

National FFA Convention - Dairy Nutrition Scenario

November 2023

Scenario: You received a call from Fabian F. Alameda, owner of FFA Dairies, LLC, located in the Central Valley of California. Mr. Alameda has some questions about the nutrition program on his dairy. His current nutritionist is on vacation and he doesn't want to bother her, so he is hoping that your team will help him in the meantime.

FFA Dairies milks 1200 cows, 3 times a day in a double-30 parallel parlor. The calves and heifers are all raised on a neighboring facility. The dry cows are housed in a separate barn close to the lactating cow facilities. The lactating cows are averaging 90 lb/day with a 4.0% milk fat and 3.2% protein test. The somatic cell count (SCC) is at 120,000 cells/ml. The cows are housed in 3 free stall barns (Figure 4) with each barn divided into 2 pens with 200 cows per pen. Each barn is 350 ft long and has headlocks down the center alleyway where the total mixed ration is fed to the cows on each side of the alleyway. The barns are equipped with fans and soakers over the feed lanes so cow cooling is good and is not an issue. There are 2 head-to-head rows of stalls in each pen (4 row barn). The stalls in the pens are sized correctly and the cows are able to comfortably lie in the stalls with no issues.

All of the cows are fed 2 times per day using a Total Mixed Ration (TMR) mixer fitted with a double screw assembly for mixing the feed (see Figures 1a & 1b). Pens 1 through 4 are fed one ration and Pens 5 and 6 are fed a different ration. Cows in Pens 1 through 4 are averaging 96 lb of milk and the cows in Pens 5 and 6 are later lactation cows and are averaging 78 lb of milk.

Challenge #1:

FFA Dairies recently received two separate rations from their nutritionist (see Table 1). The rations list the ingredients each cow should receive daily on an individual basis. The rations do not state which one should be fed to which pen of cows.

- Which ration should be fed to Pens 1 through 4 and which ration should be fed to Pens 5 and 6? Explain to Mr. Alameda how you know that you are feeding the right ration to the correct pen of cows.

Challenge #2:

The employee that feeds the milking and dry cows asked Mr. Alameda if they could feed one of the milking cow rations to the dry cows.

- Do you think this is or is not a good idea? Please explain your answer so that Mr. Alameda can explain it to the person feeding the cows.

Challenge #3:

Both of the new rations include soybean meal (Table 1), but there is only enough left for 10 more days at the current feeding rate. Mr. Alameda is going to need to add in a different ingredient to replace a portion of the soybean meal as delivery of additional soybean meal can not occur until next month. Mr. Alameda has looked into his options and can either get or has enough of the following ingredients available to put in the ration (additional information about each ingredient is available in Table 2):

- Corn (ground)
- Canola meal
- Wheat
- Oats
- Straw

- Which of these ingredients should he use to replace a portion of the soybean meal in the ration? Explain why you selected this ingredient and the reasons you did not select EACH of the other ingredients available.
- To make sure that he does not run out of soybean meal in the future, Mr. Alameda would like to plan ahead and avoid this issue in the future. He would like for you to help with the following items:
 1. Calculate how many tons of soybean meal he needs to feed his milking herd for the next 3 months.
 2. He can contract with his supplier a set number of semi-tractor loads for delivery. How many semi-loads should he contract? (A semi-load holds 25 tons of soybean meal and partial loads are not sold.)

Challenge #4:

When the nutritionist formulates a new ration, they provide a feeding sheet. The feeding sheet gives the total amount of each ingredient and the order that the feed ingredients should be added to the TMR mixer to make a batch of feed for either multiple barns or pens of cows. However, the feeding sheet that the nutritionist just sent along with the new rations was lost. Mr. Alameda would like for you to make him a new feeding sheet to mix a batch of feed for 200 cows using Ration A.

- State how much of each ingredient should be added to the TMR mixer.
- In what order would you recommend the feed ingredients be added to the TMR? Explain WHY you added the ingredients in the order you listed them to be added to the TMR mixer.

Challenge #5:

Mr. Alameda is interested in exploring new types of technology for his dairy operation. Recently, he was visiting with a friend that was telling him about robot feed pushers (Figure 3).

