



## Reading Labels – Part 4 – Feeds

Now that you have supplements sorted out, what about feeds? Comparing prepared feeds is just about as confusing as comparing supplements, but with less math, you'll be pleased to know.

Somehow, until the mid-2000's, I managed to go through life blissfully unaware of the complexities of choosing prepared feeds. I worked in racing stables, and all my clients fed a prepared racing formulation to their racehorses. Though some added bits and bobs, such as barley, supplements, and oils, they didn't really ask me that many questions about their basic feeding regimens. Then, I set up a mobile equine veterinary practice in Al Wathba, Abu Dhabi, UAE. It was a pretty interesting place where I met a broad range of people, from nearly every background and nationality, with a wide range of horses, in a whole array of different management situations, doing every possible activity. To add to the rich tapestry of experiences, I'd often find the entire equine and human smorgasbord at a single stable.

This complex set-up, the need for refrigerated feed rooms (*Outside temperatures soar to 45-50 degrees Celsius, and inside it would be even hotter. Nutrients aren't very stable when they are heated excessively, and moulds etc. do really well.*), and the ordering systems for some feeds meant that many of these stables had an entire pallet of feed, for each type of horse, in each activity. This, of course, cost a fortune and took up way more space than anyone really had in their refrigerated feed rooms. To top it all off, the forages available (...and there is no grass...ever), are variable in quality throughout the year. Some had imported hays that were expensive but quite nice for at least part of the year, and some had the highly variable and often not very nutritious local hay. This meant that feed costs and logistics were of major concern to virtually all of my clients. They pretty much all asked me about the prepared feeds they were feeding and asked about simplifying the whole ordeal. (*They also asked me about the value of dates and camel's milk in the equine diet which I looked into, being open minded and all. I was a bit impressed with camel's milk in particular and would quite like a dairy camel at home in NZ... I'll tell you about what I found out sometime...but I digress...*)

In order to answer all the questions about feeds I was getting, I took myself off to the camel souk (a market at the camel racetrack where, ironically, most horse products can be found) and had a look at the myriad feed stores. There were feeds from every company I could think of, from every country in the world. It would take a lifetime to sort through the entire selection, so I started by looking at the ranges of feeds from each of the brands that my clients were feeding.

I found an enormous number of feeds that looked pretty similar. I had a hard time telling apart...

1. the different formulations from the same company as well as
2. the formulations from different companies, all of whom had similar feeds and ranges as the others.

The bags were different, but what was in them was pretty much the same. They all had very similar ingredients, in very similar, but not quite identical, proportions. I couldn't really tell them apart, and I'm guessing, without referring to the names on the bag, like Racehorse Mix or Cool Feed, you would struggle to tell the difference too.

Before we begin sorting out how to compare different feeds, you should know some feed basics.

It is important to know something about the volume a horse will eat in a day. Most horses will eat between 2-3% of their body weight per day in feed, including hay, grass, and concentrate feed. When horses are working very hard, their feed consumption is generally at the bottom of the range, and for that reason, they can't normally meet their protein and energy requirements by eating grass or hay. A concentrated form of those nutrients must be fed.

Since a 500kg horse in hard work will only eat about 10 kg per day, all of the nutrients required must be fed in that volume of feed. It is also important to keep in mind that the larger part of the ration should be provided in the form of roughage as that is what keeps the gut moving properly and the flora healthy. For this reason, you really can't just feed a horse 10kg of a concentrated feed and nothing else.

So, before we begin to talk about feed, then, we have to talk a bit about hay and grass. It is important to know something about the quality of your forage. You can use average values for the nutrient content for each plant species to get a rough idea of what your hay or grass is contributing to your horses' daily rations, but an analysis provides more accurate information. You may be able to ask your feed supplier for an analysis of the hay they sell, or you may send samples of your pasture grass and hay to a laboratory yourself. There are also packaged hay products available in most parts of the world. These are labelled with nutritional information, just as concentrate feeds are, but there is one catch you may not be aware of. Nutritional information can be listed on a "Dry Matter Basis" or on an "As Fed" Basis. "As Fed" is pretty self-explanatory. Nutrient content is measured in a kg of the forage in the form that you'd feed it. When you feed 1 kg of it, you will be feeding the feed, moisture and all. "Dry Matter Basis" means that the nutrients are listed as a percentage

