

Calf Milk Replacer Guide



Developed by
Rob Costello, Technical Specialist



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Why Feed Milk Replacer?

Most dairy calves in the United States are fed milk replacer during their liquid feeding period. Economics, convenience and biosecurity are among the major factors that make milk replacer feeding desirable to dairy calf growers.

Economics. It is typically cheaper to feed milk replacer to dairy calves than it is to feed saleable whole milk. Milk replacers are made from byproducts of the milk manufacturing industry. Whey, the major protein source for milk replacers, is a byproduct of cheese manufacturing and is usually much cheaper than other milk protein sources such as casein and skim milk. The use of high quality, lower cost ingredients makes milk replacer a more economic choice than whole milk.

Directions: Enter the required values in boxes a and c. Carry out the calculations and enter the results in boxes b and d.

Example: You receive \$16.50 per hundredweight (cwt) of milk and pay \$63.00 for a 50 lb bag of milk replacer. Your savings is \$3.00 per 50 lb bag of milk replacer used.

Potential Savings When Feeding Milk Replacer Instead Of Whole Milk		
Price you receive for 100 lb of whole milk (\$/cwt)		a
	Times	4
Value of 400 lb of whole milk (50 lb solids ¹)	Equals	b
Cost of 50 lb of milk replacer	Minus	c
	Savings	Equals
		d
<small>Source: BAMN 1998 ¹ Whole milk is approximately 12.5% solids: 400 lb x 12.5% = 50 lb solids. Therefore 50 lb of calf milk replacer will replace 400 lb of whole milk. This is the average amount of milk required to feed a calf from birth to weaning</small>		

Convenience. Milk replacers offer a variety of choices when it comes to ingredients and nutrient levels. This provides flexibility that makes it easier for a variety of farms to meet their management needs. Additives such as vitamins and medications (antibiotics, coccidiostats and ionophores) can easily be supplied through milk replacer. Adding them by hand can be a challenge in whole milk feeding systems. In addition, protein and fat levels in milk replacers can be selected to enhance calf growth objectives and to respond to climatic conditions.

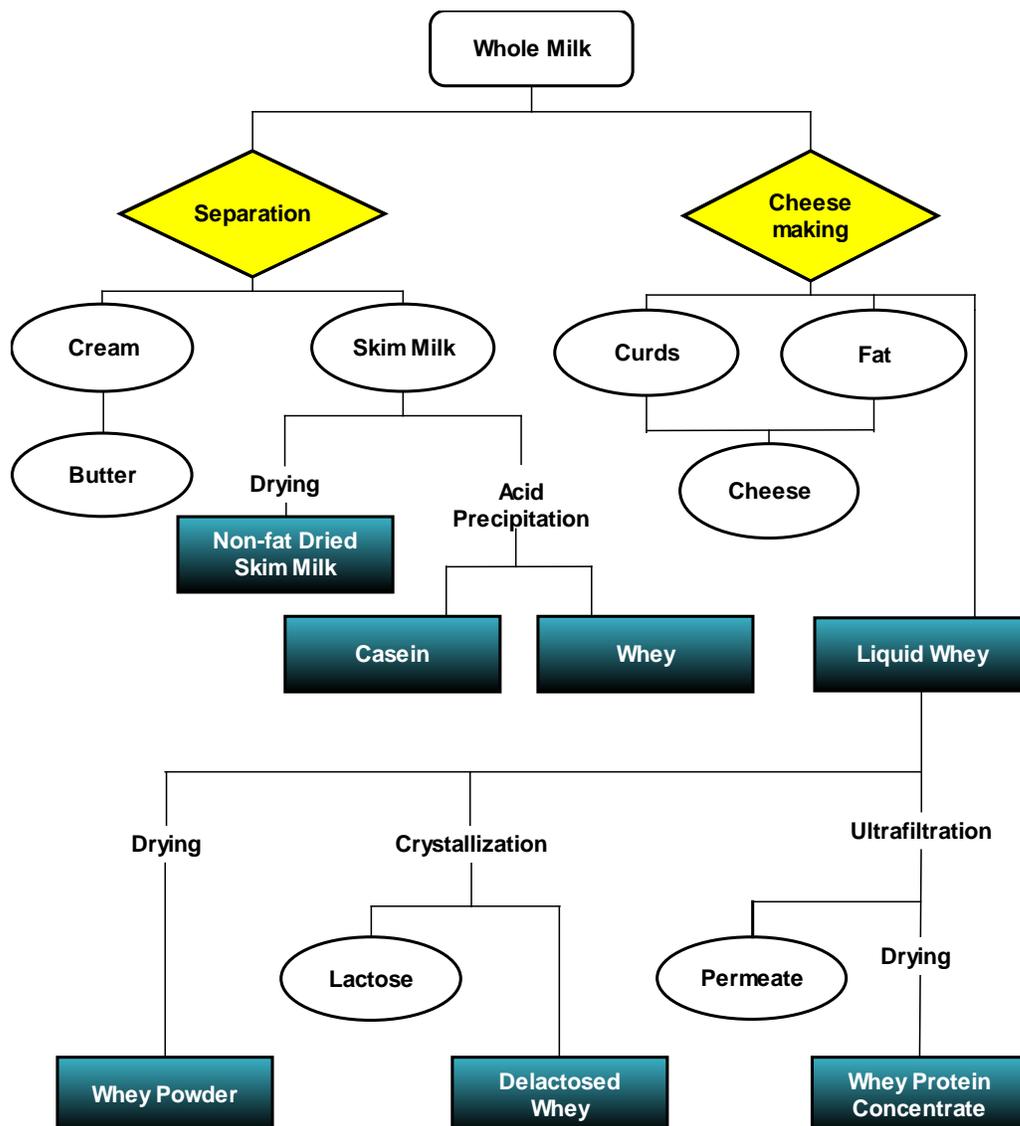
Biosecurity. Calves are especially vulnerable to disease. Diseases such as Johne's, Bovine Viral Diarrhea, Bovine Leukosis Virus, pasteurilla, salmonella, E. coli and mycoplasma can be transmitted from cow to calf through unpasteurized milk. Biosecurity and disease prevention issues contribute greatly to the popularity and use of milk replacers. Merrick's not only purchases pasteurized milk ingredients for making milk replacers, but we also include pasteurization as a key step in our manufacturing process.

