Raising replacement dairy heifers provides excellent opportunities and challenges in building for the future. Records show that about 25 to 35% of the milking herd must be replaced annually. Therefore, to maintain herd size and improve genetic potential for high milk production, quality replacements must be continuously available.

Good management is essential to raising healthy calves. Reducing death losses of newborn calves to less than 5% and raising strong, healthy heifers large enough to breed at 14 to 16 months of age are sound management objectives. Calves stunted from underfeeding or diseases may not develop into healthy and profitable cows.

Estimates are that some herds lose 15 to 25% of live-born calves consistently. This is excessive and costly to the dairy industry. Some dairy farmers consistently lose less than 2 to 3% of live-born calves. Careful attention to feeding, housing, and health management practices are key elements in successful raising of replacements.

In general, the younger the calf, the greater its risk of dying from disease. Most deaths occur in calves less than one month old. Therefore, sanitation during the pre-calving, calving and early post-calving periods is crucial.

CARE AT CALVING

A good calving environment reduces the exposure of cows and newborn calves to infectious disease organisms. Well-drained grass lots or pastures visible from the barn are ideal calving areas. In cooler climates maternity stalls are used, particularly during periods of unfavorable weather. In either situation, a clean and comfortable area that provides cows with good footing minimizes the potential for injuries. Calving areas should be selected or landscaped to allow for adequate drainage. Shade structures are recommended. University of Florida studies have shown a detrimental effect on fetal growth rate and milk production in subsequent lactations when cows are not sheltered from heat stress.

Calf mortality is closely related to the dam's health during gestation, and fewer problems arise if dietary intake is monitored (see IFAS Circular 623, Dry Cow Feeding and Management). Studies indicate that 4 to 5% of calves are born dead or die within 24 hours of birth, and losses can be as high as
15% or more in herds where calving management practices are poor. Table 1 shows the causes of death in calves less than 24 hours old for one Florida study.

Cows at or near calving should be separated and observed frequently. Heifers will normally deliver their calves within 12 hours after the onset of labor. The interval from onset of labor to birth in cows is usually six to eight hours. Difficulties occur in slightly more than 3% of calvings among dairy cattle. If the labor and delivery process is prolonged or an abnormal presentation is detected (such as the appearance first of a tail, head or one leg) corrective procedures may be needed. Common causes for calving difficulties are excessive calf size and abnormal calf posture or position. Beginning with the cow’s third calf, milk fever (also called parturient hypocalcemia) should be suspected anytime the labor process seems particularly slow or appears to have stopped. A cow with milk fever will often be wobbly or unable to rise. Milk fever can be treated rapidly and effectively by administering calcium-containing preparations.

Table 1. Cause of death in calves less than 24 hours old in a Florida dairy 939 calvings.

<table>
<thead>
<tr>
<th>Cause</th>
<th>Number of calves</th>
<th>% of total deaths</th>
<th>% of total calvings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Premature deliveries and near-term abortions</td>
<td>10</td>
<td>18</td>
<td>1.6</td>
</tr>
<tr>
<td>Dystocia (assisted births)</td>
<td>23</td>
<td>40</td>
<td>2.4</td>
</tr>
<tr>
<td>Stillbirth or calf found dead</td>
<td>24</td>
<td>42</td>
<td>2.5</td>
</tr>
</tbody>
</table>

Experience is an important prerequisite for the identification of problems or potential problems in managing calving. The calf has a better chance for survival if stress during the birth process is minimized.

Care of Navels at Birth

Calves’ navels should be dipped in disinfectant at birth using a product such as 2% tincture of iodine. Failure to do so increases the opportunity for the development of potential fatal septicemia (invasion of the bloodstream by bacterial organisms). Further, bacteria associated with navel infections in calves may lead to serious arthritis that is difficult to treat and may result in the need for premature culling of affected calves.

Feeding Colostrum

The calf should receive colostrum as soon as possible after birth. The gut of the newborn calf is able to absorb maternally-derived immunoglobulins (antibodies) contained in colostrum and transport them into the bloodstream. Antibodies transferred from the dam to the calf in this way are referred to as "passive" antibodies. The ability of the calf to absorb these colostral antibodies is greatest within the first hour following birth and remains fairly good for up to six hours. After this, there is progressive loss in the calf’s ability to absorb colostral antibodies. After 24 hours a calf may be able to absorb little or none at all.

