MINNESOTA FEED SERVICE

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Variations in Nutrient Value of Feeds

Ralph W. Wayne

If you're advising dairymen on feeding, it is important to know the nutrient value of the feeds in his dairy ration. Some values vary much more than commonly thought. Alfalfa hay is no longer just alfalfa hay, and there is great difference in the nutrient value of silage.

The amount of total digestible nutrients (TDN) has long been used as a measure of a feed's energy value. This is not the best criterion, because it measures only what the cow does to the feed. It is the part of the feed held back in the cow's digestive system—the difference between what is fed and what passes through the cow as undigested feed, or feces.

Certain losses are not used by the cow. Some energy value is lost in gases, in the urine, and in heat; this part of the TDN is not available to the cow for maintenance or milk production. When these energy losses are deducted from TDN the remainder is known as estimated net energy (ENE)—the part a cow can use for productive purposes.

So ENE is a much better basis for evaluating the nutrient value of cow feed, especially roughages. The more advanced a plant is in its development, the higher the lignin and fiber content.

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As lignin is almost completely indigestible and walls off much of the cellulose in the plant, the digestibility drops considerably as a plant approaches maturity. Also, more heat is lost during digestion so the ENE drops even more than the TDN. So the nutrients actually available in such cases are lower than TDN figures have shown.

This variation was clearly shown during a 3-year study in which 30 Minnesota dairymen sent samples of each cutting of their hay and silage to the University for study (table 1). Compared to sample 3, sample 1 of alfalfa hay had more than twice the ENE or energy feed value per ton. Practically the same difference is shown between samples 1 and 3 of corn silage.

Obviously, a dairyman feeding samples 1 of hay and silage could provide needed nutrients with the addition of much less grain and concentrates than a dairyman feeding hay and silage like sample 3. Also, the higher quality roughages are usually more palatable so the cows will eat more of them.

Since time of cutting has the greatest influence on the lignin and fiber content of hay and consequently on the final ENE or real feed value, it is of first importance to cut hay early. As the plant matures, more and more lignin develops to "cement in" nutrients so they never become available to the cow.

Table 1. Variation in samples of hay and corn silage

Crop	Dry matter	Fiber	Digestible protein	TDN	ENE
	percent				therms
Alfalfa hay					
Sample 1	92.4	20.2	16.0	71.7	65.1
Sample 2	90.3	29.4	11.3	54.2	40.7
Sample 3	88.3	36.6	10.4	44.2	31.0
Corn silage					
Sample 1	37.5	7.4	1.1	26.4	23.8
Sample 2	28.0	6.7	0.8	18.4	15.9
Sample 3	21.0	4.8	1.4	14.3	12.7

The cropping system on individual farms is determined by many factors—available land, topography, erosion problems, soil fertility, available labor and equipment, etc. The following table is useful as a guide in comparing yields of ENE in order to select the most profitable of several crops grown as feed for dairy cows.

Table 2. Annual crop yield per acre required to produce an equivalent quantity of ENE; yields listed in each column result in the same quantity of ENE

Crop	Yield per acre		
Corn (shelled), bushels	60	80	100
Oats, bushels	129	172	215
Corn (corn and cob), bushels	53	71	89
Barley, bushels	74	98	123
Corn silage (80 bu./acre) tons	6.5	8.6	10.8
Alfalfa hay (early cut), tons	3.2	4.2	5.2

In fully evaluating the nutrient value of feeds in the table above, consider the difference in protein value. Alfalfa hay contains 2½ to 3 times as much protein as corn.

Considerable differences can also exist in the nutritive value of grains. Immature corn and light oats are lower in feed value per pound. The same is true of high-moisture corn.

Pasture in Dairy Feeding

Bill Mudge

For many years pasture has been an important part of the dairy feed supply. As recently as 20 years ago, almost all Minnesota dairymen used pasture for their milking herds. The past 10 years—particularly the last 5—have seen a rapid increase in the number of farms where the milking herd is never on pasture. (See "days pasture" column in the table.) Pasture seasons are not shorter; more herds are on stored feeding. The increased *turn to page 5*

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BEEFSTEAKS FROM FERTILIZER

P. M. Burson, A. L. Harvey, and A. R. Schmid

Beef is a product of the soil, the same as any other crop grown on the farm. Like other crops, its production depends on good soil fertility, good soil management, and proper land use. High quality pastures bring a high margin of return on beef.