Milk Replacer Ingredients

Protein

The general recommendation for milk replacer protein level is 20 to 27 percent. The most common levels used by calf raisers are 20 to 22 percent. Higher protein levels are usually reserved for intensive milk replacer feeding programs designed to increase calf growth rate. With these programs, the increase in protein percentage coincides with an increase in milk replacer feeding rate and a decrease in milk replacer fat percentage.

Milk Proteins are typically more highly digestible than non-milk proteins and provide a desirable amino acid profile for calf growth. Many different milk products are used in manufacturing milk replacers. These include whey, whey protein concentrate, delactosed whey, skim milk, and casein. Whey products are currently utilized as principal protein sources in milk replacers. Protein sources are typically the most expensive milk replacer ingredients.



Whey and Skim Milk Proteins – In the early days of calf milk replacers, skim milk was the primary protein source. Alternative uses of skim milk resulted in decreased availability of the ingredient for milk replacer manufacturing and increased the price of skim milk relative to whey proteins. As a result, whey proteins became the primary protein sources for milk replacers. Today, whey proteins remain the major protein source for calf milk replacers.

Research into the nutritional value of whey and skim milk proteins and their impact on calf growth demonstrates that whey proteins are equal to skim milk. It can even be argued that whey proteins are superior to skim milk:

1. Whey and whey protein concentrate contain lactalbumin protein while skim milk contains a combination of casein-lactalbumin protein. Studies comparing the Protein Efficiency Ratio (PER)¹ of milk proteins show whey proteins to be a superior form of digestible protein.

<u>Protein Efficiency Ratio (PER) Of Milk By-products*</u>	
Whey	3.0
Whey Protein Concentrate	3.0
Lactalbumin	2.8
Skim Milk	2.8
Casein	2.8

*Based on published studies by the New Zealand Dairy Board, 1984

¹ Protein Efficiency Ratio (PER) is the gain in weight of growing animals per gram of protein eaten

2. Researchers at the Pennsylvania State University (Terosky et al, 1997²) looked at four dietary ratios of dried skim milk and whey protein concentrate as primary protein sources in calf milk replacers. The four test diets were expressed as ratios of dried skim milk to whey protein concentrate, 100:0, 67:33, 33:67 and 0:100.

Although no significant differences were noted in health or growth parameters, the researchers did find that the apparent biological value (BV³) and N retention differed among diets over all weeks. Apparent digestibility and apparent biological value of the all skim milk diet were 82.50 and 67.71 respectively. These values were surpassed by the all whey protein concentrate diet, where the apparent digestibility and apparent BV were 84.03 and 72.25, respectively.

² 1997 J Dairy Sci. 80:2977–2983

³ Biological Value (BV): is the proportion of absorbed protein retained in the body

Egg Proteins have been incorporated into commercial milk replacers for several years with excellent results. Egg proteins are often referred to as the perfect protein and have been used as the standard for evaluating proteins. Their amino acid content and digestibility are the reference against which all other proteins are compared. Egg proteins are also less expensive than milk proteins, thereby reducing the cost of milk replacer.

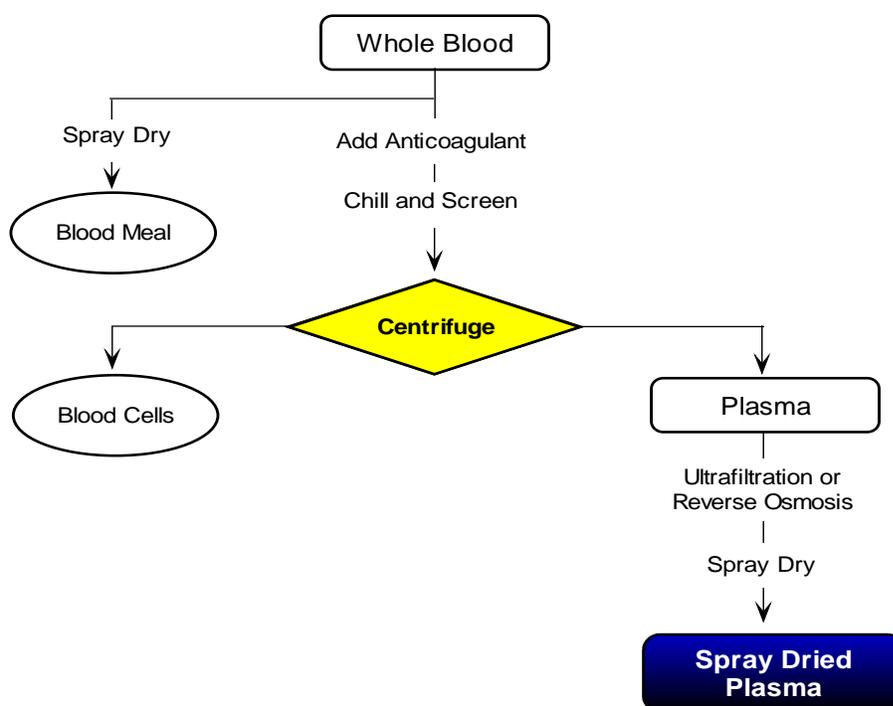
Eggs can also be utilized as a source of energy (eggs are 37% fat), iron, phosphorous, trace minerals and vitamins. They are an important source of lecithin (about 8-9% lecithin in egg yolk). Lecithin acts as a natural antioxidant as well as a skin and hair conditioner, and is a source of choline which is associated with positive hair coat characteristics.

Merrick’s unique manufacturing process begins with liquid whole eggs and is fundamental in obtaining the excellent calf performance results achieved with our egg enriched milk replacers. Liquid eggs are thoroughly mixed with our other liquid ingredients. This mixture is pasteurized and then spray dried to make the milk replacer powder. Alternative processes that rely on mixing dried egg components in a dry blending process often result in reduced calf performance.

Feeding eggs to calves is not a new concept. It wasn’t long ago that parents or grandparents cracked an egg into a calf’s milk to give it something extra to help it to a better start or help it through a case of calf scours. Obviously, egg is not just a home remedy.

