

A BAMN Publication  
**A GUIDE TO CALF MILK REPLACERS**  
Types, Use and Quality



### Introduction

This guide is published by the Bovine Alliance on Management and Nutrition (BAMN) which is comprised of representatives from American Association of Bovine Practitioners (AABP), American Dairy Science Association (ADSA), American Feed Industry Association (AFIA) and United States Department of Agriculture (USDA). The purpose of this publication is to provide the dairy industry with information relative to calf milk replacers.

Today's high quality calf milk replacers, when correctly matched to the specific calf rearing systems, provide several benefits to the dairy producer and calf raiser. These benefits include improved biosecurity, calf performance and economics. Within the last 15 years, there have been significant changes in the formulation of milk replacers. Many of today's products are the result of extensive research. When fed properly, high quality milk replacers will allow calf growth and performance equal or even greater than that attainable with whole milk.

The purpose of this guide is to explain how to evaluate a calf milk replacer for a particular calf raising system. Keep in mind that choosing and using a calf milk replacer is only one part of successful calf rearing.

Significant price differences in milk replacers occur for a variety of reasons including types of ingredients, manufacturing technology and, nutritional quality. It is important that calf raisers understand these differences and make informed decisions in order to maximize both calf performance and economic benefit.

### Classification of Milk Replacer Types

Modern milk replacers can be classified by protein source, protein/fat levels and inclusion of medication or additives.

#### **Protein/Fat Levels**

Protein and fat levels are both important to consider when choosing a milk replacer. Protein levels in calf milk replacers range from 18% to 30% and fat levels from 10% to 28%, with 18% to 22% being the most common fat levels. Generally, higher protein (greater than 22%) formulas are products fed at 1.5 lb. per head daily or greater. Because fat is the most concentrated energy source, the fat content of milk replacer will be responsible for most of the difference in energy levels. Fat sources should be highly digestible to the young calf and preserved with an antioxidant to prevent rancidity. Calf growth and performance is related to a large number of factors; and differing protein levels, protein/energy ratios, and protein sources interact. Growth is regulated by daily intake of protein and energy; therefore, different feeding levels will also affect performance. Some conditions, such as cold weather, require feeding a higher energy level. Metabolizable energy (ME) content of milk replacers is primarily determined by the fat and carbohydrate levels.

#### **Protein Sources**

Protein sources are generally classified as either all milk or a portion coming from alternative proteins.

##### **All Milk Protein**

Dried Whey Protein Concentrate  
Dried Whey  
Dried Whey Product  
Skim Milk  
Casein  
Sodium or Calcium Casenate

##### **Alternative Protein**

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

# Milk Replacer Labels and Ingredients Used In Calf Milk Replacers\*

The following information provides some criteria to use in choosing and evaluating a milk replacer. The feed tag provides information about types of ingredients and medication which can indicate the intended use of the milk replacer.

## Crude Protein

Protein provides essential amino acids for tissue synthesis in animals. Protein content should be evaluated as to amount, source (protein sources vary in their bioavailability to the animal) and presence of anti-nutritional factors.

## Crude Fat

Provides a concentrated energy source (2.25 times the energy of carbohydrates) and provides essential fatty acids. Calves raised in a cold environment have a higher requirement for energy.

## Crude Fiber

Crude fiber content in milk replacers has been used in the past as a measure of product quality. This is no longer valid criteria to use in evaluating milk replacers. Crude fiber levels above 0.15% indicate presence of a plant protein source, but levels below 0.15% do not necessarily mean the absence of plant protein. The ingredient list should be reviewed to determine the protein sources.

