

MN 2000
EB-348
1.2

EXTENSION BULLETIN 348
REVISED 1972
AGRICULTURAL EXTENSION SERVICE
UNIVERSITY OF MINNESOTA

UNIVERSITY OF MINNESOTA
DOCUMENTS
DEC 12 1972
ST. PAUL CAMPUS LIBRARY

Horse Nutrition and Feeding

R.M. JORDAN



This archival publication may not reflect current scientific knowledge or recommendations.
Current information available from University of Minnesota Extension: <http://www.extension.umn.edu>.

Horse Nutrition and Feeding

R.M. JORDAN

Horse breeders are always concerned about the amount and kind of feed to give their horses. Many variables can affect a horse's nutritional needs: 1) temperament and disposition, 2) present condition, 3) age, 4) body type and weight, 5) production stage (how many hours a day the horse is ridden; pregnant horse or lactating horse), and 6) climatic conditions.

Our knowledge about the nutritional requirements of horses is not as comprehensive as it is for cattle or swine. Some recommendations are based on research obtained with cattle and draft horses and on only a limited amount of research with light horses. The nutritional requirements of a light horse may be different from those of a draft horse due to differences in disposition and temperament and particularly to the peak energy demands of a horse when he is ridden at fast gaits.

Fortunately, considerable research on the nutrition of light horses is currently underway. It will help us determine such things as the energy, protein, mineral, and vitamin requirements of horses, whether horses can absorb and utilize bacterially-synthesized amino acids and B vitamins or whether they must be provided in the diet, why some horses are allergic to certain feeds, and what makes some horses sweat more, if indeed they do, when they are fed corn rather than oats.

A horse's digestive tract is very different from a cow's. The cow has a rumen (large fermentation vat where much of the digestion occurs) in the forepart of the digestive tract. Synthesis of the B vitamins and amino acids takes place in the rumen. The horse has a relatively small, simple stomach but does have a large cecum and colon located between the small and large intestines. To a degree, the cecum and colon serve the same purpose for the horse that the rumen does for the cow. However, the cecum's location toward the end of the digestive tract probably reduces its contribution to the horse's overall digestive efficiency. Whether

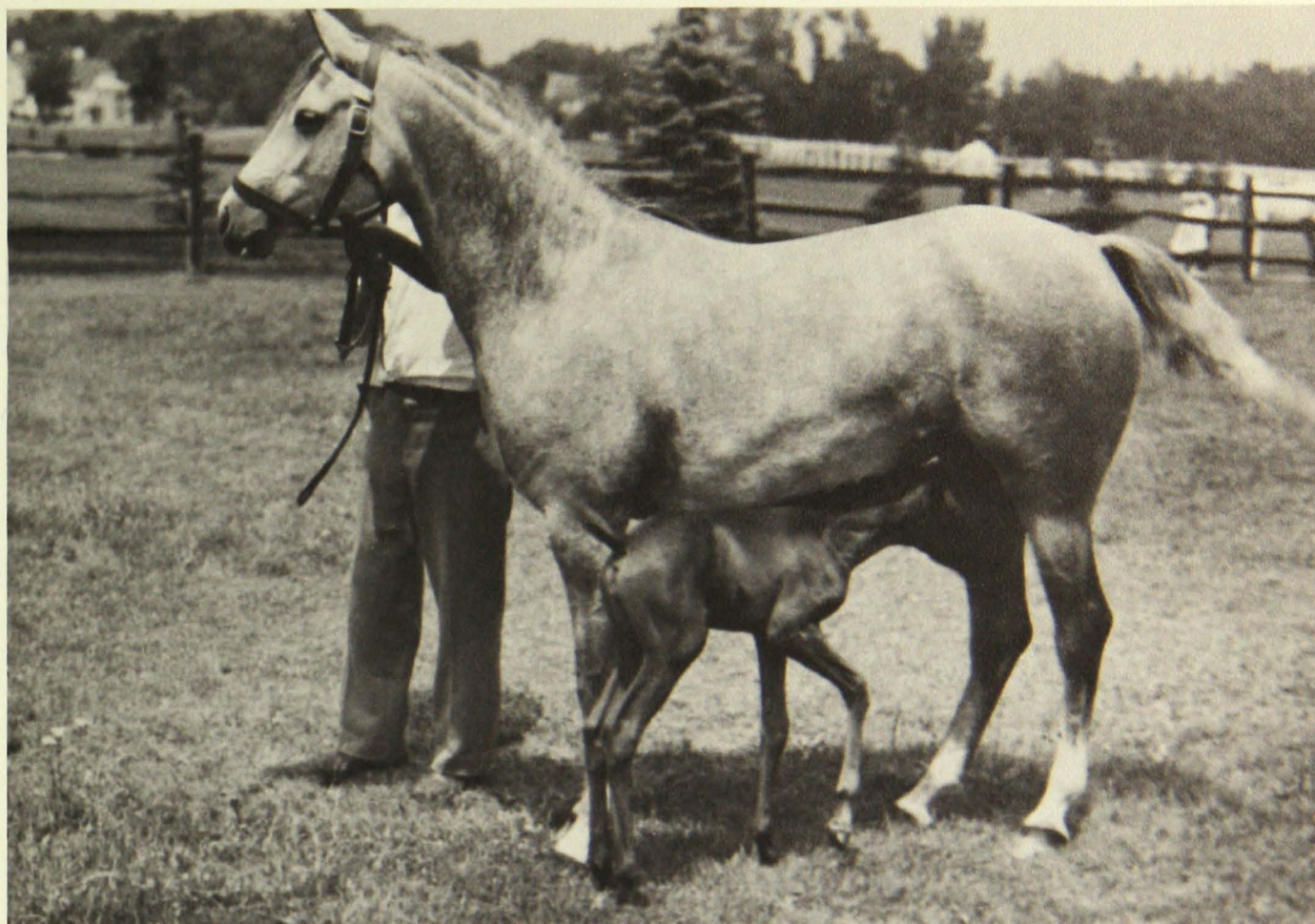
there is adequate synthesis of the B vitamins and amino acids in the cecum and whether these nutrients are absorbed and utilized by the horse in sufficient quantity to assure optimum production (weight gain, work, and speed) have not been entirely resolved, but most authorities think there is considerable synthesis in the cecum. Therefore, if given good feeds, a horse will usually obtain an adequate supply of B vitamins and essential amino acids. However, under certain circumstances it is possible for a horse to suffer from B vitamin deficiency. Weanlings definitely need a diet that provides a good balance of amino acids in sufficient quantity if maximum growth is to be attained.

