Nutrient requirements of dairy cattle

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Old saying..

”It is the farmers eye that fattens the stock”

Dairy cattle

- require some concentrates until the age of 12 mo, although forage can supply an increasing percentage of the ration after 6 mo.
- Concentrates are needed for lactating cows to complement forage nutrients.

- Concentrates do not completely compensate for lack of quality in forages fed to high-yielding cows.
- In determining the amount and kind of concentrate mixture needed, it is essential to know what types and amounts of forage are available; a concentrate can then be selected that will supply the amounts of additional nutrients needed at lowest cost.

- Hays and silages of the same species vary greatly in composition, depending on the stage of maturity at the time of cutting and curing and on preservation methods.
- Although the precise nutrient value of a hay or silage cannot be known without chemical analysis (or even a feeding experiment), its approximate value can be estimated, and a concentrate mixture of appropriate composition can be made or purchased to balance the forage available.

- Forage-testing services available either through commercial feed-testing laboratories or local feed companies can provide more precise information as to composition and should be used whenever possible.
- High-protein feeds such as soybean meal, cottonseed meal, and canola meal usually are higher in price than cereal grains.
- Therefore, it is generally more economical to use concentrate mixtures as low in protein as possible while supplying an adequate amount of amino acids.

- Simple mixtures can be as effective as complex mixes, provided RUP, RDP, and amino acid balance are considered.
- Byproduct feeds (such as distiller's grain and brewer's grain) provide economic advantages.
- Palatability and nutrient content, rather than the number of ingredients in a mixture, largely determine the value of feeds for dairy cattle.
- Minimizing dustiness and fine feed particles, mixing with silages, adding water or liquid molasses, and supplementing with oil can enhance feed palatability and dry-matter intake.

- Calves should receive colostrum for at least the first 3 days, and then milk or milk replacer at the rate of 10-12% of body wt/day during the first few weeks after birth.
- A new liquid diet program for heifer calves (accelerated system) is an aggressive, growing approach. Calves receive milk replacer containing 28% protein and 15% fat, and consume >1 kg of milk replacer fed at 14-16% of body wt, resulting in growth rates >1 kg/day.

- Traditional milk replacers contain 22% protein and 20% fat, and are fed at the rate of 1 lb of powder/calf/day.
- Heifers fed the new diet grow faster. However, the cost of the high quality and quantity milk replacer increases feed costs.
- Fermented colostrum (mixed 1:1 with water) is also an excellent liquid feed.
- Waste or discard milk from cows with mastitis or another illness is satisfactory if the milk is wholesome (avoid the first milking after udder treatment for mastitis).

- Calves usually can be weaned at 4-8 wk of age or when they are regularly consuming 2 lb (1 kg) of starter daily.
- During the first week, a complete calf starter containing 20% protein (dry-matter basis) with no forage should be offered to young calves.
- They should be allowed free-choice starter up to a maximum of 5 lb (2.3 kg)/day. Calves do not like finely ground or dusty feeds; pelleted or textured grain with wet molasses is recommended.

- They will consume coarsely cracked or rolled grains and protein sources with minerals that are pelleted.
- Forage is not required during the first 2 mo of age if the starter contains a fiber source such as oats, barley, or soy hull (complete calf starter).
- With a coarse starter, calves begin to ruminate within 2 wk.
- When forage is provided, green, leafy, soft-stemmed legume grass mixed with hay is optimal for calves.

- They can be offered hay, but they must consume 2.3 kg of calf starter daily as an energy source (“hay belly” calves may develop if they eat only hay).
- After 3 mo of age, the calf starter can be replaced with a less expensive heifer grower ration containing 16% total protein.
- Pasture or corn silage can be fed to calves after 4-6 mo of age. Well-grown heifers and young stock normally do not need concentrates after 12 mo of age if fed high-quality forage.

- More rapid growth or improved condition results from the addition of 1-1.5 kg of concentrates.
- Feeding 2-3 kg daily is advisable if the forage is of poor quality or limited in quantity.
- Pregnant cows and heifers should receive as much attention just before calving as after. If too fat, they are predisposed to ketosis
- If they are in good condition, and fed at a high level after calving, ketosis tends to be reduced.
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- During most of the dry period, cows in good condition fed good-quality legume-grass forage or pasture require few or no concentrates.
- Feeding all-corn silage (plus protein supplements and minerals) can result in heifers that are too fat at parturition and an increased incidence of left displaced abomasum.

- Two weeks before parturition, cows and heifers should be offered supplemental concentrate up to 3-4 kg/day to allow the rumen to adjust by calving time and to provide added nutrients for colostrum synthesis and fetal development.
- After calving, cows should be encouraged to increase feed intake to minimize negative energy balance and to produce to their genetic potential.
- Abrupt changes in types and amounts of feed offered should be avoided to minimize risk of displaced abomasums.

- Off-feed problems are less likely with complete feeds (total mixed rations).
- A fresh-cow ration can shift nutrient density gradually to minimize acidosis and twisted abomasal disorders.
- If grain is fed separately, an increase at the rate of 0.45 kg/day is optimal for production while minimizing digestive upsets.
- Greater feed intakes are possible if cows are fed concentrates more often (3-4 times a day with a maximum of 2.7 kg of dry matter per meal) and forages several times per day.