## CALF MILK REPLACER NON-MEDICATED

### GUARANTEED ANALYSIS

Crude Protein, not less than	22.0%
Crude Fat, not less than	20.0%
Crude Fiber, not more than	0.15%
Calcium (min)	0.75%
Calcium (max)	1.25%
Phosphorus (min)	0.7%
Vitamin A, not less than	20,000 IU/lb
Vitamin D <sub>3</sub> , not less than	5,000 IU/lb
Vitamin E, not less than	100 IU/lb

### INGREDIENTS

Dried Whey, Dried Whey Product, Dried Whey Protein Concentrate, Animal and Vegetable Fat (Preserved with BHA), Dried Skimmed Milk, Dried Milk Protein, Lecithin, Calcium Carbonate, Dicalcium Phosphate, DL-Methionine, L-Lysine, Vitamin A Supplement, Vitamin D<sub>3</sub> Supplement, Vitamin E Supplement, Niacin Supplement, Calcium Pantothenate, Thiamine Mononitrate, Choline Chloride, Vitamin B<sub>12</sub> Supplement, Riboflavin Supplement, Folic Acid, Manganese Sulfate, Magnesium Oxide, Ferrous Sulfate, Zinc Sulfate, Copper Sulfate, Cobalt Sulfate, Ethylenediamine Dihydrochloride, Sodium Selenite, Polyoxyethylene Glycol (400), Mono and Diolates, Silicon Dioxide, Artificial Flavor.

Manufactured For  
Dairytown Company  
Your Town, State  
50 lb. (22.7 Kg) NET WEIGHT

## Vitamins

Vitamin A, D and E are necessary for normal growth and health of animals.

## Ingredients

The ingredients should be listed in descending order based on the inclusion level in the formula. However, there are so many exceptions in commercially available milk replacers that using this as a criteria for evaluation would often result in erroneous conclusions.

## Medication

Medicated milk replacers should not be used as a substitute for good management and sanitization. Choosing to feed medicated or non-medicated milk replacer and which medication to use should be based on the health status, stress level (shipping, poor weather, less than optimum housing, low birth weight, etc.) of animals. Withdrawal periods, when applicable, should be followed according to the manufacturer's recommendations.

## Common Milk Replacer Ingredients

### Animal Fat and Vegetable Oil -

Fats and oils obtained by removing lipid portion of animal and vegetable tissue.

### Animal Plasma -

A concentrated source of protein obtained by removing the red and white blood cells from fresh whole blood. The resulting plasma is dried (78% protein).

### Casein (Dried Milk Protein) -

Primary protein in skimmed milk. Concentrated by coagulating milk (85% protein).

### Dried Skimmed Milk -

The fat in milk is removed. The remaining protein, lactose and minerals are dried (34% protein).

### Dried Whey -

Liquid drained from cheese during processing and then dried. Contains lactalbumin proteins and is high in lactose (12% protein).

### Dried Whey Product (Delactosed Whey) -

A portion of the lactose in whey is removed which results in higher levels of protein and minerals (20-26% protein).

### Dried Whey Protein Concentrate (WPC) -

Protein portion of whey is concentrated through ultrafiltration (34-80% protein).

### Lecithin -

Emulsifier. Aids in dispersal of fat in solution and enhances digestion of fat.

### L-Lysine and DL-Methionine -

Essential amino acids necessary for calf growth.

### Polyoxyethylene Glycol (400) Mono and Diolates (PEG 400) -

Emulsifier. Aids in dispersal of fat in solution.

### Vitamin and Mineral Supplements -

Many vitamins and minerals are supplemented to provide for normal health, growth and maintenance of calves.

Beware of the use of collective terms in milk replacer ingredient listings.

These terms include many different products:

### Animal Protein Products -

This collective term covers ingredients containing protein that originate from animal sources. A partial listing, but not all inclusive, is: casein, fish meal, meat and bone meal, dried skimmed milk, dried whey and dried animal blood.

### Plant Protein Products -

This collective term covers ingredients that originate from plant products that contain protein. A partial listing, but not all inclusive, is: cottonseed meal, soy protein concentrate, soybean meal, brewers yeast, soy flour and active dry yeast.

### Protein Modified Soy Flour -

A soy flour specially processed to increase digestibility and decrease antigenicity (50% protein).

### Soy Flour -

Finely ground soybean meal (50% protein).

