VITAMIN AND MINERAL SUPPLEMENTS REQUIREMENTS FOR ANGORA GOATS

Farmers regularly give their Angoras supplements. The costs are not high but are they justified and are they needed? What are the benefits and what are the risks?

MINERALS

An indicator of the mineral content of the karoo region would be the mineral content of tissues animals that consumed the plants of the area. Studies (J.B.J. van Ryssen and J.H. Hoon) have been conducted using Springbok in the karoo for checking copper (Cu), selenium (Se) and manganese (Mn). The tests showed springbok (being intermediate mixed feeders) had high concentrations of hepatic copper and selenium in the Karoo region. These results corresponded well with soil characteristics indicative of the availability of mineral elements present. This study confirmed that in the Karoo region it is unlikely that Angora goats would suffer from a Cu or Se deficiencies, in agreement with the map published by Bath (1979) and supporting the Se map published by Van Ryssen (2001).

It is important to realise that each farm may be different and camps within a farm may vary.

Soils in different areas can be inherently deficient in some minerals (e.g. Selenium) due to soil geology. Under acidic soil conditions, many trace minerals are less available for plant uptake.

Karoo shrubs are noted for their relatively high nutritive value. Unlike grasses, shrubs maintain their feeding value thmughout the year, with minimal variation (Du Toi). Analysis of the karoo natural pastures show that deficiencies of protein and minerals are much less likely to occur than in the pure grassveld areas.

Animals will lose weight during droughts, largely because they are unable to derive sufficient energy and protein from the drought-stricken veld. Supplementary feeding on Karoo veld during such times when the veld is unable to sustain animal production should thus emphasize energy and protein rich supplements. Energy followed by Protein and then minerals, under drought circumstances.

Trace mineral deficiencies based on animal response trials are rare in the Karoo region. In one case on a farm between Middelburg and Richmond high soil pH was thought to have precipitated a deficiency in copper. The second case was diagnosed on leached shale/sandstone soils in the mountainous region between Graaff-Reinet and Pearston.

Trials by J.H.Hoon where Angora goats were supplemented with **Zn, Mn** and **Se** was investigated in different areas in the karoo. From the results it would appear that supplementation of Zn, Mn and Se by means of commercial product in general had a positive effect on the

reproduction of Angora ewes, although differences were relatively small at most localities. At some localities, however, no differences in production and reproduction traits could be observed and some of the results were even in favour of the control groups. From the mean blood Se values, it would appear that supplementation of goats specifically with Se, will not be of economic value to the producer. As the cost of this trace mineral supplement is relatively low, an increase of less than 1% in the weaning percentages of the ewes as a result of the supplement could possibly be considered economically viable?

Trials by a manufacturer of a commercial mineral supplement (Multimin) suggested an increase in pregnancy by 0.7%, Kidding by 1.1% and weaning by 4.6% in Angora goats. The reason for this limited benefit of mineral supplementation is due to diet composition. Browse plants usually have higher mineral concentrations than grass and so Angoras are generally less likely to have mineral deficiencies than sheep. Mineral deficiencies will become evident as goats become more intensively managed under commercial conditions.

What can farmers do?

Consult with your local veterinarian as he will know your area. Liver, blood and water samples can be taken as the best indicator of your animals' deficiencies. You need to check about 5 samples in a flock. It is worth checking samples in both winter and summer as this may differ on each farm.

Minerals should not be over supplemented.

The range between safe and toxic levels is quite narrow for many of the minerals unlike vitamins which are easily excreted if in excess. Due to the complex interactions between minerals, excess consumption of one mineral may decrease absorption and/or utilisation of another. Caution should be observed particularly when the likely Copper status of the flock has not been established as Copper toxicity is not uncommon, although it is thought to be less of a problem in Angora goats as compared to sheep.

Common multi-mineral supplements available contain Manganese, Zinc, Selenium and Copper can be given at a low-end dose at 4-6 weeks before kidding where no specific mineral analysis has been done. However If there is any suspicion of undesired effects, this should be discontinued and analysis of tissue samples (or blood) carried out.

