

The Oklahoma Cooperative Extension Service Bringing the University to You!

The Cooperative Extension Service is the largest, most successful informal educational organization in the world. It is a nationwide system funded and guided by a partnership of federal, state, and local governments that delivers information to help people help themselves through the land-grant university system.

Extension carries out programs in the broad categories of agriculture, natural resources and environment; family and consumer sciences; 4-H and other youth; and community resource development. Extension staff members live and work among the people they serve to help stimulate and educate Americans to plan ahead and cope with their problems.

Some characteristics of the Cooperative Extension system are:

- The federal, state, and local governments cooperatively share in its financial support and program direction.
- It is administered by the land-grant university as designated by the state legislature through an Extension director.
- Extension programs are nonpolitical, objective, and research-based information.
- It provides practical, problem-oriented education for people of all ages. It is designated to take the knowledge of the university to those persons who do not or cannot participate in the formal classroom instruction of the university.
- It utilizes research from university, government, and other sources to help people make their own decisions.
- More than a million volunteers help multiply the impact of the Extension professional staff.
- It dispenses no funds to the public.
- It is not a regulatory agency, but it does inform people of regulations and of their options in meeting them.
- Local programs are developed and carried out in full recognition of national problems and goals.
- The Extension staff educates people through personal contacts, meetings, demonstrations, and the mass media.
- Extension has the built-in flexibility to adjust its programs and subject matter to meet new needs. Activities shift from year to year as citizen groups and Extension workers close to the problems advise changes.



Use of By-Product and Nontraditional Feeds for Horses

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Feeds are processed for many reasons, including removing portions for primary products such as flour or oil from grain. The part of the feedstuff that is not used as the primary product may be used as a by-product feed. For example, wheat middlings (mids) are a by-product of removing the flour portion from the other parts of wheat seed.

By-product feeds have long been a part of commercially available horse feeds. Feed tags will list 'grain and grain by-products' as ingredients of many of the mixes. These by-products are usually incorporated as part of a pellet.

There has been a recent heightened interest in by-product and nontraditional feeds as main ingredients in rations. This interest is fueled by the ready availability of these products on domestic grain markets and their competitive pricing as compared with whole grains. In addition, some by products may have less starches and more fiber increasing their usage in feeds designed to be low in nonstructural carbohydrates.

By-product feeds have not received much attention in horse research. If conducted, the trials are usually short-termed and on a limited number of horses. As such, recommendations are largely based on results from research on other species of livestock, or simply the nutrient analysis of the by-product.

As with all feedstuffs, by-products have advantages and disadvantages. Intake of some by-products must be limited because they contain high concentrations of digestible energy, especially nonstructural carbohydrates and starches. Feeding large amounts of high-energy feed or abruptly changing the source or concentration of energy from one meal to the next predisposes horses to colic.

Many by-products are made of several different distinct parts of the initial product. The percentages of these different parts may vary from batch to batch because of milling differences. This variability will change the nutrient content of the feedstuff. To avoid problems with changes in consistency of the by-products, feed mills should routinely sample sources of by-products for nutrient analysis prior to formulation into rations. This is especially important for feedstuffs that have high levels of nonstructural carbohydrates or significant mineral content.

Finally, storage and handling of by-products require close monitoring. All feeds, especially those stored while finely processed, must be stored in dry, clean facilities. The chances for mold growth increase when feeds contain more than about 11 percent moisture, or when storage facilities allow moisture contamination.

Nonetheless, many different by-products have been successfully fed to horses, and these products have been incorporated into processed feeds for horses for many years.

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The ingredients, when stored and processed properly, provide a very cost-effective source of nutrients.

Some of the more commonly used by-products and non-traditional feedstuffs are discussed below. Table 1 provides estimates of nutrient content of the various feedstuffs. Note that the estimates provided are averages. These values will vary with differences in sources and milling, especially in by-products that contain several fractions that differ nutritionally. Nutrient content changes as the relative percentages of these fractions change.

Almond hulls

Almond hulls are not a common feedstuff in the Midwest; they are found more in areas of almond production. Feeding trials with horses show almond hulls to be a palatable, safe product. Almond hulls are expected to contain about 13 percent fiber and a little less digestible energy than high-quality oats. Compared to grains, they will have more fiber and fewer nonstructural carbohydrates and starch. As such, almond hulls are a relatively safe feed.

Beet pulp

This is the by-product produced by removing sugar from sugar beets. Beet pulp has been fed as a part of rations for horses for many years. Beet pulp has about 9 percent crude protein. Although quite variable, the energy content is similar to that expected in good quality alfalfa hay.

Brewer's grains

Dried brewer's grain is a by-product of the brewing industry that results from drying mash solids. Brewer's grains have been used as part of horse rations for many years. The expected protein content is around 22 percent, which is intermediate between crude protein concentration in grains and protein supplements such as soybean meal. It is relatively high in crude fat (9 percent) as compared with grains, and although moderately variable, is similar in energy content to high-quality oats.

