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Feeding Race Prospects & Racehorses in Training

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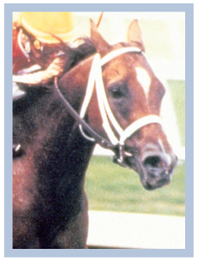


P. G. Gibbs, G. D. Potter and B. D. Scott*

In recent years, significant research attention has been directed toward the equine athlete, particularly racehorses and young horses destined for the track. New information is becoming available and new concepts are being formed about the physiology and nutrition of racehorses.

One reason for this attention is that over the past 50 years, the physical performance of racehorses has improved very little. Although racing times over common distances have improved some, the magnitude of improvement has been relatively small compared to that of human athletes. This is in spite of efforts to breed horses with greater racing ability. Further, too many horses continue to succumb to crippling injuries brought on by acute fatigue and a compromised skeletal integrity.

Conversely, the performance of humans improves yearly, monthly and in some cases even daily during certain athletic competitions. This phenomenon is explained by the dramatic improvements in the diet and training regimens being developed continually for human athletes.

Horses also can be expected to perform better if they are properly conditioned and fed a balanced diet containing the fuel (energy) and other nutrients needed to do the work. A horse that is "dead fit" and fed a good ration will run as fast as genetically possible if that horse has any "heart." The term "heart" in a horse may in fact be closely related to that horse's fitness and diet. If the horse has the available energy and the nutrients to use that energy, it can voluntarily run faster and perform at a higher level than horses with insufficient fuel and other nutrients to perform these tasks.

To ensure that racehorses can perform at optimum levels, trainers need to pay close attention to nutrition, providing the appropriate amounts and forms of energy, protein, vitamins and minerals for young prospects as well as for racehorses in training. If the nutritional requirements are met accurately and feeding management is conducted properly, racehorses' performances will be improved over those horses fed imbalanced diets in irregular amounts at inappropriate times.

Race-bred prospects

To produce and maintain a successful racehorse, you must begin with proper feeding and early development of a young prospect. This process begins soon after a foal is delivered. Two vital goals are to promote early growth and sound skeletal formation. If these goals are to be achieved, weanlings cannot be fed the same rations as yearlings, and long yearlings in training must be given nutrient mixes that are different from those fed to yearlings not being exercised.[16]

A field study was conducted on the manage-

*Professor and Extension Horse Specialist; Professor and Equine Science Section Leader, Department of Animal Science, Texas A&M University; Assistant Professor and Extension Horse Specialist; The Texas A&M University System

ment practices of 58 Texas farms raising almost 2,000 thoroughbred and quarter horse race-bred prospects.[5] Most of the owners/managers of those farms identified nutrition, exercise and genetics as three major factors contributing to problems such as contracted tendons, epiphysitis or osteochondrosis. Contracted tendons were reported more often in foals; most epiphysitis problems were observed in weanlings; and osteochondrosis appeared to be most prevalent in yearlings.

Recommendations for weanlings

The study uncovered one common feeding practice that is detrimental to weanlings: Farms are failing to provide the high ratio of concentrate to hay needed to meet the weanlings' requirements in a reasonable amount of daily feed. In fact, 90 percent of the farms are trying to grow weanlings by feeding more hay than concentrate.

Furthermore, 22 to 44 percent of these young horses are receiving a total daily diet that is either deficient in amino acids or unbalanced in its mineral concentration or mineral ratios. In short, weanlings and yearlings are being fed almost identical rations. The feeding programs for yearlings are much more in line with National Research Council (NRC)[16] recommendations than those for weanlings (Table 1).

TABLE 1.
Diet proportions for race-bred prospects of varying ages.

Age/Class	% Concentrate	% Hay
Weanling	70	30
Yearling	60	40
Long-yearling (in training)	60	40
Two-year-old (in training)	55	45

Source: National Research Council (1989)[16]

To develop properly, race-bred weanlings must be given a concentrate feed that provides at least 0.7 percent lysine, which is the primary growth-limiting amino acid.[16] They also need at least 0.7 percent calcium and 0.5 percent phosphorus in feeds containing no more than 1.4 megacalories of digestible energy per pound.

