Greater intake before weaning improves first lactation performance

by Fernando Diaz (DVM, PhD)

The preweaning period is the most important phase in the productive lifetime of a dairy cow. Two meta-analyses published recently in the Journal of Dairy Science determined the relationships between early-life parameters and the performance of first-lactation (primiparous) cows. A meta-analysis is the statistical procedure for combining data from multiple studies.

The first meta-analysis included data from 2,880 Holstein calves from 37 calf research trials conducted at the University of Minnesota Southern Research and Outreach Center. The researchers (Chester-Jones et al., 2017) found that average daily gain (ADG) during the first 8 weeks of calf life significantly improved 305-days milk yield in the first lactation: for every kg of ADG at 8 weeks, milk yield improved by 579kg.

Similarly, the second meta-analysis (including 21 treatment groups) carried out by Pennsylvania State University's researchers (Gelsinger et al., 2016) found that for each additional 100g of preweaning ADG, milk, fat, and protein production during first lactation increased by 130.4, 6.1, and 4.7kg, respectively. Moreover, this work showed that calf starter intake is as important as milk intake in calf feeding programs:

- For each additional 100g/d of milk or milk replacer intake before weaning, milk, fat, and protein increased by 138.5, 8.4, and 4.7kg, respectively.

- For each additional 100g/d of calf starter intake in the preweaning period, first-lactating cows produced 127.0kg more milk, 8.4kg more fat, and 4.0kg more protein.

A greater plane of nutrition during the preweaning period also improves mammary gland development. In a recent study conducted at Cornell Research Farm, Harford, NY, the researchers (Soberon and Van Amburgh, 2017) compared two groups of calves; a low-intake group in which the calves were fed 0.89 megacalories of metabolisable energy above maintenance and a high-intake group in which the calves received 3.75 Mcal of ME above maintenance) during the first 54 days of life.

As expected, calves in the high-intake group had higher ADG than calves in the low-intake group (0.82 vs. 0.39kg). The mammary glands of calves fed for higher nutrient intake weighed 3.4 times more than that of calves fed for lower intake (337.6 vs. 75.5g). Moreover, the parenchymal mass of the mammary glands of highly fed calves weighed 5.9 times more than the mammary parenchymal mass of low-intake calves (6.48 vs. 1.1g). These results may explain the greater performance of first lactating cows with better early-life growth.

The minimum body weight of primiparous cows necessary to optimise milk yield after calving is 85% of their mature body weight. Therefore, in order to take full advantage of the greater growth before weaning, an adequate feeding program should be implemented during the rest of the heifer period (from weaning until calving).

Fernando Diaz works as a Dairy Nutrition and Management Consultant at Rosecrans Dairy Consulting, LLC. He provides consultation to dairies and feed companies including nutrition and feeding management, operational effectiveness, people capital management, and research and product development of new feedstuffs, additives and technologies for dairy cows. He can be reached at fernando@jration.com

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Evaluating Feeding Technician performance

by Fernando Diaz (DVM, PhD)

Since feed is the highest individual cost in intensive dairy production systems, the Feeding Technician is one of the most important job positions at the dairy.

According to the USDA Economic Research Service (2018), during the last decade feed costs represented in the US between 42 and 57% of the total cost of producing milk. At current feed costs of $0.24 per kg of dry matter (DM), the average budget of a 500-cow dairy exceeds one million dollars.

One of the areas of focus for improving income over feed costs is ingredient loading accuracy. Researchers from Virginia Tech demonstrated that 4% of all total mixed ration (TMR) loads were underfed by more than 180kg in nine dairy farms located in the Chesapeake Bay (James and Cox, 2008). On the other hand, frequency of overfeeding in excess of 180kg was 33%.

Similarly, researchers from California (Trillo et al., 2016) evaluated dairy feeder performance based on loading deviations from target weight. The study included 26 dairies that ranged in size from 1,100 to 6,900 cows. Feeding records included information from more than 500,000 ingredient loads and were obtained throughout a 12-month period from the feeding software.