To feed your horse adequately, you must understand the horse's nutritional needs and the nutritional composition and contribution of various feeds. Here are some terms you should become familiar with.

Dry matter — Most grains and hays contain 88-90 percent dry matter. If a horse receives insufficient dry matter, he may become bored and chew on his stall (cribbing) and eat bedding. However, if the feed has too much bulk (excessive amounts of fiber or water), the horse might not be able to eat enough to satisfy his nutritional requirements (carbohydrates, protein, minerals, and vitamins).

Total digestible nutrients (TDN) — A measure of the energy value of a feed. TDN is what keeps the horse going and puts the fat on his back. Energy is the element most often lacking in horse rations. Grains and good quality roughages are the usual sources of energy.

Protein — Necessary for all life processes. We are mainly concerned with the quantity of protein, but its quality is also important, particularly for young horses. Legume hays, pasture, soybean meal, linseed meal, and commercial protein supplements are the usual sources of protein. Legumes and soy-



This mare is obviously well-fed and in sufficient flesh to adequately nurse her foal. For rapid development, the foal should be creep-fed a palatable and nutritious grain mixture.

bean meal both provide protein that contains a good balance of the essential amino acids.

Minerals — Salt, calcium, and phosphorus are the major minerals required by horses. Salt requirements increase with perspiration losses. Calcium and phosphorus should be provided in a ratio of not less than 1:1. Research at Minnesota indicates that calcium levels can exceed phosphorus levels by as much as four to six times with no apparent harm. But, according to Cornell University data, when phosphorus exceeds calcium, abnormal bone development and hormone imbalance occur. Required trace minerals are normally supplied in adequate amounts in a good horse ration. Commercial mineral blocks or a mixture of equal parts of trace-mineralized salt and bone meal or dicalcium phosphate are the usual sources of supplemental minerals.

Vitamins — Vitamins A and D are both fat-soluble. Vitamin A must be supplied in the ration, but

exposure to sunlight will usually supply adequate vitamin D. The various B vitamins are usually present in adequate amounts in good quality forage. Furthermore, synthesis in the horse's cecum provides adequate quantities of these vitamins under most circumstances.

Knowledge about nutrition has expanded considerably since the days of draft and cavalry horses. But some people still harbor misconceptions about feeding horses. For example, many horse owners believe that timothy hay and oats are essential components of a horse ration and that legume hay (alfalfa or clover) and corn or barley shouldn't be used. However, there is ample evidence to indicate that legume hay is excellent for horses and that many successful horse trainers prefer corn or barley as grains. Just as false a notion is that all commercial feeds are poor investments. Commercial feeds may actually provide nutrients like trace minerals, vitamins, and protein supplements in a less expensive form than the individual horse owner can provide.

