



Supplementing Vitamin A to Beef Cattle

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The Oklahoma Cooperative Extension Service WE ARE OKLAHOMA

The Cooperative Extension Service is the largest, most successful informal educational organization in the world. It is a nationwide system funded and guided by a partnership of federal, state, and local governments that delivers information to help people help themselves through the land-grant university system.

Extension carries out programs in the broad categories of agriculture, natural resources and environment; family and consumer sciences; 4-H and other youth; and community resource development. Extension staff members live and work among the people they serve to help stimulate and educate Americans to plan ahead and cope with their problems.

Some characteristics of the Cooperative Extension system are:

- The federal, state, and local governments cooperatively share in its financial support and program direction.
- It is administered by the land-grant university as designated by the state legislature through an Extension director.
- Extension programs are nonpolitical, objective, and research-based information.
- It provides practical, problem-oriented education

for people of all ages. It is designated to take the knowledge of the university to those persons who do not or cannot participate in the formal classroom instruction of the university.

- It utilizes research from university, government, and other sources to help people make their own decisions.
- More than a million volunteers help multiply the impact of the Extension professional staff.
- It dispenses no funds to the public.
- It is not a regulatory agency, but it does inform people of regulations and of their options in meeting them.
- Local programs are developed and carried out in full recognition of national problems and goals.
- The Extension staff educates people through personal contacts, meetings, demonstrations, and the mass media.
- Extension has the built-in flexibility to adjust its programs and subject matter to meet new needs. Activities shift from year to year as citizen groups and Extension workers close to the problems advise changes.

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Why is vitamin A important?

Vitamin A is considered by many to be the most important vitamin regarding the need for supplementation. Vitamin A is necessary for proper bone formation, growth, energy metabolism (glucose synthesis) and skin and hoof tissue maintenance, as well as vision. The vision function is associated with visual purple in the eye when animals are trying to adapt from light to dark.

Deficiency Symptoms:

- night blindness
- reproductive failures
- skeletal deformation
- skin lesions

The best source of this vitamin is beta-carotene, a pigment in green plants that animals convert to vitamin A. If cattle are grazing green grass, they will get plenty of vitamin A. During winter months or drought, vitamin A deficiencies are common because dormant plants don't contain the levels of beta-carotene needed compared to the green forage levels in the growing months.

How much vitamin A do cattle need?

Where other nutrient requirements are expressed as a percent of the diet or as parts per million (ppm), vitamin requirements are generally expressed in international units (IU). For example, one milligram of beta-carotene is equivalent to 400 IU's of vitamin A. The primary sources of vitamin A for the biological functions mentioned previously are 1) green, leafy forages, 2) liver stores and 3) supplemental sources such as commercial concentrate feed supplements and commercial

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mineral supplements. The liver stores vitamin A, however, it is thought that those stores can last only two to four months if a severe dietary deficiency exists. Table 1 shows vitamin A requirements for different classes of beef cattle.

How much vitamin A is present in typical feeds?

Feeds vary substantially in beta-carotene concentration and therefore, in vitamin A equivalents. Lush, green, immature forages have the greatest concentration of beta-carotene. However, those same plants may contain near-zero beta-carotene during the winter when they are mature, dormant and brown. Bright colored, early harvested hay contains relatively high amounts of beta-carotene. Harvested forage beta-carotene concentration declines over time. While the rate of degradation is extremely variable, a conservative rule of thumb is that the beta-carotene concentration (and therefore vitamin A potential) declines by about one-third to one-half each year in storage. Feed grains and other concentrate feeds are generally low in beta-carotene. Table 2 shows a summary of rounded vitamin A equivalent values from one experiment where 85 feed and forage samples were analyzed for beta-carotene concentration.

Considerations for supplementing vitamin A

Generally speaking, vitamin A has been inexpensive to include in mineral mixes and commercial feed products for many years. As a result, vitamin A has probably been overfed, and in many cases, drastically overfed. The appropriate amount of vitamin A to use in the cattle ration depends upon the level of carotene in the forage, liver stores and length of feeding period, among other factors. One consideration is that

Table 1. Vitamin A requirements for beef cattle.

	Growing Steers and Heifers*	Stressed Steers and Heifers*	Gestating Cows*	Lactating Cows*
Vitamin A, IU/lb of feed DM	1,000	2,250	1,300	1,800
Vitamin A, IU per day	12,500	15,000	34,000	54,000

*Daily requirements are calculated based on 500-pound growing or stressed calves and 1,200-pound cows.

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Table 2. Approximate vitamin A equivalents in various feed sources.