of just the dry component of feed that is left when the moisture is removed. When you compare feeds, you will need to calculate the amount of nutrients on an "As Fed Basis", as when you actually feed your horse, you will be feeding the feed, moisture and all. For example, if a packaged forage lists their nutrient content on a Dry Matter Basis, but the moisture content is listed 50%, 1kg of that forage contains only 500g of dry matter and 500g water. If the label says there is 20% protein on a dry matter basis that is the same as saying there is 200g of protein per kg of dry forage. When you actually feed it to your horse, however, you will be feeding the forage along with an equal amount of moisture (water). To get 1 kg of dry matter from that feed, therefore, you have to feed 2 kg. If 1kg of the feed, on a dry matter basis has 200g of protein, when the 1kg of moisture is added back into the calculation, there is only 200g of protein in 2 kg of the feed as fed. On an as fed basis therefore, the feed is only 10% protein or 100g of protein per kg of feed. In this example, content "as fed" = 20% protein on a DM Basis x 50% moisture/100%

To convert from dry matter basis to as fed basis, multiply by the percentage moisture and divide by 100.

With dry hays, the moisture content is less than 10%, so the "as fed" content is almost the same as the content on a dry matter basis. Grass, in contrast, is about 90% water, so the as fed content is very different than the content on a dry matter basis.

Depending on the maturity and conditions at harvest as well as the type of hay, protein content can vary from well under 10% for poor grass hay up to 18-20% or so for nice Lucerne (alfalfa) hay, chaff, or cubes. The poorer the hay being fed; the greater the importance of the hard feed.

Horses need energy, protein, calcium balanced with phosphorus, vitamins, and minerals including salt. All horses need these same nutrients, but those working hard, growing, in foal, and lactating, need more of them. You can find nutrient requirements for your specific horse by looking up NRC or by asking your feed supplier, nutritionist, or veterinarian. I talk about some of the requirements later in this post.

When nutritionists balance rations, they start by looking at the protein and energy content (and costs) of the feed ingredients available. Then, once they have decided on the main components, they look at vitamins and minerals etc. which can be added and adjusted to achieve optimal balance while considering the contribution of the main components of the feed. So, just as if we were formulating a new feed or ration, we will start with energy and protein.

The main differences between the varieties of commercial preparations include...

1. The concentration of nutrients, especially energy and protein, and
2. The specific form of energy and protein provided.

For example, spelling mixes have lower concentrations of energy and protein than racehorse mixes. This is generally because most feeds are designed to be fed at a rate of 4-6 kg per day. A spelling horse will need to eat 5kg of a spelling mix to meet its lower requirements for energy and protein, and a racehorse needs to eat 5kg of a racing mix to meet its needs. In fact, if the spelling horse ate the racehorse mix, it could just eat less of it to get the required amount of nutrients.

### Protein Quantity

*For this section, remember that there are 1000 grams (g) in 1 kilogram (kg). I'm sorry, but I didn't promise there wouldn't be ANY math; just less of it.*

Protein is often expressed as a percentage on feed bags, and horsemen tend to think of protein requirements in terms of those percentages. (ie. Racehorses need 16% protein and spelling horses need 10%.) In fact, protein requirements are in grams per day and not in percentage at all. 100g of protein could be found in 100g of a 100% protein feed; 1kg of a 10% protein feed; or 10 kg of a 1% protein feed. So, the percentage of protein in a feed is only important when you consider how much of that feed your horse will eat.

Horses in hard work need about 1000-1500g, particularly if they are also growing.

Spelling horses need about 750g

Ponies (adult weight 200kg) in hard work need 350-450g

The average 2-3 year-old racehorse in intense work needs 1000-1500g of quality protein per day. As I already said, a horse in hard work will eat 2% of their body weight per day. As a result, a racehorse could be expected to eat only about 5kg of concentrate feed and 5kg of roughage. If the average protein content of hay is 13%, then about 650g of protein can be derived from hay. The rest has to come from the concentrate feed.

A concentrate feed of at least 13% protein fed at a rate of 5 kg per day might be enough for the average horse, but some will need more like 850g of protein from their concentrate feed, and since that must be provided in 5kg or less feed, then the feed would have to be 17% protein to meet requirements. If it was 20% protein, the 850g could be fed in 4kg of feed, and the 650 would be provided in 3kg. That would allow that horse to eat a bit more hay, which has some benefits for the health of the gut.

Remember, don't worry about the percentage of protein in the feed being high. If the percentage of protein in the feed is high, you will simply be able to feed less of it to meet your horse's protein requirements.