Minerals required by the body are subdivided into

- **Macrominerals**, which are required in relatively larger quantities and include **calcium (Ca), phosphorous(P), sodium(Na), potassium(K), chloride(Cl), sulphur(S)** and **magnesium(Mg)**,

- **Microminerals** , required in relatively smaller quantities including **iron (Fe), copper(Cu), cobalt(Co), manganese(Mn), zinc(Zn), iodine(I), selenium(Se), and molybdenum(Mo).**

Evidence suggests that deficiencies of the macro elements are **unlikely** to occur under normal veld grazing conditions.

During dry seasons low levels of protein and energy may rarely result in low levels of **calcium, phosphorous** and **magnesium** in the blood plasma leading to abortions (Bhattacharyya). Goats, unlike sheep, very seldom suffer from milk fever (Calcium deficiency) in late pregnancy.

Ca (Calcium) levels are generally high in the karoo veld and water. It is also found in high concentrations in legumes (Lucerne, hays, oil cake meals) as well as animal protein meal. Grasses have low levels of calcium. Other sources include feedlime, CaCo3, dolomite lime. High Ca levels have a suppressive effect on other minerals decreasing the availability of Mn, Mg, Zn, P. **Deficiencies** are rare but symptoms include poor growth, stiff gait, posterior paralysis, swollen and stiff joints and rachitis in young animals.

P (Phosphorus) deficiency in the diet reduces levels in the body more easily than deficiencies in Ca. High Ca in the diet prevent P absorption. High levels of Fe, Mn, K, Mg cause an impairment of P absorption. Dietary Ca;P ratios should be close to 2:1 which is the same as bone. P levels in grazing halve from summer to winter grazing. P is the most common deficient mineral in South Africa. Goats due to their browsing nature **seldom** have deficiencies compared to cattle. The first sign of deficiency is in reproductive disturbances in the ewe. Deficiencies result in pica (danger of botulism), loss in condition. Over supplementation such as in excess feeding of grains (high P low Ca), animal protein, sunflower and cotton oil cake meals can result in urinary calculi which can be complicated by high Mg and Vit A deficiency. Inorganic P supplements are also available.

Na (Sodium) levels are generally high in the karoo due to the 'brak' water. It is important to remember that all ruminants have a salt appetite irrespective of their sodium needs.

Cl (Chlorine) is abundant and not likely a deficiency

S (Sulpher) is present as the S-amino acids (methionine, cysteine, cysteine) of the body proteins of hair and cartilage. Dietary S are used by micro-organisms to produce microbial protein. Increasing the S in the diet reduces Cu absorption as CuS is formed in the rumen and intestines. High levels of S cause impaired Se absorption such as in lucern and molasses. Optimum diets should contain 0.16-0.24% S. Deficiencies are not likely to occur unless urea is fed.

K (Potassium) deficiencies very unlikely to occur in normal veld conditions. Ingested K is readily absorbed. Under stressful conditions such as transport K may become deficient. Feeding lucern hay for a day before transport will help. Veld grasses and dry roughages are good sources. Molasses is high in K while concentrates are low in K.

Mg (Magnesium) requirements increase in Energy deficient diets as it is involved in carbohydrate metabolism. **Deficiencies** can result in neurological signs and staggering gait resembling Ca deficiency. Mg concentration increases in maturing grass and hay and has a poorer availability in green pasture as it is firmly bound to the chloryphyl molecule. Mg has higher concentrations in plant concentrates (eg.cotton seed) and hays (Lucerne). An increase in Ca and P impairs Mg absorption. Salt promotes the animals' uptake of magnesium.

