

Colostrum: Indicator of physiological balance in pre-fresh cows and key stimulant in the calf's lifelong genetic expression

Jon Robison for *Progressive Dairy*

AT A GLANCE

It's no secret that colostrum is essential for a calf's short- and long-term health. New research shows that including a microbial feed additive in the pre-fresh cow diet may improve colostrum quality and quantity.

The significance of the quality and quantity of colostrum harvested from the cow at parturition, and subsequently fed to the newborn calf, has been studied and documented for over 200 years. With advanced scientific technologies, we have been able to more specifically identify many of the key nutritional and nonnutrient components of colostrum, as well as their modes of action in the neonatal calf.

The production of colostrum begins approximately three to four weeks prior to parturition with the intramammary accumulation of nonnutrient biologically active substances. These include immunoglobulins (IgG1), growth hormone, prolactin, insulin, glucagon, IGF-I, IGF-II, TGF-beta1, TGF-beta2, releasing factors, lactoferrin, transferrin, erythrocytes, leukocytes, enzymes, oligosaccharides and many others, each identified as significant nonnutrient components of quality colostrum. These substances continue to accumulate and concentrate through the pre-fresh period.

Approximately two to three days prior to parturition, a significant hormonal balance shift occurs, which overrides the suppression of milk synthesis and allows for copious secretion of milk components. This effectively "switches on" the ability of mammary secretory cells to synthesize milk components. The nutrient components of colostrum include



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milk proteins, colostrum fats, lactose, vitamins, minerals and water.

The accumulation of nonnutrient biologically active substances, along with the copious secretion of milk components, vitamins and minerals, results in colostrum, which is markedly different than whole milk (**Table 1**).

Cows are genetically capable of producing high quantities of high-quality colostrum at parturition. Colostrum production is influenced by many variables: season, environment, nutrition, crowding, social interactions and health status, to name a few. Some of these can be controlled by producers, while others can only be managed. Season, for example, has been shown to influence colostrum quantity. Recent research has revealed the correlation between the photoperiod in the three weeks leading up to calving and colostrum quantity. Cows that calve in the summer months typically produce more colostrum than those calving in the winter. Nutrition also plays a role in colostrum production. Dry cow rations can be highly variable by region and farm, and the amount of metabolizable energy and protein

TABLE 1

Component	Colostrum	Whole milk
Dry matter	18.5 to 28.0%	12.0 to 15.0%
Protein*	10.0 to 17.3%	3.0 to 4.2%
Lactose**	1.7 to 2.7%	4.5 to 5.0%
Fat***	4.1 to 7.6%	3.5 to 5.3%

*Colostrum proteins consist primarily of IgG₁ and high levels of casein. Whole milk proteins are also high in casein with some whey proteins and very low levels of immunoglobulins.

**Colostrum is relatively low in lactose compared to milk as calves lack the ability to digest high levels of lactose in the first few days of life.

***Colostrum is rich in "colostral fat" which has a different fatty acid profile than normal whole milk.

supplied prepartum, as well as the inclusion of vitamins and minerals, can impact colostrum quality, although further context-specific research is required.

Quality and quantity of colostrum production are the result of genetic potential combined with the influences of the cow's environment, nutrient intake, digestion, absorption, metabolism and health status. Success or failure in colostrum production represents successes or failures in each of these areas combined. As such, colostrum quality and quantity become

indicators of the level of success achieved in the physiological status of the pre-fresh cow. The most important management question is, then, "How do we optimize each of these factors to ensure optimal genetic expression?"

The role of the rumen microbiome in colostrum production

The rumen microbiome – the diverse population of microorganisms native to the cattle rumen – plays a

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SIGNIFICANT PHYSIOLOGICAL FUNCTIONS OF COLOSTRUM

- Passive transfer of immunoglobulins and other immune factors
- High-quality nutrient content suited for the neonatal calf's digestive tract and metabolic processes
- Colostral fats are key in thermoregulation in the newborn
- Non-nutritive components interact with digestive tract cells and tissues as effectors of gastrointestinal (GI) tract functions such as:
 - Cellular proliferation, migration, differentiation and apoptosis
 - Microbial population establishment
 - Protein synthesis and degradation
 - Digestion
 - Absorption
 - Immune function within and outside of the GI tract

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critical role in nutrient absorption, metabolic efficiency and immune function. A well-balanced rumen microbiome can enhance energy utilization and metabolic health, potentially leading to improved colostrum synthesis. This raises an intriguing question: Can altering the rumen microbiome lead to increased colostrum production and improved colostrum quality?

