

General Management Practices – from Heifer to High Producing Dairy Cow

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Each stage in an animal's development is important but there are three main parts in managing females for reproduction. Develop a proper nutritional balance for **growing heifers, post-partum cows** and **transition cows** (late- lactation stage + dry period). Profitable dairy operations achieve a balance between high production, good health, and successful reproduction. Good performance in all three areas is necessary for high economic returns.

1- Heifers

Grow out heifers in a year-round program to meet your breeding schedule, no matter when you calve. Healthy, productive herd replacements are the result of good management that starts before the calves are conceived and continues until they enter the milking herd. Keep accurate records to ensure that a sound breeding program is followed. The entire process ensures that genetically superior animals will enter the herd with the maximum potential for milk production.

Feeding stages of Heifers to be inseminated at 14 months

- 3 days colostrum
- 4 -7 days colostrum surpluses or whole milk
 - Starter concentrate + high quality hay (hay is optional)
- Days 7 to +/- 60 powdered milk or discarded milk (not mastitis or antibiotic milk for milk breeds)
 - Starter concentrate + high quality hay – feed freely
- Weaning at +/- 60 days
- Dry high protein ration until 3.5 - 4 months – feed freely
- Milking cow's ration until 6.5 – 7 months – feed freely
- Heifer ration 1.4 NEL/ 14% protein until age 12 months - feed freely
- Heifer ration 1.35 NEL/ 12.5% protein until 3 weeks before calving – limit quantity (9 – 11 kg dry matter) to avoid fat animals.
- Last 3 weeks of gestation feed dry cow ration.

This allows these females a high quality menu. It keeps weight gain up and allows the heifers to develop the proper muscle tone that a mature animal needs to develop. Monitor weight and height at all stages, remember that optimum growth rates are not the same as maximum growth rates. Use Penn State Heifer Growth Charts as an efficient monitoring tool.

On many dairy farms, heifer management does not receive necessary attention. Neglect of precise nutrition requirements and preventive health care can lead to stunted growth. This results in heifers that calve much later than 24 months of age and that produce considerably less milk during their lifetime than those that are properly fed and well grown.

Undersized heifers not only are smaller and less productive, but they also are prone to more problems at calving.

On the other hand, accelerating the growth of heifers until they become fat also reduces their lifetime milk production and longevity. Overfeeding concentrates or high-quality forages can cause this condition. Published research studies show that excessive energy intake before breeding can decrease the rate of development of the secretory tissue in the cow's mammary gland and thereby reduce the number of alveolar cells available for milk synthesis. Feeding to achieve accelerated growth rates after breeding does not appear to hinder mammary development. Optimal secretory tissue development also can be aided by ensuring that heifers receive an adequate level of protein before breeding and allows the animal to be ready to breed according to your schedule.

2- Late lactation

Monitor body weight and BCS of cows during late lactation, prior to the dry period. Feed energy converts to body reserves with a greater efficiency (70 to 75 percent) in late lactation than during the dry period (only 55 percent). In late lactation the cow begins to regain weight lost during early lactation. Cows should be in good condition at dry off, the ideal body condition score is 3.00 to 3.50 on a scale of 1 (very thin) to 5 (very fat).

Potential Problems:

- Fat cows - Avoid fat cow syndrome
 - postpartum metabolic disorders
 - fatty liver
- Thin cows
 - inadequate reserves after calving
 - dry period becomes crucial

3- Dry cows

The accepted view is that cows with less than 60 or more than 70 days of dry period have been shown to have problems that carry over to the following lactation. The effects of the length of dry period on performance in the next lactation differ in various herds, in various lactations and for different cows. We have come to see that each herd must be analyzed separately and that there is no universal truth – each herd has its own "truth". The limits of 60 to 70 days dry period should be used for guidance only, BCS at drying off should be considered. Optimal drying off dates could be set for each herd from the analysis of the lactation curves.

We set the target at 60 days, because in most herds cows dried for periods shorter than 60 days produce less milk in the next lactation. Short dry periods are the possible outcomes of:

- a. Early calvings.
- b. Drying off policy adapted to milk quotas.
- c. Errors in setting up dates for drying off.

Cows with more than 70 dry days produced less milk than their peers with a dry period of 60-67 days and were more prone to metabolic disease which also caused a delay in conception.