Zn (Zinc) deficiencies in small stock are mainly low intake and growth rate, hardening of the skin (parakeratosis) and hair with the accompanying loss of hair seen in Angora goats, Angora hair may lose its crimp and become hard. Increase in the incidence of foot rot, lower fertility in rams, high occurrence of udder problems, bone abnormalities, decreased immunity and subsequent increase in

susceptibility for diseases (Zn deficiency inhibits Vit A metabolism). On a DM basis a dietary requirement of 30ppm is given for optimum production. High Ca levels such as occurs in lucerne and water in some areas will reduce the availability of Zn

Mn (Manganese) deficiencies are mainly characterised by delayed, very short and irregular oestrus, poor conception especially in young ewes, normally developed but still born kids, skeletal abnormalities, etc. High dietary intakes of Ca such as contained in lucerne reduce Mn absorption. Minimum requirements of Mn in diet 40ppm . Mn is in high concentration in outer shells of all grains.

Se (Selenium) most important role is in the enzyme Glutathione peroxidase which protects tissues from oxidative damage**.** Vit E prevents peroxidases from being formed so alongside Se is important. Se readily crosses the placenta and hence the reason for supplementation in late pregnancy. Deficiencies occur in lush pastures, sandy and acid soils with low clay content. High grain diets are low in Se. Deficiencies can be seen in lambs 3-6 weeks old (Stiff lamb disease, White muscle disease) In goats deficiencies can result in poor growth, lower reproduction rates due to reabsorption of fertilised eggs and suppression of sperm activity, early born, weak kids. Many cases of Se deficiency in South Africa seem to have been associated with a high Lucerne diet. This is due to the fact that Lucerne is high in Ca and S which has a suppressive effect on Se levels. Antagonists of selenium are calcium, sulphur and iron.

Supplements containing Se both oral and injectable are available. Overdosing will cause toxicity.

Fe (Iron) is mostly contained in haemoglobin in the red blood cells. If a Cu deficiency then Fe absorption is retarded so the reason anaemia can develop with Cu deficiency. High levels of P as found in grains may also reduce Fe absorption. Deficiencies in Fe deficiencies are rare except conditions of excess blood loss due to roundworms which is a common. All plant materials are high in Fe. Excess Fe may occasionally be found in certain borehole waters.

I (Iodine) primary importance is in the Thyroid hormone. Goitrogens as found in plants from the Brassica family reduce TH production. Dietary requirements 0.05-0.1ppm BM basis. Deficiencies result mostly in reduced growth, hair production and reproductive performance. Areas deficient in I are found in the Langkloof valley.

Co (Cobalt) occurs in Vit B12 which is stored in the liver. Vit B12 is important for growth and hair production. Co is used by rumen microbes to produce Vit B12. If Co in diet is lower than 0.11ppm DM basis a deficiency will occur. **Deficiencies** can occur in sandy soils in the Southern Cape and Humandorp. Legumes are a good source of Co. Grains and animal feeds are low in Co. Co deficiencies in the Graaff-Reinet/Murraysburg area. Supplement for Co deficiency by supplementing Vit B12.

Cu (Copper) is stored in the liver and new born kids have higher levels of Cu. Cu is important in bone, nerve production (hence ‘swayback’) hair production and the crimp formation. The first signs of **deficiencies** in animals with pigmented hair are the loss of colour and formation of a ‘steely ’ fibre (wool/mohair) where the crimp is lost and the hair breaks easily. Deficiencies also reduce the effective immune system (decreased neutrophil production) and anaemia. Cu has a very narrow safety tolerance and risk. Dietary levels are ideal 5-15ppm. High levels of S ,Mo and Fe supress Cu absorption. $CaCo_3$ and $ZnSO_4$ supress Cu absorption.

Always ensure you have a Cu deficiency before you supplement Cu (check liver samples). If Cu is deficient check Mo and S levels. In one case on a farm between Middelburg and Richmond high soil pH was thought to have precipitated a deficiency in copper. A second case

was diagnosed on leached shale/sandstone soils in the mountainous region between Graaff-Reinet and Pearston. Normal levels of Cu found in the liver 100-400 ppm with deficiencies when less than 25ppm.

