, S. J. Henisz, W. E. Brown, T. Bresolin, R. E. P. Ferreira, J. R. R. Dorea, and H. M. White. 2023. *J. Dairy Sci.* 106-5988-6004.

Balchem manufactures two versions of their rumen-protected choline product. ReaShure and a more concentrated form called ReaShure-XC. Both are designed to provide approximately 13 g/d choline ion when fed at the recommended feeding levels (ReaShure = 60/g/h/d, ReaShure-XC = 30 g/h/d). One or both of these products were used in the following trials.

### Choline's Role in Increasing Colostrum Quantity

Colostrum is essential for survival and health of the newborn calf. The cow's placenta completely separates the dam's blood from fetal blood, preventing immunoglobulin (Ig) transfer during gestation. Therefore, the newborn's immune protection relies primarily on colostrum immunoglobulins absorbed in the intestine during the first few hours after birth. This is known as passive transfer of immunity. In addition to antibodies, colostrum is an excellent source of many nutrients and bioactive compounds. These include growth factors important for development, peptides with anti-microbial activity, special choline biomolecules and, when fed fresh, can also transfer immune cells to calves. The importance of colostrum feeding goes beyond its crucial role of providing immune protection to the newborn. Feeding adequate quantities of high-quality colostrum improves performance of the calf later in life, including higher rate of gain and future productivity. Research is currently being conducted to investigate the effects of different components of colostrum on intestinal epithelial growth and the propensity for calves fed more colostrum to produce more milk as cows.

Unfortunately, high-quality colostrum is often in short supply on many dairies. This leads dairy producers to either purchase colostrum replacers, increase colostrum yield from their cows, feed lower quality colostrum, or suffer the consequences. Recent research from multiple universities suggests that supplementing cows with ReaShure® Precision Release Choline (Balchem Corp., Montvale, NJ) during the close-up period can increase colostrum production and quality. This paper summarizes results from four studies conducted at three universities that measured the impact of ReaShure supplementation on colostrum quality and yield.

### Methodologies

All the studies reported herein used a simple design to explore the effect of ReaShure on colostrum quality and quantity. Briefly, pregnant, multiparous Holstein cows were fed either a control diet or the control diet plus ReaShure for 21 d prepartum through calving. Both Zenobi et al. (2018) and Bollatti et al. (2020) investigated the effects of feeding the recommended dose of 60 g/d (12,9 g/d choline ion) of ReaShure during the experiments. Swartz et al. (2022) fed

ReaShure-XC at 1X and 1,5X the recommended dose. Similarly, Holdorf et al. (2023) fed either ReaShure or ReaShure-XC at 1X and 1,5X the recommended dose of 12,9 g/d choline ion. In all experiments, colostrum was collected at the first milking, weighed for each cow, and analyzed for quality via brix or IgG concentration. Zenobi et al. (2018), Bollatti et al. (2020), and Swartz et al. (2022) also analyzed the collected colostrum for fat, protein, and lactose concentrations. Additionally, Swartz et al. (2022) further analyzed samples for choline metabolite concentrations.

### Results

The four studies summarized in this paper represent the entire dataset measuring ReaShure's impact on colostrum quantity and quality when fed to prepartum dairy cows. Two of the trials showed a large and significant increase in colostrum volume (Swartz et al., 2022 and Holdorf et al., 2023), one experiment exhibited a large and significant increase in IgG concentration and yield (Zenobi et al., 2018a), and one showed no response in colostrum quantity or quality (Bollatti et al., 2020b).

