



Minnesota Dairy Team

*Educating the dairy industry on
today's and tomorrow's dairy technologies.*

Milk Replacers

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Prepared for 2009 MN Dairy Days

This presentation will center on basic principles, concepts and management practices when feeding milk replacers and research studies conducted on alternative milk replacer products and programs at the Southern Research and Outreach Center (SROC) in Waseca, MN.

Goals For Calf Feeders

- **Health**
- **Growth**
- **Rumen development**



Every individual who is responsible for feeding calves on the farm should have the following goals when raising heifer calves: keeping calves in excellent health, good progress on growth to meet target objectives, and developing the rumen so the calf can make an easy transition in utilizing the feedstuffs in the ration after weaning.

Milk Replacers

Protein –

- Range – 18-30%
- Generally, > 22% are fed at 1.5 lb/head/day or more

Fat --

- Range -- 10-28%
- Most common – 18-22%
- Fat content responsible for most of energy level differences
- Fat sources should be highly digestible.

- Growth is regulated by daily intake of protein and energy. Therefore, different feeding levels will affect performance.

Not all milk replacers are the same. There are many different milk replacers on the market that vary in protein and fat content and which come from different sources. Read and understand the feed tag so you know if a particular milk replacer is appropriate for your feeding program and growth goals. Also, growth is regulated by the amount of protein and energy consumed on a daily basis so different feeding levels will affect performance.

Milk Replacers

Protein Sources

All Milk Protein

- **Most expensive**
- **Acceptable:**
 - o Dried Whey Protein Concentrate
 - o Dried Whey
 - o Dried Whey Product
 - o Skim Milk
 - o Casein
 - o Sodium or Calcium Caseniate

Alternative Protein

Acceptable:

- o Soy Protein Isolate
- o Protein Modified Soy Flour
- o Soy Protein Concentrate
- o Animal Plasma
- o Wheat gluten or isolate

Marginal:

- o Soy Flour

Not acceptable:

- o Meat Solubles
- o Fish Protein Concentrate
- o Wheat Flour

BAMN, 2008

There are many different sources of **protein** that are incorporated into milk replacer products. The all milk protein sources are more expensive. Meat soluble, fish protein concentrate and wheat flour sources are not good protein sources in milk replacer.

Milk Replacer - Economics

Costs

- Price of the bag
- Feeding rate
- Weaning Age
- Calf Starter Intake
- Labor Costs

Performance

- Calf Growth
- Calf Health

When purchasing a milk replacer for your calf feeding program, cost is always a factor, but needs to be weighed against the results of growth and health of the calf.

Tough Questions on Milk Replacers

Questions:

- Do you feed medicated MR or not?
- Do you use additives or not?
- Do you feed lots of milk or not?
- Do you feed a traditional MR program or use an Accelerated program?

Some of the decisions that need to be made when purchasing milk replacer is whether or not you want to use a medicated product, use additives, feed limited or lots of milk and follow a traditional program or an accelerated milk replacer program.

Tough Questions on Milk Replacer

- Is saving money on milk replacer worth losing pounds of growth?
- Is it worth saving money on milk replacer program and then having to treat more calves for scours?
- Is the priority cost or performance?

Adapted from Hayes, SROC workshop, 2007

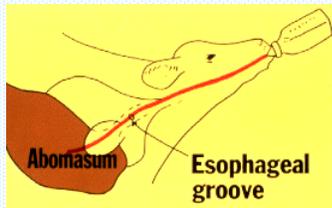
When purchasing a milk replacer it can become an issue of cost vs. expected performance of the calf. Is a cheap or cheaper milk replacer worth the risk of a less growth rate or poorer health and performance?

Milk and the Calf Stomach

- Milk stimulates closure of esophageal groove.
 - Allows milk to bypass rumen



- Fresh water goes to the rumen



This slide shows the location of the esophageal groove in the calf. Milk will stimulate closure of the esophageal groove to allow milk to bypass the rumen. Whereas, fresh water goes directly to the rumen. It is important for the milk to get directly to the abomasum since the rumen of the calf has not been developed yet.

Starter and the Calf Stomach

- Starter grain is fermented in the rumen to create volatile fatty acids (VFA's)
 - VFA production = rumen growth
 - VFA's = Energy
 - VFA's Need Water and Starter



Note the healthy rumen of a 4 week old calf fed milk and calf feed

Adding calf starter to the diet of the young calf provides the opportunity for rumen development and growth. The grain is fermented in the tiny rumen which produces volatile fatty acids, which leads to rumen growth, which leads to a need for water and starter grain, which leads to more rumen development.