But in Minnesota many of the approximately 7 million acres of land used for pasture are in low-producing pastures—hilly, eroded, and low in fertility. This land is aggravated by poor land use, poor or no fertilization, poor seeding mixtures, stand failures, poor grazing management, and improper use by livestock.

In 1951 a project to study the problems of low-producing pastures was established on the Soils Farm at the Rosemount Agricultural Experiment Station. It is directed by the authors and financed by the station and commercial donors interested in good land-use and livestock production programs.

Soil conditions on the experimental pastures are typical of the conditions on permanent pastures in the beef cattle grazing areas of Minnesota. The land is rolling and subject to severe erosion. Three pasture layouts are involved in this study:

1. Forty acres are used for pasture studies including liming, fertilization, renovation, seeding, grazing management, and use by beef cattle. This area is divided into 5 pastures, designated A through E, and arranged so that each is similar in soil type, slope, and degree of erosion.

One-half of each pasture is fertilized and limed according to the soil test and one-half is limed but left unfertilized. One pasture is renovated each year in the rotation of 1 year renovation and 4 years of pasture. If the legume stand remains satisfactory after 4 years of grazing, renovation is delayed 1 or more years.

Beginning at renovation time in 1951, a basic treatment of 500 pounds per acre of 0-20-20 was applied on the original unfertilized area. No more fertilizer will be applied until the pasture is again renovated. The original fertilized area of each pasture receives an annual application of 200 pounds per acre of 0-20-20. No nitrogen is applied to the renovated pastures until the legumes thin out or there is a need to stimulate the growth of grass to provide about a 50-50 composition of legumes and grasses.

2. Thirteen acres divided into eight pastures (designated G1 to G8) in 1956 are used to compare the use of manure, nitrogen fertilizer, and renovation. Each of these pastures also receives an annual application of 200 pounds per acre of 0-20-20.

3. Four acres, divided into 2 pastures, are used to adjust the grazing pressure on the pastures in the regular experiments.

On the basis of soil tests all pastures are limed at the rate of 3 tons per acre, and all show a need for phosphate and potash, which is supplied as 0-20-20.

Where nitrogen fertilizer is used, all pastures receive 60 pounds of actual nitrogen per acre except on the G pastures where 80 pounds per acre is applied. The 80 pounds of nitrogen is considered comparable to the nitrogen contained in 8 tons of manure, both applied annually.

The manure is applied in the fall while all nitrogen is applied in the spring and early summer as split applications at the following times: (1) all in the spring prior to grazing, (2) one-half in spring prior to grazing plus the other one-half about July 1, (3) all about the 1st week in June, and (4) one-half about the 1st week in June plus the other one-half about July 1.

Purposes of the split applications are to determine the best time of application to get the greatest carrying capacity, to reduce early spring waste of pasturage, and to extend the peak pasture season as far as possible into the summer. The July application is generally not effective unless there is above-average rainfall and the season is not too hot.

At present, applying all the nitrogen in early June appears to be the best method. At this period the lush early spring growth is beginning to recede, so the June nitrogen stimulates new recovery growth. If all the nitrogen is put on before grazing, a waste of pasturage results because the cattle are not able to utilize all the pasture. Then later in the summer pasture production drops and a severe pasture shortage may result.

Inherent fertility, seriousness of erosion, moisture-holding capacity, organic matter content, and steepness of slope can determine beef produced per acre. These characteristics were used to compare parts of pastures B and C, all in grass in 1962 and 1963:

> Pastures B and C north were rated as "fair to good" and were fertilized with 60 pounds of nitrogen per acre.
>
> Pastures B and C south were rated as "poor to fair" and were fertilized with 120 pounds of nitrogen per acre.
>
> In 1962 B and C north produced 301 pounds of beef per acre—or 1 pound of nitrogen produced 5 pounds of beef. Pastures B and C south produced 271 pounds of beef per acre—or at double the application rate 1 pound of nitrogen produced only 2¼ pounds of beef.

