

Horses! Flower arranging or knitting seemed more attractive

The year is 2008 and for the past year, having moved to a house with 12 acres of land in 2006, my horses have been sick. This sickness is manifesting itself in a variety of niggling ways; skin infections, skin sensitivity in terms of itching, lethargy, hoof abscesses, white line infections, difficulty in getting the horses fit for hunting and endurance, thrush, dull sun bleached coats and weeping eyes.

For a year I try many different feeds and supplements, some make no difference and some seem to make things worse. I am getting desperate, particularly as out of 4 horses I never seem to have more than one sound at a time, can never predict when the next hoof abscess might hit and they look dreadful. The thought of starting flower arranging or even knitting as a hobby seems pretty attractive as no one seems to have an answer to my problems, not my vet, not the nutritionists or other horse professionals.

I have been using Malaseb shampoo, on the advice of my vet, for the last year in an attempt to control a strange skin infection, which results in boils and lesions on my horses' skin. I start asking the farmers in our area whether they see problems in their stock and they mention copper deficiency. A quick look at a forage analysis I had done in 2006, when I first bought the land, reveals low copper, 5.8 mg/kg, 'Bingo' I think and ask my PhD holding organic chemist of a husband to buy me some copper sulphate. 'Why?' is of course his question and when I explain I want to feed it to my horses he categorically refuses to get me any saying I'll poison them! Well that slowed me up for a while, but those who know me personally will know that the Jack Russell in me seldom rolls over for long.

Macro Minerals		Analysis	Very Low	Low	Mean	High	Very High
Phosphorus	P %	0.29	0.10	0.20	0.40	0.50	0.60
Magnesium	Mg %	0.20	0.10	0.25	0.50	0.70	0.80
Calcium	Ca %	0.68	0.25	0.35	0.55	0.65	0.75
Sodium	Na %	0.18	0.10	0.15	0.25	0.35	1.00
Potassium	K %	1.75	0.20	0.49	3.50	4.00	5.00
Chloride	Cl %	0.70	0.10	0.20	0.40	0.60	0.80
CAB	mEq/kg	326	140	280	420	560	700

Micro Minerals		Analysis	Very Low	Low	Mean	High	Very High
Manganese	Mn mg/kg	893.2	10.0	25.0	100.0	250.0	500.0
Copper	Cu mg/kg	5.8	4.0	8.0	12.0	16.0	20.0
Pred. Copper Avail.	%	4.0	0.8	2.3	4.7	5.8	7.0
Zinc	Zn mg/kg	40.0	20.0	40.0	60.0	100.0	150.0
Selenium	Se mg/kg	0.06	0.05	0.10	0.30	2.00	3.00
Cobalt	Co mg/kg	0.08	0.05	0.10	0.20	1.00	1.50
Iodine	I mg/kg	1.22	0.05	0.10	0.20	2.00	5.00

Antagonists		Analysis	Very Low	Low	Mean	High	Very High
Iron	Fe mg/kg	217	50	100	300	500	700
Aluminium	Al mg/kg	147	70	140	210	280	350
Molybdenum	Mo mg/kg	2.46	0.01	0.50	3.00	4.00	5.00
Sulphur	S %	0.22	0.10	0.20	0.40	0.60	0.80
Lead	Pb mg/kg	1.1	0.5	1.0	1.5	2.0	2.5

My 2006 analysis of forage, note the VERY high manganese

I become a Kellonite!

Fast forward 6 years and I still live in the same house and the horses live on the same land. My horses' now have healthy skin, no skin infections and no abnormal skin itching. The Malaseb is gathering dust in the shed. The horses are bursting with sensible but limitless energy, my last hoof abscess was in 2011, white line infections and thrush are gone, getting them fit is a doddle and their coats are a rich colour with my once pale orange chestnut now sporting a magical, deep rich, mahogany, conker colour. Eyes are clear, bright and sparkling and I am now a Kellonite! I now understand completely the role of balancing the minerals available to my horses through forage so that the ratios are

within suitable parameters. That 2006 forage report and wondering about copper changed my life. The Jack Russell in me found reference to a US vet called Dr Eleanor Kellon and what she taught me made a whole load of sense when you looked at my 2006 analysis of the forage my horses were eating.