Figure 1 Effect of ReaShure-XC supplementation on colostrum yield

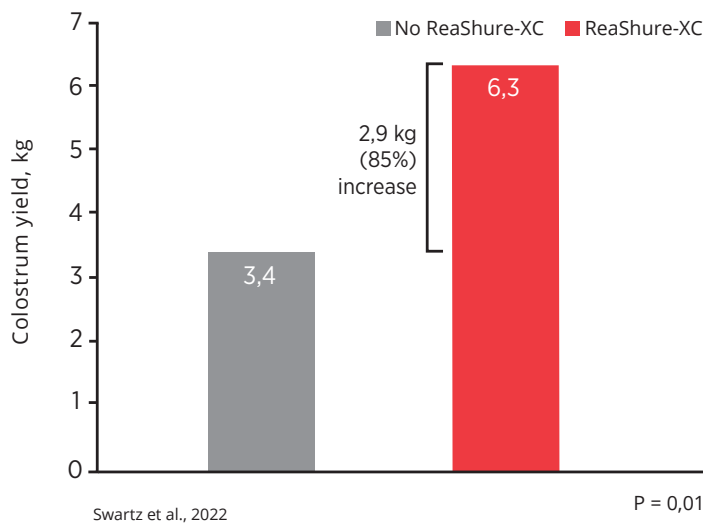
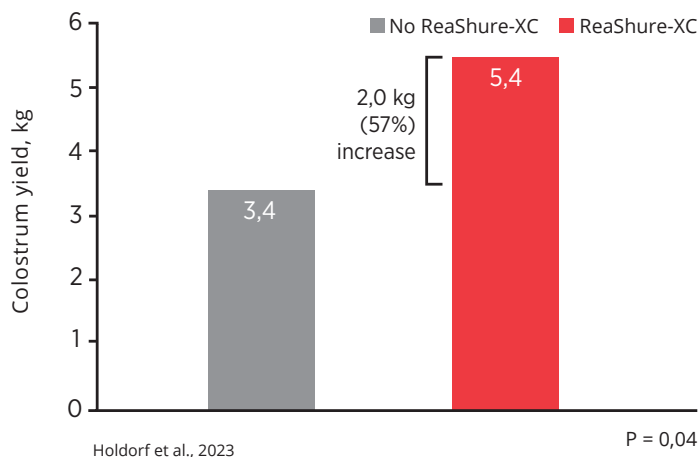


Figure 2 Effect of ReaShure-XC supplementation on colostrum yield

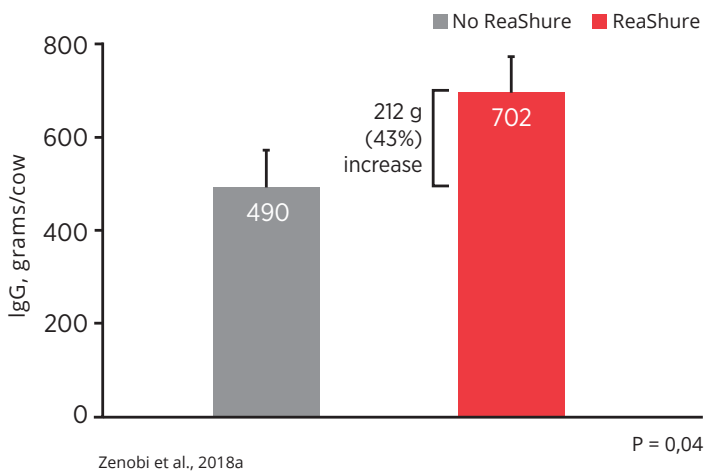


Swartz et al. (2022) reported that cows supplemented with ReaShure-XC prepartum produced 85% more colostrum than the control group (6,3 kg and 3,4 kg, respectively) with no dilution of colostrum fat, protein, or lactose percentages (Figure 1). Although ReaShure-XC supplementation increased colostrum yields, it did not affect colostrum quality as assessed by Brix refractometry ( $P = 0,29$ ) or Somatic Cell Score ( $P = 0,09$ ) in this study. Swartz and colleagues also reported that ReaShure-XC supplementation enhanced the yields of choline metabolites, resulting in a 100% increase in total choline moiety yield in ReaShure-XC-supplement cows. This study is the first to characterize choline metabolites in bovine colostrum.

