

## Understanding Protein Quality

After energy, protein is the most important nutrient in a horse's diet. Protein is needed to build good quality hoof, hair, skin, organ tissue, muscles, eyes, blood and bones. Protein is also a crucial part of enzymes and hormones. Protein is an absolutely essential nutrient in a horse's diet and after water, is the most plentiful substance in a horse's body.

But as with many nutrients, 'proteins ain't proteins'. Some protein is of very high quality, other proteins can be so low in quality that they will seriously limit a horse's ability to grow, reproduce, perform or build muscle. So what determines protein quality? First, let's look at what proteins are.

### What is protein?

Proteins are long chains of small molecules called amino acids. As a good analogy, think of amino acids as train carriages that join together with other amino acids to form a protein 'train'. Amino acids, and therefore proteins, are organic compounds containing carbon, oxygen, hydrogen, nitrogen and sulphur.

### The Amino Acid Puzzle

There are 22 known amino acids which can be joined together in almost limitless combinations to form proteins. Up to 11 of these amino acids can be manufactured by the horse in its body, so they are known as non-essential amino acids. The remaining 11 amino acids are termed ESSENTIAL amino acids. These essential amino acids cannot be manufactured by the horse and must be supplied by the diet.

The 3 most limiting amino acids in the equine diet (meaning the amino acids that are likely to become deficient first and limit the horse's ability to grow, reproduce, perform or build muscle) are lysine, threonine and methionine.

### Protein quality

While it is possible, and even likely that horses do absorb some very high quality bacterial protein from their hindgut, a majority of a horse's protein needs are met by what is fed in the diet. So the quality of protein you feed is extremely important.

Protein quality is determined by how well a particular protein meets a horse's requirement for amino acids, and particularly the essential amino acids.

### Selecting quality proteins?

Different feeds contain different levels of the essential amino acids and thus vary in 'quality'. As a general rule, grass hay and pasture contains lower quality protein than legume hay and pasture like lucerne/alfalfa and clover. C4 type grasses also contain lower quality protein than C3 type grasses.

Cereal grains like oats, corn and barley contain lower quality protein than legumes such as soybean, lupins and beans. Co-products like copra meal sit in the middle with lower quality protein than legumes, but better quality protein than cereal grains. Of the commonly used protein ingredients in horse feed, heat treated cottonseed meal contains the lowest quality protein of all. Soybean contains the highest concentrations and best combination of many of the essential amino acids and is thus touted as the best quality vegetable protein available.

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The absolute Rolls Royce of protein quality is whey protein. It has exceptionally high levels of essential amino acids that match almost perfectly a horse's needs for protein. Just a small note of caution, if you wish to use whey protein in your horse's diet, be sure to purchase 'whey protein concentrate' and not 'whey powder'. Whey powder is only about 13% protein and contains over 50% lactose, making it unsuitable for use in equine rations.

The table to the right shows the % crude protein and g/kg of lysine in some common feed ingredients.

### Which horses need high quality protein?

Not all horses need very high quality protein in their diet. Dry or early pregnant mares and horses in good condition that are either not in work or only in light work have only moderate to low protein requirements that are generally easily met by average to good quality grass pasture and/or hay.

Growing horses, late pregnant and lactating mares, performance horses and any horse needing to build and maintain muscle mass do require high quality protein in their diet. These classes of horse will not do as well as they could unless high quality protein is supplied in the diet. Grass pasture or hay based diets will generally need to be supplemented with some legume hay or grain for the best results. This is why adding lucerne/alfalfa hay to the diet of horses needing to gain weight is recommended (see Newsletter #6 – 7 simple steps for putting weight on your horse).