Excess copper can cause Enzooitic Icterus or 'Geelsiekte'. The fibre of sheep/game may turn an orange colour.

Deficiency **of iodine, copper** and **manganese** levels in the diet can cause abortion (Anke et al). The foetal liver reserves are augmented by colostrum. In contrast many **micro- minerals** do not appreciably cross the placenta resulting in no reserve and the kid's primary source comes via colostrum.

Recommended levels in diets on a Dry Matter (DM) basis

Element	**Recommended % in diet**
Ca	0.2-0.8
P	0.2-0.4
Mg	0.1-0.2
K	0.5-0.8
Na	0.1-0.2
Cl	0.15-0.3
S	0.15-0.26

Element	Minimum allowance (ppm)	Maximum Tolerance level (ppm)
Fe	30	500
Mn	20	1000
Cu	7	25
Co	0.1	10

Zn	20	300
Mo	>0.5	10
Se	0.1	2
I	0.1	50

VITAMINS

Vitamins are necessary for maintain normal body processes (growth, health, fertility, performance). Goats can generally not synthesise these itself sufficiently or at all, which is why vitamins have to be taken in from the diet to a greater or lesser extent. Deficiencies usually don't present in the form of a symptom but reflected in depressed growth rate, lowered resistance against infections and poor reproduction.

Vitamins are divided into **fat soluble** (**A,D,E** and **K**) and **water soluble** (**B** and **C**) groups . Any deficiency in a vitamin will slow or block the metabolic process in which that vitamin is involved, resulting in poor production.

The liver can store significant amounts of **fat soluble vitamins** for up to 6 months. Their levels are therefore more of a medium to long term concern.

Fat soluble Vitamins (A,D,E,K)

Vitamin A is synthesized from carotene, which is present in green plants, so levels will be determined by the veld condition and will be significantly lower in winter veld and in times of drought. B-carotene levels decrease in stored feeds over time. Most of a dose of Vit A is excreted within a week and the remainder stored in the liver. These liver reserves may last for 6 months in the Angora goat.

B-carotene deficiencies occur during droughts, when lucern hay and concentrate diets are fed. The feeding a urea lick, deficiencies in P or Vit E prevents the transformation of B-carotene to Vit A. A high Ca and low Zn diet can also result in Vit A deficiency. Vit A is essential in production of progesterone so deficiencies result in poor expression of oestrus, delayed ovulation and birth defects and negatively affect immune status . Deficiencies can also result in eye disorders, blindness, increased respiratory disease and decreased mohair production.

In South Africa vitamin A supplementation is widely recommended and used extensively in practice, both by farmers and by the feed industry. This situation prevails despite the fact that it appears that no conclusive evidence, indicating that such supplementation hold any benefit in terms of small stock performance, exits. A study by P.G.Marais was conducted under different environmental conditions to determine the effect of vitamin A supplementation on reproduction and production of sheep and goats. The trial with Merino and Dorper sheep, Boer goats and Angora goats and was repeated over four years. The stock were injected with a commercial vitamin A product 4 - 6 weeks prior to mating and again 4 - 6 weeks before lambing. It was evident that vitamin A supplementation had no effect on reproduction and production traits measured in this trial.

The only source of Vit A for the lamb is via the colostrum as it does not cross the placenta. Vitamin A is synthesized from carotene, which is present in green plants, so levels will be determined by the veld condition and will be significantly lower in winter veld and in times of drought. Multivitamin (ADE) supplementation should be considered especially under winter grazing conditions and at times of drought.

Vitamin D goes hand-in-hand with **Ca** and **P** metabolism and deficiencies can affect bone growth and development. Natural sources of Vit D are Ergosterol found in plants which is converted to Vit D by UV light. Stock in South African conditions usually receive sunlight in abundant quantities, so vitamin D is seldom considered deficient but Vit ADE could be supplemented in late pregnancy when the ewe loses large amounts of Ca and P to the foetus. Symptoms of a Vit D deficiency would be that of a Ca deficiency.