Far-off dry cows

- Maintain body condition throughout the dry period until calving. Avoid fat (BCS 3.75 or greater) dry cows; they are more susceptible to fatty liver and ketosis and consume less feed (energy) upon freshening.
- Be sure to provide adequate calcium, phosphorus, vitamin E and selenium.
- Feed a long-stemmed grass hay with low calcium (less than 0.7 percent) and potassium (less than 1.5 percent) levels.
- Corn silage alone is not an ideal forage for far-off dry cows because the energy content is too high. If corn silage must be fed, restrict the quantity. Feeding excess

concentrates and/or corn silage to dry cows may predispose them to displaced abomasum and fat cow syndrome.

Close-up dry cows

- Expect dry matter intake DMI to decline 5 percent per week two to three weeks prior to calving and by a total of 30 percent the last three to five days prior to calving.
- Limit calcium (less than 0.7 percent calcium in ration dry matter) and provide 45 to 50 grams phosphorus per day (less than 0.35 percent in total ration dry matter). Limit alfalfa which has been associated with milk fever and calcium levels that are too high.
- Adjust close-up dry cows to the forthcoming lactation ration by introducing silage and/or haylage to the diet. However, it is not recommended that the entire lactation total mixed ration (TMR) be fed to close-up dry cows, but rather feed a "special" close-up dry cow TMR to these cows to ensure a constant forage: concentrate ratio during the time that DMI fluctuates substantially.
- Expose close-up dry cows to all grains and concentrates being fed to the lactating herd. This is necessary to prepare the cow's rumen wall and its bacterial population for the forthcoming high-grain ration. **Avoid mineral supplements.**
- Dry cows should not lose weight during the dry period, particularly during the last 10 to 14 days prior to calving. Cows that lose weight at this stage deposit excessive amounts of fat in the liver predisposing them to fatty liver syndrome.

Dry period recommendations

To ensure the correct body condition score at calving by:

1- Cows should be presented for examination not later than 205 days pregnancy. Cows should be dried off according to their body score at 205 days. "Standard" cows (BCS 3.25 and more) will be dried off between 212-217 days pregnancy. Thin (3.00 and under) will be dried off between 207 and 212 days. Avoid drying off before 207 days of gestation. Carry on milking low yielders as long as possible, even by milking once daily. Pregnancy check and vaccinations could be carried out at the time of the BCS.

2- Feed cows with a whole mixed ration of 12% CP and 1.35 MgCal Nel/kg DM ad lib. Roughage should be long and at least 60% of DM. If possible avoid daily amount of more than 50 grams calcium. Do not overgrind the feed.

3- Steam up cows before the expected calving date:

a- Heifers for 21 days.

b- Cows \leq 3rd lactations with BCS \leq 3.00 for 35 days.

c- Cows with BCS \geq 3.25 for 21 days.

d- Cows \geq 4th lactations for 7 days.

Steaming up ration could be on the basis of the dry cows ration with an additional 15% of the lactating cows ration. Do not overgrind the feed. Analyze the feed for NaCl to detect the cause of the udder edema in heifers.

4- Avoid the present practice of feeding straw after drying off.

4- Post partum cows

Body condition is important. Cows that are too thin (less than 3.0 BCS) at calving lack milk yield persistency and have inadequate energy reserves for efficient reproduction. Over-conditioned cows, on the other hand, are prone to the metabolic disorders of ketosis, displaced abomasum, dystocia, retained placenta, uterine infections, cystic ovaries and delayed uterine involution. In all cases, depressed appetite leads to lower production, higher weight loss, poor reproduction and increased days open.

If logistics permit, keep post-partum cows in a separate group on a Start-up ration for 4 – 7 weeks. Strive for peak feed intake as soon as possible. Feed only high quality forage to fresh cows, ensuring adequate fiber levels and effective length. Repeatedly push up feed to cows several times a day. This activity stimulates appetite and encourages maximizing DMI.

Factors hindering the optimal performance of Fresh Cows

Twins. Multiple births.

a. Major factors responsible for twinning in a specific herd are usually not known, and therefore cannot be controlled. Most other calving traits, and future fertility and production are adversely affected by birth of twins.

b. Effects of genetic lines, nutritional aspects, hormonal treatments before AI, BST, and use of specific bulls should be investigated in severe cases.