Visual Evaluation of Feeds

Hays

Color — Green feed is normally higher in all vitamins, particularly vitamin A (as carotene) and riboflavin, and the green color indicates that the hay has not been rained on excessively.

Type — Legume hays like alfalfa and clovers are normally higher in protein, vitamin A, and minerals (especially calcium) than are grass hays.

Stem to leaf ration — A high leaf ratio makes a feed more nutritious and palatable, and such feed has greater value per ton.

Date of cutting — This is one of the best indicators of feed value. As hays mature, they decline appreciably in protein and phosphorus, increase in fiber, and decrease in digestibility.

Grains

Bushel weight — Oats weighing 26 pounds per bushel have more fiber, less energy, and therefore

less feed value than heavy oats weighing 34-40 pounds per bushel.

Color and smell — Grains should be clean and bright-colored. A dull gray appearance indicates that grains have been rained on and may be musty or have mold and bacterial growth on them.

Foreign material — Portions of cob, weed seeds, dirt, stones, etc., reduce feed value.

Kind of grain — The energy value of grains varies widely. Corn is considerably higher in energy value than oats, but oats are higher in protein and minerals and are more bulky than corn.

Moisture content — Corn and sorghums, in particular, may contain excessive moisture and thus be subject to mold and spoilage. Excess moisture adds weight but no feed value.

Table 1 indicates the relative amounts of major nutrients that various feeds contain as well as the variation often noted between a high- and low-quality feed. In general, remember that grains contain 70-80 percent

Table 1. Composition of typical horse feeds*

Feedstuffs	TDN	Protein	Calcium	Phos- phorus	Vitamin A	Relative value†	Per- centage of base feed it may replace
	percent				thousand I.U.‡		
Grains							
Oats	70	12	.09	.33	.08	100	100
Shelled corn	80	9	.02	.27	2.10	115	100
Barley	78	13	.06	.40	.30	110	100
Wheat	81	15	.04	.40	.06	115	40
Wheat bran	67	16	.13	1.30	2.00	100	20
Rye	76	13	.10	.33	.06	115	33
Beet pulp	72	9	.57	.07	.16	100	33
Molasses, beet	60	7	.05	.02	—	85	10
Protein supplements							
Soybean meal, 44 percent	78	45	.29	.64	.16	100	100
Linseed meal, 36 percent	70	36	.40	.86	—	100	100
Cottonseed meal, 41 percent	65	42	.20	1.11	—	100	100
Hays							
Timothy							
Early bloom	52	8	.41	.21	15.0	100	100
Late bloom	48	6	.15	.15	7.0		
Alfalfa							
Leafy	51	16	1.30	.24	20.0	135	100
Stemmy	46	12	1.10	.19	15.0		
Brome-grass							
Early	50	11	.42	.19	10.0	100	100
Mature	43	6	.29	.13	7.0		
Clover							
Red leafy	54	14	1.50	.21	18.0	125	100
Stemmy	49	10	1.10	.20	10.0		
Reed canary grass	46	8	.33	.16	10.0	90	100

* Frank B. Morrison, *Feeds and Feeding*, 22nd Edition, Morrison Publishing Company, 1956.

† The base feeds (oats, soybean meal, and timothy hay) for each major type are assigned a value of 100, and the other feeds of that type are compared to it; e.g., timothy has a value of 100 and alfalfa 135. So alfalfa has 35 percent more feed value for a horse than timothy does. (*Horses and Horsemanship*, Interstate Publishing Company, 1963)

‡ I.U. = International Units.

TDN and hays about 50 percent TDN. The legumes are considerably higher in protein than are grass hays. Hays are richer sources of calcium and most trace minerals than are grains, whereas grains are richer sources of phosphorus. Furthermore, grains, except for corn, contribute almost no vitamin A value to a horse ration.

Nutritional Needs of the Horse

Every horse owner should understand what a horse's needs are and what affects those needs. The four basic nutrient groups — carbohydrates, protein, minerals, and vitamins — are all required in varying amounts by horses for maintenance (horse at rest), work (riding), pregnancy, lactation, and growth.

The first requirement for all nutrients is that they simply maintain the horse. If a horse is to work, reproduce, and suckle young, additional feed beyond the maintenance requirements must be provided. The type of production (lactation, work, etc.) determines what nutrient must be increased and to what degree. For example, riding a horse 2-3 hours a day (light work) increases the animal's need for energy about 30 percent over maintenance, and 4-5 hours of normal riding increases energy needs 65-70 percent. Even more striking, when ridden hard (for polo, jumping, etc.), a horse may use as much energy in 1 hour as he requires for 24 hours of maintenance. However, protein requirements do not increase significantly with exercise. A mare during the last quarter of her pregnancy needs about 20 percent more protein than she requires for maintenance, but her energy requirement increases only slightly.