2007 coat & mane colour

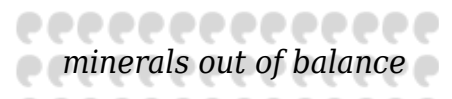
Minerals out of balance impact horse health

This forage was high in both manganese and iron (as related to horse needs, the graph refers to cattle needs) and low in copper and zinc. In 2014, after hundreds and hundreds of scientific analysis of forage, I now know that this is a really common profile throughout Europe, and throughout



2011 coat & mane colour

Europe, horses,
many horses
have the same
niggling
problems as
mine did in
2008. So why
does this
matter? It
matters
because
minerals out of
balance with
each other in
hay, haylage or
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enormous
impact on the
health of
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large
geographical
area.

A decorative graphic consisting of two rows of light grey circles. The top row has 15 circles and the bottom row has 14 circles, with the text 'minerals out of balance' centered between them.
minerals out of balance

with each other in hay, haylage or grass have an enormous impact on the health of domestic horses that are unable to browse and select from a large variety of plants over a large geographical area.

Horses evolved to eat on an unlimited range of land, to eat many, many different species of plants growing on different soil types, with grass just being one of these. They would have had access to salt deposits and roamed freely, selecting what they needed from a rich variety of plants. Domestication has placed the horse in a very different arena, one where they often eat single species hay and live in a little micro-world of just a few acres. Our domestic environments ultimately lead to narrow feed, which results in deficiencies and imbalances that cumulatively affect the horse over time and little by little nutrient deficiencies take their toll.

There appears to be a direct relationship between the imbalance of minerals in some forages and the occurrence of many of the niggling issues I experienced with my horses. The usual profile of our UK forage and also much of that throughout Europe is one where a picture of high iron and high manganese blocks the uptake of low copper and low zinc. Where molybdenum is also high, then copper absorption is further compromised. If you look, my molybdenum levels are heading towards high and are nearly half that of copper.

Think minerals, think lottery machine, think



A complicated relationship exists between all minerals and the way they compete for absorption sites in the horse's digestive system.

A very simple way of looking at this is to use the analogy of a lottery machine. Where in the lottery machine you have both manganese and zinc balls competing to get down one shoot you have a problem if you have too many of one type of ball. Ideally the ratio between the manganese and zinc balls should be 1:1 (Nutrient Requirements of Horses -sixth revised edition - NRC 2007) but in reality it is usually very imbalanced and in my 2006 report it was 22.3:1. The ratio between iron and copper should be no higher than 10:1 and ideally hit the button at 4:1 but in my 2006 report it was 37.4:1.

Now I look at the 2006 report and wonder why the very helpful UK nutritionists who looked at the results in 2007/8 didn't spot the obvious problems. Hooves and skin are keratin, and zinc and copper are crucial for strong keratin formation and so my horses were in trouble.

Zinc is present in high concentrations in normal hoof tissue and is critical for a variety of functions. It is vital for the assembly of keratin and keratin is the major structural protein from which hooves and skin are made. Zinc is also essential for a variety of enzymes that

every metabolically active cell needs and is involved in regulating the rate of cellular division, cellular activity and cellular maturation. Think lottery machine, think ratios of manganese to zinc, which are regularly over 30:1 and it is not too difficult to see that zinc deficiency is showing in our horses' hooves and skin in a number of ways. You might see:

- slow hoof growth
- thin hoof walls
- weak hoof connections (white line)
- weak flaky horn
- abscessing
- skin infections/mudfever
- skin irritations/sweet itch

The abscessing is not surprising because when the hoof horn and skin is weak at a cellular level, micro breaks in the structure make the keratin far more vulnerable to attack by organisms and or irritation, but there is more to it than just zinc. Copper is also vitally important for keratin health, as along with zinc, it enables a function, which prevents fats and oils from oxidising. Oxidative damage to the fats in the hoof structure, in particular, breaks the protective seal on the hoof, causing over drying (weak flaky horn) and weakening of the 'glue' between the cells.



Hoof abscess: one of my horses 2008

Copper insufficiency leads to weak sulphur cross bridges

Copper also enables important enzymatic functions required for anaerobic metabolism in rapidly dividing cells. The all important sulphur cross bridges that hold keratin strands

together are often compromised because these enzymatic functions are affected due to copper insufficiency in the body.

The agricultural industry know that evaluation of trace mineral levels in the diet is critical for cattle with hoof problems, they also know that high iron and manganese interfere with trace mineral absorption. So why, you have to ask, has the horse feed industry been routinely adding iron and manganese to all their adult horse broad spectrum mixes for years...