Stillbirth. Calves that are either born dead, or die within 24 hours of calving as the result of calving.

Risk factors for stillbirth could interact or act on their own. They are:

1- Disproportion between the size of the fetus and that of dam's birth canal due to:

a) Small heavy heifers or overconditioned (mainly of second lactation) cows.

Overconditioning at calving should be related to different stages of the heifer's life, to BCS at drying off, and to dry cows' and steaming up rations.

b) Unsuitable sires. They exert their effect through oversized calves, prolonged gestations, or unsuitable (beef) breeds.

2- Bad calving management due to

a) Ignoring the calving cow (mainly during night).

b) Wrong intervention policy (too early or too late).

3- Infectious or deficiencies diseases.

The more common ones are of vitamin A deficiency (mainly in heifers) and intrauterine infection with BVD. Stillbirths associated with short gestations and malformations calls for investigation in that direction.

(Milk Fever) Parturient paresis. Clinical hypocalcemia before, during or after calving.

Represents a tip of an iceberg of other calving diseases associated with hypocalcemia, and should be evaluated in that respect as well.

Main risk factors are:

1- Dry cow ration high in calcium. a low calcium diet in the dry period (below 60-gram calcium/day) will keep milk fever at a very low level

2- Long periods of steaming up in older cows.

3- An excessive feeding of cations, which leads to a grossly positive Cation Anion Balance in the dry cow rations.

Uterine prolapse. This could be the possible outcome of:

a. Subclinical hypocalcemia.

b. Dystocia.

c. Over or under-conditioning at calving.

Displaced abomasum. Any left or right displacement of the abomasum diagnosed in the first month after calving. This is a direct outcome of a drop in the rumenal pH resulting from mistakes (mainly associated with ADF and fiber amount and quality in the dry cow, steaming up, or the fresh cows' rations. Transition between two rations is often critical.

Retained placenta. Any placenta retained longer than 18 hs from calving.

Season and parity have great effects on the incidence of the trait, and should be confounded in any causal analysis. Retained placenta could be the outcome of:

1- Dystocia (mainly in heifers).

2- Twinning.

3- Premature terms resulting from induction or infectious diseases.

4- Deficiency of protein in the dry period or poor BCS at calving.

5- Deficiency in Selenium, vitamins A or E.

6- Subclinical hypocalcemia.

Primary metritis. (Not associated with retained placenta).

- a. Diagnosed in a routine examination 5 to 21 days postpartum.
- b. The common factors responsible for metritis are:
 - 1- Missed cases of retained placentae.
 - 2- Over or under-feeding in late lactation or in the dry period.
 - 3- Overconditioned heifers (mainly small ones) that are raised on high energy - low protein ration.
 - 4- Dystocia, over involvement of herdsmen, and bad hygiene in calving.

Ketosis. Cows with ketonuria in concentrations of ≥ 1.5 mmol/l, before or after calving.

a. We advise to check all calving cows for ketosis only in problematic (metabolic) herds and for definite periods. Otherwise examine cows with high risk for the disease:

- 1- All sick cows.
- 2- Those that yield less than 25 kg of milk on the day before the postparturient examination (5 to 12 days from calving).
- 3- Dried off in BCS of ≥ 3.75 .
- 4- Dry for more than 70 days.
- b. Ketosis could be the outcome of:
 - 1- Negative energy balance before calving. Gaining or losing weight (as in twins pregnancy) might end in ketosis.
 - 2- Negative energy balance after calving due to insufficient feeding, as secondary to other calving diseases, or due to inadequacy of liver function.

Calved with mastitis. Heifers or cows that calved with clinical mastitis, or developed one in the first week after calving. This could be the outcome of:

- a. Infection in heifers.
- b. Infection during the dry period.
- c. An unsuccessful dry cow therapy.

Cows with dry period longer than 70 days. We set the target at 70 days, because in most herds cows dried for periods longer than 70 days suffer from lower fertility in the next lactation. Long dry periods are the possible outcomes of:

- a. An early drying off due to:
 - 1- Lactation curves with lower peaks or poor persistency.
 - 2- Long open-periods.
 - 3- Drying off policy adapted to milk quotas.
- b. Errors in setting up dates for drying off (sometimes not taking into consideration pregnancies sired by beef bulls).