Nutritional requirements of a 1,000-1,100 pound horse for various types of production, along with the percentages of these nutrients in the ration necessary to supply these requirements, are given in table 2. This

table is an excellent guide, but horse feeding still involves some art. Individual horses vary considerably and should be fed accordingly. To accommodate for deviations, many horsemen provide 15-20 percent more nutrients than the amounts given in table 2.

Compared to previous recommendations, those in table 2 represent:

- a 10-percent increase in energy for maintenance and growth,

- recognition of the large energy requirement for fattening,

- about a 35-percent increase in protein requirement for growth, and

- a 50-100 percent increase in calcium and a 10-50 percent increase in phosphorus requirements

Tables of this type can be worked out for horses of various weights. This table demonstrates the significant increase in energy and, therefore, the amount of feed required by a horse that is ridden frequently. The table also shows that the energy requirement of a 1,000-1,100 pound mare during the last quarter of gestation amounts to only ½ pound more TDN (1 pound of good hay) than the amount required to maintain a nonpregnant mare of the same weight.

Proper nutrition for horses is especially vital during lactation and early growth. Note that the amount of protein needed during lactation is almost twice that required for maintenance (2.8 pounds vs. 1.3 pounds), and that nearly twice as much TDN is required for lactation as for pregnancy (14.1 pounds vs. 8.7 pounds). Calcium and phosphorus needs also are more critical for lactation and growth. Vitamin A requirements during the last quarter of pregnancy are almost twice those needed for maintenance or for light work, and calcium and phosphorus requirements are likewise increased during lactation. All nutritional requirements are given on a daily basis.

Table 2. Daily nutritional requirements of a 1,000-1,100 pound horse at various stages of production*

Stage	TDN, pounds	Protein		Calcium		Phosphorus		Vitamin A	
		Pounds	Percent	Grams	Percent	Grams	Percent	I.U./ horse†	I.U./ pound feed
Maintenance	8.6	1.30	9.0	20	.33	15	.23	12.5	860
Gestation (last quarter)	8.7	1.34	10.4	25	.40	19	.28	18.5	1,590
Lactation	14.1	2.88	11.8	40	.40	31	.28	18.5	1,590
Fitting	15.0	1.30	9.0	25	.40	19	.28	12.5	860
Light work	10.9	1.30	9.0	25	.40	19	.28	12.5	675
Medium work	14.3	1.30	9.0	25	.40	19	.28	12.5	530
Growth									
Weanling	7.7	1.62	14.5	30	.55	18	.33	9.0	860
Yearling	8.4	1.60	12.5	26	.45	17	.26	11.0	860

* Requirements listed are similar to those that are to be published by the National Research Council.

† I.U. = International Units.

It is imperative that a growing horse's nutritional needs be met. A 400 pound foal that will mature to a 1,000-1,100 pound horse requires 1.6 pounds of total protein and 7.7 pounds of TDN daily. This is more protein and almost as much TDN as required for a 1,000-1,100 pound mare, although the foal is only 40 percent as heavy. To supply these amounts, high-quality feeds rich in protein and energy must be fed. Calcium and phosphorus requirements are slightly higher for the 400 pound foal than for maintaining a 1,000-1,100 pound horse. Minimum vitamin A requirements are in proportion to weight (1.5 milligrams of carotene/100 pounds of body weight).

The information presented in tables 1 and 2 is basic to formulating an adequate ration. Most people's interest in horse nutrition stops when they learn that their horse does well on half a bale of hay, three cans of oats, and a pinch of conditioner (vitamins and minerals) a day. If the hay never varies in quality, if a bale always weighs 40 pounds, and if the horse is not ridden much, the owner probably will be fairly successful. But if he acquires a mare and foal or tries to condition a yearling for show or if the quality of his hay changes drastically, he'll soon have problems.

How to Formulate a Horse Ration

Formulating an adequate ration for your horse is simple if you remember several things: what the horse requires, what kind of feed will fill those requirements economically, what feeds are palatable and will satisfy the horse yet not encourage wood chewing, tail biting, cribbing, etc., and how much of a given feed the horse can eat.

Let's try to use the information in tables 1 and 2 to formulate a concentrate (grain and protein supplement) ration that will be suitable for all types of horses. The type of horse you have (foal, lactating mare, mature gelding, etc.) and the kind of hay you intend to use are the two major factors that determine what supplement to feed and how much of it. Let's assume you intend to use mature timothy hay.

You will note that the hay is stemmy and straw-colored, so you should conclude that:

It will be low in palatability and low in digestibility of the nutrients.

Its carotene (vitamin A), calcium, and protein content will be low in relation to high-quality hay.

Its protein *quantity* and *quality* (amino acid balance) and its trace mineral and B vitamin content are apt to be minimal.