Animal Plasma Proteins provide a unique protein source that contains active albumin and globulin proteins such as IgG and IgM. This highly soluble, high quality protein source has an amino acid profile and nutritive value comparable to nonfat dried (skim) milk and casein. In the digestive tract, IgG has a direct effect on pathogens and may also have a direct effect on the intestinal lining, or mucosa.

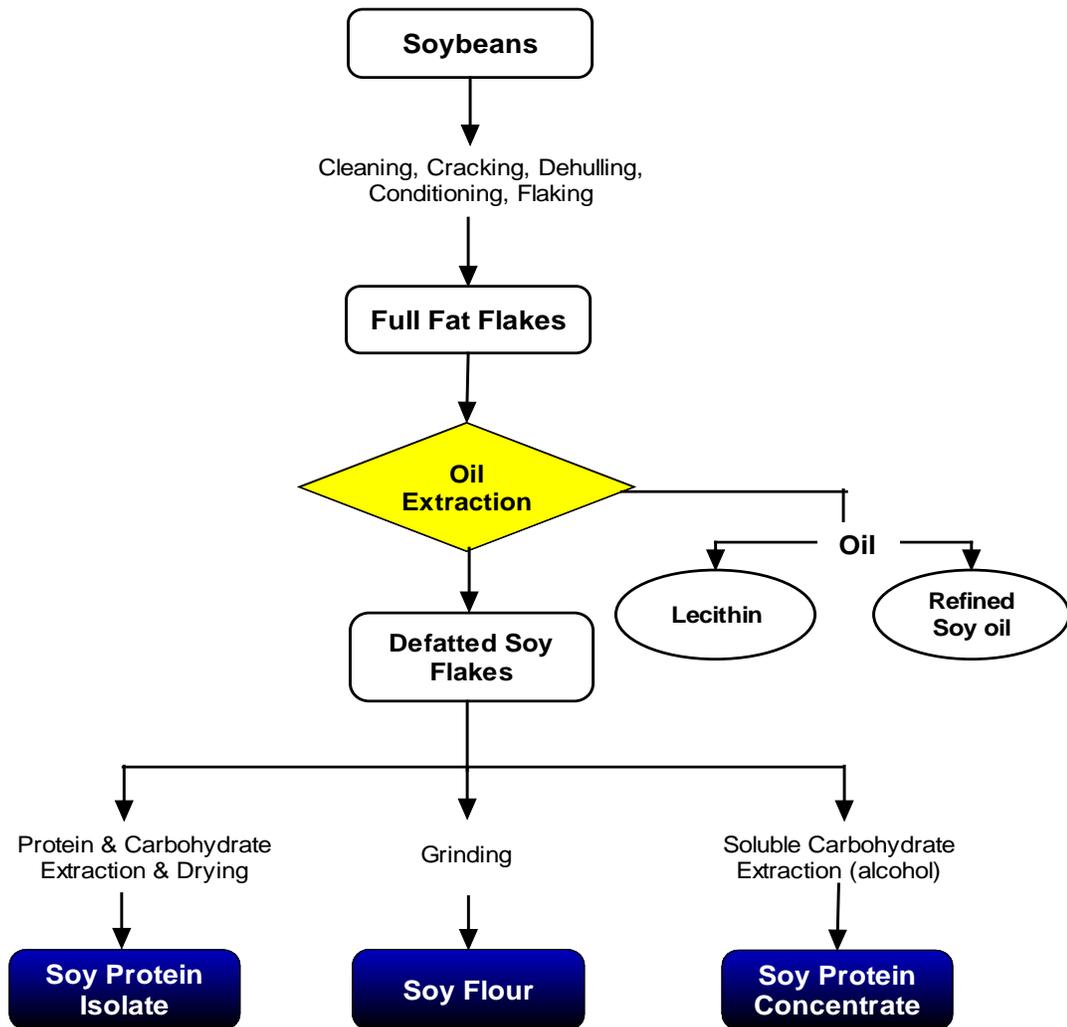
Animal plasma is obtained by centrifuging whole blood into its major components, plasma and blood cells. The two main types of animal plasma are bovine (ruminant) and porcine (swine). Animal plasma of porcine origin is exclusively used in Merrick’s calf products.



Wheat Protein Isolate is the wheat ingredient used in Merrick’s wheat protein milk replacers, providing a high quality, economical protein source. Wheat protein isolate is manufactured from wheat flour by separating the gluten protein from wheat starch. This protein is then enzymatically hydrolyzed and transformed to small proteins and peptides before drying.

Wheat protein isolate is ideally suited for incorporation into calf milk replacers. It is low in fiber and ash and contains a much higher percentage of protein compared to whey protein concentrate (80% protein vs. 34% protein). Digestibility of wheat protein isolate dry matter, organic matter and crude protein is very high and is estimated to be 95%. It is also free from anti-nutritional factors such as those common to soy proteins that are known to reduce animal performance.

Soy Proteins can provide an economic alternative to milk proteins. The popularity of soy proteins stems from their widespread availability, relatively low cost and generally favorable amino acid profile. These vegetable proteins can be substituted for a portion of the milk proteins in milk replacers, providing acceptable calf growth and performance. Soy proteins should be avoided when raising calves on an intensive milk replacer feeding program.



Energy

Fats and oils provide a concentrated energy source for animal feeds. Fat levels in milk replacers typically range from 10 to 24 percent with 15 to 20 percent being the most common. Higher fat milk replacers are often selected for cold climates while low fat formulas are more often used in hot climates and in formulations designed for intensive milk replacer feeding programs.

Lard and choice white grease are of swine origin and are the animal fats used in Merrick's milk replacers. Excellent performing milk replacers can be made using vegetable oils exclusively such as soy, palm and coconut oil. However, they are substantially more expensive to use than animal fats.

Comparison Of Fat Source Digestibilities In Calves	
Fat Source	Digestibility %
Milk Fat (in whole milk)	95 - 97
Lard, Choice White Grease	88 - 96
Coconut Oil	92 - 96
Palm Oil	92 - 96

Source: adapted from Davis and Drackley, 1998

Carbohydrates also supply energy in milk replacers. **Lactose** is a carbohydrate and is the other major energy source in milk replacers. Lactose is a natural component of whey and whey protein concentrate and has about ½ the energy value of fat. A typical milk replacer formulation contains about 40-45% lactose. Since fat is typically 15-20% of the formula, lactose is obviously a major energy source in milk replacers. However, due to the reduced ability of young lambs to digest lactose, Merrick's Super Lamb milk replacer contains no more than 25% lactose.