The indice is of both future health and economic importance, and is used here for monitoring only.

Cows with dry period shorter than 60 days. We set the target at 60 days, because in most herds cows dried for periods shorter than 60 days produce less milk in the next lactation. Short dry periods are the possible outcomes of:

- a. Early calvings.
- b. Drying off policy adapted to milk quotas.
- c. Errors in setting up dates for drying off.

The effects of the length of dry period on performance in the next lactation differ in various herds, in various lactations and for different cows. The limits of 60 to 70 days dry period should be used for guidance only, BCS at drying off should be considered. Optimal drying off dates could be set for each herd from the analysis of the lactation curves.

Induction of calving.

- a. High rates of induction might point out to:
 - 1- Breeding with unsuitable bulls.
 - 2- Overconditioned heifers.
 - 3- Over-active herdsmen.

4- Mistaken parameter in the computer. The mean gestational length for the Israeli Holstein was 275 days in 1993, but 278 in 2005 and should be calculated for each country.

5- Mean gestational length of cows inseminated by beef bulls is longer (about 282 days).

- b. Potential damages of induction (retained placenta and at times impaired production) should be weighed against those that will occur if heifers are not induced (stillbirth, culling and retained placenta).

Edema.

- a. The disease increases the rate of metritis, mainly in heifers.
- b. Caused mainly by an excess of NaCl in the steaming up ration.

Calved with BCS ≥ 4.00 . Scoring is carried out in the postparturient examination (5 to 12 days postpartum) in the scale 1 to 5.

- a. Overconditioned cows are rare in the present high yielding herds.
- b. Effects of BCS in first lactation cows should always be considered together with their respective heights.
- c. Over conditioned cows tend to suffer more from metabolic diseases and poor fertility.

Calved with BCS ≤ 3.00 . Scoring is carried out in the postparturient examination (5 to 12 days postpartum) in the scale 1 to 5.

Underconditioned cows produce less milk (mainly fat), and at times suffer from adverse fertility.

Lost ≥ 0.5 units of BCS in the dry period.

- a. Cows that lose score in the dry period are at greater risk of:
 - 1- Retaining the placenta.
 - 2- Being culled.
 - 3- Suffering from inactive ovaries and adverse fertility.
 - 4- Producing less milk.
- b. Heavier cows at drying off lose more weight in the dry period. Main reasons for losing weight in the dry period are:
 - 1- Dry cow ration deficient in quality or in quantity.
 - 2- Errors in steaming up time or ration.

Gained ≥ 0.25 units of BCS in the dry period.

- a. With the present BCS of the drying cows most cows will benefit from gaining weight in the dry period. Milk production will increase in the next lactation. Situation could be different in cows drying off with BCS of ≥ 4.00 .
- b. When group fed on a ration that is not TMR, overconditioned cows eat more than their share.

5- Nutritional Management of the High-Producing Dairy Cow

Grouping Strategies

Feeding Systems

Body Condition Scoring

Production Records

Nutritional Strategies for Feeding the High-Producing Cow

Nutrition Requirements for High Milk Production

An effective feeding system allows maximum intake of a nutritionally balanced ration. The use of production-enhancing compounds, such as Bovine Somatotropin (BST), makes proper nutritional management of high-producing dairy cows even more critical. This NebGuide discusses important aspects of grouping and feeding systems, body conditioning, and nutritional requirements for high-producing dairy cows.

As herd production levels continue to increase along with the average herd size, it is becoming more difficult for many dairy producers to feed their cattle adequate nutrients to maintain high production. Within a given herd a producer usually has cows at varying production levels and lactation stages, all of which require different ration formulations and energy levels if the cattle are going to produce at optimum levels. Also, proper nutrition is required early in the lactation to prepare the cow's reproductive system for conception and pregnancy. Proper nutrition is also important if cattle are to ward off infections, such as mastitis and metabolic problems. A properly nourished cow will be in better physical condition to handle stress and other physical challenges. Therefore, the feeding system must undergo significant modification as production levels increase, not only for the producer to maintain profitable production, but also for the physical well-being of dairy cattle.