Table 1. Unfertilized versus all fertilized pastures, 11-year average (1952-63)

	Average pounds of beef produced/acre		Average steer days/acre	
	Unfertilized	Fertilized	Unfertilized	Fertilized
	236	335	110	162
Increase	....	99	....	52

Table 2. Nitrogen fertilizer versus manure versus renovation, 6-year average (1958-63) pasture G

Average pounds of beef produced/acre				Average steer days/acre			
Unfertilized	Manure	Nitrogen	Renovated	Unfertilized	Manure	Nitrogen	Renovated
202	287	306	339	113	154	159	186

Table 3. Average returns per acre over fertilizer cost, pasture G

Year	Unfertilized	Manure	Nitrogen	Renovated
1962	$49.09	$66.05	$63.00	$68.01
1963	42.95	57.69	67.95	70.19
Estimated value per 100 pounds of beef at time of annual field day.				
1962	$23.50			
1963	18.00			

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In 1963 the results were similar, with B and C north producing 356 pounds of beef per acre—or 5.1 pounds of beef per pound of nitrogen —while B and C south produced 314 pounds of beef per acre at double the nitrogen rate—or 2.6 pounds of beef per pound of nitrogen.

During the 11-year period covered in table 1 the estimated average annual price of the steers on pasture at the time of the annual field day in September was $24.19 per cwt. This amounted to about $57 per acre return for beef on the unfertilized compared to about $81 per acre on the fertilized pastures. Average annual cost for lime, nitrogen, phosphate, and potash on grass pastures containing very little legume was $10.17 per acre—or $71 per acre return in beef over soil treatment costs of $13.83 per acre return in beef over the unfertilized pastures.

On renovated pastures the average annual cost for lime, phosphate, potash, seed, and tillage was about $6.60 per acre. Estimating a $6.60 per acre charge for fertilizer, seed, and tillage spread over a 4-year period, this amounted to about $74.40 per acre return in beef over soil treatment and renovation costs or $17.60 per acre return in beef over the unfertilized pastures.

Data in the tables indicate the returns a beef producer might expect if he follows a consistent soil fertility and pasture management program with average quality beef steers.

VITAMIN A IN CATTLE FEEDING

O. E. Kolari

Recent experiment station and field reports indicate an increased incidence of vitamin A deficiency in cattle fed rations considered adequate in carotene content or vitamin A activity. Suggestions made to explain this greater incidence include: (1) increased use of high-grain, low-roughage rations; (2) inefficient utilization of carotene from plants; (3) nitrates in feedstuffs and water; (4) altered thyroid activity; (5) carotene losses in storage and handling of feedstuffs; and (6) other reasons.

This article covers a synopsis of research in each area, a summary of information, and recommendations on feeding vitamin A to cattle.

High-Grain, Low-Roughage Rations

In recent years many beef cattle feeders have increased the amount of grain in the ration to the maximum amount consistent with good health of cattle. Some grains, such as oats, barley, and ear corn, contain adequate "built-in roughage factor," thus eliminating the need for hay in the ration.

Rations composed of barley and/or oats, and plant protein supplements are practically devoid of vitamin A activity. All-ear corn rations fed with a plant protein supplement require supplemental vitamin A, since ear corn contains only about 1 milligram (mg.) carotene per pound.

Arizona studies (1961) indicated that steers fed 10 percent roughage rations lost 64 percent of their liver vitamin A stores in 28 days compared to a 50 percent loss for those fed 55 percent roughage rations. Similar results were reported by Erwin et al. (1963) who noted that hepatic vitamin A expenditure was increased as result of increasing the dietary energy in the ration of steers from 70 to 81 therms per 100 pounds of feed.

The decrease in amount of high-quality roughage in cattle rations partially explains the greater incidence of vitamin A deficiency during the past decade. However, field reports indicate that some cattle fed hay in their rations have shown vitamin A deficiency symptoms and responded quickly to vitamin A supplementation. The Illinois Experiment Station (1960) reported vitamin A deficiency in cattle fed rations considered adequate in carotene content. More recently (1963) they reported nearly complete depletion of liver vitamin A stores in cattle wintered on corn silage rations considered adequate in carotene. Their studies demonstrated that cattle (with an initial starting weight of 900 pounds) failed to maintain their liver vitamin A stores when provided about 57 mg. carotene daily either hay- or corn silage-corn-soybean meal diets.

On the other hand, Ohio researchers (1963) reported that fattening cattle were able to meet their vitamin A requirements from carotene in corn silage. Since vitamin A deficiency has occurred in cattle fed rations considered adequate in carotene, it appears likely that some of the problem may be due to (1) increased destruction of carotene in the gastrointestinal tract, (2) impaired absorption, or (3) decreased ability to utilize carotene.