- After the peak of lactation, the ration or amount of concentrate should be adjusted gradually, based on the amount and fat content of the milk produced and the quality of the forage consumed.
- Size and age of the cow and her feed intake capacity must be considered in deciding on concentrate allowance.
- Computer programs consider these factors to determine optimal levels of nutrition.

- Cows fed complete feeds or total mixed rations should be grouped by age and production and offered rations ranging from a maximum of 60% concentrate and 40% forage (dry-matter basis) for early lactation cows, to 20% concentrate and 80% forage for low-producing cows.
- When corn silage is a major forage ingredient, <50% concentrate and >50% forage is optimal for high-producing cows. For maximal fat test, the total ration should contain at least 19% acid detergent fiber (ADF) or 28% neutral detergent fiber (NDF).

- However, the optimal levels of ADF or NDF depend on level of milk production, type of forage, and processing of forages being fed.
- Feed consultants, company representatives, and extension personnel can assist in determining best-cost rations.
- All dairy producers should participate in some type of milk-testing association as a means of evaluating their herd and its feeding and management program.

- Feed Additives: Feed additives are ingredients that cause a desired response in a non-nutrient role such as a shift in pH, rumen environment, or metabolic change.
- Several feed additives contain nutrients (eg, sodium in sodium bicarbonate, protein in yeast culture).
- Feed additives are not a requirement for or guarantee of high productivity. *See Table: Feed Additives* for properties that may help determine the use of various feed additives.
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Energy

- Ruminants need a daily supply of all nutrients required for maintenance and production: milk, meat, growth and pregnancy.
- Quantitatively any type of nutrient can limit performance levels, but the most likely to be in short supply are energy and protein, this is especially true for high and average yielding cows.
- Both energy and protein must be considered.

- For energy, the feeding system uses the metabolisable energy (ME) in the feed as a basis to formulate rations.
- The ME is the energy remaining in the digested foodstuffs after the loss in faeces, urine, gases and body heat.
- The basic unit used to measure the energy content is the MegaJoule (MJ).

Protein

- The digestible crude protein (DCP) is widely used to evaluate protein requirements, and it corresponds to the crude protein that remains after losses in the faeces.
- However, a system has been introduced which takes into account the degradability of the protein in the ration during digestion.

- It is a better system to calculate requirement levels, especially for high-yielding cows which have been shown to benefit from protein that escape microbial degradation in the rumen and is absorbed as amino-acids in the small intestine.
- Following this approach crude protein can be split into Rumen degradable Nitrogen (RDN) and Undegraded Dietary Nitrogen (UDN). Fish meal is for example considered as a good source of UDN.

- Inorganic nitrogen sources from plants as well as other non-protein nitrogen, such as urea, are completely degraded by microbes in the rumen.
- Hence, the RDN is broken down by rumen microbes and used for their protein synthesis by the microbes.
- Later in the digestion process the microbes are themselves digested and the microbial protein becomes available to the animal

- Nevertheless this microbial synthesis is only optimal when the animal receives sufficient energy supplements.
- Therefore, if sufficient RDP is not available, the rate of digestion of fibrous as well as concentrate rich diets will be reduced.
- This leads to a reduction in intake, lower energy supply and reduced milk production.
- On the other hand, some protein nitrogen can resist microbial breakdown in the rumen and can pass directly to the cows intestine.

- This feed protein fraction is called by-pass protein which is especially profitable for high-yielding cows.
- At a low level of productivity a cow can meet her protein requirements entirely from microbial protein and the diet only needs to contain degradable protein.
- This explains why such a cow can be fed with urea or chicken manure instead of high quality protein can meet the protein requirements. It is therefore important to have the optimum balance of UDP and RDP in the diet. Figure HYPERLINK illustrates the increasing requirements for both as milk yield increases.

Minerals and Vitamins

- The major mineral requirements for dairy cows are calcium and phosphorus.
- The calcium phosphorus ratio is important, and an imbalance can cause infertility.
- There are reserves of both elements in the skeleton.

Pasture

- Often deficient in minerals, mainly in phosphorus.
- In some grazing areas, dairy cows are subject to a mineral deficiency (especially during lactation),
- Obvious phosphorus deficiency symptoms are frequently observed (probably caused by very acid soil); these symptoms include sore legs, animals will limp, show long hooves and depraved appetite (pica).

- Seashells and fish meal are good mineral sources.
- Magnesium is frequently required to prevent hypomagnesaemia on grazing animals.
- All the required minerals can be successfully incorporated in feed blocks supplements.
- Animals feeding on green pasture normally receive all vitamins that are needed.

Vitamin supplements

- Often added to balanced rations prepared as feed to be used in animals housed and reared in intensive systems.
- Vitamin A is one of the most important vitamins in animal nutrition.
- This vitamin is found in the carotenoid pigment of green plants
- Vitamins D, E and K are also present in green plants.