Grouping Strategies

Several management and physical changes may be needed in the dairy operation to adequately feed the high producing cow. One of the most effective ways to feed cattle to their production potential is to group them. There are several criteria to consider when grouping cattle. The more common grouping methods are:

1. by milk production level,
2. by age or lactation number,
3. by days or stage of lactation, and
4. by reproductive status.

All four methods have advantages and disadvantages, but grouping by production is most recommended if one is to gear the cows to their optimum nutrient requirements. If cows are grouped by production level, rations can be specifically formulated for given milk yields. This allows feed inventory to be used more efficiently since top quality feeds can be targeted for the top cows and poorer quality feeds can be fed to low producers.

Grouping by production levels also offers the advantage of being able to better manage feed allocation so as to not underfeed top producers or overfeed low producers. Of course, having three or four groups also increases the time needed to balance rations; however, the increases in milk yield and persistency far outweigh the disadvantages of formulating more rations.

Another system is to group cattle in quartiles. This means grouping the top 25 percent of the herd for production in one group, the second 25 percent of cows in the second group, and so on. Many producers also like to separate the first lactation cattle so that they can be more closely monitored during early lactation and then regroup them into production groups as they near mid lactation. Of course, dry cows should always be managed in a separate group so that they are not over fed and become fat (over conditioned). This will help prevent several health problems associated with obesity.

Grouping herds by production also can result in efficient use of the milking parlor since groups should milk out more uniformly. Also, the reproduction checks, breedings and pregnancy checks will tend to be concentrated in the higher production groups, thereby increasing the efficiency of both veterinarian herd health checks and routine reproductive checks.

Grouping Strategies Conclusions:

- Separate first lactation cows. The general recommendation has been, where possible, to milk first lactation cows before older cows who could be carrying sub-clinical mastitis infections. First lactation cows are still growing and their nutritional needs differ.
- Group cows by DIM, as cows calve fill groups. These groups will have more homogeneity in their nutritional needs than with any other system. This also facilitates the logistics of Inseminations and Vet Checks.
- Avoid group changes as much as possible, aside from exceptionally low producers and cows at the end of their lactation. Cows are most susceptible to group change around peak time. Cows movement in the first 30 days of lactation will have the least negative effect on production potential. If you use a Steam-up group from 0-30 DIM, these animals will not suffer when they are moved to the "general population", as long as they are moved in small groups and not individually.

Feeding Systems

Four commonly used feeding systems include bunk, grain feeding in milking parlor, computerized grain feeder, and a total mixed ration (TMR).

The advantages of feeding cows in a stanchion or tie-stall include tight control of grain fed, easy detection of off-feed cows, and ability to easily supplement high producing cows with more grain. Disadvantages include high labor requirements, the potential for cows selecting only certain portions of their total diet, and the difficulty of using baled hay.

Many producers feed some or all of the daily grain allotment in the milking parlor. This is particularly true in Pasture farming. This practice allows grain feeding to be mechanized and makes individual cow feeding possible. However, time spent in the parlor is short and might limit the quantity of grain a high-producer could consume. Feeding grain in the parlor requires more equipment and causes more dust, increased defecation and slower exit times. Allowing the cow to consume her total grain allotment could slow the milking operation considerably. When feeding grain in the parlor, the number of feedings per day is obviously limited to the number of times cows are milked.

Another excellent way to individually feed cows the concentrate portion of the ration is to use a computerized feeding system. It can regulate the grain (concentrate) intake for specific milk production levels. Individual cow allocation can be automated according to an array of parameters such as: Milk Yield, DIM, % of Milk from Body Weight, Pregnancy days and more. An efficient computerized feeding system eliminates the need to group cows by production, DIM or any of the other parameters used in a TMR regimen. We know that in each group being fed the same TMR there are great differences between the cows. The cows MY, BW, DIM, milk components, lactation number can vary greatly. In any group of milking cows the "exceptions" can reach 40%. Fat cows with lower yields, thin cows with high yields, cows that haven't reached their peak and cows which have. The system deals with this issue through individual feeding thus compensating very high production cows and allowing them to reach their full potential without overfeeding others. Another advantage is the increase in the number of daily feedings. The more often a cow consumes feed, the more efficient her rumen function and nutrient use

A TMR (total mixed ration) feeding system should theoretically do the best job of stabilizing rumen function. In essence, every mouthful of ration the cow consumes contains a balance of the required nutrients for her level of milk production. With all components of the diet mixed together, there is no need for free-choice minerals or separate grain feeding. Unpalatable feeds are masked or diluted, and non-protein nitrogen such as urea is consumed more slowly.

