Protein and Amino Acids

Protein is the third component that will add calories to a diet and they vary in structure, role and efficacy**.**

What is protein and what does it consist of?

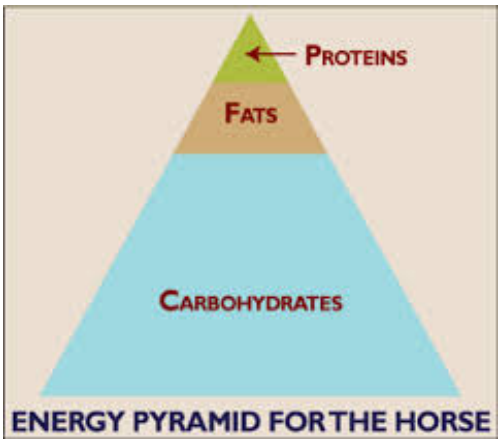
The building blocks for protein are amino acids, 22 in total. A number of those can be produced by the horse but there are 10 amino acids which are essential, which means they have to be in the diet because the horse cannot produce them himself in sufficient quantities to meet the demand for them.
The quality of a protein is higher when all 10 essential amino acids are present and in proper proportions to each other. In order to balance all these amino acids and to have a 'pool' of amino acids the body can take from, it is necessary to combine certain feed elements together. To build any protein, all the necessary amino acids for that particular protein need to be present at the same time.
Of those 10 amino acids, there are 3, which are typically out of balance in horse feeds: Lysine, Threonine and Methionine. They are called the limiting amino acids.

It is very important to know that not all proteins are made the same. This is where the **quality of protein** comes in play, which should be your main concern when putting together a diet.

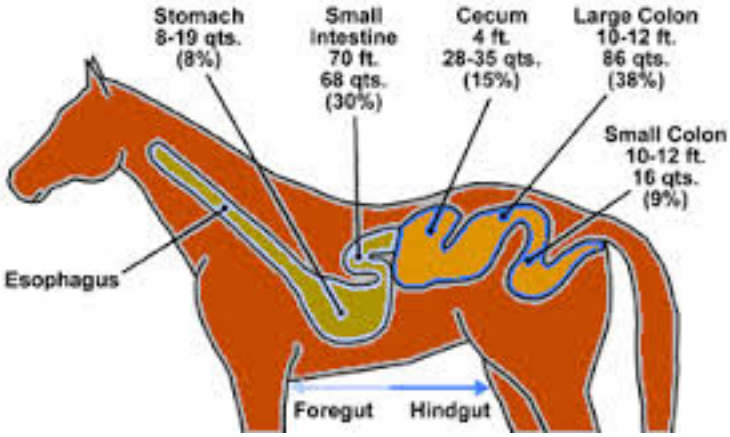
What is protein used for?

An important misconception is that protein is a source of energy for the horse. That is not correct if one thinks of kinetic energy. In fact, proteins main function is to create body proteins or to make the body function:

- Vital organs such as heart, liver, kidneys, liver, lungs
- Skeletal muscles (by far the largest storage of protein in the body)
- Blood proteins (to carry substances through the body)
- Skin, hair, hooves
- Bones (create the 'grid' upon which calcium and minerals can build)
- Eyes
- Connective tissue (collagen found in healthy joints)
- Enzymes to aid in digestion
- Immune function (antibodies are protein)



Digestion of Protein



Protein is mainly digested and broken down into amino acids by acids and enzymes in the stomach and small intestine (foregut). Those will then be absorbed into the bloodstream and added to the amino acid 'pool'. From there the body will utilize the necessary amino acids to build the protein chains it needs for its bodily functions. Any protein that ends up in the hindgut will be broken down for the synthesis of microbial protein but is otherwise not useful to the horse. When large amounts of protein have to move through the foregut, not all of it will be digested before it ends in the hindgut and it becomes a waste. Here the **digestibility of protein** is playing an important role. The higher the digestibility of the protein source, the higher the absorption of the amino acids to contribute to this amino acid 'pool' for tissue synthesis and repair.
For example, within forages alfalfa has a digestibility of 73-83% compared to fescue or brome grass (67-74%) or coastal Bermuda grass (57-64%).

