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## DAIRY REPLACEMENT HEIFER NUTRITION

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## The Challenge

Proper nutrition and management are necessary to provide adequate numbers of healthy herd replacements. Satisfactory heifer programs must take into consideration care of the dam and characteristics of the newborn calf, including the deficiency of circulating antibodies at birth and the lack of a functioning rumen.

## Care of the Dam

Nutrition. Nutrition of the dry cow is very important because of the effect this has on the next lactation as well as on the developing fetus. Several points should receive special attention. (1) Provide adequate protein and energy to meet requirements. (2) Increase concentrate intake gradually during the last part of the dry period, so that rumen microorganisms will be adapted to the ration to be fed after freshening. Do not allow cows to get too fat. (3) Be sure intake and balance of minerals are correct. A calcium-phosphorus ratio of about 1.4:1 is recommended.

Housing. By nature, the cow attempts to isolate herself from other animals to deliver her calf, and this practice helps prevent contamination of the newborn calf with infectious agents. With increased confinement, this is not possible, and special precautions should be taken to provide a clean environment for the calf during and following calving, when it is highly susceptible to diseases. A clean, well bedded, well ventilated stall should be provided in a location where the cow can be observed frequently with a minimum amount of disturbance.

Other. The udder of the cow should be cleaned before the calf nurses. It is especially important that bacteria do not gain entrance to the intestines before absorption of colostrum takes place.

## Care of the Newborn Calf

The newborn calf should be checked as soon as possible to be sure that it can breath normally. Some calves die because of placental membranes over the nostrils or in the throat. Disinfect the navel with tincture of iodine; it may be desirable to repeat this one day later. Be sure that the calf receives colostrum as soon as possible, either directly from the dam, by bottle, or by tube. Calves are able to absorb intact immunoglobulins directly into the blood stream for only a short time. Efficiency of absorption begins to decrease by 4 h after birth and has decreased markedly by 12 h after birth. The importance of colostrum cannot be

over emphasized. It is by this means that the calf receives antibodies to help fight infection. The greater the amount of colostrum given at first feeding, up to 2 quarts, the higher the immunoglobulin concentration of serum in the calf. The calf should receive at least 4 quarts of high quality colostrum during the first day of life. Measurement of plasma protein at 24 to 36 h after birth will give a good indication of the amount of immunoglobulins absorbed from colostrum. Concentrations greater than 5.5 grams per 100 ml indicate an acceptable level of protection.

Often injections of vitamins are given at this time. Suggested amounts (I.U.) would be: Vitamin A = 500,000; Vitamin D = 75,000; Vitamin E = 50.

The calf can be separated from the dam soon after birth or at any time up to 3 days, depending on individual management. In any case, give the calf colostrum during the first 3 days. Immunoglobulin in the colostrum is beneficial in the digestive tract, even beyond the time when immunoglobulins are absorbed into the blood stream, to help prevent attachment of pathogenic bacteria on the lining of the intestine. Permanent identification (ear tattoo) and ear tag or neck chain identification should be completed before the calf is separated from the dam.

### Nutrition of Calf to 3 Months of Age

#### Liquid Feed

Milk or colostrum. Milk or colostrum are unsurpassed as the liquid feed for calves. An average cow produces about 80 lb of colostrum. Properly diluted, this is enough to feed a calf for about 15 days. If only heifer calves are kept, there may be adequate colostrum to feed until the calves are 4 wk of age. Added to this will be some mastitic milk and milk unsaleable for other reasons. Excess colostrum can be frozen or preserved by allowing it to ferment at environmental temperature. Before use, the colostrum should be diluted at the rate of two parts colostrum to one part water. Some other suggestions concerning fermented colostrum include: (1) store it in plastic containers; (2) don't use colostrum containing antibiotics, which prevent fermentation; (3) stir the fermenting colostrum daily; and (4) don't use colostrum over 3 wk old.