- Explain why pushing up feed is important for the lactating cows at FFA Dairy.
- Discuss the advantages and disadvantages of a robotic feed pusher for Mr. Alameda's dairy operation.

Figure 1a. The double screw TMR mixer used for feeding the cows at FFA Dairy.



Figure 1b. Diagram of how the double-screw TMR mixer works to mix the feed. (Photo credit: <https://www.agcentral.coop/dairy-services/patz>)



Gray arrows indicate direction of screw rotation.
Green arrows indicate Balanced Flow™ of feed

Table 1. Rations received from the nutritionist for the lactating cows.

Feed ingredients	Ration A Pounds per cow per day (as fed)	Ration B Pounds per cow per day (as fed)
Corn Silage	50.0	55.0
Alfalfa Haylage	15.0	18.5
Ground Corn	14.3	9.3
Byproduct/Mineral and Vitamin Mix	8.8	7.5
Alfalfa Hay	5.0	4.0
Almond Hulls	5.0	4.0
Soybean Meal	3.75	2.6
Straw	1.0	0.0
Nutrient		
Dry matter, %	56.8	51.5
Crude Protein, %	16.5	16.2
NDF, %	29.5	31.1
Starch, %	28.0	26.0

Figure 2. Soybean meal and almond hulls that FFA Dairy is currently feeding.



Table 2. Nutrient composition of potential ingredients to include in the ration to extend the supply of soybean meal.

Ingredient	Crude Protein (% DM)	Starch (% DM)	Calcium (% DM)	Phosphorus (% DM)
Corn	8.5	70.4	0.04	0.31
Canola meal	41.5	1.6	0.79	1.15
Wheat	13.5	63.0	0.10	0.36
Oats	12.2	44.7	0.13	0.38
Straw	4.5	1.8	0.38	0.12

Figure 3. One example of a rotating feed pusher. (Photo credit: <https://agupdate.com>)



Figure 4. Picture of one of the freestall barns



Answer Key:

FFA Dairy, LLC has several positive strengths. Overall, their milk production, milk components, and SCC are good and at or above averages expected in the dairy industry. Cows are comfortable and the barn is designed to help cool the cows. FFA Dairy is working with a nutritionist to help get additional expertise and advice on feeding the cows. Mr. Almeda has a good working knowledge of nutrition principles that he knows what questions to ask his nutritionist and to have a productive conversation with her.

Cows are being fed 2 times a day, which will help to keep the feed fresh and bring the cows to the feed bunk more often.

Challenge #1:

Concept illustrated: Higher producing cows require more nutrients and eat more total feed than lower producing cows.

Answer: Ration A should be fed to the “high group” found in Pens 1 through 4 as they are producing more milk. There are several indicators that Ration A is the high group ration. These include:

- More overall feed being fed in Ration A. Cows with higher milk production will have higher dry matter intakes and will require more feed.
- Ration A includes higher amounts of corn, byproduct/mineral and vitamin mix, and soybean meal. These ingredients are all more nutrient dense and will supply more nutrients to the cows.
- The crude protein concentration is higher in Ration A, thus the ration will supply more protein for higher producing cows.
- The starch concentration is higher in Ration A, thus the ration is supplying more energy and would be needed for higher producing cows.
- The concentration of fiber (NDF) is lower in Ration A as the ration contains more energy and protein.

Challenge #2:

Concept illustrated: Diets need to be formulated to reflect the stage in the cow’s lifecycle. Dry cows have lower nutrient needs compared to a lactating cow and rations need to reflect these changing nutritional needs.

Answer: A different ration which is lower in energy and protein density compared to the 2 rations for a lactating herd needs to be formulated for the dry cows. Overfeeding energy, protein, minerals and vitamins results in higher feed costs, environmental impacts (excess nitrogen and P), and negatively impacts the health of dry cows. Dry cows overfed energy have more health issues after calving, lower milk production and reproductive performance the next lactation. All of these factors impact the profitability of the dairy operation.

Challenge #3:

Concept illustrated: Specific feed ingredients are included in diets to provide a higher concentration of certain nutrients. Also, illustrates the amount of feed cattle consume and how dairy farmers purchase certain ingredients (i.e. semi loads).