The really surprising thing is that in cattle, deficiencies of copper and zinc have been linked strongly to soft feet, cracks, sole haemorrhages, abscesses, thrush ('foot rot' in cattle and sheep) and laminitis yet in the horse nutrition world the connection appears to have been missed.

Supplementing extra copper and zinc reduces these problems and for years now the agricultural industry, have been formulating bespoke mineral supplements, for farmers, based on balancing to the mineral profile of the forage their stock are eating. The agricultural industry know that evaluation of trace mineral levels in the diet is critical for cattle with hoof problems, they also know that high iron and manganese interfere with

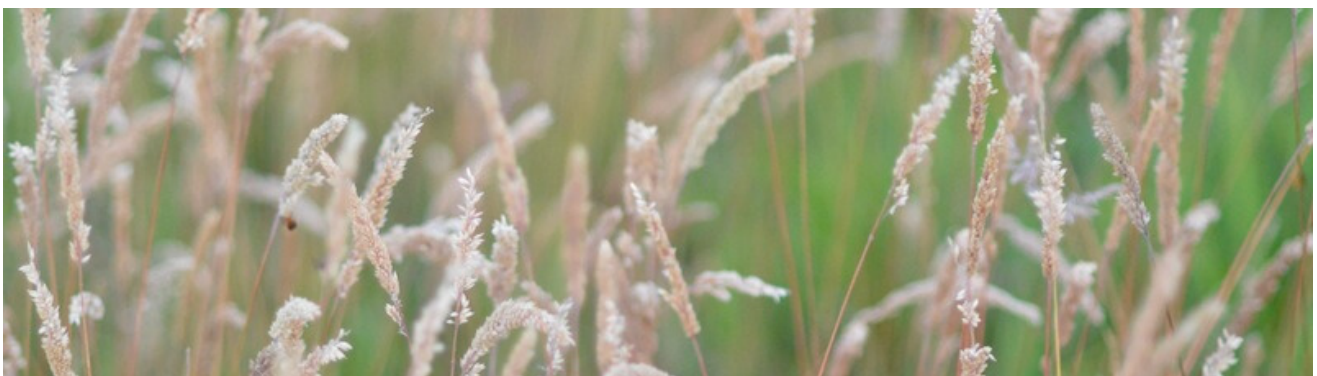
trace mineral absorption.

So why, you have to ask, has the horse feed industry been routinely adding iron and manganese to all their adult horse broad spectrum mixes for years, when the average profile of UK and European forage shows horses will be exposed to such high levels of these minerals from the day that they are born, that supplementing them will cause even greater problems and effectively cancel out the pitiful levels of copper and zinc added in those very same broad spectrum supplements?

Balanced Minerals – A new way of thinking about equine nutrient availability

The trouble with a bag of compound feed is that the one size fits all approach just doesn't help where you have a horse, which sniffs grass and gets fat. Many horses cannot be fed the recommended levels and even when given the most highly fortified feeds, the broad spectrum approach takes no account of the common profile of the forage fed, no account of those minerals which might get down that lottery machine shoot because they are grossly in excess. This makes those which are deficient even more deficient!

Know what nutrients are commonly available in forage before supplementing horses



Supplement your horse matched to mineral levels in the grass

Mineral levels in grasses vary widely even between different areas of the same field, and different types of plants have different profiles, but typically in the UK the common profile is one where phosphorous, magnesium, sodium, chloride, copper, zinc, selenium and

iodine need supplementation. However, for adult horses, the other minerals, calcium, iron and manganese are more than adequately provided for and block the uptake of the minerals needing supplementation.

Sodium is usually low and often deficiency of this mineral accounts for unexplained lethargy in horses. Supplementing around 5 grams of salt per day will provide enough sodium for maintenance needs. Depending on a salt lick is a unwise strategy as getting enough mineral through licking takes too much time and some horses won't touch a lick even though deficient.

Calcium is usually adequately provided and where beet pulp, grass nuts or alfalfa is fed as a concentrate, calcium becomes even more abundant. Phosphorous is usually very poor, (the dairy industry know this and are currently pouring millions into research to develop high phosphorous grasses), and needs careful supplementation for all horses and especially for lactating mares and growing young stock.