Lactase is the primary enzyme produced by the young calf for digesting carbohydrates (lactose). Enzymes such as amylase and maltase for digesting starches are low at birth, but do increase in number and activity as the calf grows. Therefore, lactose, glucose and galactose are the only carbohydrates usable in large amounts by young calves.

Carbohydrates In Milk Replacers For Young Calves	
Acceptable:	Lactose, Dextrose (Glucose), Galactose
Unacceptable:	Starch, Sucrose (table sugar)

Medications

Several medications are available for inclusion in milk replacer. The decision to use a medicated milk replacer can be based on a number of factors including calf facilities, disease history and personal preference. The appropriate medication to use depends on the pathogen(s) affecting calves. The three most common milk replacer medications are described below.

Protozoa: coccidia. Coccidia are very small parasites that invade the lining the intestines. The organism is passed from animal to animal via feces and is spread through contaminated feed, water and equipment. Coccidia damage the cells of the intestinal lining. Severe coccidiosis results in bloody diarrhea, weight loss, dehydration and death.

Deccox (Decoquinat) - a coccidiostat that stops the growth of coccidia, but does not kill coccidia

- inhibits activity of the cells' mitochondria (the powerhouse of the cell)
- acts at 5 developmental stages of coccidia, providing the widest range of all the anticoccidial agents

Bovatec (Lasalocid) – a coccidiocide that kills coccidia

- an ionophore that moves potassium, sodium, calcium and magnesium into the cell causing the cell to burst
- works primarily on one developmental stage

Bacteria: *E. coli*, *Clostridia*, *Salmonella*, *Giardia*

Oxytetracycline/Neomycin Sulfate – a broad-spectrum antibiotic combination

- not effective against viruses or protozoa, but can prevent bacterial infections that occur in combination with viruses and protozoa
- broad spectrum antibiotics are effective against a variety of gram negative and gram positive organisms
 - advantage: high likelihood of efficacy against an unidentified pathogen
 - disadvantage: high likelihood of destroying beneficial bacteria in the digestive tract

Calf Milk Replacer Medications

Medication	Use Level	Statement
Decoquinat (Deccox)	45.4 g/ton (to provide 22.7 g decoquinat per 100 lbs body weight daily)	For the prevention of coccidiosis in ruminating and nonruminating calves and cattle caused by <i>Emeria bovis</i> and <i>E. zurnii</i> . Feed for at least 28 days during periods of coccidiosis exposure or when experience indicates that coccidiosis is likely to be a hazard. Coccidiostats are not indicated for use in adult animals due to continuous previous exposure.
Lasalocid (Bovatec)	90 g/ton (to provide 1 mg lasalocid per 2.2 pounds of body weight daily)	For control of coccidiosis caused by <i>E. bovis</i> and <i>E. zurnii</i> .
Oxytetracycline	To provide 0.05 to 0.1 mg/lb of body weight daily	For increased rate of weight gain and feed efficiency
Oxytetracycline/Neomycin Sulfate	(i) To provide 0.05 to 0.1 mg/lb of body weight daily	Calves (up to 250 lbs): For increased rate of weight gain and feed efficiency.
	(ii) To provide 10 mg/lb ^a of body weight daily	1. Calves and beef and nonlactating dairy cattle: For treatment of bacterial enteritis caused by <i>E. coli</i> and bacterial pneumonia (shipping fever complex) caused by <i>P. multocida</i> susceptible to Oxytetracycline; treatment and control of colibacillosis (bacterial enteritis) caused by <i>E. coli</i> susceptible to Neomycin. 2. Calves (up to 250 lbs): For treatment of bacterial enteritis caused by <i>E. coli</i> susceptible to Oxytetracycline; treatment and control of colibacillosis (bacterial enteritis) caused by <i>E. coli</i> susceptible to Neomycin.

^a Withdraw 5 days before slaughter

Oxytetracycline and Neomycin Sulfate

This 1:1 antibiotic combination provides equal amounts of Oxytetracycline and Neomycin Sulfate and delivers broad spectrum antibacterial activity. Two levels of Oxytetracycline/Neomycin Sulfate (Neo/Oxy) are allowed in milk replacers.

Sub therapeutic. This low inclusion level, 0.05 to 0.1 mg/lb of body weight daily, is a sub therapeutic dose, far below the level required to prevent or treat disease. Milk replacers providing this level of Neo/Oxy can be fed to calves up to 250 lb for increased rate of weight gain and improved feed efficiency, and can be fed on a continuous basis. The sub therapeutic level does not carry a withdrawal before slaughter warning.

Treatment. The high level, 10 mg/lb of body weight daily, is for the treatment of disease and is limited to a feeding schedule of 7-14 days. This limitation is stated in the milk replacer feeding instructions. Milk replacers containing this level of Neo/Oxy are used to treat bacterial enteritis in the digestive as well as respiratory disease associated with shipping fever complex. Neomycin sulfate and Oxytetracycline are both effective within the digestive tract against various scours-causing bacteria. Although Neomycin sulfate remains within the digestive tract, Oxytetracycline also moves into the bloodstream where it delivers its effect against pneumonia-causing organisms. The treatment level carries a *5 day withdrawal period before slaughter* warning.

The amounts of Neomycin Sulfate and Oxytetracycline in a milk replacer are listed on the milk replacer tag as *grams per ton*. This inclusion level may be different for different milk replacers. This is because the feeding rate of the milk replacer determines the Neo/Oxy inclusion level. To meet the 10 mg/lb of body weight requirement, a milk replacer that is fed at 1.50 lbs of powder per day will have a lower inclusion level of Neo/Oxy than a milk replacer being fed at 1.0 lb per day.

A milk replacer with a standard feeding rate of 1.0 lb of powder per day will contain 2000 g/ton of Oxytetracycline and 2000 g/ton of Neomycin Sulfate. A milk replacer fed at 1.25 lbs per day will contain 1600 g/ton of Oxytetracycline and 1600 g/ton of Neomycin Sulfate. A milk replacer designed to be fed at a rate of 1.5 lbs per day, such as Super Star, will contain 1333 g/ton each of Oxytetracycline and Neomycin Sulfate.