The Ration Helps Determine Rumen Status



8 week old calf fed milk and starter



12 week old calf fed milk and hay

The type of ration fed to a young calf will determine the development of the rumen. Note the slide showing an 8 week old calf fed milk and starter vs a 12 week old calf fed milk and hay. The 8 week old calf has far greater rumen development because of consuming grain along with the milk.

Concepts to Remember

- Calves less than 3 weeks of age get a majority of their nutrients from milk.
- More energy from liquid milk leads to reduced calf starter intake.
- Early calf starter intake leads to earlier rumen development which can lead to earlier weaning.

Here are some concepts to remember when deciding on your milk replacer program:

Weaning Guidelines

- Eating Calf Starter for at least 3 weeks
- Eating at least 2 # starter for 3 days in a row

Remember...

free choice water increases calf starter intake

The question often arises as to when should calves be weaned. The answer to that question is based on these guidelines: a calf should have been eating starter for a least 3 weeks and the calf should be eating at least 2 lbs for 3 days in a row. Remember, water needs to be available to help the calf increase its calf starter intake.

SROC Research study profiles 2004 thru 2008:

Nursery Studies

- 17 studies, 15 completed, 1700 calves
- 56 day studies mostly using individual pens from 2-4 days to 58-60 days of age

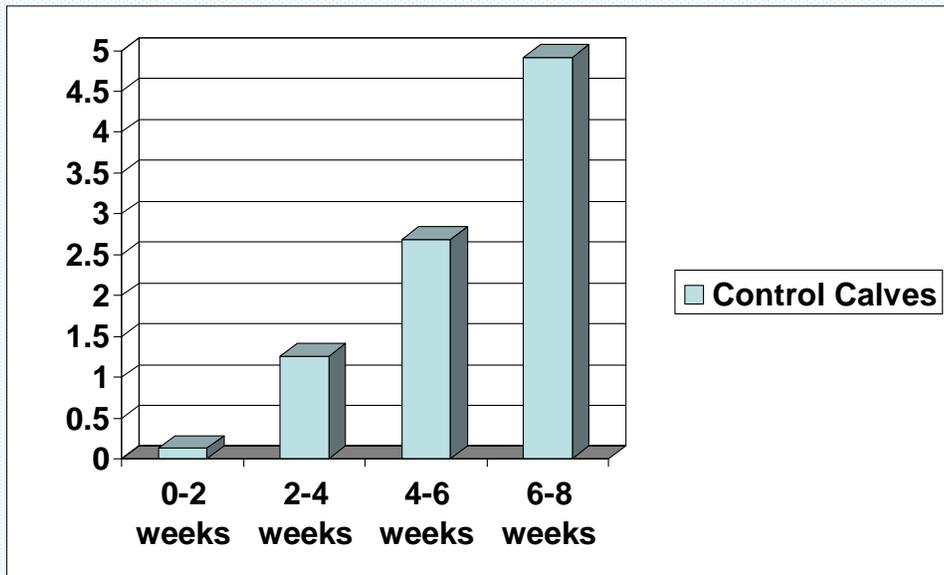
The following slides show results of nursery studies conducted on dairy calves brought to the Southern Research and Outreach Center in Waseca from three commercial dairies in southern Minnesota. Research started in April, 2004 when two new nursery calf barns and one new grower barn were opened to house calves for research purposes at SROC. Calves are picked up from the dairies and brought to SROC every Monday and Thursday. Up through 2008, 17 nursery studies were started with 15 of them completed involving 1700 calves. These nursery studies run for 56 days mostly using individual pens.

SROC Control Calves

- Arrival at SROC – about 24-72 hours old
- Incoming weight: 89 #
- Average Serum Protein: 5.28
- Milk Replacer:
 - 20 / 20 All Milk
 - Neo / Terra at 200 / 400
- Calf Starter - texturized:
 - 18% protein with Rumensin
- 56 Day Totals: 176 # calf (ADG = 1.55)
- Mortality ~ 2% (Arrival to 6 months)

These 1700 dairy calves on nursery studies from 2004 thru 2008 had an initial average weight of 89 lbs. Serum protein analysis is done on every calf that comes to SROC. These calves averaged 5.28 g/L IgG. All calves that are put into a control group for the research trials are feed a 20% protein, 20% fat milk replacer. They are given a texturized 18% protein calf starter that includes Rumensin. The average daily gain on the 1700 calves was 1.55 lbs/day. Death rate at SROC is around 2% calculated from date of arrival to 6 months of age.