In summary:

- In 2.5% of the total loads, ingredients were loaded under the target weight set by the tolerance level, representing between 0.1 to 21.1% loads of feed per dairy.

- When expressed in kg, at least 20% of the time ingredients were loaded with a deviation from target >35kg on seven dairies or <-35kg on two dairies.

- Rolled corn and almond hulls were loaded with adequate precision and adequate accuracy ,while alfalfa hay, corn silage, and canola were loaded with poor precision.

- As result of deviations from the target weight, the ration cost increased by at least $3 per metric ton <5% (15 dairies), 5 to 20% (six dairies), or >20% (two dairies) of the time.

These findings show that while some dairies are doing an excellent job for loading the mixer on their operations, others must improve loading accuracy and precision considerably.

In conclusion, high-producing herds require a high level of feeding management to assure the supply of a consistent diet.

Recommendation for loading accuracy:

- Ingredients from upright bins: less than 15kg fresh matter (FM).

- Ingredients from open-sided commodity sheds: less than 20kg FM.

- Dry hay: less than 25kg FM.

- Silages and wet corn co-products (30-60% DM): less than 50 FM.

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Histidine – is it the third limiting amino acid?

by Fernando Diaz (DVM, PhD)

Fine-tuning and balancing diets for essential amino acids has become a common practice during recent years. In general, lysine and methionine are the main limiting amino acids in dairy cow diets. Histidine has been identified as the first limiting amino acid mainly in cows fed grass silage-based diets. However, new research shows histidine may be a limiting amino acid in corn silage-based diets as well.

In a series of studies conducted at The Pennsylvania State University's Dairy Teaching and Research Center, researchers evaluated the effects of histidine supplementation of low-protein diets on lactation performance of high-producing dairy cows. In the first work (2015), the authors supplemented a metabolisable protein (MP) deficient diet, already supplemented with rumen-protected methionine, with 50g of a rumen-protected histidine product (bioavailability = 54%).

The diet, based on corn silage (43.3% of DM), was formulated to contain 15.5% of protein in dry matter (DM) basis and provide 96% of the MP requirements (according to the dairy National Research Council; NRC, 2001). The results, published in the Journal of Dairy Science, showed that supplementing histidine:

- Increased DM intake (28.3 vs 26.6 of kg DM/day).
- Increased milk protein content (3.26 vs. 3.16%).
- Increased milk protein yield (1.46 vs. 1.37kg/day).
- Tended to increase glucose in blood (80.4 vs. 74.6mg/dL).

Similarly, in the second study (2016), the authors supplemented a protein-deficient diet (98% of the MP requirements) with 120g of an experimental rumen-protected histidine product (bioavailability = 18%). This diet contained 42% of corn silage and 14.5% of protein in DM basis. In summary, feeding protected histidine:

- Tended to increased DM intake (29.2 vs. 28.4 kg of DM/day).
- Increased milk protein content (3.11 vs 3.00%).
- Increased histidine concentration in blood (44.3 vs 26.3µM).

Finally, in the last study (2017), cows fed a MP deficient diet were supplemented with 400g of blood meal. Blood meal is an excellent source of histidine. The corn silage-base diet was formulated to contain 16.2% of protein in DM and to supply digestible histidine at 2.5% of MP requirements.

In this case, supplementing histidine by feeding blood meal:

- Increased DM intake (28.5 vs 25.4kg of DM/day).
- Increased milk yield (40.5 vs 37.57kg/day).
- Increased energy-corrected-milk yield (37.4 vs 34.4/day).
- Increased milk protein yield (1.18 vs 1.07kg/day).
- Increased histidine concentration in blood (90.9 vs 37.3µM).

These findings indicate that histidine may stimulate feed intake and milk protein production in dairy cows fed a diet based on corn silage.

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Different approaches for boosting milk fat yield

by Fernando Diaz (DVM, PhD)

Milk fat is the most valuable component in milk. Three recently published studies show different approaches for improving milk fat yield.

