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Strategic Vitamin A and E Use for Livestock During a Shortage

Vitamins A and E are important nutritional factors in livestock production. Producers need to be aware that changes in the availability of these essential vitamins can have an effect on their operation.

Background

On October 31, 2017, a fire broke out at the BASF factory in Germany. This plant produces nearly half the world's global feed grade vitamin A and some of the vitamin E precursors. The fire has contributed to an already tight supply of these two vitamins, which affects vitamin supplies available to feed companies.

This factsheet will discuss the implications of the vitamin shortage to ruminants and modified ruminant animals.

Producers should know the risk factors for vitamin deficiencies

Vitamin inventories

Many major feed companies will be examining their inventory of available vitamins as a result of the global shortage. To stretch supplies, some companies are reducing vitamin fortification levels in feed supplements and minerals. The reduced vitamin levels meet regulations set out by the Canadian Feed Inspection Agency (CFIA) as set out in Schedule 4 of the *Canadian Feed Act*.

The bulk sale of powdered or crumbled and injectable vitamins A and D will be reduced or temporarily discontinued until supplies are expected to return to normal by the third quarter of 2018.

Vitamins A and E degrade over time, so purchased products that are stored for several months before use may not supply adequate vitamin levels when fed. To minimize losses, store purchased products in a dry, cool area to help prolong shelf life. CFIA recommends vitamins be used within 6 months from the date of manufacture.

When to supplement

There are certain times in the year when vitamin supplementation is required. During the summer, actively growing plants in hayland and pasture have high levels of Vitamins A and E precursors. These naturally occurring precursors are converted to their active form, which is used by the animal. The amount of vitamins supplied from the growing plants is more than adequate to meet requirements.

When forages are cut for hay or grazed after plants have gone dormant, the vitamin precursors oxidize, and the potency or availability of the vitamins declines over time. When hay is cut or the forages are dormant for six months, a majority of the vitamin precursors have lost their activity and do not supply adequate amounts of vitamins to meet animal needs.

Two-year old hay cannot be expected to have any vitamin precursors remaining. The ensiling process for either bagged or chopped silage destroys vitamin precursors in the forage, so these feed sources should be considered to supply minimal vitamin amounts to the ration.

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It is when these preserved and stored feeds are being used that supplemental Vitamin A, D and E should be added to diets to avoid deficiency or disease symptoms. The effects of not feeding vitamins will be discussed further on in this factsheet.

Supplements

Many commercial mineral mixes have vitamins A, D and E added at levels sufficient to meet animal requirements. Most mineral and vitamin supplement tags will include a guaranteed analysis that lists the amounts of individual minerals and vitamins. Vitamin quantities are expressed as International Units (IU), which are set amounts defined for each specific vitamin form.

Reasonable rates of vitamin supplementation for cattle consuming a 3 to 4 ounce (0.19 to 0.25 lbs.) daily intake of mineral and vitamin supplement are as follows:

- Vitamin A - 500,000 IU/kg
- Vitamin E - 1,500 to 2,500 IU/kg

To calculate the amount of vitamin supplied by the mineral or supplement, divide the expected intake (grams) by 1,000 to convert to kg. Multiply the expected intake in kg by the concentration of the vitamin (listed as IU/kg) to determine the IU's supplied. This approach allows the comparison of different supplement products. Amounts supplied can be evaluated against requirements for the type of animal being fed.

Vitamin A can be stored in the liver for the animal's use over a 3 to 4 month period. Vitamin E is only stored for 2 to 4 weeks. Therefore, it will take less time for the animal to become vitamin E deficient than vitamin A deficient.

It is best to supply vitamins as required on a regular basis. Injectable vitamins have a high availability for the first week or two after injection, but levels drop quickly in the body. Even though some level of vitamins are available for the period indicated on the label, they may not be sufficient to meet requirements after the initial peak period has passed.

Some injectable products are currently out of stock. There is no injectable Vitamin E product registered for use in Canada.

Risk factors for vitamin deficiencies

A number of "animal" and "environmental" factors influence vitamin requirements.

Animal factors

A thin animal has less body fat as a percentage of body weight than an animal in good condition. It is true that vitamins are primarily stored in the liver, but some are stored in body fat. Therefore, a thin animal has less vitamin storage capacity, which may result in an animal becoming deficient sooner.

The size and age of the animal as well as the production status (e.g. stage of pregnancy, bulls during breeding season, stage of lactation, etc.) are also relevant factors. Reduction in animal performance (reproduction efficiency and disease resistance, for example) will occur sooner when animal requirements are the highest.

Environmental factors

Variable weather patterns, such as in 2017 (precipitation, either a lack of or excess, temperature, and sunlight intensity), may have an influence on the formation and storage life of vitamin precursors in forages and hay. Any stress factor that reduces the plant efficiency could reduce precursor formation. These precursor levels could also be reduced due to late cutting or other harvest problems.