What happens with insufficient Protein supply or low quality protein?

Amino acids are used according to priority. If a horse lacks glucose for energy to keep his 'engine' running, the amino acids will be used to provide for this. Otherwise the amino acids will be used to build body protein for all the other functions discussed before. This in usually only the case when horses are without any other source of carb or fat (normal source of energy) and will lead to muscle wasting, low immune function, liver problems, skin and hoof problems etc.

Poor quality protein is protein that does not have all essential amino acids available or in the wrong proportions. Then the body of the horse needs to choose on how to utilize the amino acids that are available.
The vital organs will use them first in order to keep functioning and staying alive. Skin, hair, hooves and muscle tone are usually low on the list and allow you a view 'inside' the horse. If those look good, chances are your horse is doing well on the inside as well.
Another tell-tale for poor quality protein is excessive and foul smelling urine. Excessive nitrogen from unusable amino acids is being excreted after being processed by the liver and both liver and kidneys can become overworked in that instance.

How do we determine protein quality?

Unfortunately CP, which is mentioned on a label of a feedbag, only gives you the amount of nitrogen that is in the feed. It tells you nothing about the source of protein, its digestibility or the profile (which ones) of the amino acids that are in the bag.
The combination of these characteristics determines the bio-availability of the protein source.
The list of ingredients is a better source of information. If it is unclear what the ingredients are or what the source of them is, it is probably with good reason the company did not put them there and an even better reason for you to stay away from that product.

Quantities of ingredients in animal feed are not in order of appearance as it is the case with human food. This can be very misleading to the reader of the label.
The main two amino acids to keep an eye on are the 'limiting amino acids' Lysine and Methionine. If those are low, the overall usage of the other 8 amino acids will be reduced, making the whole protein less usable. Their ratio also should be about 3:1 with Lysine being the largest component.

Sources of Lysine and Methionine

Here are some sources of the 3 limiting amino acids in different feeds:
(% based on Dry Matter Basis)

Feedstuff	Lysine %	Threonine %	Methionine %
Alfalfa pellets	0.8-1	0.8-0.9	0.2-0.4
Alfalfa hay	0.2	0.8	0.06
Orchard hay	0.1	0.1	0.04
Oats	0.44	0.48	0.24
Rice bran	0.66	0.52	0.29
Beet pulp	0.55	0.41	0.08
Speedi beet	0.45	0.51	0.15
Flax	1.32	1.27	0.65
Soybean meal	3.08	1.9	0.67
Copra	2.5	2.3	1.8

Soybean meal makes a good choice, however soy is GMO in the US and this has very negative effects on the health of the horse.
Rice bran is also a good choice, however it is high in phosphorus and needs to be balanced with calcium if it is going to be used. Rice bran is also susceptible to arsenic and depending on the area it was grown, it will have residues present.
Overall, alfalfa, beet pulp, flax and copra make a good choice for protein sources.

Feeding too much protein – is that a problem?

Healthy horses can tolerate more protein than what they strictly need. It will be used as energy or stored into fat for later use. There are two things to consider in this situation:

- Nitrogen must be excreted for this process and in some horses the excess urine is taxing on kidneys and liver and one needs to make sure the horse stays sufficiently hydrated.
- Calcium can be lost when protein intake is high because the kidneys can't retain the calcium. This in turn can lead to imbalances with phosphorus and magnesium in the body.

Other remarks

- If a blood test reveals high protein levels, it is an indication of an underlying disorder such as inflammation, infection or too much fat in the blood. It does not indicate you are feeding too much protein in the diet.
- Protein does not cause laminitis. Laminitis has several causes, the most common being too much fructan in the hindgut or elevated insulin levels caused by high starch/sugar diets.
- Alfalfa is higher in protein than other grasses or hays but it is low in sugar and high in calcium as well as other minerals. It is highly digestible in the foregut and makes a good element in the mix overall.

Bottom line

Protein needs to be fed in large enough quantities and be of a decent quality to provide the amino acid pool necessary to keep body tissues healthy.
Lifestyle, workload, stage of life, overall condition etc. will influence the optimal quantity of protein which is needed at that time.
Quality is of great importance, determined by amino acid profile and digestibility.

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