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Carotene

It has been suggested that corn fed today contains less carotene than formerly. Corn stored for a long time prior to feeding does lose carotene; it may lose one-fourth, or more, of its carotene content after a year of storage. Hay may lose over 90 percent of its carotene content when stored for a similar period of time. Therefore, the carotene content of rations made from old corn and hay may be less than required by feedlot cattle.

The appearance of vitamin A deficiency in cattle fed rations considered adequate in carotene has resulted in renewed interest in the evaluation of the biological value of carotene. By definition, 1 mg. B-carotene is equivalent to 1,666 international units (I. U.) vitamin A for rats. The National Research Council (1963) has adopted a conversion value of 1 mg. B-carotene equals 400 I. U. vitamin A.

The relative value of carotene to vitamin A is known to vary with the level of dietary intake. Early studies suggested a carotene to vitamin A ratio by weight of 6:1 to provide freedom from night blindness and a ratio of 10:1 for significant storage. Recent Connecticut data also clearly demonstrated an increasing ratio of carotene to vitamin A with increasing levels of dietary carotene fed to calves (range, 4:1 to 14.6:1). And several researchers suggested that vitamin A is used more efficiently than carotene by vitamin A deficient cattle.

Nitrates

For several years nitrates in feed and water have been implicated in causing feedlot problems associated with vitamin A deficiency. Missouri experiments (1960) with rats indicated that nitrites adversely influenced the conversion of carotene to vitamin A and liver stores of vitamin A. Arizona studies (1961) suggested a similar trend (although differences were small) in which nitrate interfered with the vitamin A status of cattle.

Illinois researchers (1961) fed corn silage containing 0.16 percent to 0.75 percent potassium nitrate (KNO_3) (dry basis) to 500-pound steers. After 88 days on feed, steers fed the higher nitrate silage had less vitamin A in their livers. After 133 days on feed, liver vitamin A values were equally low for cattle assigned to either high- or low-nitrate silage, averaging 3 micrograms per gram fresh liver.

More recent studies by the Illinois Station (1963) indicated that the feeding of 4 percent KNO_3 to sheep had no effect upon rate of gain or liver storage of vitamin A.

Similar results were reported by South Dakota researchers in 1963. They fed 1 percent sodium nitrate with corn-hay rations to cattle with no apparent effect upon plasma or liver vitamin A or carotene values.

The destruction of carotene in ensiled forage by nitrate was demonstrated by South Dakota researchers (1963). Their results showed that increasing levels of nitrate additions to corn silage prior to ensiling increased the rate of destruction of carotene. They also reported rapid destruction of carotene by nitrite under acid in *in vitro* (test tube) conditions (pH 3); carotene stability was not affected in buffered solutions. However, Kentucky workers (1963) reported approximately similar rates of destruction of vitamin A incubated in either abomasal or ruminal fluid.

In Illinois experiments (1962) supplemental vitamin E or Santoquin reduced rumenoreticular losses of vitamin A. They estimated *in vivo* (body) losses of carotene and vitamin A at about 40 percent in 12 hours.

A pH of 1 to 3 is not likely to occur in the rumen. Under favorable rumen conditions, nitrate is rapidly reduced to ammonia by rumen micro-organisms. In addition, nitrite is absorbed through the rumen wall. These conditions greatly reduce the possibility of significant amounts of nitrite reaching the abomasum except under high nitrate dietary conditions.

The rate conversion of nitrate to nitrite and subsequently to ammonia is more rapid when adequate energy is contained in the ration. When excess dietary nitrate is introduced into the rumen, reduction to nitrite apparently occurs readily. However, further reduction from nitrite to ammonia may be the limiting step and nitrite appears far more effective than nitrate in destroying vitamin A activity. When nitrate is fed in rations in quantities sufficient to produce toxicity symptoms, carotene or vitamin A losses may become of secondary importance.

Altered Thyroid Activity

Researchers have suggested that thyroid activity influences the efficiency of conversion of carotene to vitamin A. Thyroid activity appears related to temperature; activity appears lower under high temperature conditions.

Studies with laboratory animals suggest increased carotene conversion when thyroid activity is stimulated and that the increased conversion is due to triiodothyronine rather than thyroxin *per se*. Some experimental results suggest triiodothyronine increased liver stores of vitamin A; others have noted decreased liver stores. The relationship of hypo- or hyperthyroidism to the physiological requirement of animals for vitamin A is not known. Nitrates have been suggested as being goitrogenic. But research results on the relationship of thyroid activity to the vitamin A status of cattle are conflicting.