Feeding System Conclusions:

- The bottom line is that regardless of the feeding system used, **a complete** adequate ration is a precise combination of all needed dietary ingredients, formulated to specific requirement levels, and offered ad libitum.
- Modern dairy farming is getting away from Tie-stall barns. Computerized Feed Systems with Self-feeders in the barns are manageable only in small to mid-sized dairy farms.
- In Parlor feeding of concentrates is a good choice for Grazing based farms. It allows for more flexibility in the face of the precariousness of an all grass system. It allows for increased milk production and better control of animal conditioning thus improving health and fertility.
- TMR is the prevalent system for the reasons cited above and it is also the least labor consuming system for cows in stabulation.

Body Condition Scoring

An important component of any feeding system is to properly monitor the body condition of cows at various lactation stages. Body condition should be recorded during the first two weeks of freshening. Routinely recording a body condition score on your herd will be a valuable aid in monitoring your nutrition program. The first two months of lactation are critical. Milk production peaks at a lower level in under-conditioned cows. Over conditioned cows are susceptible to metabolic disorders, diseases, mastitis and reproductive problems. Body condition scoring is subjective, a well trained person from the staff or the Vet (if possible always the same) should record BCS. Monitor BCS around the start of breeding (40-60 DIM) and before dry-off (195-210 days pregnant).

Recommended body condition scores at various stages of lactation are:	
Calving	3.0 to 3.5
Breeding	2.5
Late lactation	3.0 to 3.5
Dry period	3.0 to 3.5

Production Records

To have an effective nutrition program, it is essential to have accurate routine production records. Production records are obviously important if cows are to be grouped by production. They also are necessary for fine tuning the nutrition program for individual cows. In addition to milk production data, milk protein and fat data are needed. The amount of protein and fat that a cow produces also will affect the energy requirement in the diet. Another important component in many ration balancing programs is body weight. Accurate body weights are needed to be certain that the ration is producing enough nutrients for both production and body upkeep. Computerized Herd Management Programs combining animal events and "Real Time" data from parlors with electronic Milk Meters are the preferred tools for monitoring Production. Daily records of milk yields are much more reliable for decision making than random Test day milk data. Another way to obtain accurate production data as well as body weight information is to enroll in a Dairy Herd Improvement Production Testing System. Simply give your local DHI supervisor a call and have the supervisor visit your herd and see how easy it is to have a production test. The overall best approach is to use a Computerized Herd Management Program, Milk Meters and DHI test as well. The main advantage of the link to the DHI is for Sire and Genetics data.

Nutritional Strategies For Feeding the High-Producing Cow

Dairy cows in early lactation will be in negative energy balance. That is, the cow does not consume enough nutrients to meet the energy demand of lactation. Dry matter intake typically lags behind peak milk production by eight to 10 weeks, resulting in a loss of body condition. Anything which will increase feed intake will increase production. Maximizing intake will be especially critical for BST-treated cows due to their high milk production level.

Many management factors may enhance feeding activity and increase intake. One of the most critical factors affecting feed intake is the availability and timing of feeding. Feed and water should always be available when the cow wants them. Shading of the feedline will enhance intake by reducing silage heating. Feedlines should be kept clean to avoid spoilage and subsequent reduced intake. Feeding frequency and sequence of feeding play major roles in determining how well a balanced diet will support high levels of milk production. Minimize the amount of leftover feed to an acceptable amount of +/- 1kg per day. Leftovers should be removed on a daily basis and can be used as part of the older heifers' ration – do not exceed 5-7% of the total heifer ration. This feeding approach has been shown to increase milk production and milk fat test. Manage stress by using shade, sprinklers and fans to improve reproductive performance. The most common guideline for diet formulation is the National Research Council's (NRC) publication, *Nutrient Requirements of Dairy Cattle, 2001*. This publication provides equations to compute nutrient requirements for any size cow and milk production level and any stage of the life cycle. Therefore, actual dry matter intakes and a computer program that includes NRC and/or other research based equations should be used to formulate diets. Test feed stuffs on a regular basis and adjust your rations accordingly. In a Computerized Feed System feeding forage before grain and/or concentrates, especially in the morning, promotes saliva production so the rumen is buffered and ready for the concentrates. The concentrate portion of the diet should be fed as often as practical to minimize digestive problems (acidosis) and enhance milk production.