1. Reducing the risk of milk fat depression:

A work conducted at the University of Nebraska-Lincoln evaluated the additive effects of starch and fat as risk factors associated with milk fat depression in dairy diets. The researchers (Ramirez Ramirez et al., 2015) compared a control diet (fat 5.2%, starch 19%) with three other similar diets containing either 0.97% added corn oil (fat 6.4%, starch 18%) or 8.5% additional ground corn (fat 5.5%, starch 22%), or both 0.97% corn oil and 7.6% corn (fat 6.5%, starch 23%). All diets contained 33% corn silage, 10% alfalfa haylage, and 20% DDGS. The results, published in the Journal of Dairy Science, showed the inclusion of oil, starch, or a combination of both induce milk fat depression, measured as a reduction on the overall concentration and yield of de novo synthesised fatty acids (<16 carbons) in milk. Compared with the control diet (3.3% milk fat), diets with additional corn oil or corn starch decreased milk fat by 0.3 percentage units, whereas the diet containing both risk factors decreased milk fat by 0.6 units. Interestingly, ruminal pH was not affected by the diet, averaging 5.87 with an average minimum of 5.50 and an average maximum of 6.71 across treatments.

2. Avoiding sorting behaviour:

A study published recently (Miller-Cushon and DeVries, 2017) showed the association between sorting behaviour and milk fat production. The researchers evaluated feeding behaviour in 28 lactating Holstein cows individually housed in a tiestall barn at the University of Guelph, Kemptville Campus Dairy Research and Innovation Center. Particle size distribution in the offered diet was 8.0% long particles (>19mm), 53.5% medium particles (8-19mm), 29.1% short particles (1.18-8mm), and 9.4% fine particles (<1.18mm). Cows sorted against long particles and in favour of short and fine particles. On average, intake of the longest particles, expressed as a percentage of the predicted intake, was 78% (ranged from 45 to 103%). Milk production in the group was 40.2kg/day with 3.81% and 3.30% protein. The authors found negative associations between feed sorting and milk composition: every 10% increase in sorting against long particles, milk fat content decreased by 0.1 percentage units.

3. Feeding management:

A recent study from the University of Alberta published in the Journal of Dairy Science evaluated the effects of feeding frequency on performance of lactating dairy cows. All cows were fed a high-grain diet containing 36.5% forage (barley silage), 17.9% forage neutral-detergent-fibre (NDF), 29.4% NDF, and 31.6% starch distributed either once per day at 0800 hours or three times per day at 0800, 1500, and 2200 hours. The researchers (Macmillan et al., 2017) reported feeding cows three times per day does not affect intake or milk yield; however, it increases milk fat yield by 0.14kg/day (1.22 vs. 1.08kg/d) and tended to increase milk fat concentration (3.45 vs. 3.14%) compared to one time feeding. As result, feeding three times improved 3.5% Fat-Corrected-Milk production from 34.2 to 36.4kg per day.

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How many wrapping layers on your baleage?

by Fernando Diaz (DVM, PhD)

Baled silage is a common practice for storing grass and legume silages mainly in small and medium-size dairy farms. Forage is cut into a wide swath that covers at least 75% of the cut area to reduce moisture content to about 50% as soon as possible.

Wide swaths lead to a more uniform drying which can reduce the presence of wet or green spots in the windrows at baling.

Wrapping baled silage with four plastic layers is recommended to maintain anaerobic conditions within the silage mass; however, this practice may be inadequate for long storage periods.

A recent study published by Researchers from the University of Wisconsin, and the US Dairy Forage Research Center evaluated the effects of 4, 5, or 6 layers of plastic wrap on the silage fermentation and the nutritive value of baled alfalfa-grass silages.

The researchers (Coblentz et al., 2016) wrapped large round bales of a mixed alfalfa-grass sward (60% dry matter; DM) with 4, 5, or 6 layers of a commercial polyethylene wrap (750mm × 1500m × 25µm).

