

Trace Element Disorders in Beef Cattle

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Technical Note

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SUMMARY

- **Copper, cobalt, selenium and iodine are essential components of the diet to maintain health and productivity.**
- **Forage varies in its content of trace elements due to factors such as soil type, drainage and pH and plant species. Therefore, animals on forage only diets are most at risk of trace element deficiency.**
- **Ideally forage should be assayed for trace elements and any trace element supplementation of the diet formulated accordingly.**
- **Whilst deficiencies of these trace elements can cause ill-thrift and infertility there are other far more common causes of these problems.**
- **If there is a health or production problem you should confirm that a deficiency state exists in the animals and / or feed before supplementing with trace elements.**
- **Trace element status can be confirmed by testing samples from the animals or feed for the trace element(s) in question.**
- **Diagnosis should always be confirmed by monitoring response to supplementation.**
- **Over supplementation is at best a waste of money and at worst can poison the animals.**

Introduction

Trace elements are minerals that in small quantities are essential for the normal health and function of animals. In Britain the trace elements that may be limiting are copper, cobalt, selenium and iodine. The absence or deficiency of these elements can result in ill-thrift or reproductive failure (see table 1), however when supplied to excess poisoning can occur. While deficiency is often suspected as the cause of ill-thrift or poor production, rations that are limiting in energy or the presence of gut parasites or liver fluke are more common causes of ill-thrift and infertility and must always be considered before assuming 'a deficiency' exists. In fact over the last ten years Veterinary Investigation Centres throughout Great Britain have diagnosed copper, selenium and



Late term abortion showing a goitre associated with iodine deficiency

cobalt deficiency syndromes in cattle with reducing frequency whilst iodine deficiency has remained constant.

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Nevertheless rations must be formulated to provide the required amount of these trace elements and in some situations supplementation beyond the provision of proprietary mineral supplements will be necessary.

Supplementation where it is not required is a waste of money and indeed it may be harmful (see section on copper poisoning below) therefore there is a need to correctly evaluate the situation. This note describes the background to trace element deficiency, where it should be suspected, how it can be assessed and the common ways to supplement.

Background

The common trace element deficiencies mostly arise as a consequence of the deficiency inherent in the soil series in the land producing herbage for the cattle either through grazing or conserved forage such as silage or hay. The 'soil series' is the combination of soil factors influencing the uptake of trace elements by the herbage. Examples are the type of soil (sandy soils generally contain less trace elements than clay soils) and the soil's drainage characteristics (freely draining soil types generally contain less trace elements than poorly draining). These soil trace element deficiencies may be simple as occurs with cobalt and selenium or complex as occurs for copper when excessive amounts of iron, sulphur or molybdenum will cause the copper to be "locked-up" and absorption or the animals' ability to use copper reduced. This is seen at its most dramatic in the teart soils of Somerset where the alkaline pH and high molybdenum content of the soil cause 'induced' copper deficiency. Therefore in many farming situations the trace element deficiencies for the soil series will be known and the risk of trace element deficiency also recognised. However, whilst variations in trace element concentration between different soil series is high, so is variation within a particular soil series making the occurrence of trace element deficiency more unpredictable than would be ideal.

In addition to this are the man-made situations that have gone with land improvement. Replacing permanent pasture that contains a rich diversity of plant species with a more or less monoculture of productive grasses will reduce the uptake of trace

elements from the soil. Reducing the acidity of soils through the application of lime reduces the cobalt concentration in the herbage and increases the molybdenum concentration which in turn reduces the availability of copper to the grazing animal. Hence on improved land deficiencies in cobalt and copper may arise beyond those predicted by the soil series and previous experience in the locale.

From this it can be concluded that trace element deficiency will most often occur in situations where one or more of the above background factors apply and the ration consists mainly of grazed or conserved forage with perhaps home mixes without mineral supplementation. Cattle going through a store period before grass finishing are at risk as is the cow herd calving in the spring or autumn if no trace element supplements have been fed particularly in the second half of pregnancy. Ideally forage should be assayed for trace elements and any trace element supplementation of the diet formulated accordingly.

Signs of deficiency

Copper deficiency will most easily be seen in young stock. The classic description is the spectacling of dark coated cattle. This is caused by a reduction in pigmentation of the hair that is seen most vividly around the eyes. Such animals will also tend to have diarrhoea, something that may not be noticeable at grass. Thickening of the bones around the joints may be appreciated in extreme cases. In contrast cows can tolerate extremely low levels of dietary copper and may show no signs even when there is marked deficiency. The infertility that is described for copper deficiency is only thought to arise when there is concurrent molybdenum excess.

Cobalt deficiency is also known as pine, which says everything about this deficiency. Cobalt is required by the micro-organisms in the rumen and is used to produce vitamin B12 which in turn is essential for energy metabolism of the animal. A deficiency of cobalt will result in ill-thrift accompanied by a poor appetite. Young stock are most at risk and adult cows are fairly resistant to deficiency, however a deficiency in the cows may reduce the viability of their young calves and for this reason supplementation in deficient situations is essential.

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TABLE 1

Trace element	Common signs of deficiency seen in UK
Copper [absorption reduced by molybdenum (Mo), sulphur and iron in diet]. 'Teart' pastures have high Mo content in soil and herbage.	Ill-thrift, infertility (where excessive Mo intake), brown coat colour, scour (where excessive Mo intake), sudden death.
Cobalt	Ill-thrift and anaemia
Selenium	'white muscle' disease, infertility (& Ill-thrift)
Iodine	Abortion, stillbirth and birth of weak calves.

Selenium acts along with vitamin E to protect tissues against metabolic damage. It is essential for proper immune function, but the most widely recognised deficiency state is white muscle disease. In this condition young stock that experience unaccustomed exercise at turnout along with the oxidative stress of high dietary levels of poly unsaturated free fatty acids that are present in lush pasture are at risk of severe muscle damage that may prove fatal.