Colostrum’s chief importance is providing antibodies which give the newborn calf resistance to disease. In addition, colostrum acts as a mild laxative which aids in removing digestive residue from the gut of the newborn calf. Colostrum is also high in nutrient value, especially vitamin A or its precursor carotene, B vitamins, proteins and minerals. The total solids and protein content of colostrum is about 23.9% and 14% as compared to 12.9% and 3.6% for normal milk.

Evaluating Colostrum Quality

Several factors affect the passive transfer of colostral antibodies to the calf: the immunoglobulin mass ingested; time delay after birth of ingestion of colostrum; the method of feeding; and genetic, physiological, and environmental influences. Of these, the most important are mass of colostral...
antibody consumed and the length of time after birth before ingestion.

In the late 1970s researchers at the University of Arizona developed a method to estimate the antibody content of colostrum. The device used, known as a colostrometer, was designed for on-farm use and has become particularly valuable to dairies that store colostrum for hand-feeding newborn calves. The colostrometer is simply a hydrometer specially calibrated to provide a measure of colostrum specific gravity which is directly related to antibody concentration. Using this tool, dairy farmers can estimate the protective quality of the colostrum they collect from cows and thus selectively feed or store that which is of an acceptable value.

Florida field trial results demonstrate the importance of monitoring colostrum quality. A total of 891 first-milking colostrum samples were scored with the colostrometer in a Florida dairy over a one-year period. Only 96 (10.8%) of the colostrum samples examined at first milking contained 50 mg/ml or more of colostral antibody. This suggests that indiscriminate collection of first milking colostrum and pooling with other sources may result in storage of inferior quality colostrum. When possible, at least two liters of colostrum scoring in the zone over 50mg/ml should be preserved for each newborn calf. Colostrum with lower than optimal antibody levels may be fed as is or diluted for feeding to older calves.

Detecting the Colostrum-Deprived Calf

Several methods can be used to determine if a calf has absorbed adequate levels of protective antibodies from colostrum. A popular procedure for large dairies is measurement of serum total proteins. This is by far the most efficient and practical method for routine screening of large numbers of calves and can easily be performed on the dairy by a veterinarian or dairy personnel.

Previous studies demonstrate that blood antibody levels correlate well with serum total proteins in calves at 2 to 10 days of age. Serum fractions from calves containing less than 5.0 gm/100 ml indicate insufficient colostral antibody absorption (Table 2). Total protein values in excess of 7.5 gm/100 ml are suggestive of dehydration and may be cause for concern. Herds experiencing severe losses in calves under two weeks of age should evaluate calves to determine if colostrum deprivation is a problem. In very large herds we can often times determine how successful the neonatal calf management program is by monitoring a sample of the calves between 2 to 10 days as opposed to checking all calves.

STARTING THE NUTRITION PROGRAM

The milk feeding period in most calf operations is 4 to 5 weeks for large breed calves and 5 to 6 weeks for small breed calves. Liquid feeds commonly used are whole milk, milk replacers and colostrum. The choice of which to use depends on availability, practicability and cost.

Regularity in calf feeding is important. Too much milk at one feeding is likely to cause loose bowels which may develop into scours. For best results, weigh or measure the milk at each feeding.

Most dairy farmers prefer to feed milk to calves at about body temperature (90 degrees F to 100 degrees F). However, research has shown that temperature may vary from slightly warm to about 100 degrees F. Apparently, the temperature of the milk is relatively unimportant so long as a similar pattern is followed each day.

• Whole Milk - This is the most common liquid for calves. It is usually fed twice a day but in recent years has been fed once a day with success. Calves should receive from 6 to 10 lbs per day depending on the size of animal (about 8 to 10% of body weight at birth).

• Milk Replacer - Some of the primary concerns in the selection of a milk replacer is cost, physical properties and the nutritional value of the product. Milk replacers should mix easily, not settle out to any objectionable degree on standing and have milk-like appearance in dry and liquid form. The major difference between brands of milk replacers is usually the source of
Table 2. Interpretation of serum total proteins.

<table>
<thead>
<tr>
<th>Total Protein (mg/dl)</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 5.0</td>
<td>colostrum deprived</td>
</tr>
<tr>
<td>5.0-5.5</td>
<td>suspect deprived</td>
</tr>
<tr>
<td>5.5-7.5</td>
<td>colostrum satisfied</td>
</tr>
<tr>
<td>greater than 7.5</td>
<td>suspect dehydration</td>
</tr>
</tbody>
</table>

*Clinical signs of septicemia, diarrhea or other problems should be noted at the time of sampling.