Other Reasons

The precise reason for the apparent increase in vitamin A deficiency in cattle is elusive. Other reasons have been suggested to explain the greater incidence of vitamin A deficiency in cattle during the past few years, such as:

1. The presence of oxidizing agents (such as trace minerals, i.e., iron, copper, cobalt).
2. The absorptive effect of some minerals (such as soft phosphate with colloidal clay, sodium betonite).
3. Decreased fat content of rations.
4. Ratio of carotene to vitamin E.
5. Inadequate or excess dietary protein.
6. Phosphorus deficiency.
7. Individual differences between animals.
8. Unknown interfering substances or factors.

It has also been suggested that vitamin A requirements of cattle are increased during periods of stress (temperature extremes, shipping).

Changing farm practices may affect the carotene content of feedstuffs fed. These include: baling hay (often when quite wet); use of bunker silos (greater surface area exposed to air); ensiling forages when drier (wetter products pack better when stored in conventional silos); increased use of fertilizers; and a greater population of plants per acre.

However, some studies tend to refute some of the theories advanced to explain recent feedlot problems with vitamin A. For example: the feeding of trace minerals has not influenced the vitamin A status of cattle; blood carotene and vitamin A values of beef cows fed either hydraulic (5 percent fat) or solvent extracted (1 percent fat) cottonseed meal were essentially similar; plasma carotene levels have been reported higher in phosphorous-deficient beef cows and plasma vitamin A levels appeared unaffected by phosphorous status of the cattle.

Time Required for Depletion

Comprehensive studies (Texas, 1943) showed that the time required for depleting cattle of vitamin A activity depended upon the amount of rainfall, vitamin A activity of the forage, body stores, and age of animals. Lightweight calves grazed on pasture that had received less than normal rainfall during the summer months showed vitamin A deficiency symptoms within 56 days after being placed in drylot. Heavier calves grazing normal pastures required 136 days to show symptoms of vitamin A deficiency.

South Dakota researchers fed yearling steers rations devoid of vitamin A activity and observed vitamin A deficiency symptoms within 50 days. Minnesota experiments have shown that western weanling calves, wintered on high corn silage diets, developed vitamin A deficiency symptoms about 4 months after the start of the high energy phase of feeding. They were fed ear corn, hay, and protein supplement.

Response of Cattle to Vitamin A

Practical feedlot experience has shown that vitamin A deficient cattle respond dramatically to the administration of vitamin A. Usually, cattle show a marked increase in appetite and remission of some of the symptoms of vitamin A deficiency within a few days after administering adequate quantities of vitamin A. Studies show that plasma vitamin A levels increased to normal levels in less than 2 days when fed 36,000 I.U. per 100 pounds bodyweight for 5 days; liver values increased to a peak value in about 7 days. High levels of vitamin A do not appear to be toxic to cattle. Arizona workers (1961) fed yearling steers about 2.5 million I.U. vitamin A for 168 days with no toxic effects.

Conditions Under Which Vitamin A Deficiency May Occur

Conditions under which vitamin A deficiency are likely to occur include:

1. Fall-dropped calves from cows grazed or fed poor quality forage.
2. Weaned calves shipped from poor pasture areas and fed rations low in vitamin A activity.
3. Calves wintered in range areas on poor quality forages, shipped into the Corn Belt in late winter or early

spring, and subsequently fed rations minimal in vitamin A activity.

4. Cattle fed high-energy (or all-grain) rations with inadequate vitamin A activity.

5. Long-fed cattle.

6. Cattle fed hay and/or grains stored for 1 year or longer.

7. Other factors, including heat stress and unusual diets such as raw soybeans or soft phosphate.

Occasionally, vitamin A deficiency occurs when top-quality corn silage is fed. Some factor(s) appear either to reduce the amount of carotene in the silage (i.e., nitrate) or somehow interfere in its utilization by cattle. Field reports have indicated unusual problems as a result of feeding hay or haylage. These apparent vitamin A deficiency cases apparently respond to feeding vitamin A at high levels (up to 50,000 units per head daily).