Canola meal

This meal is a by-product created when oil is removed from canola. Canola oil is a popular oil for human consumption. Canola meal should be used as a protein supplement,

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Table 1. Average nutrient content of some by-products and non-traditional feedstuffs (as fed basis).

Feedstuff	Crude Protein %	Lysine %	Digestible Energy (Mcal/lb)	Fat %	NSC ¹ %	Starch %	Fiber %	Calcium %	Phosphorus %
Traditional (for comparison)									
Corn	9	.3	1.5	3.6	70	60	2	.05	.27
Oats	12	.4	1.3	5.0	50	30	11	.08	.34
Alfalfa Hay	18	.8	1.0	2.0	15	3	20	1.30	.20
Soybean Meal	44	2.8	1.4	1.4	30	7	6	.30	.60
Almond Hulls	5	.1	1.1	3.6	31	3	13	.2	.1
Beet Pulp, Dry	9	.5	1.1	0.6	31	4	15	.2	.1
Brewers Grains	22	.8	1.3	9	14	10	15	.2	.6
Canola Meal	36	2.5	1.2	4.1	18	9	10	.6	1.0
Corn Gluten Feed	21	.6	1.3	3.2	27	23	8	.2	.7
Cottonseed, Whole	24	1.4	1.4	18.0	5	-	23	.1	.6
Cottonseed, Hull	4	-	0.6	-	3	-	40	.1	.1
Distillers Grains	28	.8	1.5	12.0	19	16	9	.1	.7
Hominy Feed	10	.4	1.5	5.5	54	22	6	-	.6
Rice Bran	13	-	1.4	18.0	34	22	12	-	1.6
Soybean Hulls	11	.5	1.1	2.3	15	5	32	.5	.1
Sunflower Meal, with hulls	25	.9	0.8	1.0	18	-	22	.3	.9
Sunflower Hulls	5	-	0.8	3.9	3	-	44	.3	.1
Wheat Mids	15	.6	1.4	3.6	41	34	7	.1	.8

¹ NSC is non-structural carbohydrate, which primarily contains starches, sugars, and pectin.

and several trials suggest it is comparable to soybean meal in expected animal growth performance. It contains about 36 percent crude protein and is relatively high in the amino acid lysine, the most limiting amino acid for growth of horses.

Corn Gluten (feed and meal)

These are by-products of milling corn for starch or syrup. Two by-products are potentially produced: corn gluten feed and corn gluten meal. Corn gluten feed is the part of shelled corn that remains after removing most of the starch, gluten, and germ. Corn gluten meal is produced similarly; however, it contains less of the bran fraction of the seed. As such, corn gluten meal will contain less fiber than corn gluten feed.

Crude protein averages a little more than 20 percent in gluten feed; however, if fiber content is lowered, crude protein percentage increases significantly. Lysine content is relatively low.

The concern with corn gluten is with the potential variability of energy-containing nutrients. Corn gluten has relatively high levels of digestible energy and significant amounts of starch and non-structural carbohydrates. Variations in the consistency of the product will significantly alter the digestible energy content of the ration. Restricting the contribution of corn gluten to the total ration and close monitoring of the nutrient composition of different batches of feed will guard against variability in energy content.

These safeguards are most important when feeding high levels per feeding. Variations in energy content of rations fed at levels of 0.25 percent of body weight or less per feeding are much less a concern than when feeding at double that amount (0.5 percent of body weight or more per feeding).

As noted in Table 1, corn gluten feed is relative high in phosphorus and nearly void of calcium. Calcium levels will need to be supplemented, as all horses require more calcium than phosphorus in the total diet. Additionally, combining corn

gluten with lower phosphorus-containing feedstuffs is suggested, as recommendations for the amount of phosphorus in the diet are generally lower than the amount contained in corn gluten.

There is additional concern with high levels of sulfur (.4 to 1 percent) in corn gluten, as the higher levels are proving to be toxic to cattle. Toxic levels of sulfur have not been as accurately detected in horses, and horses appear to be more tolerant of high sulfur feeds. Nonetheless, similar to energy, monitoring nutrient profiles and reducing the contribution of corn gluten to the total ration are recommended safeguards.

Cottonseed (whole and hulls). Cottonseed meal, the by-product of extracting oil from cottonseeds, is a protein supplement alternative for livestock rations. However, because it is lower in the amino acid lysine, cottonseed meal does not promote the same growth rates in horses as higher quality protein supplements such as soybean meal.

Unprocessed cottonseed or cottonseed hulls are not commonly fed to horses. Usually these products are relatively expensive, and the lint attached to the seed coat makes them hard to process and feed. Whole cottonseed is expected to contain about 24 percent crude protein, 18 percent fat, and relatively high digestible energy. However, cottonseed products are known to contain varying levels of a toxin, gossypol, which causes problems related to infertility, slow growth, and sudden death in other species. Horses appear to be fairly resistant to gossypol toxicity as this problem has not been reported on a clinical basis in horses consuming gossypol at levels commonly associated with cottonseed. However, because of problems with other species of livestock, possible gossypol toxicity should be noted as a concern.