Answer:

- Soybean meal provides a source of protein and another ingredient higher in protein concentration needs to be used when replacing soybean meal in the diet. The best ingredient source to replace a portion of the soybean meal would be **canola meal**.
- Corn, wheat and oats are used in diets as a means of providing primarily energy.
- Replacing the soybean meal with straw would greatly increase the fiber level and reduce the overall energy of the diet. The straw is less palatable and the cows would not eat as much if straw was used. Also, the cows would be short on protein.
- Amount of soybean meal to purchase in the next 3 months:

	Amount SBM/cow/day	Total Lbs SBM/day
2 pens = 400 cows	2.6	1040 (2.6 * 400)
4 pens = 800 cows	3.75	3000 (3.75 * 800)
Total for herd		4040 lbs or 2.02 tons/day
Amount needed for 3 months		182 tons or 8 semi-truck loads 2.02 tons/day * 90 days = 182 tons (182 tons/25 tons/load = 7.3 loads) If account for 3% feed shrink—182 tons * 1.03 = 187 tons (187 tons/25 tons/load = 7.5 loads)

Challenge #4:

Concept illustrated: Amount of feed consumed by a pen of dairy cattle. Also, one must manage how feed is added to the mixer for optimal cow health and performance.

Answer:

Even though a pen of 200 cows are being fed, they are fed 2 times a day so mixing a batch of feed would mean that only half of the total daily allotment of feed would be included in the mixer at one time.

(Hard challenge – a twin screw mixer wouldn't actually hold the total amount of feed for 200 cows at one time as it would be over capacity.)

Ingredient	Ration A Lbs/cow/day	Total Lbs to add to the TMR Mixer for 1 feeding for 200 cows
Straw	1.0	100
Alfalfa Hay	5.0	500
Soybean meal	3.75	375
Almond hulls	5.0	500
By-product/mineral and vitamin mix	8.8	880
Corn	14.3	1430
Alfalfa haylage	15.0	1500
Corn silage	50.0	5000
<i>Totals</i>	<i>102.85</i>	<i>10,285</i>

The straw and the hay should be added to the TMR mixer first to allow the particle size of these ingredients to be broken down during the mixing process as they have long particles and the cows will sort them more if they are not processed. They are also low inclusion ingredients, so adding them earlier will allow a better chance for them to get mixed in the load. The order of addition of the meal feeds (soybean meal, almond hulls, byproducts/mineral and vitamin mix, and corn) could vary some, though it is generally better to add the feeds with the lower inclusion rates first to give them more a chance to mix. The silages (haylage and corn silage) are typically added last as these forages have shorter particle lengths and too long of mixing time reduces particle size more than is desired.

Challenge #5:

Concept illustrated: Cows and feed need to be managed to allow them to consume large amounts of feed over the entire day.

Answer:

- Pushing up feed is important to make sure cows have access to feed at all times during the day. Cows are not able to reach all of the feed that is typically fed if it is not pushed up towards them multiple times daily. Also, while cows are eating they will often push some feed out of reach, making it inaccessible to them unless it is pushed closer.
- Robotic feed pusher:
 - Advantages:
 - They are able to be programmed to run routinely throughout the day so the feed is always being pushed up, even during the night/early morning hours.
 - They save labor over having a person push up feed.
 - Disadvantages:
 - Robotic feed pushers are costly (>~\$25,000 each) and require ongoing maintenance.
 - Multiple feed pushers may be needed for FFA Dairy as there are separate barns and one may not be able to get to all of the barns.
 - Technology doesn't always work and sometimes the feed pushers don't work like they should.
 - Feed pushers just push feed and are not able to move feed around or know if feed is running low in a pen.

Additional considerations:

- The barn is listed as only being 350 ft long and each pen houses 200 cows. This would result in only 21 inches of bunk space per cow, which is below the minimum recommended amount of 24 inches per cow.
- Pens are overcrowded—reducing lying times especially for fresh cows
 - 350 ft total length of barn- with minimum of 4 cross overs per pen found within each pen and at ends of barn (16 ft each)
 - Leaves 286 ft for freestalls in each row or 71 stalls/row (each freestall 48 in or 4 ft wide)
 - 2 rows per pen or 142 stalls for 200 cows
 - $200 \text{ cows} / 142 \text{ stalls/pens} = \text{stocking density of } 1.41$