Vitamin E functions as an antioxidant in conjunction with **selenium** and marginal deficiencies can be significant. Effects of a combined vitamin E/ Selenium deficiency are well documented and include poor reproduction, poor growth and mortalities in kids. Deficiencies result in striated muscle damage in young animals (tongue affected and can't suckle), retained placentas. Vitamin E is therefore particularly important in areas with marginal or deficient levels of **selenium**. Stress situations are regarded as precipitating factors for Vit E deficiencies. Green feed has high levels of vitamin E so again may be deficient in winter veld.

Vitamin K is produced by bacteria in the digestive tract and absorbed so does not need to be supplemented. Vit k is also present in green plant material. Vit k is involved in the blood clotting cascade

Kids and Vit A/E)

Fat soluble **vitamins (A,E)** do not cross the placenta in any quantity, which means a new-born kid has no reserves of these vitamins in its liver and must obtain these via the colostrum. It is therefore worth supplementing these in late pregnancy if there is any doubt as to the status of the ewe. This is best done using a multivitamin (vitamin ADE) injectable, 4-6 weeks before kidding.

Water soluble vitamins (B,C)

Water soluble Vitamins cannot be stored by the body and so must be provided for on a daily basis.

Vitamin B is synthesised by bacteria in the rumen. Day-to-day food intake is generally enough to maintain the health of these vitamin-B synthesising bacteria.

Thiamine (vitamin **B1**) may occasionally become deficient if a high concentrate diet , especially one with high S content (e.g. molasses) is fed. Defficiencies in B1 would reflect as poor leg co-ordination, head often retracted along shoulder. Heart arrhythmias,, anorexia and diarrhoea may be seen. Head pressing, convulsions and collapse are seen. Eye and muscle twitching and grinding of the teeth often occur.

B2 (Riboflavin) is synthesised in the rumen

B6 (pyridoxine) adequate in diet

B12 (Cyanocobalamine) deficiencies are closely related to Co deficiency. Vit B12 defficiencies can also occur on high concentrate diets. Deficiencies cause the rate of proprionate clearance from the blood to be poor which supresses the appetite. B12 injection stimulates the appetite overnight.

Symptoms of deficiency include poor appetite, growth.

Vitamin C requirements are met by the daily consumption of fresh plant material, coupled with the production of vitamin **C** in the body tissues, Vit C tends to localise around healing wounds and is important in healthy mucous membranes. Vit C stimulates leucocytes and formation of antibodies (immune system).

CONCLUSION:

In conclusion browse plants usually have higher mineral concentrations than grass and so Angoras are generally less likely to have mineral deficiencies than sheep. Mineral deficiencies will become evident as goats become more intensively managed under commercial and under drought conditions. Mineral and Vitamin supplementation is more likely to be beneficial at strategic times and the following may suggest an underlying deficiency:

- **Condition of veld**:
- Vitamin ADE supplementation should be considered especially under winter grazing conditions and at times of drought.
- Mg requirements increase in Energy deficient diets as it is involved in carbohydrate metabolism

- **Intensive feeding**:
- Lucern lands (Mg, Se/Vit E, Zn, Mn)
- Green pastures (Mg) as it is firmly bound to the chloryphyl molecule
- Molasses (Se/Vit E)
- Urea (Vit A)
- Concentrates (Vit B1,B12, Co, Vit A)
- Lucern hay (Vit A)

- **Reproduction stages:**
- Ewes last 4 weeks pregnancy (Se, Vit ADE)

- **Soil types:**
- Acid soils (Se/Vit E)
- Sandy soils (Se/Vit E, Co/Vit B12)
- Lime soils (Co/Vit B12)

- **Overall Nutritional status:** Energy and protein needs to be adequate in order for the supplemented vitamins and minerals to function optimally.

Consider having tissue samples evaluated to determine the optimum mineral supplementation requirements specific to the flock. Where this is not done minerals should be supplemented with caution.

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