Feeds with higher levels of energy need even more lysine, calcium and phosphorus to ensure that they have the proper nutrient-to-calorie ratio. The mineral-to-calorie ratio is more critical than the calcium-to-phosphorus ratio, which also merits some consideration.

A well-formulated balanced feed will most likely provide the minimum acceptable amounts of amino acids and minerals as well as trace minerals and vitamins. Such a feed almost always eliminates the need for any supplements because the nutrient mix is balanced.

Conversely, a diet of straight oats and either alfalfa or grass hay is unsuitable because it:

- Fails to provide the requirement for absorbable lysine.[6]
- Provides less than desirable amounts or ratios of minerals.[5, 16]
- Often jeopardizes skeletal development.

Furthermore, overfeeding hay and feeding unbalanced concentrates will combine to give foals a "pot-bellied" appearance. Oats can be used as the primary grain source if they are fortified with a good amino acid source as well as the mineral concentrations needed to provide the proper calcium:phosphorus ratio and to meet the needs for trace minerals. Although most commercial feeds contain some oats, other grains are also used routinely.

Recommendations for yearlings

If not being conditioned for sale, yearlings can achieve a moderate rate of growth on good-quality, improved pastures. The digestive tract of a yearling can process more roughage than that of a weanling. Good-quality grazing appears to support acceptable growth and development at this stage.[7]

However, yearlings being prepared for sale or being retained for placement into pre-race training have significantly different nutrient requirements when rapid growth and/or forced exercise becomes part of the management scheme. For these horses, you must provide a balanced concentrate.

These horses typically need to be fed a concentrate with at least 14 percent crude protein, 0.6 percent lysine, 0.6 percent calcium and 0.4 percent phosphorus in a feed that contains 7 percent or more fiber and not more than 1.4 megacalories of digestible energy per pound. Many companies manufacture horse feeds that meet or exceed these minimums.

Once training or forced exercise begins, the feeding program should be evaluated even more carefully.

Horses in race training

Researchers have recently found that the fuel supply available in the muscles of a horse and the horse's ability to use that fuel may be altered by including different ingredients in the diet and by using appropriate feeding management and training regimens.

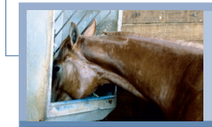
To achieve high performance, racehorses in training must have adequate energy, protein, vitamins and minerals, and overall feeding must be managed well.

Energy

Racehorses often require twice as much energy (measured in calories) as do nonworking horses. You must ensure that the racehorses' diet provides enough energy to complete the assigned work (Table 2).

A significant challenge in feeding a racehorse is to achieve and maintain ideal body condition for training and racing while providing enough

TABLE 2.
Approximate daily nutrient requirements of race-bred prospects and racehorses in training (1,100 pounds mature weight).



	Digestible Energy (Mcals)	Crude Protein (pounds)	Lysine (grams)	Calcium (grams)	Phosphorus (grams)	Magnesium (grams)	Vitamin A (IU)
RACE-BRED PROSPECTS							
Weaning (moderate growth)	15.0	1.7	32	29	16	4.0	10,000
Weaning (rapid growth)	17.2	1.9	36	36	20	4.3	10,000
Yearling (moderate growth)	18.9	1.9	36	29	16	5.5	15,000
Yearling (rapid growth)	21.3	2.1	40	34	20	5.7	15,000
RACEHORSES IN TRAINING							
Long yearling	26.5	2.6	50	49*	27*	15.5*	18,000
Two-year-old	26.5	2.5	45	46*	26*	17.6*	20,000
Mature-intense work	32.8	2.9	45	40	29	15.1	22,000

*Source: National Research Council (1989) *Based on recent work of Nielsen et al,[13] Stephens et al[22] and Nolan et al.[15]*

fuel to support performance at an intense level of work. Therefore, a primary concern is energy, which allows the horse to maintain optimum body condition while performing at a heavy workload.