Magnesium is always pitifully low and when matched to calcium, the ratio is usually way short of the ideal 2:1. Potassium is high in all the forages we test.

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sodium for maintenance needs. Depending on a salt lick is a unwise strategy as getting enough mineral through licking takes too much time and some horses won't touch a lick even though deficient. Where horses are sweating from exercise, a general rule of thumb would be to supplement around 20-30 grams per hour of heavy sweating. Table salt, rock or sea salt can be used, nothing special is needed but extra salt in the diet can often be like a miracle for a slow, lethargic horse or an endurance horse which keeps crashing out at rides. Chloride is usually better supplied in forage but horses in heavy work excrete large amounts of this mineral so again supplementation of salt is wise to replace the loss of this electrolyte.

Are you seeing a nutritional light bulb in front of your eyes?



Trace minerals are those needed only in small, milligram amounts. While the requirement is small, the impact is huge. These minerals are indispensable for enzyme functions, carrying oxygen to the tissues, energy generation, immunity, antioxidant protection, thyroid function, reproduction, pigment production - to name a few.

The nutritionally important trace minerals include iron, iodine, copper, zinc, selenium, chromium and manganese.

Here in the UK full blown, life-threatening deficiencies are of course rare but scientific analysis of forage shows a pattern of low copper, zinc, selenium and often iodine which results in health issues which need not be tolerated and will respond well to balancing minerals to forage.

Copper and zinc are needed at much higher levels than previously recognised. Iodine is highly variable but is usually slightly low unless very close to the coast. Selenium is almost without exception deficient and 1 mg per day for horses up to light work is vital, for horses in hard work 2 mg is a wise level according to our forage report statistics.

My 2006 report showed my horses were being exposed to around 8932 mg of manganese per 10 kgs of hay they ate each day, this was more than 20 times the daily recommended amount. Think lottery machine! Think now I know why some horses move to an area and either get all sorts of problems or miraculously get better as if by magic!

Inadequate levels of some of these minerals can produce a variety of symptoms. Two of the most common are poor hoof quality/abscesses, including a predisposition to thrush, and “bleaching” of the coat. Another is immune system dysfunction including allergies, exaggerated reactions to vaccines or insect bites, and exaggerated inflammatory reactions in general. Ability to maintain and repair tendons, ligaments and other connective tissues may also be impaired. And so the list goes on and by now if you are anything like me when I started reading Dr Kellon’s work you should be seeing the mother of all big light bulbs in front of your eyes!

So the take home message has to be, that here in the UK and all over Europe, zinc and copper deficiencies, in particular, are extremely common and are not being addressed. Conversely iron and manganese levels are rarely low and usually very, very high but added into the compound feeds and supplements fed by owners.

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A Forageplus, happy healthy horse, but I still need to balance the soil to get even better health.

How do I feed my healthy horses now?

So now my horses get a forage focused mineral supplement served up to them each day in a bed of something tasty like beet pulp, high fibre cubes, a chaff or grass nuts. Each year I analyse the forage and check that the balancer I am feeding is matching the excesses and deficiencies as matched to ratios shown in the report. Commonly I need way more copper, zinc and magnesium than is generally found in any broad spectrum mineral supplement on the market.

I no longer believe that for the majority of horse owners a broad spectrum supplement or vitamin and mineral premix is appropriate because this scatter gun approach does not seek to address the effects of the antagonist minerals which are commonly hindering the absorption of the correct levels of minerals in the horse's diet.

The ideal way to perfectly supplement and balance the horse's diet is by having the forage, either hay/haylage or pasture, scientifically analysed. This allows for precise management of the ratios between minerals and is especially important for compromised

horses. However, horses in good health can handle some imbalances better and can do well with a well formulated supplement which contains only those minerals which are commonly deficient as matched to ratios.

The soil maketh the plant which maketh the horse



And then there are the vitamins, the amino acids and the soil! Oh yes, the soil, now there is a can of worms, for the soil maketh the plant which maketh the animal..... your horse! However perhaps for now you need to digest just the mineral implications for horses and if you want to know more, and believe me there is more, keep coming back to Forageplus Talk where I try to share the many things I am learning on my journey, all of which started with that 2006 analysis, Dr Eleanor Kellon and forage focused minerals.

Written by Sarah Braithwaite (just an obsessed horse owner who now owns and runs Forageplus Ltd with her now copper convinced PhD, organic chemist husband, Dr Lee Proctor)

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