Feeding and Management of Young Dairy Calves

- Protein - casein, soy flour, etc. Select a good quality milk replacer.

- Fresh Colostrum - In many dairy operations, more colostrum is available than can be fully utilized by newborn calves. Rather than discard a valuable product, it can be preserved by freezing and fed as needed. Colostrum's laxative properties, coupled with its extra total solids may increase the incidence of scours in calves unless diluted with water.

- Mastitic Milk - Milk from cows with mastitis, which cannot be marketed, may be fed to calves with good success. Such milk should be fed to calves in individual pens to prevent the possible spreading of organisms since calves in community pens tend to nurse each other after drinking milk.

- Fermented Colostrum - In recent years some dairy farmers have used fermented colostrum (sometimes called pickled milk or sour colostrum) to feed dairy calves. Research shows that colostrum can be successfully stored as a fermented product for a month or longer and remain readily acceptable to calves. The acidity of sour colostrum is reduced from 6.5 to a pH of about 4.0 which preserves the material. The increased acidity prevents the growth of harmful bacteria. For good results, store in a plastic or non-corrosive container. Colostrum milk from other cows freshening within a few days can be added and mixed with the batch as needed. Start a new container when colostrum milk has not been added daily. Do not add milk from a cow being treated for mastitis because the antibiotics stop fermentation and the milk will not sour properly. Mix the stored colostrum before feeding. Feed a minimum of one quart (two pounds) and preferably three pounds of fermented colostrum diluted with about one-third water twice a day. Fermented colostrum appears to be a satisfactory nutrient source for calves when 4 to 6 pounds of colostrum is fed daily. Weight gains have been equal to calves receiving whole milk or milk replacer.

Once Versus Twice-Daily Milk Feeding

During the past few years several studies have shown that milk may be fed to calves once instead of the usual twice per day. The once-daily feeding has not increased the number of digestive and health problems as compared to twice daily feeding. Calves receiving milk once daily remain active and consume their portion of liquid feed. Amounts up to 10% of body weight (8 to 12 lbs per calf) are consumed readily by larger calves.

An important question, particularly in Florida, is whether calves fed once daily during hot weather can perform as well as calves fed twice daily without supplemental water. An Ohio study showed that once daily fed calves provided with supplemental water gained an average of 4.5 pounds more than calves not given water. Consumption of calf starter averaged 7.0 pounds more at 30 days of age for the water-supplemented calves and resulted in greater efficiency of growth and increased body weight gain.

Once daily feeding reduces the time required for milk or milk replacer preparation and feeding pail washing. Food management makes the program work. Even though calves may be fed milk once daily, they should be observed at least twice daily for health and general management problems. Early detection of problems is an important aspect of any young animal management system.
Table 3. Suggested pounds of milk to feed daily.*

<table>
<thead>
<tr>
<th>Age of calf</th>
<th>Large breed (lb per day)</th>
<th>Small breed (lb per day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 day (first 24 hours)</td>
<td>Suckles cow or is fed colostrum</td>
<td></td>
</tr>
<tr>
<td>2-7 days</td>
<td>8-10**</td>
<td>5-8</td>
</tr>
<tr>
<td>2nd week</td>
<td>10-12</td>
<td>6-9</td>
</tr>
<tr>
<td>3rd week</td>
<td>10-12</td>
<td>6-9</td>
</tr>
<tr>
<td>4th week</td>
<td>5-6</td>
<td>3-4</td>
</tr>
</tbody>
</table>

*If scours occur during milk feeding, the amount of milk may be withhold or reduced to one-half. Provide an equal amount of water to replace the milk withheld.

**One gallon of milk weighs 8.6 lb.

Early Weaning

Calves may be successfully weaned from milk or milk replacers at 3 to 6 weeks of age depending on breed and appetite. Smaller breed calves should receive milk a little longer than Holsteins and all calves should have been eating a minimum of 1 to 2 lbs of calf starter (grain mix) daily for the 7 to 10 days prior to weaning. Those consuming less may lose weight and do poorly for several days after weaning. To encourage starter consumption, reduce milk fed by about one-half a few days prior to weaning (Table 3).

