

# Carbohydrates in dairy cow rations: The difference between starch and sugar supplementation

Sydney Moore and Kaitlyn Dancy for *Progressive Dairy*



## AT A GLANCE

Sugar supplementation has the ability to increase milk yield and milkfat percentage.

Carbohydrates are the major component of every lactating cow diet, making up approximately 70% of the total ration, with around 30% of these carbohydrates taking the form of starch. When formulating and feeding lactating diets, we rely on starch to support the energy demands for milk production. For decades, nutritionists and researchers have focused mainly on dietary starch content, often overlooking the benefits of targeting dairy cows' sugar requirements.

While starch is an effective

and essential energy source, the consequences of overfeeding starch (i.e., ruminal acidosis, profit loss, etc.) have recently prompted researchers to explore the use of other energy-rich carbohydrates in the diets of dairy cows. Sugar supplementation promotes dry matter intake (DMI), milkfat and total milk yield, as well as rumen metabolism across both the lactating and dry periods. While starch cannot be eliminated from the diets of high-producing lactating cows, it can be refined and reduced. This article will outline the use of sugar supplementation as an effective strategy to supply energy to dairy cows and support their overall health, welfare and nutritional requirements throughout the lactation cycle.

## Feeding and supplementing sugars

Sugar is a water-soluble

carbohydrate that ferments extremely quickly in the rumen (about 300% per hour versus starch, which ferments at 12% to 30% per hour). Through fermentation and processing of feeds, we have eliminated many of the naturally occurring sugars in dairy cow diets, feeding only approximately 1.5% to 3% sugar without further supplementation. Feeds such as soybeans, sugarbeets, cottonseeds, legumes, peas, citrus pulp, whey and molasses are all naturally effective sugar sources that can be fed to dairy cows. In terms of supplementing additional sugar in the diet, commercial liquid feeds consisting of molasses or whey are typically the most common method used, as they can easily be mixed into the TMR or supplemented directly at feedstalls or in automated milking machines. Molasses is more durable and affordable compared to liquid

## Sydney Moore

Ph.D. Student  
University of British Columbia

whey and is thus the most common method used within the dairy industry for supplementing sugars to cows.


## Sugar supplementation and feed intake

Sugar supplementation supports microbial growth, particularly for fibre-digesting bacteria, speeding up fibre degradation and allowing for greater DMI. This concept has been supported by multiple studies, with greater daily DMI being observed in cows supplemented with dietary sugar.

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**Carbohydrates in dairy cow rations: The difference between starch and sugar supplementation, cont'd from page 31**

The U.S. Dairy Forage Research Center reported increased DMI for cows supplemented with 2.5% starch and 5% sucrose as well as zero percent starch and 7.5% sucrose. Studies at the University of Guelph observed that peak- to mid-lactation cows supplemented with molasses-based liquid feed had increased DMI by 1.4 kilograms per day compared with control cows. A more recent study conducted by the University of Guelph demonstrated that supplementing dry cow diets with liquid molasses can help maintain DMI in the week leading up to calving, further supporting metabolic health in the fresh period by limiting the amount of body fat mobilized prior to and following calving.

Another important factor to consider is the physical properties of sugar (specifically molasses-based liquid feeds). Molasses is highly palatable and “sticky” in texture. These attributes are likely what predispose liquid sugar supplementation to not only increase daily DMI but reduce unwanted feeding behaviour like feed sorting. Multiple studies from the University of Guelph have demonstrated reduced feed sorting, particularly a reduction in sorting against the longest fraction of the diet, when cows were supplemented with a molasses-based liquid feed. Limiting feed sorting is crucial to ensuring cows are spending their time efficiently at the feedbunk and eating a well-balanced diet formulated to their specific energy demands and stage of lactation.