Oxytetracycline and Neomycin Sulfate Inclusion levels¹

Milk Replacer Feeding Rate (daily)	Grams Neo/Oxy per Ton of Milk Replacer	Grams Neo/Oxy per Pound of Milk Replacer	Daily Amount of Neo/Oxy Consumed By Calf	Daily Amount of Neo/Oxy Consumed By Calf per lb of Body Wt.
1.0 lb	2000 g	1.0 g	1.0 g	10 mg
1.25 lb	1600 g	0.8 g	1.0 g	10 mg
1.5 lb	1333 g	0.667 g	1.0 g	10 mg

¹ inclusion levels are standardized for a 100 lb calf

Note: Use of more than one product containing neomycin or failure to follow withdrawal times may result in illegal drug residue.

Minerals

Minerals are important for the structural development of the calf. They are an important part of body fluids, playing a critical role in maintaining acid-base balance and nerve transmission. Merrick's milk replacers are reinforced with the following minerals.

Calcium - important in bone and skeletal formation, muscle contraction, heart and nerve function and blood clotting

Chlorine – vital for maintaining acid-base balance and is an integral components of gastric secretion

Cobalt - an essential component of vitamin B₁₂, which cannot be synthesized by rumen organisms without dietary cobalt

Copper - necessary along with iron for hemoglobin formation, is an integral part of many enzymes and is important for normal bone, collagen and elastin formation

Iodine – required for the syntheses of hormones that regulate energy metabolism

Iron - an essential component of hemoglobin and oxygen transport throughout the body

Magnesium - often low in whole milk; important to enzymes involved in energy metabolism and is a normal constituent of bone

Manganese - a component of enzyme systems and is essential for normal bone formation

Phosphorous – a major component of bones and teeth; involved in appetite and almost all energy transactions in the body

Potassium – involved in acid-base regulation, water balance, nerve function, muscle contraction and transport of oxygen and carbon dioxide

Selenium - closely linked to vitamin E function and is involved in protein synthesis, muscle development and growth. Merrick's milk replacers provide the organic form, selenium yeast, for improved selenium retention by the calf

Sulfur – an important component of several amino acids, cartilage and the B-vitamins thiamine and biotin

Zinc - plays an important role in enzyme systems involved in energy and protein metabolism

Vitamins

Vitamins play an important role in metabolism and are involved in enzyme systems. The young calf, with its limited storage of vitamins, is dependent on dietary sources of these essential nutrients. Merrick's milk replacers are supplemented with the following vitamins.

Vitamin A – helps protect the body from infections by maintaining mucous membranes and is necessary for normal vision

Vitamin D – required for calcium metabolism, bone and tooth formation

Vitamin E - involved in immune system function and acts as an antioxidant to maintain cell integrity

Vitamin B₁₂ - an integral part of several enzymes used to metabolize energy

Thiamine (vitamin B₁) - necessary for normal energy metabolism and supports nerve and brain function

Vitamin C (ascorbic acid) – an antioxidant that also functions in tissue repair and connective tissue synthesis and is an essential nutrient for calves 3 weeks of age or younger

Biotin – acts as a cofactor for many enzymes and is involved in both carbon-dioxide fixation and decarboxylation

Choline – involved in the transmission of nerve impulses and plays a major role in fat metabolism

Folic Acid – used in the synthesis of amino acids and the production of nucleic acids for DNA synthesis; improves red blood cell formation and oxygen carrying capacity of the blood

Pyridoxine (vitamin B₆) – functions in several enzyme systems concerned in protein metabolism

Vitamin K – required for the synthesis of many proteins and blood clotting factors that prevent hemorrhage

Riboflavin (vitamin B₂) – a constituent of several enzyme systems associated with metabolism

Niacin – plays a critical role in carbohydrate, lipid and amino acid metabolism and essential for mitochondrial respiration

Pantothenic Acid – a constituent of coenzyme A and is essential for metabolic reactions such as fatty acid oxidation, amino acid catabolism and acetylcholine synthesis

Other Additives Available for Inclusion in Merrick's Milk Replacers

The following additives can be included in milk replacer during manufacturing

BIG CALF – Big Calf Technology utilizes natural immunoglobulin proteins to minimize unnecessary intestinal inflammation in baby calves. Most immunoglobulin products target specific challenges such as salmonella, clostridia, and *E. coli*, and are effective only if the pathogen is present. BIG CALF patented technology supports gut health by targeting a specific inflammatory enzyme in the digestive tract. This unique approach reduces inflammation in the gut, allowing for better utilization of nutrients and energy consumed – and does not require the presence of a specific pathogen to be effective. BIG CALF can be used in combination with medications and/or other additives. No withdrawal period. Available only at Merrick's Inc.

BIO-MOS - Mannan oligosaccharides (MOS) contain cell wall fragments of the yeast, *Saccharomyces cerevisiae*. These cell wall fragments provide antigenic binding sites that can bind pathogens such as *E. coli* and *Salmonella*. Since MOS is not digested by the animal, the attached pathogen likely passes from the small intestine without doing any further harm. MOS may also enhance health by stimulating antibody production.

Celmanax – a combination of yeast culture and yeast extract. In addition to Mannan oligosaccharides (MOS) from yeast extract, Celmanax also provides yeast culture.

APEX - a blend of specific plant extracts formulated to encourage feed intake and improve performance in calves. The botanical ingredients in Apex enhance digestion by stimulating appetite and gastric secretion. Specific ingredients provide antimicrobial action against pathogenic bacteria and fungi, optimizing gut flora balance. Apex also has antioxidant activity which can help improve cellular function and reduce the negative physiological effects of stress conditions.

E-guard – provides a blend of specific plant extracts and direct-fed microbials. Allicin (garlic extract) is a non-antibiotic sulfur-containing plant ingredient proven to inhibit the growth of pathogenic bacteria, viruses and protozoa (such as cryptosporidia). FOS (fructooligosaccharides) are special sugars, indigestible by the calf, that provide a nutrient source for beneficial bacteria in the large intestine. Direct-fed microbials provide a source of live, beneficial organisms and are the third component in this trio of ingredients designed to optimize gut flora balance.