### Soy Protein Concentrate (SPC) -

Protein portion of soybeans concentrated by removal of soluble carbohydrates. Contains fiber (66% protein).

### Soy Protein Isolate -

Isolated protein of soybean with carbohydrate fraction removed. Water soluble and fiber free (86% protein).

## Quality Evaluation

### Dry Powder

**COLOR** Cream to light tan, free of lumps and foreign material. If powder is orange to orange-brown in color and has a burned or caramelized smell, the product may have Maillard Browning (non-enzymatic browning) as a result of excessive heat during storage. If the product has “browned”, there will be some loss of nutrient quality and product palatability.

**ODOR** Powder should have a bland to pleasant odor. If odor is characterized as smelling like paint, grass, clay or gasoline, the fat portion of the product may be rancid.

### Reconstituted Liquid

**MIXING** The product should go into solution easily. Milk replacer should be mixed at manufacturer’s recommended water temperature. Mix until all powder is in solution or suspension without clumps of undissolved powder on the surface of the solution or at the bottom of the pail. Ingredients that are in suspension but are not soluble will settle out of solution (form a sediment at the bottom of the container) if allowed to stand without agitation. This sediment layer will be more apparent as the fiber content and/or level of added minerals and/or medication increases. In some feeding situations (automatic feeders, nipple bottles, etc.), milk replacers containing significant amounts of insoluble components may not be acceptable. Care should be taken not to over mix. If agitation is continued after product is in solution, excessive foaming can occur or the fat portion of the product may separate and form a greasy layer on the surface.

**COLOR** Cream to light tan.

**ODOR** Pleasant with no “off” odors noted.

**FLAVOR** Milky with no “off” flavors. Some milk replacers are supplemented with organic acids. These milk replacers will have a “tangy” (sweet tart) taste. This should not be confused with the “off” lactic acid taste found in sour milk.

**Clotting or lack of clotting with rennet of milk replacers as a measure of product quality is no longer an indication of quality with today’s formulations of calf milk replacers.** Most milk replacer formulas have replaced skim milk or casein protein with whey protein (lactalbumin protein). Both are excellent sources of protein but whey protein will not “clot” when mixed with rennet.

### Commonly Used Milk Replacer Medications

Medication in milk replacers can provide significant benefits in calf health and performance. However, use of medication may require a withdrawal period prior to slaughter. Five medications, listed in the table below, are approved for use in milk replacers. (g/ton refer to grams per ton of dry powder.)

Medication	Use Level	Statement	Withdrawal Period
Chlortetracycline	20 g/ton (to provide 0.1 mg per pound body weight daily)	Increased rate of weight gain and improved feed efficiency	None
	2000 g/ton (to provide 10 mg per pound body weight daily)	Treatment of bacterial enteritis caused by <i>E. coli</i> susceptible to chlortetracycline. Treat for not more than 5 days.	10 days before slaughter
Oxytetracycline	10 to 20 g/ton (to provide 0.05-0.1 mg per pound body weight daily)	Increased rate of weight gain and improved feed efficiency	None
	2000 g/ton (to provide 10 mg per pound body weight daily)	Treatment of bacterial enteritis caused by <i>E. coli</i> susceptible to oxytetracycline. Feed continuously for 7 to 14 days.	5 days before slaughter
Oxytetracycline/ Neomycin	8 mg/gallon Oxytetracycline and 100 mg/gallon Neomycin	Aid in the prevention of bacterial enteritis (scours).	30 days before slaughter
	100 mg/gallon Oxytetracycline and 200 mg/gallon Neomycin 40 mg/gallon Oxytetracycline and 200 mg/gallon Neomycin 40 mg/gallon Oxytetracycline and 400 mg/gallon Neomycin.	Aid in the treatment of bacterial enteritis (scours)	
Decoquinatate	12.9 to 90.8 g/ton (to provide 22.7 mg decoquinatate per 100 lbs. body weight daily).	For the prevention of coccidiosis in ruminating and non-ruminating calves and cattle caused by <i>Eimeria bovis</i> and <i>Eimeria zuernii</i>	None
Lasalocid	60 to 90 g/ton (to provide 1 mg lasalocid per 2.2 pounds of body weight daily)	For control of coccidiosis caused by <i>Eimeria bovis</i> and <i>Eimeria zuernii</i> in replacement calves.	None