Name	Crude Protein %	Lysine g/kg
<b>Whey Protein Concentrate</b>	80	89.8
<b>Soybean Meal</b>	45	30.1
<b>Soybean (Full Fat)</b>	37	23.3
<b>Canola Meal</b>	37	21.1
<b>Faba (Tick) Beans</b>	24	14.8
<b>Wheat Germ</b>	23	14.7
<b>Cottonseed Meal*</b>	36	14.7
<b>Lupins</b>	28	13.3
<b>Linseed Meal</b>	32	11.8
<b>Sunflower Meal</b>	32	11.0
<b>Linseed</b>	24	9.2
<b>Copra Meal</b>	21	8.4
<b>Lucerne Hay</b>	17	8.0
<b>Rice Bran</b>	14	7.0
<b>Palm Kernel Meal</b>	17	6.4
<b>Millrun</b>	15	6.3
<b>Wheat Pollard</b>	14	6.3
<b>Wheat Bran</b>	14	5.6
<b>Black Sunflower Seeds</b>	29	5.1
<b>Soybean Hulls</b>	12	4.7
<b>Sugarbeet Pulp</b>	9	4.0
<b>C3 Type Grass Hay</b>	11	3.8
<b>Barley</b>	10	3.7
<b>Oaten Hay</b>	8	3.0
<b>C4 Type Grass Hay</b>	9	2.8
<b>Oats</b>	8	2.8
<b>Wheaten Hay</b>	8	2.8
<b>Corn (Maize)</b>	10	2.8
<b>Rice (White)</b>	8	2.7
<b>French White Millet</b>	11	2.1
<b>Oat Hulls</b>	4	1.8

\* Heat treated cottonseed meal appears to have moderate levels of lysine, however during the oil extraction process, a toxic compound called gossypol binds itself to lysine, which means the gossypol is no longer toxic, but it does render the lysine indigestible, so digestible lysine levels are much lower than this.

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### Using FeedXL to monitor protein quality

The FeedXL Pro and Advisor plans include lysine as part of the nutrition analysis of a horse's diet. Making sure that crude protein as well as lysine requirements are met in a diet will ensure your horse is getting the level of protein quality it needs.

If your diet is low in lysine, this indicates that the overall protein quality of the diet is low. In these situations, your horse's ability to use the protein in its diet to grow, reproduce, build muscle or perform will be limited, even if crude protein requirements are met in the diet. If your horse's diet does indicate lysine levels are too low, the following steps to increase lysine are recommended (in order):

1. Substitute some alfalfa/lucerne or clover pasture or hay for grass pasture or hay in the diet, adding up to 1 kg/100 kg of bodyweight (1 lb/100 lb bodyweight). In most cases, you will find this is enough.
2. If you use a complete feed, look for feeds that contain high quality protein legumes or if you mix your own feeds add legume grains like soybean, lupins or faba beans/tick beans/field beans to the diet. Avoid any feeds containing cottonseed meal or unnamed vegetable protein meals.
3. Small amounts of whey protein concentrate (or whey protein based products) can be used. For best effect in working horses, the whey protein should be fed within 15 minutes of the completion of exercise.

Lysine supplements are also available and can be used to boost lysine levels in your horse's diet. You should however be aware that the level of lysine as shown by FeedXL in your horse's diet is an indicator for overall protein quality in the diet. Increasing lysine by using legume hays or grains or whey means that along with lysine, you are also adding methionine, threonine and the remaining 7 or 8 essential amino acids. Adding purified lysine will certainly fill the specific lysine deficiency, but it may leave your horse with unquantified deficiencies of other essential amino acids.

### Take Home Message

When looking at protein in your horse's diet, always remember 'proteins ain't proteins'. Depending on their amino acid composition, some proteins are very high quality with good levels of essential amino acids while others are low in essential amino acids and therefore low in quality. The high quality proteins, including those from legume forages including lucerne/alfalfa and grains like soybean are able to support growth, pregnancy, lactation and muscle building, while low quality proteins like those from cottonseed meal and cereal grains will not be capable of properly supporting horses with large requirements for quality protein.

Not all horses require high quality protein, but if your horse is pregnant, lactating, growing or working hard and needing to build and maintain muscle mass the quality of protein in the diet will play a big role in determining how well your horse 'performs'. Use FeedXL Pro to keep track of protein quality and to alert you when the diet is deficient.