Inulin/FOS (fructooligosaccharides) – are complex sugars that nourish beneficial bacteria in the gut, such as *Bifidobacteria*, allowing them to out-compete potential detrimental organisms. Health benefits ascribed to *Bifidobacteria* include the following: inhibiting the growth of harmful bacteria, stimulating components of the immune system and aiding the absorption of certain ions and the synthesis of B vitamins. Inulin/FOS is not digested by the calf and is poorly utilized by major intestinal pathogens.

Omni-bos[®] CB Plus – a multi-strain direct-fed microbial based on three unique scientifically selected *Bacillus subtilis* strains for use in the young dairy calf that helps maintain a healthy and balanced gut microflora. The key to efficient nutrient utilization, rumen development and growth, and resistance to disease caused by pathogenic bacteria invading the calf's digestive tract is healthy, well-developed gut microflora. Because the calf's gut is sterile at birth, rapid establishment of a healthy gut microflora optimizes digestion and minimizes the risk of enteric disease.

Chelated Minerals - Mineral chelates are organic trace minerals that enhance mineral absorption and improve bioavailability. Research with organic trace minerals shows improvements in production characteristics such as feed efficiency, growth, breeding, body composition and hoof integrity. Calf research shows better retention of minerals during stress and improved response to vaccines when organic

trace minerals are fed. Organic forms of zinc, copper and manganese are provided. Organic selenium is already included in all of our milk replacer products.

Vitamin E – an antioxidant that helps protect cells and improve both cellular and humoral immune responses. Vitamin E supplementation of calves has been shown to increase dry matter intake and growth rate. Calves fed 125 or 250 IU/d of vitamin E gained significantly more body weight compared to non supplemented calves. The optimum inclusion level in milk replacers is 150 IU/lb.

Vitamin C (ascorbic acid) – cannot be synthesized by calves until they are about 3 weeks old, and is therefore considered an essential nutrient for calves less than three weeks of age. Ascorbic acid is an antioxidant and is found in high concentrations in steroid secreting cells. The concentration of ascorbic acid in plasma is lower in stressed calves than non-stressed calves. Oral supplementation of ascorbic acid elevates the ascorbic acid level in plasma of preruminant calves.

Acidification - Organic acids can be added to milk replacers. Lowering the pH of milk replacers helps them stay fresher longer when reconstituted. A lower pH in the upper digestive tract may enhance the growth of beneficial bacteria and suppress the growth of pathogenic bacteria.

Gel – A gelling agent is available for inclusion in milk replacer. When reconstituted with water the milk replacer will have a somewhat thicker consistency than regular milk replacer.

The following additives can be added to reconstituted milk replacer on the farm

Super Guard & Super Guard Plus – Type B Medicated Feeds containing a 1:1 combination of Oxytetracycline and Neomycin sulfate that can be added to non-medicated milk replacer for treatment of scours and pneumonia. **Super Guard** contains the maximum allowable level of Neo/Oxy . **Super Guard Plus** provides the regular Super Guard formulation with the added benefits of Direct-Fed Microbials, Kaolin and high levels of vitamins A, D3 and E.

Plas/Magic – combines the power of E-guard (described on the previous page) with the unique combination of proteins in plasma. Animal plasma contains active albumin and globulin proteins such as IgG and IgM. In the digestive tract, immunoglobulins have a direct effect against pathogens and may also have a direct beneficial effect by improving villi growth. Plas/Magic also provides an additional source of vitamins and minerals to help support the calf during stress and optimize intestinal health.

Brelactis – Merrick' new generation of microbials provides a unique, patented blend of lactic acid bacteria found only in this new product. The six strains of bacteria in BRELACTIS are normal inhabitants of the small intestine of young calves. These six bacterial strains were originally isolated from the calf' digestive tract and were selected because of their superior performance. Other microbial products use bacteria derived from yogurt and cheese manufacturing. These off-the-shelf microbial collections are not specific to the unique conditions in the young calf' digestive tract. BRELACTIS, on the other hand, targets this dynamic, changing environment

Super Calf-Kit – increases the caloric density in milk replacer or whole milk. Newborn calves have limited body fat as energy reserves, a sparse hair coat and a high energy need relative to their body weight. Stress and cold weather significantly increase their need for energy. A calf's survival in cold weather depends on its ability to generate and maintain a constant core body temperature. To maintain normal body temperature in cold weather, calves need a high energy feed -- calves need Super Calf-Kit.

Key Benefits Of Merrick's Manufacturing Process

Liquid Ingredients. Use of liquid ingredients ensures thorough mixing and distribution of each ingredient throughout the product. It is not possible to achieve equal results with a dry-blending manufacturing process. Our liquid mixing process is fundamental to our ability to pasteurize and spray dry ingredients.

Human Grade Ingredients. We use the finest ingredients for high digestibility and consistency in our products. These human grade ingredients include whey, oils and fats. Insisting on high quality fat ingredients in our milk replacers lets us incorporate the highest digestible energy to achieve maximum performance.

Pasteurized Ingredients. Our milk replacer fat and protein bases are pasteurized, ensuring product safety and quality.

Quality Assurance. Laboratory technicians test and evaluate all incoming ingredients. Testing continues throughout the manufacturing process to ensure specifications are met in the final product. This strict quality control assures consistent, high quality products.

Double-sealed bags. To protect product quality during shipping and handling, milk replacers are packaged in double sealed bags within separate, heavy-duty plastic liners. The plastic liner is heat-sealed while the outer paper bag is stitched separately.

Excellent Mixability. Due to our unique manufacturing and instantizing process, our milk replacers “flash mix”. Our products mix so well they go into solution instantly.



Milk Replacer Tags



GOLD STAR™

**INSTANT CALF MILK REPLACER
MEDICATED**

For the prevention of coccidiosis in non-ruminating and ruminating calves and cattle caused by *E. bovis* and *E. Zurnii*.