## Matching Calf Milk Replacers to Calf Rearing Systems

In choosing a milk replacer, the requirements (protein source, vitamin supplementation, medication, ease of mixing, etc.) of a particular calf rearing situation must be evaluated. Many "quality" problems associated with milk replacers actually result from choosing the wrong type of milk replacer for a particular situation. Suitability of various protein sources is listed below.

**Acceptable** - Protein sources which are either from milk or are specifically manufactured and processed for use in calf milk replacers. Their use in calf milk replacers is well researched.

**Marginal** - Protein sources which are sometimes used in calf milk replacers but may vary in quality and may not be suitable for the very young calf.

**Not Acceptable** - Protein sources which research has shown to produce deleterious results when fed to young calves.

### Protein Sources

<b>Acceptable</b>	<b>Acceptable</b>	<b>Marginal</b>	<b>Not Acceptable</b>
Dried Whey Protein Concentrate	Soy Protein Isolate	Soy Flour	Meat Solubles
Dried Skim Milk	Protein Modified Soy Flour		Fish Protein Concentrate
Casein	Soy Protein Concentrate		Wheat Flour
Dried Whey	Animal Plasma		
Dried Whey Product	Wheat gluten or isolate		

Other alternative protein sources continue to be researched (e.g. egg protein) with mixed results.

### Calf Rearing Systems

There are both different calf rearing systems and different climates to consider when matching a milk replacer to a specific set of conditions. The table below provides guidelines for these systems.

<b>Calf Rearing System</b>	<b>Recommended Calf Milk Replacer to Use</b>	<b>Recommended Feeding Programs</b>
Traditional	Use milk replacers containing protein sources listed under "acceptable" above. Protein level of the milk replacer should be 20 or 22%	Bucket or nipple bottle. Generally, feed 2 to 3 quarts twice daily for 4 to 6 weeks.
Intensified or Accelerated	Use milk replacers specifically designed and recommended for this feeding regime. Protein level should be matched to energy intake.	Follow manufacturers recommendations relative to mixing rate, feeding rates and management recommendations.
Winter Feeding At Low Temperatures	It is preferable to use a higher energy (20% fat) milk replacer when ambient temperatures fall below freezing. In addition, milk replacer quantities fed should be increased 25%-50%.	Bucket or nipple bottle. Feed calves 3 times a day to increase energy intake or feed a greater volume of milk replacer per feeding, but gradually step up volume fed.
Cold <i>Ad libitum</i> (Self-Serve/ Free Choice / Acidified Feeding)	Use only an acidified milk replacer specifically recommended by the manufacturer. Do not use a product which produces a heavy sediment when reconstituted.	Nipple feed only from a reservoir with a suitable nipple assembly and hose. Keep milk available at all times during the first 3 weeks until the weaning process begins.

**All calves should have access to fresh, clean water and fresh, high quality calf starter at all times.**

Milk replacer bags should be stored in a clean, dry place not subject to excessive heat. Opened milk replacer bags should be stored in an air tight fashion to prevent exposure to contamination, pests, heat and humidity.

### Summary

Extensive evaluation of the nutritional integrity of a calf milk replacer involves complex chemical and microbiological analyses. This bulletin is a general guide for a rapid evaluation of calf milk replacers and is not meant to replace consultation with a qualified nutritionist. **The single best criterion for evaluating a calf milk replacer is calf performance.** If calf performance is poor, more detailed evaluation of management, calf health and calf milk replacer quality is necessary to determine the reason for poor performance.

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AFIA Publications	Fax: 703-524-1921
2101 Wilson Blvd., Suite 916	Phone: 703 524-0810
Arlington, Virginia 22201	E-mail: <a href="mailto:afia@afia.org">afia@afia.org</a>
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