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REVIEW

REVIEW: Colostrum supplements and replacers for dairy calves[1]

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ABSTRACT

Colostrum is key in establishing the initial immune protection for the neonatal calf. However, colostrum quality is highly variable between and within farms. Therefore, it can be difficult to ensure the calf receives necessary Ig to thrive. Colostrum supplements and replacers were developed to provide additional Ig or to totally replace maternal colostrum. Data concerning efficacy of colostrum supplements and replacers have been inconsistent. This review presents data from several publications using different types of colostrum supplements and replacers and notes their effects on IgG uptake in neonatal calves and kids.

Key words: colostrum supplement, colostrum replacer, dairy calf

INTRODUCTION

Quality colostrum is classified as having a minimum of 50 g of IgG/L (Besser et al., 1985; 1990) and <100,000 cfu/mL total plate count (**TPC**; McGuirk and Collins, 2004). Much of the colostrum produced does not meet this qualification. Of colostrum collected from 1,250 cows, 57.8% of colostrum samples had less than 50 g of IgG/L (Gulliksen et al., 2008). Morrill et al. (2012) gathered 827 colostrum samples for IgG analysis and TPC. Of the samples collected, almost 43% of the samples had a TPC >100,000 cfu/mL, with 16.9% of those samples having >1 million cfu/mL. Overall, only 39.4% of the samples collected met quality standards for both IgG concentration and TPC. Alternatives are available in cases when the colostrum produced is of poor quality or the dam is leukosis or Johne's positive or unable to stand for milking. Colostrum supplements (**CS**) and replacers (**CR**) have been created for supplementation of colostrum or as a total colostrum replacement. The purpose of this review is to compare data from studies using CS and CR.

COLOSTRUM SUPPLEMENTS

Data from experiments evaluating CS are in Table 1. Because of the number of calves that do not achieve passive transfer and the lack of quality maternal colostrum (**MC**), CS were developed. These products are designed to provide supplemental IgG to the neonate during the time of macromolecular transport (Davenport et al., 2000). Colostrum supplements provide exogenous IgG from bovine lacteal secretions or bovine serum. These products are intended to supplement and provide <100 g of IgG/dose but not totally replace colostrum (Quigley et al., 2002).

Santoro et al. (2004) used 48 bull calves fed either colostrum (73 g/L of IgG) ± 1 g of trypsin inhibitor or a CS (22.5 g/L of IgG) ± 1 g of trypsin inhibitor. Calves were fed either 2 L of colostrum or 2 L of CS within 90 min of birth and another feeding of colostrum or CS at 12 h. Serum IgG concentrations were lower in calves fed CS compared with MC. Their results indicate that calves fed CS did not have as much serum IgG as calves fed MC (4.55 vs. 14.6 g/L) at 24 h of age. These results are in agreement with data of Morin et al. (1997). Calves were fed 2 feedings of 2 L of low-quality colostrum (26 mg/mL of IgG) or 1 of 2 CS treatments providing a total of 142 or 185 g of IgG within 12 h. Addition of the CS decreased apparent efficiency of absorption (**AEA**) and did not result in greater concentration of serum IgG at 48 h.

Hopkins and Quigley (1997) tested the effect of a lacteal-based CS combined with MC on absorptive efficiency and serum IgG concentration. A total of 52 calves were blocked by sex and assigned to 1 of 3 types of feeding regimens: 1 feeding of 3.8 L of MC (≥200 g of IgG), 1.9 L of MC in 2 feedings, or 1.9 L of MC in 2 feedings plus 272 g (25 g of IgG) of CS at first feeding. Blood was collected via jugu-

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Table 1. Effects of colostrum supplements on failure of passive transfer (FPT), 24-h serum IgG concentrations, and apparent efficiency of absorption (AEA)

Authors	Origin	% FPT	24-h IgG, g/L	AEA,[1] %
Zaremba et al., 1993	LCS[2]	—	2.5	—
	LCS + 3 kg of MC[3]	—	9.8	—
	LCS + 1.5 kg of MC	—	5.4	—
Mee et al., 1996	WPC[4]	—	3.0	—
	WPC + 1 L of MC	—	9.5	—
Hopkins and Quigley, 1997	LCS + 3.8 L of MC	—	16.6	30
Morin et al., 1997	BSP[5] (142 g of IgG_1) + 2 L of MC	—	11.4	24.9
	BSP (185 g of IgG_1) + 2 L of MC	—	11.0	18.1
Arthington et al., 2000a	BSP	—	6.8	28
	LCS1	—	2.2	17
	LCS2	—	3.5	24
Arthington et al., 2000b	BSP	—	8.3	—
	PSP[6]	—	4.2	—
	BSP + 2 L of MC (95.2 g of IgG, 47% from BSP)	—	10.3	37
	BSP + 2 L of MC (98.8 g of IgG, 70% from BSP)	—	10.7	38
Davenport et al., 2000	BSP	—	5.7	30
	BSP + 200 g of casein	—	5.5	29
	BSP + 400 g of casein	—	3.9	19
	BSP + 200 g of WPC	—	6.6	34
	BSP + 400 g of WPC	—	7.3	32
	MC + 100 g of casein	—	16.7	21
	MC + 200 g of casein	—	14.4	20
	MC + 100 g of WPC	—	16.1	22
	MC + 200 g of WPC	—	15.8	21
Quigley et al., 2001	BSP	—	5.5–14.1	25–28
Quigley et al., 2002	BSP	—	8.0	33
Hammer et al., 2003	BSP	42	10.6	29
	BSP + GF[7]	57	9.1	30
Santoro et al., 2004	BSP	100	4.5	22.7
	BSP + trypsin inhibiter	100	4.6	19.6

[1]AEA = [plasma IgG (g/L) × BW (kg) × 0.09/IgG intake] × 100% (Quigley and Drewry, 1998).

[2]Lacteal-based colostrum supplement.

[3]Maternal colostrum.

[4]Whey protein concentrate.

[5]Bovine serum product.

[6]Porcine serum product.

[7]Growth factor.

lar venipuncture at 0, 24, and 48 h to be analyzed for IgG. At 24 h postpartum, serum IgG concentrations were lowest for calves fed 2 MC feedings with CS compared with the 2 feedings without CS. At 48 h, however, serum IgG levels did not differ among any of the treatments. This suggests that supplementation is unnecessary if high-quality colostrum is available or that there may be a component of the supplement that binds or inhibits absorption of IgG.

The efficacy of whey protein concentrate (**WPC**) as a CS was evaluated in 2 experiments using 29 calves per treatment (Mee et al., 1996). In experiment 1, calves were assigned to 1 of 2 treatments: group 1 calves were fed 2 L of pooled colostrum and group 2 calves were fed 500 g of WPC providing 124 and 18 g of Ig, respectively. Serum IgG, globulin concentrations, and Ig antibody activities to *Escherichia coli* and rotavirus were improved for group 1 calves at 24 to 36 h and 3 wk of age. Weight gain through 3 wk of age was lower for group 2 calves, and mortality rate was greater for group 2 calves compared with group 1 calves (28 vs. 3%, respectively). Experiment 2 calves were fed either 2 L of colostrum (group 3) or a solution of 1 L of colostrum plus 500 g of WPC (group 4) providing 117 and 69 g of Ig, respectively. Absorption rate of IgG was less for group 4 calves. Serum IgG, globulin concentrations, and Ig antibody activities to