Milk replacer. Some milk replacers also will give good results and may be more economical. These are two things to remember in economic appraisals of milk replacers. (1) Milk replacers are usually much lower in fat content than milk and, thus, are much lower in energy. (2) Milk replacers, when mixed as recommended, often contain more water than milk does and, thus, are not equivalent to milk, even if they were equal on a dry matter basis. A rule of thumb for comparison is—if 25 lb of a good milk replacer (at least 12% fat) can be purchased and mixed for less cost than the value of 160 lb of the milk it replaces, it may be economical to use the replacer. If not, it will not be economical to use the replacer and there would be no other reason to use it. If the decision has been made to use a milk replacer, only a high quality one should be used. Higher calf mortality and unthrifty calves are a high price to pay for a few cents saved in purchase price. The replacer should contain at least 22% protein and 12% fat. Higher fat levels will be beneficial to the calf. Almost

without exception, the protein and carbohydrate should come from properly processed milk products such as dried skim milk, dried whey, whey protein concentrate, dried buttermilk, etc. Some other proteins can be utilized by the calf in limited amounts but these must be evaluated on an individual basis. Other types of fat, if properly processed, can replace milk fat. Most milk replacers will contain the proper amount and types of supplementary vitamins and minerals.

Mastitic milk. Mastitic milk can be fed to calves, if the following precautions are observed:

1. Don't feed to calf less than 2 days of age.
2. Don't allow calves to suckle each other.
3. Don't feed to calves intended to be slaughtered soon for meat.
4. Don't feed milk from cows with coliform or Pasteurella mastitis.

Feeding level and frequency. For desirable growth of herd replacements, milk or reconstituted milk replacer should be fed daily at a level of 8 to 10% of birth weight. The higher level would be advised when calves are not doing well, but not scouring, or to compensate for lower energy content of milk replacer. Overfeeding of milk is undesirable because of increased incidence of digestive upsets and because dry feed consumption will be decreased.

Considerable research and experience during recent years have shown that calves perform essentially the same whether fed milk once or twice daily. Young calves should be checked frequently, so one of the best reasons for feeding calves twice daily is that the calves are observed at least that often.

Feeding equipment. For feeding of milk or milk replacer, equipment may range from an open pail to an automatic feeder costing several thousand dollars. For smaller operations, a pail, nipple pail, or nipple bottle are recommended. The nipple pail, especially, is harder to clean, and unless care is taken, may be a source of infection. The nipple bottle is easier to clean than the nipple pail and makes measurements of milk easier. An advantage of the open pail is that it allows "stimulation" of dry feed consumption. Stimulation refers to the act of putting dry feed in the bucket used to feed milk just when the calf finishes drinking milk. In this way, it is taught to eat dry feed. If a pelleted feed that does not break apart in milk is used, the pellets can be put in the milk at the time the milk is given to the calf.

When to wean. With conventional feeding programs, calves are usually weaned after 6 wk of age. Age, size, and health should also be taken into consideration but the most important criterion is dry feed consumption. The healthy calf that is eating at least 1.5 lb of dry feed before weaning can be weaned successfully. Using prestarter and an early weaning program, developed at Kansas State University, calves are being weaned at 2 to 3 wk of age with good results. Advantages of early weaning include reduced sickness, labor required, and feed cost.

## Dry Feed

Starter. The rumen of the newborn calf is nonfunctional because of small size and lack of absorptive ability and microbial population. Furthermore, liquid feed does not go into the rumen because of the esophageal groove, which directs the liquid into the abomasum. Development of the rumen takes place when dry feed is consumed and is fermented within the rumen. Thus, in order to hasten rumen development and the time when the calf can be weaned, consumption of dry feed at an early age is important. A good calf starter will contain several ingredients that add to its palatability. Some recommendations concerning calf starters are as follows:

Protein	at least 16%
Net Energy (NE <sub>m</sub> )	.86 Mcal/lb
Net Energy (NE <sub>g</sub> )	.54 Mcal/lb
Corn, cracked	at least 30%
Molasses	5%
Wheat Bran	10 to 15%, if starter is pelleted
Oats	15 to 25%
Vitamin A	1000 I.U./lb
Vitamin D	140 I.U./lb
Vitamin E	25 I.U./lb

The mixture should be fed as a coarsely ground, cracked, or rolled mash or as a pellet. Calves do not like a finely ground mixture, so if the particle size is small, the mixture should be pelleted. A soft pellet (but not one that crumbles easily) of about 3/16 inch in diameter is desirable.

If desired, hay can be ground and incorporated into a pelleted total mixed ration at a level of 20 to 25%, or the hay can be chopped and fed along with the concentrate mixture in meal form. An example of a starter that has given good results is shown in Table 1.