Feed Source	Vitamin A Equivalents, IU/lb feed dry matter
Fresh grass pasture	18,000
Orchardgrass hay	1,400
Alfalfa hay	1,300
Wheat/ryegrass hay	900
Corn silage	3,000
Cracked corn	68
Dried Distiller's Grains	200
Wet Distiller's Grains	350
Soybean hulls	20

Source: Adapted from Pickworth et al., 2012 available at <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3849816/pdf/nihms527534.pdf>

most commercial feed and mineral products have historically included 100 percent or more of the vitamin A requirement for most classes of cattle. This could change with the vitamin A shortage, so be sure talk to your feed or mineral supplier to determine what current level is being included in the supplement product.

Another consideration is not to double up on vitamin A. For example, if a free-choice mineral supplement is put out, and a commercial concentrate supplement of some sort is fed, there may be more than twice the amount the animals need ingested. If this is occurring during the spring of the year, perhaps as much as five times the amount required is consumed.

As shown above, high-quality hay may contain 50 to 100 percent of the Vitamin A needed. Consequently, a supplement product containing 50 percent of the animal's requirement would be appropriate. If your hay quality is marginal, 100 percent supplementation is suggested. Obviously, cattle grazing wheat pasture and spring/early summer abundant immature growing forage should not require vitamin A supplementation.

Examples and amount of vitamin A provided based on feeding rate and concentration

Table 3 provides examples of the amount of vitamin A supplied per day, based on forage intake and forage quality. Tables 4, 5 and 6 provide guidelines regarding the amount of vitamin A supplied, given the concentration of vitamin A in the mineral or concentrate product and given the amount of mineral or feed being provided. These tables can be used to estimate the vitamin A balance of your current program. They can also be used to determine the approximate concentration of vitamin A that might be appropriate in the feed or mineral product you are considering purchasing. For example, assume gestating beef cows are being wintered with one-half high-quality hay and one-half low-quality hay similar to the forages described in Table 3. The requirement from Table 1 is approximately 34,000 IU per day. Subtracting the amount provided from forage in Table 3 (18,200) from the daily requirement, a supplemental need of 15,800 IU is determined. This value can be compared to the amount supplied by different products in Tables 4, 5 and 6. From there, one can determine

Table 3. Approximate vitamin A equivalents supplied by class of cattle and forage quality.

Forage source	Approximate Vit A equivalents supplied by forage, IU per day*		
	Growing	Cows, Gest	Cows, Lact
Green, early-harvested new crop hay*	17,500	36,400	42,000
Low quality, late-harvested, 2-yr-old hay	0	0	0
50% high quality, 50% low quality hay	8,750	18,200	21,000

*Forage consumption is estimated to be 12.5, 26 and 30 pounds DM per day for calves, gestating and lactating cows, respectively. High-quality hay estimated to contain 1,400 IU/lb DM.

Table 4. Approximate vitamin A delivered by mineral supplements.

IU/lb Mineral Mix	Mineral Intake, ounces/day			
	2	3	4	5
400,000	50,000	75,000	100,000	125,000
200,000	25,000	37,500	50,000	62,500
100,000	12,500	18,750	25,000	31,250
50,000	6,250	9,375	12,500	15,625
30,000	3,750	5,625	7,500	9,375

Table 5. Approximate vitamin A delivered by concentrate supplements.

IU/lb Feed	Feeding Rate, pounds/day			
	2	4	6	8
30,000	60,000	120,000	180,000	240,000
10,000	20,000	40,000	60,000	80,000
5,000	10,000	20,000	30,000	40,000
4,000	8,000	16,000	24,000	32,000
3,000			18,000	24,000
2,000			12,000	16,000
1,000			6,000	8,000

the approximate vitamin A concentration and daily supplement consumption for this situation without drastically overfeeding vitamin A.

Besides standard mineral packages, vitamin A can be supplied by injectable products and liquid drench forms. The issue with injections is they need to be repeated approximately every 28 days to maintain safe liver stores. The critical time for injection in pregnant cows is two months prior to calving.

Table 6. Approximate vitamin A delivered by complete feeds.

IU/lb Feed	Feeding Rate, pounds/day		
	15	20	25
5,000	75,000	100,000	125,000
4,000	60,000	80,000	100,000
3,000	45,000	60,000	75,000
2,000	30,000	40,000	50,000
1,000	15,000	20,000	25,000

If you don't feel comfortable with nutrition topics, consult resources like the local county Extension educator, livestock nutritionist or veterinarian for help.