Symptoms of Deficiency

Symptoms of vitamin A deficiency in cattle vary for unknown reasons. However, the following symptoms have been reported:

1. Night blindness.

2. Eye problems—watering, inflammation, opacity of cornea, ulceration, protruding eyes, papilledma, keratinization of conjunctival cells.

3. Convulsions, muscular incoordination (animals sway), stiffness, tremors or twitching of muscles, animals may fall.

4. Cattle may suffer from solar heat, pant with protruding tongue, and frantically seek shade.

5. Nasal and mouth discharges.

6. Edema of hoofheads, legs, thigh, and brisket.

7. Harsh, dry, "dead-looking" hair coat.

8. Diarrhea.

9. Off-feed—and this may be one of the first symptoms of deficiency.

10. Symptoms of urinary calculi.

Methods of Administering

The most popular method of administering vitamin A to beef cattle is by continuous feeding. However, it may be given by intraruminal or intramuscular injection, oral boluses (largely experimental), water soluble vitamin A, and by feeding in salt. Most commercial protein supplements contain 10,000 to 20,000 units vitamin A per pound for continuous feeding, although under certain conditions they may contain 30,000 or more units per pound.

Stress feeds fed for a few days to 2 weeks upon arrival of cattle into feedlots may supply about 100,000 or more units vitamin A per head daily. Injectable vitamin A products given shortly after the arrival into the feedlot may supply 500,000 to 1 million units per head.

Recommendations for Vitamin A and Carotene for Beef Cattle

The 1963 NRC recommendation for calves finished as short yearlings, finishing yearling cattle, normal growth for heifers and steers, and wintering weanling calves is approximately 5 mg. carotene or 2,000 I.U. vitamin A per 100 pounds liveweight daily. Recent recommendations from various experiment stations have varied from about 1,000 to 3,000 I.U. vitamin A or 3 to 5 mg. carotene per 100 pounds liveweight per head daily.

The amount of supplemental vitamin A needed in feedlot rations depends upon rations fed. For example, yearling cattle fed nominal amounts of high-quality legume hay or large amounts of high-quality silage may need no additional vitamin A. Those fed nominal amounts of fair-quality hay may need 10,000 units per head daily. And those fed low-quality forage or all-grain rations may need 20,000 units or more vitamin A per head daily.

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from page 1 amounts of hay and silage are about equal in hay equivalent to the decrease in pasture days.

There are several reasons for this trend to stored feeding: (1) the quality of stored feed is more uniform than the quality of pasture. This minimizes production slumps from which many pastured cows never fully recover, (2) larger herds make pasture management more difficult, and (3) mechanization has made hay silage making and feeding much easier.

Several characteristics of pasture determine the feeds needed to supplement it. Young fast-growing pasture is high in water content, protein, and vitamin A. It is also low in fiber.

The high water content produces a problem. The pasture is very palatable so the cow fills on it, unless her grazing time is limited. As a result she often refuses part of her grain ration. Dry matter and total energy intakes are often lower than the requirements for heavy production. Then body weight is lost and, if this goes on long enough, production drops.

These dairy management practices are recommended for pasture season:

1. To reduce bloat danger, cows should be full of hay before going on pasture.

2. Leave cows on new pasture only 2 or 3 hours the first day. Increase the time gradually.

3. Make hay available to the cows at all times. Cows will eat some hay even on the best pastures. This helps reduce butterfat test drops, common on lush low-fiber early pastures. It also helps get more total energy into the cows.

4. If possible remove cows from pasture 3 hours or more before milking time. This reduces the amount of grain refused due to pasture fill. It also helps reduce grassy flavor in milk.

5. Keep the grain mix palatable to encourage consumption. Addition of molasses and more variety in the grain mix may help. Variety is desirable but not worth much extra expense.

6. Remove refused feed from mangers before the next feeding. It quickly becomes unpalatable.

7. Young fast-growing pasture is high in protein. Farm grains supplement it; additional protein is not necessary. If pasture is allowed to become mature, protein content drops, and the protein in the grain must be increased to 14 to 16 percent.

It is important to supply hay or silage to cows on pasture, particularly when pasture is washy, short, or too mature. If additional feed is not fed the cows drop in milk. If such a drop lasts several days the cow seldom returns to normal production regardless of improved feeding later. This is most serious for the spring-calving cow because the production loss is continued through the rest of her lactation.

Good pasture management, including fertilization and rotation, provides the best pasture. To get the most milk from it, good cow management is necessary.