In summary, after the four month storage period, there were no differentiating responses to the number of wrapping layers:

- DM content in the surface (58.2%) and core of the baleages (58.6%).
- Recoveries of DM (99.5%).
- pH in the surface and core of the baleages (5.7).
- Concentrations of total acids (0.89% DM), lactic acid (0.11%), acetic acid (0.78% DM), and ammonia (0.16%).
- Losses of water-soluble carbohydrates (0.5 percentage units) and total-digestible-nutrients (1.0 units).

Overall, these findings show there is no advantage gained by using more than four wrapping layers in baleage. In a subsequent study, the investigators evaluated the quality of the forage stored for different lengths of time. Large round bales were wrapped with four layers and kept in storage for 99, 243 and 357 days of storage.

Similarly, the researchers (Coblentz et al., 2017) did not find any difference in the pH of the baleages (5.8), and contents of total acids (2.68% DM), lactic acid (1.47%), and acetic acid (0.85% DM).

As expected, water-soluble carbohydrate concentration was reduced slightly from 6.2% DM at baling day to 5.1, 4.4, 3.7% at 99, 243 and 357 days. Surprisingly, losses in total-digestible-nutrients were slightly greater at 99 days (2.8 percentage units) than at 243 and 357 days of storage (1.8).

In conclusion, these findings suggest that four wrapping layers are adequate to preserve feed quality in baleages during long periods.

Fernando Diaz works as a Dairy Nutrition and Management Consultant at Rosecrans Dairy Consulting, LLC. He provides consultation to dairies and feed companies including nutrition and feeding management, operational effectiveness, people capital management, and research and product development of new feedstuffs, additives and technologies for dairy cows. He can be reached at fernando@jration.com

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Feeding sugar beets and beet pulp to dairy cows

by Fernando Diaz (DVM, PhD)

Sugar beet is a temperate climate crop grown mainly for production of sucrose. A recent study from the Atlantic Dairy and Forage Institute, NB, Canada, determined if sugar beets can be efficiently added to mid-lactating dairy cow diets as a source of energy.

The researchers (Evans at al., 2016) replaced corn and barley with sugar beets at 0, 8.0, 16.0, and 24.0% of the total diet dry matter (DM). Soybean meal was used to adjust protein content in the diets (16% protein).

Sugar beets used in the current study were harvested in the Port Dover region of Ontario, Canada, in early November 2014. Dry matter, protein, fibre (NDF), and sugar contents in the beets were 23.3, 2, 3, 11.6, and 71.2% of DM, respectively. They were chopped just before being added to the TMR at particles that ranged from 2-4cm in length and approximately 1cm in width. Sugar level in the diets increased with the inclusion of beets from 4.61% in the TMR without beets to 19.12% in the TMR with the greatest inclusion of beets.

The results, published in The Professional Animal Scientist, showed similar performance (26.33kg of milk/day, 31.2kg/day 3.5% fat-corrected milk, 3.68% milk fat, 3.47% milk protein) and feed efficiency (1.25kg of energy-corrected milk/kg of dry matter intake) among diets.

Sugar beet pulp is a co-product of the sugar industry high in fibre concentration and pectic substances that is used as a feed for ruminant. Using data obtained from 34 studies published from the last 26 years, researchers (Münnich et al., 2017) from the Institute of Animal Nutrition and Functional Plant Compounds in Vienna (Austria) performed a meta-analysis to evaluate the effects of beet pulp inclusion in cows' performance and the rumen environment.

The inclusion levels of beet pulp in these studies averaged 14.5% of diet dry matter (ranged from 0-44.7%), and the amount of beet pulp fed to cows averaged 2.79kg DM per day (0-5.56kg).

The findings, published in the Animal Feed Science and Technology magazine, showed that although milk and milk protein yield did not change, beet pulp inclusion had a positive effect on milk fat yield and milk fat percentage.

However, the highest yield and highest milk fat percentage were found in medium beet pulp inclusion level (10-20% of DM). The increase in milk fat yield is due to a greater production of ruminal acetate, since this volatile fatty acid is an important precursor for de novo milk fat synthesis.

In conclusion, these studies showed that sugar beets and beet pulp can be included in lactating cow diets without affecting performance.

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