Your horse will use much of the gross energy from the hay for heat; little will be available for work,

growth, etc. The hay will provide bulk and help prevent boredom, so it isn't all bad. But to meet the horse's needs for growth, work, lactation, etc., the concentrate (grain and protein supplement) you choose must correct the hay's many shortcomings.

The chemical analysis (protein, calcium, etc.) of feeds depends on their source or the quality of the hay analyzed. Let's assume your timothy hay has the following composition (values similar to those in table 1):

TDN, percent	48
Protein, percent	8
Calcium, percent35
Phosphorus, percent15
Vitamin A, I.U./pound	6,000

Comparing the composition (percentage protein, calcium, etc.) of the timothy with the requirements of a diet necessary to meet the needs of various types of horses as presented in table 2 leads you to the following conclusions: If you feed timothy hay as the entire ration, protein and phosphorus will be inadequate regardless of what kind of horse you have, and calcium will not be provided in adequate amounts except for maintaining a mature horse; however, vitamin A will apparently be adequate (compare composition of timothy with requirements as listed in table 2). Since vitamin A is destroyed (oxidized) in time, particularly under warm conditions, your hay may contain far less than the value given.

Obviously, your concentrate should be formulated to correct these deficiencies. The correct proportion of concentrates to hay in a ration depends on the type of horse you have. Table 3 presents the approximate amounts of feed (grain and hay) that various types of horses can consume daily and approximate proportions of grain and hay in the total ration. Obviously, you wouldn't want to feed a weanling 12 pounds of a ration that contained only one part grain or feed a gestating mare 20 pounds of a ration that was one-third grain.

Next you must decide which grains and supplements to use. Consider cost, availability, palatability, and other factors that may contribute to the ration.

Table 3. Suggested feed intakes and grain: hay ratios

Type of horse	Feed intake, percentage of body weight	Grain:hay ratio
Weanling	3.0	1:1
Yearling	2.5	1:2
Mature	2.0	1:12
Gestating	2.0	1:9
Lactating	2.2	1:2
Fitting (fattening)	2.0	1:2
Light work	2.0	1:3
Medium work	2.0	1:2

Table 4. Calculating the protein content of a concentrate to be fed with timothy hay

Ingredient	Amount, pounds	Protein content, percent	Pounds protein supplied
Oats	40.0	12	4.8
Corn	15.0	8	1.2
Dehydrated alfalfa	15.0	18	2.7
Soybean meal	25.0	44	11.0
Molasses	2.0	6	0.1
Dicalcium phosphate	1.5	—	—
Limestone	0.5	—	—
Trace-mineralized salt	1.0	—	—
Vitamin A	+	—	—
Vitamin D	+	—	—
Percentage of protein in ration: 19.8			

Your first consideration should be to select feed-stuffs rich in the nutrient that timothy lacks most: protein. Some typical ingredients that might be used to meet the requisites mentioned are listed in table 4. For example, oats are bulky, safe to feed, palatable, and usually available. Corn is inexpensive and, like oats, a good source of phosphorus. Dehydrated alfalfa is high in calcium, is palatable, and will contribute a source of high quality protein, B vitamins, and vitamin A as well as protein. Soybean meal will be a major contributor of protein and is high in phosphorus. Other ingredients could be substituted, but table 4 illustrates a good ration. Note in table 4 that content of protein, or content of any nutrient in the ration, can be calculated by simply multiplying the amount of ingredient by its nutrient percentage.

You have now formulated a grain ration that you intend to feed, along with timothy hay, to all types of horses. Does it provide the correct percentage of protein when fed at the suggested concentrate to hay ratios? Table 5 answers that question. The ration appears to be suitable for all types except horses that are being fitted (fattened) or ridden. It is somewhat high in protein. To provide ample energy for fitting or for riding, the amount of concentrate must be high in relation to the timothy. The excess protein is harmless, but, for

Table 5. Protein content of total ration when concentrate containing 20 percent protein is fed with timothy hay in suggested concentrate:hay ratios

Type of horse	Protein requirement		Concentrate: hay ratio	Percentage protein in total ration
	Percent	Pounds		
Weanling	14.5	1.62	1:1	14.0
Yearling	12.5	1.60	1:2	12.0
Mature	9.0	1.30	1:1.2	8.9
Gestating	10.4	1.34	1:9	9.2
Lactating	11.8	2.88	1:2	11.9
Fitting (fattening)	9.0	1.30	1:2	12.0
Light work	9.0	1.30	1:3	11.0
Medium work	9.0	1.30	1:2	12.0

those types of horses, you can dilute a concentrate containing 20 percent protein with equal parts of oats if you wish. When you use mature nonlegume hays like timothy, the concentrate has to be high in protein (18-20 percent). Formulating such a concentrate requires the addition of a considerable amount of high-protein supplement, 25 percent soybean meal in this case.