Main risk factors that could contribute to a feeding program deficient in Vitamin A

bleached pasture or drought grown hay
high concentrate diets
harvested crop residues
feeds subjected to prolonged storage
"heated" or caramelized forage
weathered forages (excess sunlight, moisture or heat)
feeds with increased oxidation (processing and inclusion of minerals)

Main risk factors for a Vitamin E deficiency include feeds that contain the following

high nitrate concentrations
prolonged storage or weathering
increased oxidation (processing and inclusion of minerals)
higher levels of polyunsaturated fats

Vitamin A: main deficiency symptoms

reduced feed intake resulting in reduced performance
rough hair coat
joint and brisket edema (swelling)
tearing and dry eye
improper bone growth
abortions
stillborn calves
night blindness (unique to Vitamin A) and total blindness
reduced immune function
diarrhea
seizures
low conception rates (cows cycle but do not conceive)
retained placenta
reduced bull libido
reduced sperm numbers, motility, and normal sperm

Studies indicate that the majority of vitamin A is transferred to the fetus during the last 3 months of pregnancy and by the colostrum in the first 12 hours post calving.

Vitamin E: main deficiency symptoms

reduced immune function in calves
reduced calf growth rates
white muscle disease (selenium also involved)
reduced reproductive efficiency

Vitamin E is transferred to the colostrum 4 to 8 weeks before calving, and colostrum is the only means by which this nutrient is transferred to the calf. As a result, females in late pregnancy require higher levels of vitamins A and E approximately 8 weeks before calving and for the first 3 to 4 months of lactation or until calves are eating significant amounts of growing forage.

As noted earlier, vitamin E is not stored for long in the animal, so deficiency symptoms or reduced performance can be expected sooner due to a lack of vitamin E than vitamin A.

Producers can assess the herd health status by contacting their local veterinarian and if necessary, conducting a blood test for vitamins A (retinol) and E (alpha-tocopherol). Testing for vitamin E would be more beneficial because storage in the body is for a shorter time, so animals would first become vitamin E deficient. Animals that are deficient should be provided with supplemental vitamins at recommended amounts.

If vitamin supplies in the animals are deficient or are suspected to be deficient, it is recommended that producers start vitamin feeding programs as soon as possible. Supplementation should continue until animals are turned out onto green grass. Vitamin requirements are higher for breeding cattle to maintain milk levels for calves and to avoid reproductive failure.

Level of concern

High risk animals are those that have grazed dry or dormant grass since the previous July and have received a silage-based or straw-grain ration after coming off pasture. The same concerns apply to animals fed two-year-old hay, greenfeed, silage or forage produced under the same stress conditions.

In addition, the following conditions apply:

- no supplemental vitamins have been provided to date
- calving is to start within a few weeks
- breeding season starts well before the animals are turned onto fresh grass.

Under these conditions, body stores of vitamins have been depleted.

Under high risk conditions, it is possible for calves to be born dead. Calves born alive are likely to have greater health risks such as white muscle disease or higher rates of infectious diseases such as scours or pneumonia as a result of poor immunity. A lack of vitamins will persist until calves start consuming substantial fresh forage (3 to 4 months of age). Cows are at risk of poor conception rates due to reduced fertility, for either cows or bulls, at the start of the breeding season prior to turnout on fresh grass.

Medium risk animals are those that grazed forages that went dormant in September and have received medium to marginal quality forage after coming off pasture. Animals on swath grazing or grazing corn for the majority of the winter are in the same situation.

Animals may have some reserves to draw on. Vitamin supplementation should start a minimum of 4 to 8 weeks prior to calving. Calving starts 4 to 6 weeks prior to turnout on grass, and breeding season starts one month after turnout to grass.

Low risk animals are those that have been fed appropriate amounts of vitamins since fall and are in good body condition. Backgrounding steers in good condition that received adequate levels of vitamins in the diet or supplement and have been well vaccinated and will be returning to spring pasture would be considered low risk animals. Non-breeding animals have lower vitamin requirements than breeding animals.

Conclusion

In the short term, vitamin deficiencies in individual animals is possible depending on vitamin supplementation programs. The product shortage has made the problem more acute, but the concern with inadequate vitamin supplementation is a problem that can occur in any year.

Herds in the medium to low risk categories that have been provided vitamins and minerals as part of a balanced ration to date are unlikely to experience the effects of a vitamin A deficiency. However, these herds may be at some risk of a vitamin E deficiency due a more rapid metabolism of the nutrient and a shorter storage duration in body tissues.
Herds that start calving in March or April may experience more problems because the vitamin content in the mineral products have been reduced because of the 2018 shortage.

Vitamin deficiencies may result in small changes in performance over the short run. Lower milk production, reduced average daily gain and a slight increase in open cow rates are outcomes that may not come to notice immediately. If deficiencies continue, the losses in performance and in livestock deaths become more severe.

It is possible to have a serious problem if body vitamin stores are depleted and the situation is not corrected. Even though vitamin and mineral products have increased in price, it is prudent to continue feeding vitamins.

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