A special feed termed prestarter is commercially available and has been used by some dairy farmers to aid in early weaning. Experiments with the program have shown that calves can be weaned as early as two weeks. Although growth is slower for a few weeks, it is non-significant at three months of age. Calves respond differently to such an early weaning program. Advantages in such a program are reduction of labor and costs. Disadvantages are slower growth and possible increased death losses.

Calf Starter Ration

The calf's appetite increases as it grows. Offering a small amount of good starter ration to the calf at 2 to 3 days of age is an excellent way to meet this increasing need. Also, unlike milk, a starter ration will stimulate early rumen function and the establishment of the rumen microbial population and growth of the rumen papillae. The grain starter is more effective than hay in encouraging rumen development. Early rumen development allows early weaning and helps the calf overcome stresses associated with the milk feeding period.

A calf starter should be palatable and chewy. Some of the grain should be in the cracked, rolled or whole form. Variety is more important in a calf starter than in rations for the milking herd or older heifers. Pelleting is another method of increasing palatability when the ingredients are finely ground.

The calf starter ration should contain about 16 to 21% crude protein with added minerals and vitamins. University of Florida studies show an advantage in adding 10 to 15% cottonseed hulls to calf starter rations. Such rations need only contain 15 to 16% crude protein.

The calf starter should be supplied in a very small amount during the first week of life and then gradually increased. Feed only the amount that the calf will consume that day to help keep the feed fresh. Some calves will be consuming 3 to 5 lbs of calf

Fresh Water Needs

Growing dairy calves should have access to clean, fresh water at all times after they are weaned. Most dairy farmers offer water during the milk feeding period. Pail feeding fresh water is best. Avoid feeding water just before feeding milk. Young dairy calves have a higher requirement for water than older animals per unit of body weight. As calves get older, provide about one foot of water space for each 10 heifers.


Feeding and Management of Young Dairy Calves

Table 4. Dairy calves receiving hay and a concentrate as the total ration.

<table>
<thead>
<tr>
<th></th>
<th>lb</th>
<th>DM</th>
<th>CP</th>
<th>TDN</th>
<th>CA</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bermuda Hay</td>
<td>2.00</td>
<td>1.76</td>
<td>0.14</td>
<td>0.80</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Concentrate mix</td>
<td>4.50</td>
<td>1.35</td>
<td>0.63</td>
<td>3.12</td>
<td>0.03</td>
<td>0.02</td>
</tr>
<tr>
<td>Mineral</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Totals</td>
<td>6.50</td>
<td>3.11</td>
<td>0.77</td>
<td>3.92</td>
<td>0.04</td>
<td>0.03</td>
</tr>
<tr>
<td>Requirements</td>
<td></td>
<td></td>
<td>0.79</td>
<td>3.92</td>
<td>0.04</td>
<td>0.02</td>
</tr>
</tbody>
</table>

(150 lb body weight)

starter daily at one month of age. Continue feeding the calf starter until the calf is about two months of age. As calves increase in age and size, larger calves may be limited to about 4 to 6 pounds of grain per day and the smaller calves about 4 to 5 pounds per day in order to encourage consumption of roughage, especially hay (Table 4).

Hay Feeding

There have been a number of recommendations on the age when hay should be offered to young dairy calves. Some prefer to start feeding hay when calves are as early as one week old, while others recommend waiting until the calves are two months old.

Most calves will eat very little hay before they are two months old. A few, however, seem to have a strong appetite for roughage and may need to be fed some hay at an earlier age. For this reason, we recommend some hay when the calf is 1 to 2 months of age. Calves that select hay over grain should have hay restricted until they are consuming from one to two pounds of grain per day. Calf starter rations containing 10 to 15% cottonseed hulls provide adequate roughage during the first one to two months of life.

Hay is important for normal rumen function and should be made available to all calves over 1 to 2 months of age. More hay will be eaten if fresh hay is provided each day. Do not let hay get packed in hay racks for several days. Feed about the amount the calf will eat each day. An exception is where calves have free access to hay in round bales.

Minerals and Vitamins

Minerals and vitamins are important to all livestock, especially growing heifers. A free-choice commercial mineral containing calcium and phosphorus in about a 2:1 ratio with 20 to 25% salt and added trace minerals and vitamins should be adequate. Calves and heifers will consume less free-choice mineral if they are receiving a grain mixture containing a good balance of minerals. However, as heifers get older and pasture becomes more available, a free-choice mineral should be provided.