How do you determine the protein, calcium, or phosphorus content in a total ration? You simply multiply the proportions of concentrate and hay by the percentage of protein, calcium, or phosphorus that each contains and divide by the total. For example, assume you are feeding one part concentrate and three parts hay. If the concentrate contains 20 percent protein and the hay contains 8 percent protein, your calculations would be:

$$20 + (8 \times 3) = \frac{44}{4} = 11\% \text{ protein in total ration.}$$

You have a good concentrate to provide protein, but what about calcium and phosphorus? The same procedure used to calculate protein can be used to calculate calcium and phosphorus content (table 6). Just multiply the amount of ingredient by its calcium or phosphorus content. To rectify the calcium and phosphorus shortcomings of timothy, your concentrate ration must be high in both (.85 percent calcium and .64 percent phosphorus).

Table 7 presents the percentages of calcium and phosphorus provided in the total ration (hay and concentrate) when fed at the suggested concentrate to hay ratios. Remember that you are trying to come up with a single concentrate that would be suitable for all types of horses. In this case, you find that a concentrate containing adequate calcium for a gestating mare (.40 percent) fed at a concentrate to hay ratio of 1:9 provides a slight calcium excess for other horses. Research indicates that an excess of calcium is harmless. The main concern is that the phosphorus does not

Table 6. Calculating the calcium and phosphorus in the concentrate

Ingredient	Amount, pounds	Content, percent		Pounds supplied	
		Calcium	Phos-phorus	Calcium	Phos-phorus
Oats	40	.10	.35	.040	.140
Corn	15	.02	.28	.003	.042
Dehydrated alfalfa	15	1.30	.23	.195	.034
Soybean meal	25	.25	.60	.062	.150
Molasses	2.0	.16	.02	.003	—
Dicalcium phosphate	1.5	24.00	18.50	.360	.298
Limestone	0.5	38.00	—	.190	—
Trace-mineralized salt	1.0	—	—	—	—
Vitamin A	+	—	—	—	—
Vitamin D	+	—	—	—	—

Percentage of calcium in ration: .853
Percentage of phosphorus in ration: .644

Table 7. Required amounts of calcium and phosphorus compared to amounts supplied by a timothy and concentrate ration

Type of horse	Requirement, percent		Grain: hay ratio	Percentage in total ration	
	Calcium	Phosphorus		Calcium	Phosphorus
Weanling	.55	.35	1:1	.601	.397
Yearling	.45	.26	1:2	.518	.315
Mature	.33	.23	1:1.2	.389	.203
Gestating	.40	.28	1:9	.400	.199
Lactating	.40	.28	1:2	.518	.315
Fitting (fattening)	.40	.28	1:2	.518	.315
Light work	.40	.28	1:3	.476	.274
Medium work	.40	.28	1:2	.518	.315

exceed the calcium. The phosphorus supplied does exceed the requirement in several instances, but so long as the excess is not great and the amount of calcium exceeds the phosphorus (Ca:P ratio greater than 1:1), no harm is done. Due to the low phosphorus content of the timothy hay (.15 percent) and the small amount of concentrate fed to the mature horse (maintenance)

and the gestating mare, their phosphorus intake is still inadequate. It can be corrected by providing access to a mixture of equal parts of salt and dicalcium phosphate or bone meal.

This problem illustrates that one concentrate seldom meets the nutritional requirements of every type of horse. Horses' requirements differ and in many cases so should their rations.

Not everyone uses timothy hay for horses. Since hay quality greatly affects the composition of the concentrate that should be fed, let's determine what you need in a concentrate fed in conjunction with a high quality green legume-grass hay mixture. The nutrient content of a typical legume-grass hay is:

TDN, percent	50
Protein, percent	15
Calcium, percent	1.2
Phosphorus, percent	.22
Vitamin A, I.U./pound	22,000

Compared with the requirements for various classes of horses (table 2), alfalfa is adequate in protein

This horse has been fed to show; the animal has a shiny coat, spirit, animation, and the desire to perform.



Table 8. Suggested concentrate formulation to be fed with legume-grass hay

Ingredient	Amount, pounds	Content, percent			Pounds supplied		
		Protein	Calcium	Phosphorus	Protein	Calcium	Phosphorus
Oats	50.5	12	.10	.35	6.0	.050	.175
Corn	20.0	8	.02	.28	1.6	.004	.056
Bran	13.0	15	.10	1.20	1.9	.013	.156
Soybean meal	10.0	44	.25	.60	4.4	.025	.060
Molasses	5.0	6	.16	.02	0.3	.008	.001
Mono-sodium phosphate	0.5	—	—	22.00	—	—	.110
Trace-mineralized salt	1.0						

Percentage of protein in ration: 14.2
 Percentage of calcium in ration: .100
 Percentage of phosphorus in ration: .558

and has an abundance of vitamin A and calcium, but is deficient in phosphorus. So your concentrate need not be higher than 14 percent protein (for weanlings), but it must contain supplemental phosphorus.