DHIA cow feed consumption averages

Year	Grain	Hay	Silage	Days pasture
		pounds		
1953	2,700	4,100	5,300	152
1954	2,700	4,100	5,700	151
1955	2,700	4,100	5,700	155
1956	2,900	4,400	5,900	150
1957	3,000	4,600	6,400	145
1958	3,200	4,600	6,600	139
1959	3,300	4,900	7,000	136
1960	3,400	4,600	7,200	127
1961	3,500	4,900	7,700	116
1962	3,800	5,200	7,400	115
1963	4,100	5,000	9,500*	97

*Increase accelerated by early freeze, fall 1962.

Should a Dairyman Feed Thyroprotein?

John D. Donker

Thyroprotein is a protein treated with iodine so that some of it becomes thyroxine. Several kinds of protein can be used, but in the United States casein is most common.

Iodinated casein and thyroprotein are used synonymously to indicate materials that contain the hormone thyroxine. Trade names for thyroxine products most commonly fed to cattle in the United States are Protamone, the iodinated casein, and Stimulac, a proprietary compound of a carrier with Protamone.

Thyroxine is the hormone secreted by the thyroid gland of all warm-blooded animals. This hormone regulates metabolic rate, the speed at which an animal's body functions. If the amount of thyroxine is insufficient the individual is termed hypothyroid, is very sluggish, and will not develop or function properly. On the other hand, if the thyroid is overactive due to too much thyroxine, the individual is very active and becomes easily excited.

Generally more thyroxine is released by younger than older animals and more in winter than in summer. Better dairy cattle supposedly have greater amounts in their blood than poorer ones. There is no doubt that thyroxine is needed in cattle for growth, reproduction, and lactation because, for all practical purposes, if thyroid glands are removed these bodily processes cease.

It was natural to suppose that certain cows were low producers because of low thyroid function. It followed that thyroprotein would be tried to see if milk production might be increased. Many experiments have been conducted; the major findings are outlined below.

The administered hormone or drug is not at all effective until more is given than the body normally produces. This is due to the delicate built-in mechanism controlling thyroxine concentration in the body. As concentrations in the body are increased the output from the thyroid declines. Therefore, in animals given effective amounts of the drug, the thyroid glands are completely quiescent.

Milk production is often increased when thyroprotein is fed in effective amounts. These amounts depend on the size and age of the animal and on unknown factors, as quite often no effects are seen in some animals in contrast to others in similar circumstances. The recommended amount of Protamone is 15 to 20 grams for an adult cow.

Milk production has been materially increased within a week or so of feeding the material. The response depends upon the amount of drug given, but in general the increase is 20 to 25 percent.

Stage of lactation is important to response. Cows in early and late stages do not generally respond. The duration of the response is in dispute. Most researchers believe that the greatest benefit is derived during the first 6 to 10 weeks. Where it has been used from mid- to late-lactation increases have been nominal—3 to 5 percent.

Increased milk production must be supported by increases in nutrient intake. Since most high-producing cows eat to capacity, they need increased concentration of energy—or more concentrates. Generally, the response is related to the quality of the cow: the better the cow, the higher the response. But the cow's efficiency of conversion of feed to milk is not increased.

The evidence for effect on milk composition from treated cows is controversial. The percent of fat is at least temporarily higher, but it may not remain elevated for the total lactation. It appears that the protein content is lowered slightly and other constituents are not affected.

Department of Dairy Husbandry research with yearling heifers indicates that feeding enough thyroprotein to cause 10 percent increase in heart rate has no effect on growth rate, but the efficiency of conversion of feed to growth is somewhat lowered.

Thyroprotein can be toxic if given in too great amounts. Since it greatly increases body heat production, some animals have trouble getting rid of excess heat, particularly in warm weather. The performance of these animals is adversely affected. There is no indication of adverse effects on animal health or reproductive life when the recommended quantities are fed.

A dairyman must consider the cost of the drug itself, the work involved in feeding it, and the extra feed involved against the possibility of extra milk. Extra milk produced during a "base period" would have year-round benefits. But feeding thyroprotein is only one of several practices which might result in extra production during this critical period.

It is illegal to stimulate by drugs or feed drugs to induce more milk from dairy cows enrolled in any official testing program. This includes cattle registered in the breed associations and those in county Dairy Herd Improvement Associations (DHIA), because the records are used to prove sires used throughout the country.

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