Antibiotics Used as Feed Additives

Antibiotics may be useful in starter rations in helping to reduce digestive disorders, increase feed consumption and improve daily weight gain in baby calves raised in some areas of Florida. In general, though, healthy dairy calves do not benefit from antibiotic supplementation.

Chlortetracycline (aureomycin) and oxytetracycline (terramycin) are of greatest value for calves when the untreated animals have had diarrhea or digestive disturbances.

Housing

Calves need clean, well lighted, properly ventilated quarters. Damp stalls, drafts, and wet bedding may lower the calf's resistance to certain diseases, especially pneumonia. Poorly ventilated quarters usually lead to strong undesirable odors. Individual, portable pens work very well in Florida.

Young calves should be placed in individual pens until 6 to 12 weeks of age, depending on facilities. The two most common types are portable...
and permanent pens. Permanent pens usually have wood-slatted or expanded metal floors that require no bedding and are easy to clean. Portable pens are popular in Florida. In addition to providing plenty of fresh air and shelter, they are inexpensive to make. Structures known as calf hutches are used in colder climates but are usually not needed in Florida.

There is less danger in spreading disease when calves are kept in individual pens. Portable pens are usually placed on clean permanent pasture with good drainage and a thick sod that serves as bedding for the calves. It is best to move the pens on a rotational basis every one to two weeks or as often as needed.

**GROUPING HEIFERS**

Ideally, heifers should be placed in groups of 10 to 12 heifers per lot as soon as they are removed from individual pens. In most operations, this occurs at two to three months of age and provides ease in observing the heifers and detecting problems. Also, heifers tend to be more competitive at the feed bunk and, as a result, grow faster. As heifers become ready to be put on pasture at 5 to 6 months of age, larger groups are more desirable.

**Preparation for Grouping**

Before calves leave the individual pens, they should be dehorned, identified and extra teats should be removed.

Dehorning is a necessary surgical procedure in dairy calves. When performed early (at less than one month of age) setback is minimal. However, if the calf is near weaning age or beyond, dehorning can be particularly stressful. The preferred methods are burning the horn buds with an electric dehorner, or surgically removing them with specially designed dehorning gouges. Both of these instruments can be bought from most livestock supply companies. An alternate method of horn removal is chemical cautery. This must be performed with great care in order to confine the caustic material to the horn bud area. Not uncommonly, calves will rub their heads on surrounding structures and inadvertently spread the caustic beyond the horn bud area, causing severe chemical burns to the head and face. When using caustics, calves should be isolated to eliminate contact with other calves.

The method chosen will determine the age at which dehorning is performed. Burning of horn buds can be done as early as one to two weeks of age on some calves. On others, horn buds may not be distinct until three to four weeks of age or older. Surgical removal requires a discernible horn bud. With either method, failure to burn or remove an adequate amount of the underlying horn bud tissue may result in the development of horn scurs. Aside from being unesthetic they can be troublesome and later require surgical removal. The best time to remove horns is when the calves are about one to two weeks old or as soon as the buttons can be distinctly felt.

Identification may be accomplished with commercially available numbered plastic ear tags as well as tattooing a number in the ear.

Removing extra teats is sometimes necessary because occasionally heifer calves are born with one or more extra teats. Later, these detract from the appearance of the udder and may interfere with milking. Removal of these extra teats is conveniently performed at the same time as dehorning or at least before the calf reaches six months of age. Disinfect the cut area with tincture of iodine or another antiseptic. If the extra teats cannot be readily distinguished or are attached to one of the regular teats, consult a veterinarian about removal.

**Age-Based Grouping System**

The following suggests a possible grouping system for replacement heifers:

- **Weaning age to six months.** This group requires special attention and feeding to grow well. Vaccination programs for bangs and blackleg may be needed.

- **Six months to nine months.** These calves need grain supplementation and good pasture.

- **Nine months to breeding age.** This group may do well for short periods on quality forages and a mineral supplement. However, some rain may be needed for good growth.
• *Breeding age to springing heifers.* Heifers in this group require special attention for breeding and mammary development.

Provide adequate eating space for all heifers. Usually, 12 inches of manger space is needed for young calves and 18 inches for older heifers.