### **Protein Quality**

In order for horses to make proteins (which are the building blocks of muscle cells), 10 essential amino acids must be provided in particular ratios. (Essential amino acids are those that horses cannot synthesise and, therefore, must consume.) If even one of these essential amino acids is in short supply, protein production will stop. The amino acid, available in the lowest relative amount, is said to be the limiting amino acid. The excess amino acids (the ones in higher amounts than the limiting amino acids, that now can't be used for protein and muscle cell synthesis in the horse) become waste products, resulting in increases in heart rate and load on the kidneys. For this reason, the best protein sources have the best essential amino acid balance, and as many of the amino acids provided as possible can be used for protein synthesis and muscle development in the horse.

Grains, like barley and oats, have some imbalances in the amino acid ratios, and as a result, only about 40% of the protein in an oat or barley-based feed will actually be useable by the horse to make muscle. In comparison, the ratio of essential amino acids in peas, lucerne (alfalfa), lupins, or soy allows for about 80-90% of the protein to be used. Make sure you consider, therefore, the type of protein provided in a feed.

### **Energy**

Horses in hard work need about 26-35 Mcal of DE (Digestible Energy)

Spelling horses need about 15-18 Mcal of DE

Ponies (200kg mature weight) in hard work need 11-14 Mcal of DE

Energy requirements can often be met by pasture or hay in spelling horses, but for horses in hard work, it is necessary to feed a concentrated feed in addition to forage. Energy is provided in equine feeds in the form of carbohydrate (grains, corn, etc.) and as fat. Traditionally, oats and barley were fed as the primary energy source. They are a cost-effective way to provide energy, and some horses do very well on them. Some individuals, however, do not. Horses that suffer from a tendency to tie-up, those that have a tendency to founder, and those that colic are generally better avoiding grains.

Normal carbohydrate digestion starts in the small intestine. Starch is broken down to complex sugars, and the complex sugars are, in turn, broken down to glucose. Glucose is absorbed through the small intestine. Any starch or sugars that aren't digested and absorbed by the time the digesta leaves the small intestine are dumped into the cecum and large intestine. That part of the gut, known as the hindgut, is a big fermentation vat. Bacteria in the hindgut work slowly on the digesta, breaking down roughage to molecules called volatile fatty acids that can be used by the horse for energy.

Horses' guts, however, were never designed to process large amounts of starch, so the enzymes required for its digestion are produced in limited supply. Grains are very high in starch and sugar and can, therefore, pose problems for digestion. If large amounts are fed at one time, some starch and sugar pass undigested into the hindgut, making it's environment more acidic. The beneficial population of bacteria can't survive in an acidic environment, and when they die, they release endotoxins. Those endotoxins are responsible for problems such as colic, laminitis, and diarrhoea. In addition, undesirable bacteria are able to thrive, further disrupting the cecal pH and worsening the environment for beneficial bacteria and so on.

While the rule of thumb is to limit grain feeding to 2kg at a single meal, some susceptible individuals will not even tolerate that quantity at once.

In comparison, fat is a reasonably safe source of energy. While horses were not really designed to eat fat either, they do not seem to have problems with it. Researchers have found that horses tolerate as much as 10% of their diet as fat. For horses in hard work who may require quite a bit of extra energy in their concentrate feed, or for individuals prone to laminitis etc, look for a feed that has less grain and more fat. It can take muscles cells 2-4 weeks to adapt to fat as an energy source, so if you are switching a racehorse to a high fat, low soluble carbohydrate diet (low grain), try to do it when they are not racing in a week. Once metabolism adapts to fat, there is evidence of improved endurance, lower body temperatures, and a reduced incidence of tying-up, laminitis, and colic.

### **Vitamins, Trace Minerals, and Extras**

Pasture and hay may not meet all of the vitamin and trace mineral requirements, even in spelling horses. These nutrients, in most cases, will need to be supplemented, either on top of a plain feed, or in the form of a prepared feed. I wrote about vitamin and mineral requirements as well as the need for balance between each of these elements in the first parts of this reading labels series, so I'll just mention a few things here.

I generally prefer people to provide a prepared feed rather than mixing their own, unless they know a bit about nutrition or have had advice from a nutritionist. It is easy to get the balance wrong and cause more problems than you fix. Companies making feeds employ nutritionists and provide reasonably balanced preparations for you. I would go so far as to say that *all* feed companies refer to nutrient requirement standards when formulating their products. In reviewing the huge range of feeds available in the UAE and New Zealand, all I looked at appeared to meet the basic, daily requirements for fat soluble vitamins and trace elements when fed according to package

directions. Some provided those nutrients in more bioavailable forms than others (see part 2 of our reading labels post), and I would certainly choose the feeds that include more bioavailable forms of nutrients, but most would be pretty acceptable.