Your concentrate ingredients (table 8) need not be different from those used with timothy, except you choose bran because it's a good source of phosphorus and you substitute mono-sodium phosphate for limestone because legumes are high in calcium and low in phosphorus. The suggested concentrate to be fed with legume hay contains 14.2 percent protein, .100 percent calcium, and .558 percent phosphorus. If the concentrate were the only feed the horses receive, this would be five times too much phosphorus, but remember that the concentrate is to be fed with a hay that is high in calcium and low in phosphorus.

How does the concentrate fit the horses' needs for protein when it is fed with mixed legume-grass hay?

Table 9. Protein content of a legume hay and concentrate ration when concentrate containing 14.2 percent protein is fed at various concentrate:hay ratios

Type of horse	Protein requirement		Concentrate: hay ratio	Percentage protein in total ration*
	Percent	Pounds		
Weanling	14.5	1.62	1:1	14.6
Yearling	12.5	1.60	1:2	14.7
Mature	9.0	1.30	1:12	14.9
Gestating	10.4	1.34	1:9	14.9
Lactating	11.8	2.88	1:2	14.7
Fitting (fattening)	9.0	1.30	1:2	14.7
Light work	9.0	1.30	1:3	14.8
Medium work	9.0	1.30	1:2	14.7

* The excess protein will not harm your horse, although he will require additional water.

Table 10. Calcium and phosphorus content of a concentrate and mixed legume hay ration

Type of horse	Requirement, percent			Percentage in total ration	
	Calcium	Phosphorus	Grain: hay ratio	Calcium	Phosphorus
Weanling	.55	.35	1:1	.650	.385
Yearling	.45	.26	1:2	.835	.330
Mature	.33	.23	1:12	1.100	.245
Gestating	.40	.28	1:9	1.090	.253
Lactating	.40	.28	1:2	.833	.330
Fitting (fattening)	.40	.28	1:2	.833	.330
Light work	.40	.28	1:3	.925	.302
Medium work	.40	.28	1:2	.833	.330

As you can see in table 9, it supplies more protein than needed for all horses other than weanlings. Soybean meal could be deleted to reduce the protein content of the concentrate, but since you included only 10 percent soybean meal, you would save little by excluding it.

Phosphorus in the total ration is slightly higher than needed for all classes of horses other than maintenance and gestating, but the level is satisfactory in view of the calcium levels provided (table 10). Again you must conclude that a single concentrate can never provide exactly the right amount of nutrients for all classes of horses. With legume hay, the calcium level will be high regardless of the amount of grain fed. But, as mentioned previously, excess calcium is apparently harmless, and, as long as the ration contains more calcium than phosphorus (ratio wider than 1:1), the extra phosphorus is not detrimental.

The data presented in the first 10 tables and the discussion pertaining to those tables should aid horse owners in formulating rations suitable for a variety of circumstances. Also, the material should provide a sound basis for decision-making. However, most ques-

Table 11. Composition of example grain rations to be fed with timothy hay

Ingredient	Pounds
Rolled corn	18
Rolled oats	40
Dehydrated alfalfa	15
Soybean meal	25
Trace-mineralized salt	1
Dicalcium phosphate	1
Vitamin A, 20,000 I.U./pound	+
Vitamin D, 5,000 I.U./pound	+

Amount to feed daily to 1,000 pound horse, pounds:

Maintenance	1-2
Ridden 2-4 hours daily	5-8
Last quarter of pregnancy	3-4
Lactating mare, first 3-4 months	8-10
Weanling	4-6
Yearling	7-9

Table 12. Composition of example grain rations to be fed with legume hays

Ingredient	Pounds
Rolled corn	20
Rolled oats	51
Bran	13
Beet pulp with molasses	15
Trace-mineralized salt	0.5
Mono-sodium phosphate	0.5

Amount to feed daily to 1,000 pound horse, pounds:

Maintenance	1-2
Ridden 2-4 hours daily	5-8
Last quarter of pregnancy	3-4
Lactating mare, first 3-4 months	8-10
Weanling*	4-6
Yearling	7-9

* Topdress the grain ration with 1/4-1/3 pound of soybean meal or a suitable commercial supplement.

tions dealing with horse feeding concern how much and what kind of a concentrate ration or vitamin-mineral supplement to feed a mare, foal, or stud. The data in tables 11 and 12 provide ready answers. These rations are based on the paramount considerations in horse feeding: the type of horse and the quality of the hay being fed.