ACTIVE DRUG INGREDIENTS

Decoquinatate45.4 grams per ton (22.7 mg/lb)

GUARANTEED ANALYSIS

Crude Protein, Minimum	20.00%
Crude Fat, Minimum	20.00%
Crude Fiber, Maximum	0.15%
Calcium, Minimum	0.50%
Calcium, Maximum	1.00%
Phosphorus, Minimum	0.60%
Ash, Maximum	9.00%
Moisture, Maximum.....	3.00%
Vitamin A, Minimum.....	35,000 IU/lb
Vitamin D ₃ , Minimum.....	7,500 IU/lb
Vitamin E, Minimum.....	150 IU/lb

INGREDIENTS

Dried Whey, Dried Whey Product, Dried Milk Protein, Dried Skimmed Milk, Animal Fat preserved with BHA, Lecithin, Dicalcium Phosphate, Calcium Carbonate, Vitamin A Supplement, Vitamin D₃ Supplement, Vitamin E Supplement, Vitamin B₁₂ Supplement, Thiamine Mononitrate, Ascorbic Acid, Biotin, Riboflavin, d-Calcium Pantothenate, Niacin Supplement, Choline Chloride, Menadione Sodium Bisulfite Complex (source of Vitamin K Activity), Folic Acid, Pyridoxine Hydrochloride, Magnesium Sulfate, Zinc Sulfate, Manganese Sulfate, Copper Sulfate, Cobalt Sulfate, Iron Sulfate, Selenium Yeast, Calcium Iodate, Mineral Oil, Sodium Aluminosilicate, Natural and Artificial Flavors.

Feeding Instructions on Back of Tag

Manufactured by
MERRICK'S, INC.
Middleton, WI 53562

Net Weight on Bag

Medicated

This indicates the product contains a medication and provides a statement about the use of the medication. Be aware of warning and/or withdrawals*.

Active Drug Ingredients

Under this heading, the medication in the milk replacer is listed along with its concentration. Medications for milk replacers are:

- Chlortetracycline
- Oxytetracycline
- Lasalocid

Decoquinatate OR
Oxytetracycline/Neomycin Base

Guaranteed Analysis

Crude Protein

Protein provided the building blocks (amino acids) for tissue growth. The amount of protein provided should be listed. 20% is standard. 24% and higher may indicate a milk replacer designed for intensive feeding.

Crude Fat

Fat serves as an energy source in milk replacer. It also supplies essential fatty acids.

Only high quality animal fats and/or vegetable oils should be present. 20% is standard. A lower level may indicate a milk replacer designed for intensive feeding or hot climates. A higher level may indicate a milk replacer designed for cold climates.

Crude Fiber

Fiber is an indicator of protein quality. Products with 0.15% fiber or less contain milk, egg and/or plasma proteins, or may contain soy protein isolate. Fiber levels higher the 0.15% indicate plant origin proteins.

Ash

% Ash indicates the overall level of minerals in the product. Excess ash content should be avoided.



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Decoquinatate45.4 grams per ton (22.7 mg/lb)

GUARANTEED ANALYSIS

Crude Protein, Minimum 20.00%
 Crude Fat, Minimum 20.00%
 Crude Fiber, Maximum 0.15%
 Calcium, Minimum 0.50%
 Calcium, Maximum 1.00%
 Phosphorus, Minimum 0.60%
 Ash, Maximum 9.00%
 Moisture, Maximum 3.00%
 Vitamin A, Minimum 35,000 IU/lb
 Vitamin D₃, Minimum 7,500 IU/lb
 Vitamin E, Minimum 150 IU/lb

INGREDIENTS

Dried Whey, Dried Whey Product, Dried Milk Protein, Dried Skimmed Milk, Animal Fat preserved with BHA, Lecithin, Dicalcium Phosphate, Calcium Carbonate, Vitamin A Supplement, Vitamin D₃ Supplement, Vitamin E Supplement, Vitamin B₁₂ Supplement, Thiamine Mononitrate, Ascorbic Acid, Biotin, Riboflavin, d-Calcium Pantothenate, Niacin Supplement, Choline Chloride, Menadione Sodium Bisulfite Complex (source of Vitamin K Activity), Folic Acid, Pyridoxine Hydrochloride, Magnesium Sulfate, Zinc Sulfate, Manganese Sulfate, Copper Sulfate, Cobalt Sulfate, Iron Sulfate, Selenium Yeast, Calcium Iodate, Mineral Oil, Sodium Aluminosilicate, Natural and Artificial Flavors.

Feeding Instructions on Back of Tag

Manufactured by
MERRICK'S, INC.
 Middleton, WI 53562

Net Weight on Bag

Vitamins

Vitamins A, D and E are essential for health and normal growth. Vitamin E level is especially important. Research shows that 150 IU/lb of vitamin E results in improved rates of gain. Vitamin E supplementation also stimulates antibody formation in the calf and enhances immunity to disease.

Ingredients

This list includes all ingredients used in the manufacture of the milk replacer. Careful inspection of this list is required to understand more about the quality of the product inside. Be sure that trace minerals and B-complex vitamins are included. Ingredients are typically listed by category, such as proteins, fats, minerals etc. Ingredients are generally listed by decreasing order within category according to inclusion level in the product.

Feeding Instructions

Be sure to read the mixing and feeding directions. Different formulas require different mixing and feeding rates to assure adequate nutrition and desired performance results.

Raising a Healthy Calf

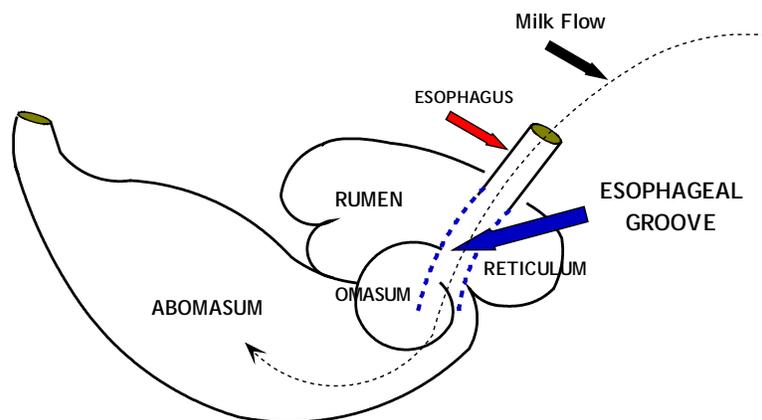
Colostrum. Colostrum is the first milk produced by the cow after calving. It is high in protein, fat and immunoglobulins (Ig), or antibodies. The protection a young calf has against disease challenges comes from colostrum. Calves should consume enough colostrum to provide between 100 and 150 g of IgG. Large breed calves must consume between 2 and 5 quarts of colostrum, depending on colostrum quality, for adequate disease protection. Smaller breeds should consume between 1.2 and 3 quarts. Since the calf's ability to absorb immunoglobulins decreases steadily after birth, colostrum must be administered as soon after birth as possible. The calf's digestive tract stops absorbing immunoglobulins by the time the calf is 24 to 36 hours old. Colostrum also has beneficial effects in the digestive tract and should be fed for the first two to three days of life.