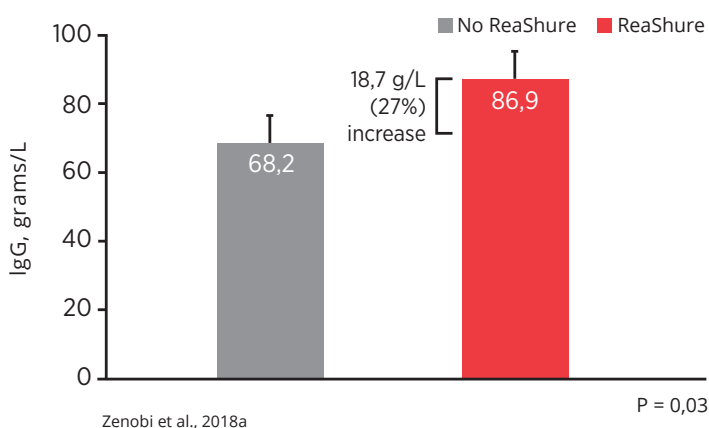
Likewise, Holdorf et al. (2023) reported that ReaShure-XC-supplemented cows produced 5,35 kg of colostrum as compared to 3,4 kg for the control group ( $P = 0,04$ ; Figure 2). This represents a 2,0 kg (57%) increase for the ReaShure-XC-supplemented cows with no negative impact on IgG concentrations.

In Zenobi et al. (2018a), colostrum production was numerically higher for the ReaShure fed cows

**Figure 3 Effect of ReaShure supplementation on colostrum IgG yield per cow**



**Figure 4 Effect of ReaShure supplementation on colostrum IgG concentration**



(9,4 kg vs 8,7 kg). However, ReaShure supplementation significantly increased IgG yield (702 vs. 490 g/cow,  $P = 0,04$ ; Figure 3) when compared to the control group. This was due to numerically greater yield of colostrum and greater concentration of IgG in colostrum (86,9 vs. 68,2 g/L,  $P = 0,03$ ) as compared to cows that did not receive ReaShure supplementation (Figure 4).

A subsequent study, Bollatti et al. (2020b), reported that supplementing ReaShure during the transition period did not affect either colostrum yield or composition. It is worth noting that in this study, the mean concentration of IgG in colostrum was 118 g/L, 52% higher than previously reported (Zenobi et al., 2018a).

## Discussion

The mode of action by which ReaShure supplementation influences colostrum yield and quality is still up for debate. The mammary gland produces Ig, but primarily transfers large amounts of plasma IgG across the mammary barrier to epithelial cells for secretion into colostrum. The mechanisms by which choline or derived phospholipids influence colostrum IgG content are unknown. Possible areas to be explored are proliferation of mammary cells or enhanced transport of Ig from plasma to the mammary epithelial cell. Improvements in lipid metabolism are most likely involved. However, considering the role of choline in methyl donation (epigenetics, protein expression), cellular structure, function, and integrity (intestinal, mammary) and immunity (functionality, inflammation), there are certainly other possible contributing factors to enhanced colostrum quantity and quality. While the exact mode by which ReaShure does this is still debated, increased colostrum yield is a great Key Performance Indicator of a sound transition cow program. While there may be undiscovered benefits to feeding cows ReaShure in other phases of the lactation cycle, it is recognized as beneficial to do so for essentially every cow in the prepartum period. The long-term impacts on performance of offspring discussed previously are derived from the targeted application during a very short period prepartum.

## Summary

Dairy producers have known for many years that ReaShure can help support a healthy transition into lactation. New research now suggests it can also improve colostrum yield and quality, helping to build a foundation for healthier calves. A short-term investment during the transition period can help transition your cows into a healthy and productive lactation today while paving the way for significant returns in the future as your heifers enter the milking string.\*

## References

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