Nutrition Requirements For High Milk Production

The nutritional requirements for a 1,300-pound dairy cow producing 4.0 percent fat milk at various production levels is given in *Table I*. Considerations specific to the high-producer are discussed below.

Energy

High quality forage is necessary to meet the energy requirement for the high producing dairy cow. In general, this means using an alfalfa forage of 18-20 percent crude protein and good quality corn silage. If high quality forage is unavailable in the necessary quantities, increase the diet's grain content. Diets containing more than 50 percent grain (dry basis), however, may cause metabolic disturbances resulting in less milk fat, rumen acidosis, and laminitis. To avoid these problems, work closely with your nutritionist and vet on balancing rations to fit your cows' production levels.

Protein

The crude protein content of the total diet required for high levels of milk production (90+ lb/day) may exceed 16 percent to 17 percent. It is necessary to meet the total crude protein requirements, as well as the undegradable crude protein requirements ("escape" or bypass" protein). In general, 35 percent to 40 percent of the dietary crude should be undegradable in the rumen to maximize milk production. Common sources of escape protein include heat treated soybeans or soybean meal, distillers grains, feather meal.

Fiber

The fiber levels given in *Table I* are minimum levels required in the total ration. When diets contain less than the recommended fiber level, metabolic disturbances, such as milk fat

depression, may result. The fiber requirement for high milk production is not only a matter of level, but of particle size as well. Forage which has been too finely ground will not maintain normal rumen function and milk fat test.

Specific nutrient requirements for all production levels are given in the National Research Council's publication *Nutrient Requirements of Dairy Cattle 2001*. This information is available through area cooperative extension offices and some feed companies.

Table 1 Selected nutrient requirements of dairy cattle (as determined by sample diets)¹

Holstein, 1,500 lb cow, avg. body condition, 65 months of age Milk yield, lb/d =	-----Stage of production-----						Dry, preg. 270 days in gestation BW=1,656 lb	660 lb heifer @ 1.91 lb gain/day
	--- early lactation ---		-----90 days in milk-----					
	55	77	55	77	99	120		
Dry matter intake, lb/d	29.7	34.3	44.7	51.9	59.2	66	30.1	15.6
Net energy, Mcal/lb	0.94	1.01	0.62	0.67	0.70	0.73	0.48	1.03
Diet, % RDP	10.5	10.5	9.5	9.7	9.8	9.8	8.7	9.4
Diet, % RUP	7	9	4.6	5.5	6.2	6.9	2.1	2.9
Crude protein, % ²	17.5	19.5	14.1	15.2	16.0	16.7	10.8	12.3
NDF, min %	25-33	25-33	25-33	25-33	25-33	25-33	33	30-33
NFC, max %	36-44	36-44	36-44	36-44	36-44	36-44	42	34-38
Calcium, %	0.74	0.79	0.62	0.61	0.67	0.60	0.45	0.41
Phosphorus, %	0.38	0.42	0.32	0.35	0.36	0.38	0.23	0.23
Potassium, % ³	1.19	1.24	1.00	1.04	1.06	1.07	0.52	0.48
Sodium, %	0.34	0.34	0.22	0.23	0.22	0.22	0.10	0.08
Copper, mg/kg ⁴	16	16	11	11	11	11	13	10
Zinc, mg/kg	65	73	43	48	55	65	22	27

1 Adapted from tables 14-7, 14-8, 14-9, and 14-16, *Nutrition Requirements of Dairy Cattle*, 7th revised edition, 2001, National Research Council (NRC), National Academy of Sciences, National Academy Press, 2101 Constitution Ave., Washington, DC 20418 (J.H. Clark, chair, Subcommittee on Dairy Nutrition).

2 Equivalent to the sum of rumen degradable protein (RDP) and rumen undegradable protein (RUP) only when they are perfectly balanced.

3 Heat stress may increase the need for potassium.

4 High dietary molybdenum, sulfur, and iron can interfere with copper absorption, increasing the requirement.

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