Milk replacer. Begin milk replacer feeding as soon as colostrum feeding has ended. Calves should receive a minimum of 8 ounces (½ lb) of milk replacer powder dissolved in water to make about 2 quarts of milk replacer solution at each feeding. Calves should be fed this solution twice daily. We recommend that calves receive about 10 ounces of milk replacer powder at each feeding to increase the level of nutrition and decrease the likelihood of serious calf health issues.

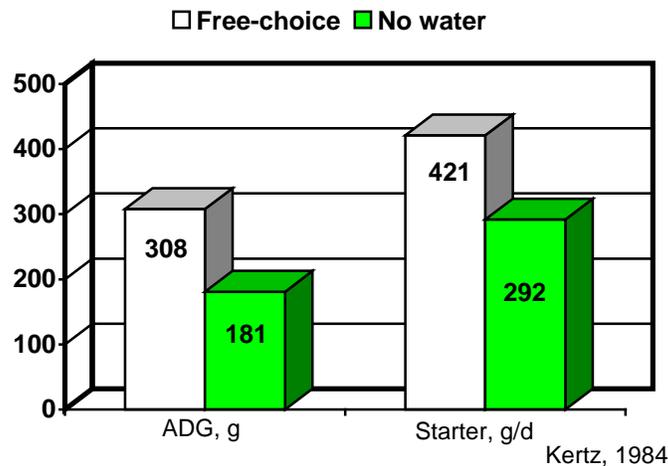
Starter feed. Offer starter feed to calves each day once the calves are receiving milk replacer. The most important components of a good quality starter feed are cereal grains. They provide texture and contain high levels of fermentable carbohydrates, providing a readily available energy source. The end products of grain digestion stimulate rumen papillae growth. Hay, on the other hand, does not have a major beneficial effect on rumen growth. Its presence in the diet reduces energy density, takes up space in the digestive tract and tends to increase the time to weaning. Hay should be reserved as an after-weaning feed, when it is important to develop rumen musculature. Research shows that starters containing 19-20% crude protein provide an optimum growth rate.

Water. Fresh, clean water is critical for successful rumen development and should be made available as soon as the calf begins drinking milk replacer. For rumen development to occur, bacteria must be present. Since the calf is born without rumen bacteria, it must build the bacterial population over time. Consumption of water is critical for this process since bacteria live and grow in a water environment.

Water must be fed separate from milk replacer for water to enter the rumen. This is due to the formation of a unique structure called the *esophageal groove*. When milk or milk replacer is fed, a groove forms that carries the liquid past the rumen and delivers it to the abomasum (stomach).



Since the groove remains for up to 10 minutes after feeding, water must be fed later if it is to enter the rumen. Research shows that calves receiving free-choice water had a 127g higher average daily gain compared to calves receiving no additional water. Starter intake was 129g per day more for the calves receiving free-choice water.



Weaning. A calf can be weaned when its rumen is sufficiently developed to support it without supplemental milk replacer feeding. The best measure of rumen development is feed intake. A calf raised on a conventional milk replacer feeding program can be easily weaned when it is consuming between 1 ½ and 3 lb of starter feed per day. The calf should be eating starter at this level for at least three consecutive days prior to actual weaning. Abrupt weaning is recommended. If desired, calves can be fed one milk replacer feeding for several days prior to complete weaning. However, if the rumen is sufficiently developed, there is no need for a gradual weaning.

Calves should remain on their current starter feed and in their current location for at least two weeks after weaning. Hay can be added to the diet after this time. Big changes such as large dietary adjustments and grouping calves into pens or other new housing should not occur all at once. To minimize stress and susceptibility to disease challenges, large changes should be made separately.

Milk Replacer Start-up Tips & Feeding Suggestions

1. When upgrading to a Merrick's milk replacer be sure to note any medication in the previous milk replacer. Sometimes the medication is unnecessary, but other times, omitting the previous medication can result in health/scour problems.
2. Calves need to be *transitioned* onto milk replacer from whole milk or from other milk replacer. This process will take several days to accomplish. A 50/50 mix should be sufficient to accomplish the job.
3. Weigh a scoop/cup of the milk replacer to see how closely your measuring technique corresponds to statements in the mixing instructions. Personal preference and perception can result in large differences in the amount of powder and nutrients calves receive. Calf growth rate and health can easily be affected.
4. Any water the calf consumes should go into the rumen to help stimulate grain intake and digestion. Wait at least 10 minutes after the calf finishes drinking milk replacer before offering water. This helps assure water drops into the rumen and does not bypass to the abomasum through the esophageal groove. Free choice water should be made available between feedings.
5. Calf starter should have very few fines and be very palatable. Crude protein should be at least 18%. Starter quality and consumption are more important than milk replacer relative to overall calf growth and weaning time. An 18% CP calf starter that calves eat readily will produce faster growing, younger weaning calves than a 24% CP starter that calves eat only because there is nothing else.
6. Calves should be weaned on the basis of starter intake, not size or age. Calves should be consuming between 1.5 and 3 lbs of starter per day for 3 – 4 days in a row before they are weaned. High quality starter and access to clean water are major factors influencing weaning time.
7. In cold weather, the nutrients and energy provided by one scoop of a 20-20 milk replacer each feeding is not enough when calves are outside. Calves can quickly become very severely stressed. Increase the amount of powder provided at each feeding by 2 to 4 oz, or add a high-energy supplement such as Super Calf Kit.