In other countries selenium deficiency has been associated with poor growth rates, but in the UK there is debate as to whether deficiency of this element is ever severe enough on its own to result in ill-thrift. It is also reputed to play a role in infertility.

Iodine deficiency has long been recognised as a cause of late abortion, stillborn or weak calves. The calf is often born normal size, but as a consequence of the reduced thyroid function that follows iodine deficiency it is unable to make the transition from a healthy calf in the womb to a breathing calf once it is born.

Identifying the problem

As discussed above the first step in assessing the situation is the local knowledge of the soil and pasture type and whether trace element deficiencies are known to occur in the locale. Consideration must also be given to the general adequacy of the diet (always remember that energy deficiency is commoner than trace element deficiency) and whether parasitic disease may be a factor in the disease or lack of productivity.

Trace element status of animals can be assessed to some degree through measuring the element in the blood of the animals and in liver samples collected at the abattoir. When examining liver tissue (collected by biopsy or from the abattoir) at least 3 animals should be tested and for blood at least 6 and preferably 10 animals should be sampled. The variation seen in the results between different animals can give a confusing picture and for this reason it is best to sample a good number of animals in the first place otherwise you may need to go back and sample more. In addition the trace element content of soil and herbage or conserved forage can be very useful in providing evidence of deficiencies on individual farms.

Copper and selenium deficiency can be investigated by examination of liver tissue or more conveniently and most commonly by testing blood samples for the concentration of copper or the selenium containing enzyme glutathione peroxidase.

Blood copper concentration suffers from the disadvantage that it falls only in the deficient state and gives no indication of the size of the liver copper store. Furthermore blood copper is falsely elevated in animals responding to infection or vaccination. Liver copper assay is a more useful test and gives an indication of the size of the liver copper store, but the sample is more difficult to obtain.

There is no reliable blood test to assess cobalt status in cattle (this does not apply to sheep) so liver tissue or the feed itself must be assayed.

When collecting samples avoid the poorest or

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obviously ill animals. Animals should also be on the ration for a period of at least 6 weeks before sampling is carried out otherwise results will reflect the previous ration.

Where iodine deficiency as a cause of abortion, stillbirth or weak calves is being investigated the thyroid gland of the affected calves should be examined post mortem for lesions of goitre and for iodine content. This is best achieved in the first instance by submitting the whole carcase to a veterinary investigation laboratory where other causes of the calf's death can also be investigated. Testing blood for inorganic iodine has the disadvantage that it only reflects very recent iodine intake and gives no indication of historic iodine intake and how the thyroid gland is functioning.

Finally veterinary and nutritional expertise are needed to interpret the results and decide if supplementation is required with one or more trace elements. In some situations the laboratory results may show no clear evidence that a deficiency state exists but status appears to be in the 'marginal band'. This is the grey area of uncertainty between sufficiency and deficiency. For herds with results in the 'marginal band' assessing the response to supplementation may be the only way of confirming the diagnosis.

Supplementation

Where it is confirmed that supplementation is required there is a range of possible methods. Simplest and cheapest where animals are housed or are being fed outside is to add an appropriate proprietary supplement to the ration. Where this is not possible because animals are grazing then supplementing drinking water, injections or rumen boluses must be considered. Individual animal intakes of free access minerals are too variable to be effective. The detail of what methods are available and their cost-effectiveness for the situation in which they will be used varies depending on the trace element in question; your veterinary practice should be able to help here. Oral dosing is usually too labour intensive but oral doses of selenium are effective at infrequent intervals. Top dressing of pasture with cobalt salts provides long-term supplementation, although the price of cobalt salts

has increased substantially in recent years, which has tended to moderate their use as fertilizers.

Even where a diagnosis of deficiency is thought to be clear-cut it is sensible to check that supplementation is effective. Where there is a disease problem a reduction in incidence of the disease should be seen. Where ill-thrift or infertility are the problems then assessing response to supplementation is best carried out objectively by regularly weighing growing animals to measure growth rates and recording simple indices of fertility. If a response is not seen an alternative diagnosis for the problem should be sought.



Poisoning through supplementation

As discussed above the diagnoses of copper deficiency have been reducing in the past 10 years, however in contrast outbreaks of copper poisoning have been increasingly diagnosed during this time. The reasons for these trends are not clear but are probably linked to a reduction in sulphur emissions into the atmosphere by industry (thus allowing livestock to absorb more of the copper they eat) and

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increasing use of trace element supplementation by farmers. These poisoning incidents have often arisen due to over supplementation with copper where it was not needed. For example between 1999 and 2002 thirty-three dairy herds in England and Wales experienced severe copper poisoning problems in dairy cows resulting in fatalities. In many cases these herds were supplementing with copper on the basis of scant or no laboratory evidence that the herd was copper deficient. Recently in Scotland copper poisoning in yearling pedigree bulls has been confirmed where "copper supplementation" was being carried out with no evidence of copper deficiency on the farm. As far as trace elements are concerned, particularly copper, it is definitely not the case that if a small amount is a good a lot must be better!

The lesson to be learned is to ensure that the trace element status of livestock is known before additional supplements are given. Supplementing with trace elements where they are not needed can at best be unnecessary expenditure and at worst poison the supplemented animals.

Further sources of information

The Mineral Nutrition of Livestock 3rd edition; by E. J. Underwood and N.F. Suttle. Published 1999 by CABI Publishing, Oxford. ISBN 0 85199 128 9

Trace Element Deficiency in Ruminants; report of a study group, March 1982. The Scottish Agricultural Colleges and The Scottish Agricultural Research Institutes. ISBN 0 905084 19 5

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