Calcium and Phosphorus must be provided in the diet of horses in a 1.5-2:1 ratio. Commercially prepared feeds will all be pretty well balanced in this department, so you won't have to worry about this much. In general, grains are high in phosphorus, while lucerne (alfalfa) is high in calcium. Be careful to get this right if you are mixing your own feeds or adding additional grains to prepared feeds.

I talked about most of the trace minerals in previous sections of this marathon post about reading labels, but I didn't say much about selenium. NRC says that horses in hard work require 1 mg per day, and most nutritionists would probably agree that 3mg is a better dosage to aim for in the diet. The interesting thing about the requirements, is that horses really don't have a requirement for elemental selenium (just plain, selenium). Their requirement is actually for the selenium containing amino acids, seleno-methionine and seleno-cysteine. This is important.

Selenium is described as having a "narrow therapeutic range". What that means is that the amount that is toxic for horses is not that much more than the amount they require for normal health. This is also important to know.

Selenium can be provided in several forms. It is provided in feeds as sodium selenite, sodium selenate, selenium yeast, seleno-methionine, and seleno-cysteine. These forms have some fundamental differences. They are not all absorbed, used, and excreted by animals to the same extent. Selenium yeast is a form of selenium that is created when yeasts are grown in an environment with lots of selenium. The yeasts incorporate the selenium into their own amino acids, so the selenium in selenium yeast is actually provided as seleno-methionine and seleno-cysteine for the most part. So, you can consider the last three forms as essentially equal. They are organic molecules that the body is good at absorbing and using.

The sodium selenite/selenate molecules, on the other hand, are inorganic salts that are unpredictably absorbed and used by animals. Studies done about 20 years ago in dairy cows demonstrated that cows supplemented with the same, standard amounts of those forms of selenium in the same diets, ended up with very different levels of selenium in their blood. Some were in the normal range, and some were deficient. When the level of supplementation was increased to correct the deficiencies seen in part of the herd, others started to show signs of toxicity. The conclusion was that the ability to absorb and use sodium selenate and sodium selenite was very individual and quite unpredictable. It was recommended to measure blood selenium in each animal before deciding on the appropriate dietary amount of selenium to feed. When the herd was placed on organic forms of selenium instead, the absorption and use was much more uniform across all individuals in the population. I haven't found a link to this study to post, but Alltech, a supplier of vitamin and mineral supplements, used this study in their promotional info in Canada probably 20 years ago, so you might have a look at their website for more details about selenium yeasts. Dr. Pagan from KER did a study that demonstrated much higher bioavailability of yeast-based selenium compared to inorganic forms, (link below) and many other researchers have demonstrated similar results with all the organic forms.

The other thing that is worthwhile noting is that inorganic selenium is not excreted very easily. If you end up with a low-grade toxicity, it can take months for the levels to drop back down to normal. If you feed a feed that has selenium in one of those forms, it's fine, but make sure you have your veterinarian check blood selenium levels from time to time and follow their recommendations for supplementation. Please don't sprinkle inorganic selenium on your feeds willy-nilly! More is NOT better in this case!

The moral of that story is... when you are comparing different feeds, try to choose one that includes selenium in an organic form. The chances of having normal blood selenium levels will be improved.

Finally, the end is near!

To summarize, evaluate your forage and determine how much additional protein and energy will be required from the concentrate portion of the ration. Then, you can probably just pick a company that you like to deal with, as most have similar ranges. Pick a feed from their range that has nutrients in a high enough concentration that your horses in intense work can meet their protein and energy requirements by eating no more than 5kg of hard feed so they can eat 5 kg of hay (or other forage) to meet fibre requirements and to maintain healthy gut motility etc. Try to pick a feed that has a good quality protein, so pick one with a bit more soy, peas, lupins, or alfalfa, rather than just oats and barley. If you want to avoid problems related to high carbohydrate diets, then look for higher fat diets with little or no oats and barley. Finally, have a look at the trace minerals provided in the daily ration. Pick a feed that has bioavailable forms of trace minerals in proper balance with each other.

Once you have selected a good quality, safe, and healthy feed, then you can probably feed it to most of the horses at your stable. Spelling horses and smaller horses will need to eat less of it with more hay or grass. Racehorses or broodmares etc will need to eat more of it.

Best of luck with choosing feeds. Remember... we are happy to help you read feed and supplement labels, and we are happy to do comparisons for you. Contact us via the website.