Distiller's grains. This by-product is derived from the distilled liquor and ethanol industries. It is nutritionally similar to brewer's grains. Crude protein concentration is expected to be around 30 percent; however, the lysine concentration is relatively low. On the average, the grains are similar in energy

content to high-quality oats, although energy content can be expected to vary considerably between sources. Distiller's grains would be used typically as a protein supplement or as a supply of B vitamins rather than as a sole source of nutrients in a ration. As such, the potential variability in energy content should not pose a major concern.

Hominy feed. Processing corn to produce pearl hominy or hominy grits for human consumption produces this by-product made of corn bran, corn germ, and starch. It is similar to oats in crude protein content, has about 6 percent fat, and is relatively high in energy content. As with all powdery feeds, hominy feed should be processed into a larger, harder component such as a pellet before feeding.

As with other feeds containing high levels of nonstructural carbohydrate and starch, intakes need to be restricted to avoid feed-related colic and founder. Additionally, the nonstructural carbohydrate content is expected to vary from source to source, so safety of this product is questionable.

Rice bran. Bran is the outer layer of a grain kernel that is removed during the processing of cereal grains. Wheat bran is the most commonly fed bran, although rice bran is marketed as a by-product feed in some areas. Rice bran is about 13 percent crude protein, moderately low in lysine content, and about 18 percent fat. With its high fat content, rice bran tends to go rancid with prolonged storage. Some processors remove fat to levels of 1 to 2 percent to combat this potential. Removing fat lowers the energy value, and as such decreases the value of using rice bran as a source of energy.

Similar to other bran, rice bran is high in phosphorus and low in calcium. As such, it must be balanced with other ingredients in the diet. It also may contain high levels of indigestible silica, which has been suggested to promote urinary calculi formation in dogs and ruminants.

Soybean (hulls and whole). Soybean hulls are a by-product of processing soybeans for soybean meal. Soybean hulls are about 11 percent crude protein and similar to alfalfa hay in energy content. They are higher in digestible energy than other hull products. Soybean hulls contain about 2 to 3 percent fat and are low in starch. They are used in processed feeds to increase the fiber content as they contain between 30 and 40 percent fiber.

Raw whole soybeans are usually avoided because they contain substances that decrease growth rate in most species of livestock. Since heat processing destroys these growth inhibitors, soybeans should be heat processed. Whole soybeans are about 35 percent crude protein, high in lysine, and high in energy.

Sunflower (hulls and meal). Sunflower hulls are the outer covering of sunflower seed. Hulls contribute fiber and are relatively low in other ingredients.

Sunflower meal is the by-product that remains after removing oil from sunflower seeds. Nutrient content of sunflower meal varies with the amount of hull included in the meal. As hull content increases, protein, fat, and energy content decrease. Crude protein percent of sunflower meal without hulls is expected to be about 45 percent. With hulls, sunflower meal contains about 25 percent crude protein. The lysine content is expected to be relatively low for high-protein feeds — about 1.6 percent for sunflower meal without hulls. As the hull content increases, lysine content will decrease.

As phosphorus content is relatively high compared to calcium content, rations using sunflower meal will need calcium supplementation, and sunflower meal will need to be mixed with feedstuffs lower in phosphorus.

Wheat mids. Wheat middlings are a by-product of processing wheat for flour. It consists of fine particles of wheat bran, wheat shorts, wheat germ, and wheat flour. Crude protein is expected to be about 15 percent.

Energy levels vary because there is variability in the percentage of the remaining parts following the milling of flour from the wheat. Nonstructural carbohydrate content is relatively high and is expected to vary from source to source. As such, there are concerns related to colic and founder. Because of this variability in energy, wheat mids should supply a limited portion of the total ration (20 to 30 percent of the mix). This amount can be more if the level of the total grain mix is limited to 0.25 percent of body weight or less per feeding.

Similar to other feeds containing high levels of phosphorus, calcium supplementation will be necessary to balance calcium with phosphorus. Also, combining wheat mids with feedstuffs low in phosphorus is recommended to reduce the phosphorus percent in the total ration.

Summary and Recommendations

- By-products include a variety of secondary feed products that result from milling a primary product from the initial grain.
- Commercially available feeds routinely contain by-products as part of the total mix.
- Like all feed, different by-products will contain different levels of nutrients.
- Nutrient content of some of the similarly labeled by-products is expected to vary considerably from source to source.
- Those by-products high in nonstructural carbohydrates and starch should be fed at restricted levels. Feed these by-products at levels less than 0.25 percent of body weight per feeding when using them as the main source of feed. Or combine them with more traditional feeds at levels below 20 to 30% of the total mix.
- As with all feedstuffs, by-products should be fresh, free of mold, and stored properly.