Calf Starter Intake



This slide shows the calf starter intake by weeks of age for the calves used in the control groups during research studies. Calves are weaned at 6 weeks of age. They are moved to a grower barn at 8 weeks of age, with a very reasonable consumption level of calf starter that helps them make a good transition.

SROC Research studies

Nursery growth goals and standard feeding program

- Starts with a strong healthy calf
- **Goal = double arrival BW and increasing HH by 4 inches after 56 days.**
- Standard control program –
 - 20:20 medicated all-milk protein milk replacer fed at 1.25 lb/day for 35 days
 - 0.625 lb/day from day 36 to weaning at 42 days (12.5% solids).
- A texturized 18% calf starter is offered free choice plus fresh water

A reasonable goal for any calf raiser is to double the body weight at birth and increase the hip height by four inches by 56 days of age. It all starts with a strong healthy calf. At SROC the control group is fed 1.25 lbs/day of 20:20 medicated all-milk protein milk replacer for 35 days, then the amount fed is reduced to 0.625 lbs/day from day 36 to weaning at 42 days of age. A texturized 18% calf starter is offered free choice along with fresh water.

Focus of Calf Studies 2004-2008

Milk Replacer (MR) programs:

- Varying protein (wheat gluten, soybean concentrate, bovine animal plasma) and energy (fats) MR sources and levels.
- Intensive, modified intensive, vs conventional MR programs.
- Medicated vs non-medicated MR compared with/without supplements to impact intestinal health
- Strategies for 1x vs. 2x daily MR feeding

Various milk replacer programs were studied at SROC over the 5 year period of 2004-2008. Different protein sources were used. Comparisons were made between intensive, modified intensive and conventional milk replacer programs, between medicated and non-medicated milk replacers with and without supplements, and between feeding once per day or twice daily.

Typical or Tradition Calf Feeding Recommendations

Milk Replacers

- 20 or 22% protein
- 15 to 20% fat
- Feed 1 to 1.25# powder/calf/day
- For a 100 lb calf
 - 8-10 oz in 2 qts water 2x/day
 - Free choice calf starter
 - Free choice water

GOAL – Maximize Starter, Minimize milk

Hayes, DCHA 2008

With a typical or traditional milk replacer program the goal is to maximize starter and minimize milk intake.

Accelerated Growth Programs

Milk Replacer formulas

- 26-30% protein
- 15-20% fat

Feeding levels

- 2-3% of BW fed/day
- Feeding levels vary with age of calf
- Powder intake of 2-3#/calf/day

Goal – Maximize milk, minimize starter

Hayes, DCHA 2008

With an accelerated program where a higher protein percent formula is being fed, the goal is the maximize milk intake and minimize starter intake.

Accelerated Growth Calf Trial

Feed	20-20	28-16 (1.5)	28-16 (2.25)
Day 1-35	1.25 # /calf	1.50 # /calf	2.25 # /calf
Day 36-42	0.625# /calf	0.75# /calf	2.25# /calf
Day 43-49	0.0 # /calf	0.0 # /calf	1.125 # /calf
Day 50-56	0.0 # /calf	0.0 # /calf	0.0 # /calf
Starter	18% FC	22% FC	22% FC
Water	Yes	Yes	Yes

These are the feeding rates for an accelerated growth trial conducted at SROC using a standard 20:20 milk replacer, and a 28:16 milk replacer fed at two different rates. The calf starter offered was 18% protein with the 20:20 milk replacer and was 22% protein with the two 28:18 milk replacer treatments.

Accelerated Growth Calf Trial

Feed	20-20	28-16 (1.5)	28-16 (2.25)
Milk Replacer	49.2 #	59.3 #	97.8 #
Starter	123.6 #	127.1#	88.3#
Total Feed	172.8 #	186.4 #	186.1 #
Total Gain	80.54 #	90.35 #	99.75 #
A.D.G.	1.43#	1.61#	1.78#
Ave G:F (DM)	0.51	0.53	0.58

Results of the accelerated growth study show a higher average daily gain and grain to feed ratio with the higher feeding rate (2.25#/day) followed by the lower rate (1.5 #/day) using the 28:16 milk replacer program as compared to the traditional 20:20 program.