To explore this potential, we conducted a trial evaluating the effects of including a microbial feed additive designed to enhance rumen function (Galaxis Frontier) on colostrum production. The microbial feed additive used is composed of four rumen-native microorganisms (*Clostridium beijerinckii*, *Pichia kudriavzevii*, *Butyrivibrio fibrisolvens* and *Ruminococcus bovis*) that were each isolated from healthy, high-producing dairy cows and preserved to be delivered alive to the rumen. The colostrum study was conducted at Bar 20 Dairy near Fresno, California, in collaboration with Fresno State University. Matched groups of pregnant cows were randomly assigned to either treatment or control close-up pens approximately 21 days before calving. The trial took place over the winter, with final sampling in January and February. Both groups were fed identical base diets, and the treatment group received an additional 5 grams per head per day of the microbial feed additive, mixed into the total mixed ration (adequate mixing was monitored using an equivalent mass of colored microtracer particles). Colostrum from the first milking after parturition was collected within 12 hours of calving and evaluated by Fresno State University. Colostrum from 94 multiparous animals in the control group (average lactation 2.7 +/- 0.9) and 111 multiparous animals in the feed additive group (average lactation

2.3 +/- 0.5) were analyzed.

Key findings

• *Increase in colostrum yield:* Cows supplemented with the feed additive produced on average 2.4 pounds more colostrum than those in the control group (18 pounds versus 15.6 pounds, $p=0.03$).

• *Enhanced colostrum fat content:* Treatment-group cows exhibited significantly higher levels of colostrum fat (6.13% versus 5.08%, $p=0.007$),

which is crucial for calf energy and health.

• *No dilution of IgG concentration:* Despite increased colostrum volume, IgG levels remained stable, ensuring sustained immune protection for calves.

Colostrum management is vital for dairy calf health and overall herd productivity. Our research suggests that targeting the rumen microbiome with a microbial feed additive is a promising new approach to enhancing colostrum yield and quality. Increased

quantity and improved quality of colostrum is an indicator the cow is primed for a successful transition into lactation, and better colostrum can provide dairy producers with an innovative tool to strengthen calf growth and immunity. Overall, the study at Bar 20 shows how a microbial feed additive can support colostrum production and ultimately provide benefits for long-term herd success. 🐄

References omitted but are available upon request.

TABLE 2 Effects of native direct fed microbials on colostrum quality and quantity in multiparous cows¹

Item	Con	TRT	CSE	TSE	P-Value
Nutritional value					
Fat (%)	5.08	6.13	6.15	4.51	0.0070
Protein (%)	14.34	14.68	0.28	0.30	0.56
Fat (kg)	0.36	0.51	0.04	0.06	0.0013
Protein (kg)	1.12	1.27	0.18	0.97	0.28
Dry matter (%)	23.84	25.02	0.32	0.36	0.08
Colostrum quality					
Refractometer, Brix ²	22.49	23.21	0.29	0.30	0.23
Misco, Brix ³	22.93	23.49	0.32	0.32	0.38
SDK Refractometer, Brix	22.24	22.82	0.32	0.34	0.39
SDK Misco, Brix	22.33	23.16	0.33	0.37	0.23
SCCL Brix ⁴	24.41	24.04	1.03	0.40	0.90
Colostrum quantity					
Weight (kg)	7.07	8.17	0.54	0.61	0.03
IgG content					
IgG ⁵	85.88	84.80	3.82	3.08	0.88
gIgG ⁶	610.63	665.10	39.09	43.55	0.35

¹Data presented are Least Square Means, treatment, n=94 control, n=111

²IgG quantity measured on a brix scale

³Digital refractometer measurement of IgG quantity on a brix scale

⁴Measurement of IgG

⁵Immunoglobulin G, antibody quantity





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