**Sugar supplementation in relation to milk production and components**

Many studies have assessed the effect of sugar supplementation on milk yield. Research from Paradox

Nutrition demonstrated an increase in milk yield of 1.4 kilograms per day for cows fed an added liquid sugar supplementation. Similarly, in another study conducted by Paradox Nutrition with a dry sugar supplement, a 1.5-kilograms-per-day increase was seen in milk yield for cows producing more than 40 kilograms per day. Furthermore, research done by the University of Guelph fed peak-lactation dairy cows a molasses-based liquid feed (approximately 41% sugar) and found that milk yield increased by 1.9 kilograms per day for cows fed this liquid feed supplement compared with control cows who did not receive any supplementation.

In terms of milk components, it is well documented that sugar supplementation has the ability to increase milkfat percentage. This is thought to be a result of sugar increasing the concentration of butyrate in the rumen. Butyrate is the key volatile fatty acid used in milkfat synthesis and stimulates rumen epithelial cells, improving absorption of VFA from the rumen.

Furthermore, research from the Paradox Nutrition group also observed an increase in true milk protein yield (0.07 kilogram per day) of 3.5% fat-corrected milk (1.45 kilograms per day) for cows supplemented dietary sugar. These results were supported by the University of Guelph, which also reported a significant increase in protein yield (0.09 kilogram per day) and 3.1 kilograms per day in 4% fat-corrected milk.

**Refining starch with sugar**

After outlining some of the benefits of supplementing sugar, next we will discuss determining how to effectively incorporate sugar

**TABLE 1** How different levels of starch refinement with sugar can impact DMI and milk characteristics

	7.5% starch 0% sugar	5% starch 2.5% sugar	2.5% starch 5% sugar	0% starch 7.5% sugar	P Value (significance)
Starch (% DM)	28.3	27.4	24.5	21.5	-
Sugar (% DM)	2.7	5.1	7.1	10.0	-
DMI (kg/d)	24.5	25.4	26.0	26.0	0.02
3.5% FCM (kg/d)	40.7	42.1	43.8	43.2	0.13
Milk fat (%)	3.81	3.80	4.08	4.16	0.02
Fat (kg/d)	1.47	1.53	1.65	1.62	0.05

Source: Table has been adapted from research done by Broderick et al. 2008 at the U.S Dairy Forage Research Center

into dairy cow rations to maximize its benefits. Researchers recommend incorporating around 1 kilogram per cow per day of supplemental sugar, with the diet consisting of 6% to 8% dietary sugar and 22% to 27% starch.

While feeding sugar to all cows can provide several benefits, producers can also supplement sugar to certain groups of cows depending on their specific needs. For example, studies have supported the benefits of sugar supplementation for high-producing dairy cows to support their energy demands. If farms are experiencing a high prevalence of ketosis (a consequence of severe negative energy balance), sugar supplementation could be beneficial to these animals both in the lactating diet and dry cow diets. Additionally, cows with previous exposure to acidosis may also benefit from a higher concentration of sugar in their diet and a reduction in starch, as sugar increases rumen pH and promotes the propagation of a more favourable rumen microbiome.

Producers may also wish to supplement sugar to increase milk yield as well as certain milk components within their herd. **Table 1**, generated from research done at the U.S. Dairy Forage

Research Center, outlines how different levels of starch refinement with sugar can impact DMI and milk characteristics.

**Conclusion**

Overall, there are several benefits to including sugar in your dairy cow diets. Sugar supplementation has the ability to support and improve rumen pH, increase DMI and reduce feed sorting. While starch is an essential energy source, the consequences of overfeeding starch to encourage milk production can result in bouts of ruminal acidosis and an altered ruminal microbiome. Refining starch inclusion with sugar supplementation can encourage healthy feeding behaviour and intake, and thereby support yield of total milk and components.

Speak to your nutritionist about how to supplement sugar in your diets and how it may benefit you and your herd. 🐄

*Kaitlyn Dancy, MSc, is a research assistant at the University of Guelph and Sydney Moore is a PhD student at the University of British Columbia. They provided the article on behalf of Liquid Feeds Inc.*

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