Accelerated Growth Calf Trial

56 Day Cost Overview

Feed	20-20	28-16 (1.5)	28-16 (2.25)
Milk Replacer	\$63.96	\$92.51	\$152.57
Starter	\$25.96	\$27.96	\$19.43
Total Feed Cost	\$89.92	\$120.47	\$172.00
Total Gain	80.54#	90.35#	99.75#
Cost / # / Gain	\$1.12/ #	\$1.33/ #	\$1.72/ #

Over the 56 day study, although there is an increased average daily gain with the 28:16 accelerated program, it also costs more per lb of gain.

1st Lactation Production

(adapted from Ziegler, 2008)

	Treatments				
	Control- Combined	IHS	ILS	IHSHF	SEM
Number	39	18	21	22	
Age at Calving, d	743.3	731.1	737.5	717.0 ^a	10.4
305SME Milk, lbs (Standardized Mature Equivalent)	28,386	28,870	28,091	30,096 ^b	835
Fat, %	3.60	3.60	3.70	3.60	0.10
Protein, %	3.0	3.1	3.0	3.0	0.03
Log SCC	4.8	4.8	4.7	4.7	0.20

Control = (20% CP, 20% fat), (13.9% DM)

IHS = (28%CP, 16% fat) high solids (16.7% DM)

ILS = (28%CP, 16% fat) low solids (12.5% DM)

IHSHF = (28%CP, 16% fat) high solids, high feeding rate (16.7% DM).

Calves in this study were followed through their first lactation to look at data from DHI records to compare age at first freshening, final mature equivalents, fat and protein percentage, and somatic cell counts.

Accelerated Growth Calf Trial

Results:

- Increased BW and HH during the pre-weaning, early post-weaning period and at 112-d post-weaning grower period
- Calves were heavier d 56 of the pre-weaning and early post-weaning period however this growth advantage was not maintained in the post-weaning heifer grower period.
- Feed cost/lb gain during pre-weaning and early post-weaning was lowest for conventional MR (20% CP, 20% fat) nonacidified (13.9% DM); conventional MR acidified (13.9% DM); intermediate for intensive MR (28%CP, 16% fat) high solids (16.7% DM) and Intensive MR (28%CP, 16% fat) low solids (12.5% DM); and highest for the intensive MR high solids, high feeding rate (16.7% DM)
- No difference in feed cost/lb of gain during the post-weaning grower period.

Mary Raeth-Knight

This slide and the next show the results of the accelerated growth study at SROC:

Accelerated Growth Calf Trial

Results (continued):

- 1st lactation performance was not statistically different across treatments.
- However, there was a tendency for increased 305 SME and decreased age at first calving for heifers that received the intensive MR high solids, high feeding rate (16.7% DM) MR pre-weaning as compared to a conventional MR.
- There was also a tendency for increased 305 SME for the intensive MR high solids, high feeding rate (16.7% DM) treatment as compared to the modified intensive MR treatments.
- All treatments resulted in healthy calves, acceptable growth rates, age to first calving and lactation performance.

Mary Raeth-Knight

Continuing the results of the accelerated growth study:

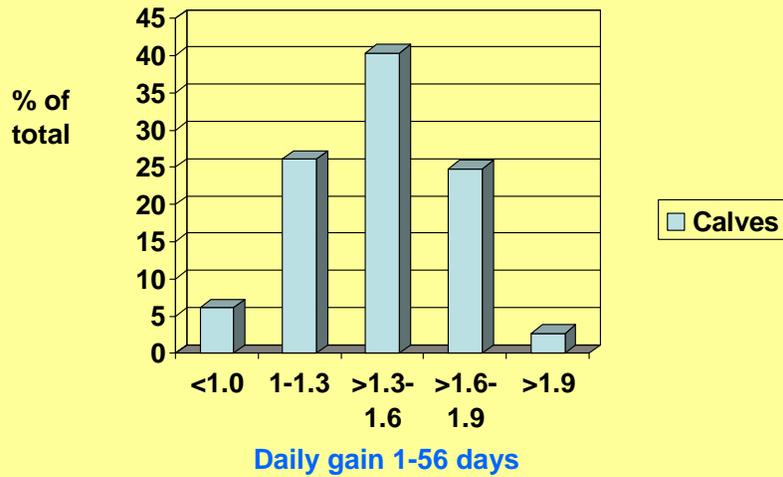
Accelerated Growth Programs

- Decide on your operation's goals
- Focus on your goals
- Evaluate your options
 - Cover the basics
 - Alternative proteins
 - Amount fed/calf/day
 - Weaning age
 - Phase feeding options
- Monitor performance and focus on goals

Determining whether or not you want to raise calves using an accelerated milk replacer program depends on a number of factors including goals for your operation and what options you have available. Focus on your goals, evaluate your options and monitor the performance of the calves.