Feeding Pointers

To provide adequate nutrition for your horse, you should be able to recognize when you need to change the amount fed or the composition of the ration.

Your horse's appearance is the obvious starting place. If he is long-haired and thin during the summer, something is wrong. Sharp corners on his teeth or parasites might be the problem. If not, he probably lacks some nutrients, and you must determine which feedstuffs will correct the situation. Feeding him more of the same ration probably will not be the solution. Remember that some nutritional inadequacies are not apparent until irreparable harm has been done. For example, horses fed too much or too little calcium or phosphorus will gain weight and look normal even though their boney tissue may be developing abnormally.

When formulating a ration, remember these facts:

Grains have four to ten times more phosphorus than calcium, they are high in energy, and they usually are an essential ingredient in rations for growing horses, lactating mares, and horses being fitted or ridden. However, except for corn, grains contain virtually no carotene (vitamin A).

Forage quality is the key in determining what concentrate or supplement is required. Typical pasture is normally high in digestible protein and vitamin A and high in moisture during May and June.

During this period, your supplemental feed should be rich in energy. During late July and August, the amount of available feed will shrink and its protein percentage will decline appreciably. During this period, be sure your supplement is rich in protein (15-20 percent) and phosphorus (.5-.6 percent) to compensate for these deficiencies in mature grass.

Alfalfa or alfalfa-grass mixtures are ideal forages because of their high protein content (12-18 percent), good balance of amino acids, and high calcium and carotene content. They require minimum supplementation.

Pastures

Although pastures are not absolutely essential for successful horse production, they do provide an excellent source of good-quality feed and a place for exercise. The value of the pasture from a nutritional standpoint depends on the amount of forage available, the maturity of the forage, and the type of forage. Obviously, if the feed is so scarce that the horse must work for it, the pasture may do more harm than good. As the forage in the pasture matures, it increases in fiber and decreases in carotene, and its nutritional value declines appreciably, necessitating the addition of some grain and/or protein to the horse's diet.

A mixture of grass and legume makes an ideal horse pasture. Legumes are not only rich protein and mineral sources but are also laxative. The latter trait may be undesirable for horses being ridden; dry hay should be fed to them. Legumes may also cause horses to sweat profusely when worked hard.

Keep in mind that pasture forage during the early season is extremely high in water content and, unless some dry forage or grain is fed in conjunction with the pasture, the horse may be unable to eat enough to fulfill his nutritional requirements.

For more information, see University of Minnesota Animal Husbandry Fact Sheet 16, *Horse Pastures*, available from your county extension office.

Pelleted Rations

Good hay is often difficult to find, and storing hay is sometimes a problem. For these reasons, horsemen are interested in feeding a pelleted ration (hay and grain combined). Research indicates that feeding pelleted rations presents some problems. A horse can eat 20 pounds of pelleted hay faster than he can eat 20 pounds of baled hay. Thus a horse fed pelleted hay often grows bored, chews on his stall, and may become a cribber. Pelleting does not increase the digestibility



During the breeding season, a grain ration containing 12-14 percent protein (possibly fortified with vitamins A and D) should be fed in sufficient amounts to keep a stud like this in strong, vigorous condition.

of the ration but does speed its passage through the digestive tract. But when the same amount and quality of hay is fed as long hay or as pellets, the weight gains and condition of the horse are the same. Because some vices may develop when the entire ration is pelleted, about 25 percent of the daily ration should be long hay.

A well-fed horse has a slick coat, is alert, relishes his feed, and is content. If your horse is well-fed but is losing weight, has a rough hair coat, or slobbers his feed, he may have bad teeth or be parasitized. Your veterinarian can help you remedy such problems.

General Feeding Rules

1. Know the weight and age of your horse.
2. Feed and water at a regular time.
3. Avoid sudden and radical changes in the type and amount of feed.

4. Keep feed boxes and water clean.
5. Avoid moldy or dusty feeds.
6. Feed horses as individuals according to nutritional needs and condition of the animal.
7. Examine teeth periodically and have the sharp edges floated.
8. Control internal and external parasites with a systematic treatment program.
9. Provide adequate exercise to avoid boredom and the development of stable vices.
10. Don't overfeed.

R. M. Jordan is a professor, Department of Animal Science, and extension animal husbandman.

Issued in furtherance of cooperative extension work in agriculture and home economics, acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture. Roland H. Abraham, Director of Agricultural Extension Service, University of Minnesota, St. Paul, Minnesota 55101. We offer our programs and facilities to all persons without regard to race, creed, color, sex, or national origin.