Dr. Jim Morrill showing one of his early-weaned calves

Table 1. Example of a good calf-starter diet

Ingredient	% of Diet
Alfalfa, ground	25
Corn, cracked	30
Oats, rolled	20
Sorghum grain, rolled	8.5
Soybean meal	10.0
Molasses, dry	5.0
Dicalcium phosphate	.7
Limestone, ground	.3
Salt	.25
Trace mineral salt	.25
Vitamins A and D	**

\*Pellet, 4.8 mm (3/16 inch) diameter

\*\*1000 I.U. Vitamin A and 140 I.U. Vitamin D per lb

Prestarter. Research at Kansas State University and elsewhere has led to the use of a special feed (prestarter) in an early weaning program. This prestarter, which contains milk solids, supplementary fat, and additives, is very palatable to very young calves and, thus, encourages dry feed consumption. The prestarter is pelleted and a small amount can be added directly to milk to stimulate dry feed consumption.

Roughage. Rumen papillary development will not be normal unless calves have access to fibrous feed. The best source is good quality legume-grass hay provided free choice. If a fibrous starter is used, hay may not be necessary for the first few weeks. In either case, hay should be fed after the calves are weaned. Feeding silage to young calves is neither desirable nor practical. Calves on pasture have the advantages of exercise and sunlight but must be fed the proper amount of supplemental feed. They also may pick up internal parasites.

Feeding program. Dry feed should be available to young calves at all times. To encourage consumption, the feed should be kept fresh by feeding in small amounts and changing feed when necessary. If prestarter is used, it should be provided by itself until consumption is 0.5 lb per day. Then a mixture of 0.5 lb of

prestarter and whatever amount of starter the calf will eat should be provided until 6 wk of age.

From 6 wk until 12 wk of age, the calf should be allowed to consume all of the concentrate it wants from a self feeder and roughage in the usual form. This concentrate mixture can be calf starter or it may be a less complex grower mixture for calves over 8 wk of age. It is desirable to avoid several stress conditions at once. For example, do not move calves from individual pens to group pens and change feed at the same time. A gradual change from one feed to another is recommended.

### Feeding Heifers From 3 Months to Freshening

Calf starter should be formulated to contain ingredients that make it more palatable; however, these ingredients also make it more expensive. There is no point in continuing use of this type of mixture beyond the time when a calf would eat approximately 4 lb per day of a less expensive mixture. Depending on the individual calf and the type of mixture, this usually will be around 8 to 12 wk of age. Often the concentrate mixture fed to the lactating cows will be adequate for calves after 12 wk of age.

Growing heifers need concentrates that provide nutrients not supplied by roughages, thus, the quality of the roughage determines the amount and type of concentrate mixture. Heifers should be bred to freshen no later than 24 months of age. They can be fed so that they will be large enough to freshen even at 21 months of age, and they usually will produce well, but difficulty in calving will likely be a problem. At no time should heifers be allowed to get too fat, since this is expensive and will decrease future production.

Assuming that a weight of 1200 lb at 24 months of age is desirable for Holsteins, a calf weighing 230 lb at 12 wk of age will need to gain an average of 1.5 lb per day during the period from 3 months to 24 months of age. To achieve an average age at calving of 24 months, breeding must commence soon after 13 months of age. A reasonable goal is to have heifers weighing 700 lb at 13 months of age. This requires an average daily gain of 1.5 lb from 3 months to 13 months of age. Since Holstein heifers begin coming into heat at about 600 lb body weight, the heifer would have had several heat periods before breeding. For reproductive efficiency, the heifers should be gaining weight at breeding time.

The above figures are presented as guidelines and should be modified to fit the management programs of the individual dairyman. When possible, roughage and concentrates should be fed together in a complete, mixed ration, with the proportions of roughage and concentrate changed as the need changes. One problem often experienced when concentrates are fed separately is the difficulty in providing the proper amount of concentrate mixture to each heifer, since heifers within a lot often differ in size and aggressiveness. Self-feeding of concentrates and roughage, when the heifers are young, and of mixtures of concentrates and ground hay or straw along with roughage, when heifers are older, offers several advantages. The ratio of concentrate mixture and ground hay

or straw can be changed as the heifers grow older and the mixture of grain needed decreases.



Graduate research assistants, Paul Dawson, P. G. Reddy and Paula Flynn tend to one of the calves at the Calf Research Unit



Calf hutches at the KSU Dairy Center