Medicated 20:20 MR

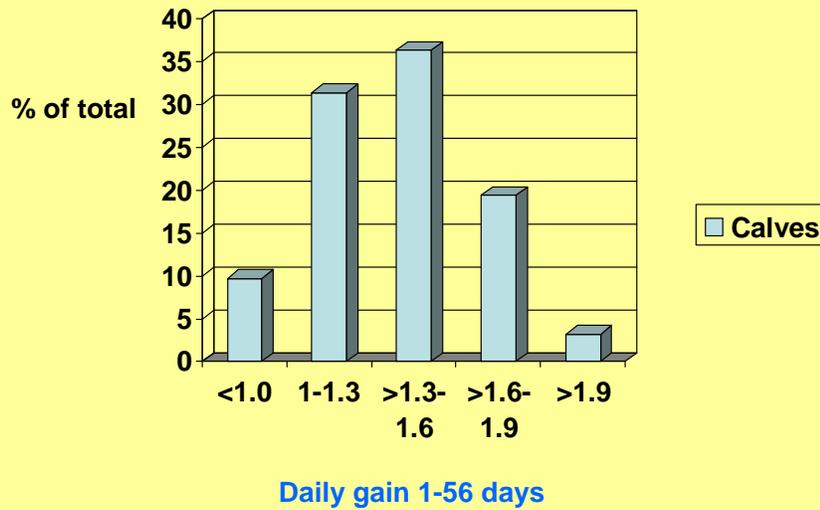
Distribution of gain 1-56 days across 10 studies
1087 nursery calves



This graph shows the percent of calves and average daily gains of 10 studies on 1087 nursery calves using a medicated 20:20 milk replacer from day 1 thru day 56. A total of 40% of the calves had daily gains from 1.3 to 1.6 lbs/day.

Non-Medicated 20:20 MR

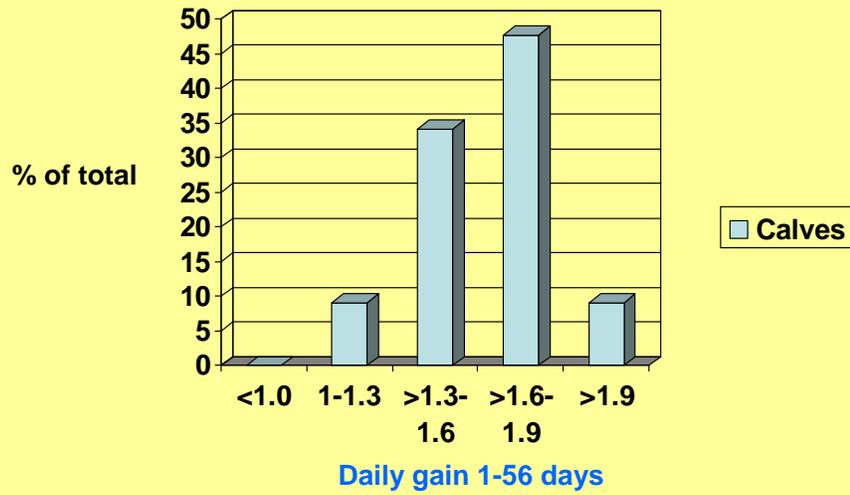
Distribution of gain 1-56 days fed to 124 calves



This graph shows the percent of calves and average daily gains on 124 nursery calves using a non-medicated 20:20 milk replacer from day 1 thru day 56. About 36% of the calves had daily gains from 1.3 to 1.6 lbs/day. Note there was a greater percentage of calves that had less daily gains than in the previous slide where medicated milk replacer was used. And, there were less calves that had higher rates of gain with non-medicated milk replacer.

Medicated 20:20 MR

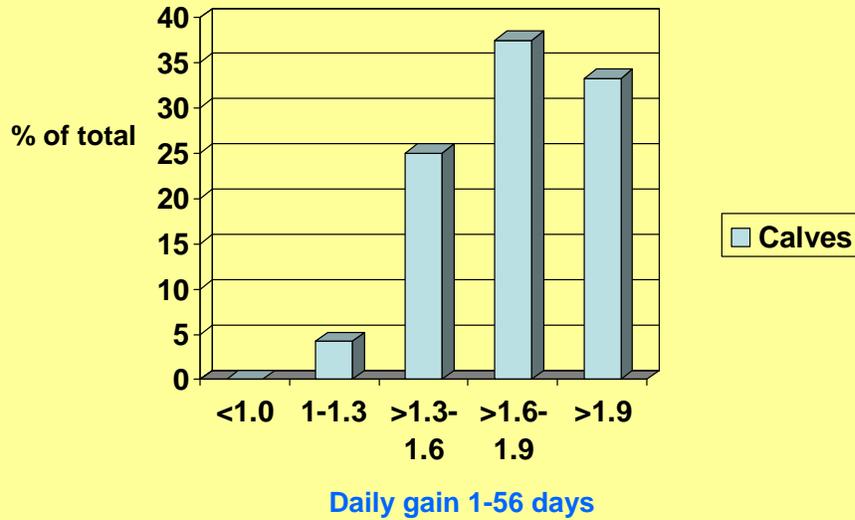
Distribution of gain 1-56 days for 44 calves fed at 1.50 lb



Results of a medicated 20:20 milk replacer fed to 44 calves at a rate of 1.5 lb/day show a higher percentage of calves had a rate of gain between 1.6-1.9 lb/day.

Medicated 28:16 MR (49 d)

Distribution of gain 1-56 days for 24 calves fed at 2.25 lb



Results of a medicated 28:16 milk replacer fed to 24 calves at a rate of 2.25 lb/day show 1/3 of the calves had rates of gain of 1.9 lb/day or more, and about 37% had a rate of gain between 1.6-1.9 lb/day.

Animal Plasma

An alternate protein used in MR

- Summary of 5 studies done at SROC and other universities
- Two reasons used:
 - A nutritional protein source
 - Offers functional proteins (compounds such as immunoglobulins, growth factors, other peptides)

Results:

- These studies showed that MR containing plasma performed statistically equal to an all milk diet.
- Animal plasmas can successfully replace milk protein
- Mix well, stay in solution and are palatable
- Do not expose the plasma proteins to > 150F
- **Has been rated as an acceptable alternate protein by BAMN, 2008**

Adapted from Hayes, APC

There has been interest in using animal plasma as an alternate protein source in milk replacer. A summary of 5 studies done at SROC and other universities show animal plasmas can successfully replace milk protein.

Economics of Feeding Milk Replacer -- Other Considerations

- Quality of Supplier
 - Consistent Product
 - Good Mixing
 - Palatable
- Additives and Medications
 - Neo/ Terra // Deccox // Bovatec
 - Mos
 - Fos
 - Botanicals
- Supplier Support

There are other factors that need to be considered when choosing a milk replacer program including the quality and support of the supplier, and what additives and medications are needed for your calf raising operation.

Basic Principles - Be Consistent

- Feed calves at the same time every day
- Mixing milk replacer
 - Time
 - Temperature
 - Concentration (oz powder + oz water)
- Feeding milk replacer
 - Temperature
 - Quantity
- Cleaning equipment

Vermeire, Nouriche Nutrition Ltd.

It is important to be consistent when feeding calves. Not only when they are fed, but the consistency of the product being fed, time after time, day after day.

Clean with Standard Protocol

- Rinse – warm water (110-120° F)
- Wash – hot (165° F) with chlorinated alkaline soap
- Rinse – warm water (70° F) acid sanitizing solution
- Dry – bacteria don't like dry conditions

Vermeire, Nouriche Nutrition Ltd.

Cleaning and sanitizing calf feeding equipment is important to keep calves healthy. There should be a standard protocol used and understood by everyone feeding the calves, so it's the same process and procedure every time.

Summary:

1. Know Your Economics and Goals
2. Evaluate Alternative Proteins
3. ↑Protein Levels = ↑lean tissue = ↑Cost
4. Discuss Fat and Level with Supplier
5. ↑Milk = ↑Growth = ↓Starter Intake
6. Delayed Weaning Increases Costs
7. Look at Earlier Weaning or 1X/day Milk
 - Usually will lower labor costs
8. If It's Not Broke, Don't Fix It

Hayes, DCHA 2008

In summary, when choosing and feeding a milk replacer program, assess the points mentioned on this slide.