To determine the types of diets to feed and the energy substrates (carbohydrates and fatty acids) to make available, you need to understand the extent to which a horse depends on its system of anaerobic energy metabolism. During regular training and racing, a racehorse must perform both aerobic and anaerobic work.

Aerobic work occurs during exercise in which the heart rate does not exceed about 150 beats per minute. While performing aerobic work, a horse is able to get enough oxygen to the tissues to burn fat as a fuel source.

During anaerobic work (heart rate is typically above 200 beats per minute), the horse is unable to rely totally on fat for use as fuel. For this work, it must rely primarily on blood glucose, and liver and muscle glycogen, which are produced from dietary carbohydrates. In a race, a horse performs mostly anaerobic work using carbohydrates, but a combination of carbohydrates and fatty acids in the diet can help a horse work harder and delay fatigue.

Race prospects must be fed balanced concentrate in two or more feedings daily.

To meet the short-duration, high-speed energy demands of anaerobic work, it is critical that racehorses receive enough readily available energy from dietary carbohydrates to maintain blood glucose and store energy in the form of muscle glycogen.[12, 17, 18, 20, 25] During anaerobic exercise and competition, these are primary fuel sources for horses.

Energy must be provided to racehorses in a reasonable amount of daily feed that they can consume safely. Depending on the level of activity and the energy concentration of the diet, a horse will take in forage and concentrate in amounts ranging from 2.0 to 3.0 percent of its body weight daily.

Racehorses performing at intense levels have very high energy requirements; they often have trouble getting enough energy from conventional diets of hay and other fibrous feedstuffs. They must be fed grain-based concentrates. They also need a comparatively large amount of highly digestible starch in the diet to meet both aerobic and, particularly, anaerobic energy demands.

Most stables are very accustomed to using concentrates to supply soluble carbohydrates for energy. Cereal grains such as oats, barley and corn can be mixed together in a variety of ways to produce concentrates of differing energy concentrations. Cereal grains should be processed to promote digestion of starch in the small intestine and to ensure that high amounts of glucose are absorbed. Grain feeds provide carbohydrates that can be used directly or stored in the muscles and liver in the form of glycogen for later use.

By manipulating the diet and exercise regimen of exercising horses, you can dramatically increase the concentration of glycogen stored in the muscles.[23] Horses deplete their muscle glycogen stores and become unable to work at a high level when they are fed too few carbohydrates and put into high levels of training. But their work performance can be improved by feeding them high-energy diets with an adequate supply of carbohydrates.

Many studies have shown that adding fat to the diets of horses in race training can improve their muscle glycogen storage and work performance.[12, 17, 20, 26] Fat provides a concentrated supply of energy in an amount of feed that can be consumed safely by the horses. You can incorporate fat or oil into a grain mix and increase it to 10 percent of the concentrate without negatively affecting dry matter or fiber digestibility.

Although the amount of energy supplied daily is important, it is equally important that significant amounts of that energy be supplied in a form that promotes synthesis and storage of muscle glycogen in horses that are expected to do short-term, high-velocity, anaerobic work.

Note: To achieve maximum performance in racehorses, feed them a fat-supplemented, high-carbohydrate diet…not a high-fat, high-fiber diet.

When feeding a fat-supplemented diet, consider several factors:

- Horses need time to become adapted to fat in the diet, sometimes as much as 4 weeks.
- Because a fat-supplemented diet provides more energy, you should decrease the total daily feed intake if the work level and body condition are to remain the same.
- If you plan to top-dress fat or vegetable oil on the feed, begin with a small amount and increase it gradually, keeping an eye on eating behavior and general well-being. You must reassess the total dietary nutrient balance (see section on protein), especially for race-bred yearlings and 2-year-olds receiving exercise.

Remember: The energy requirements for work take precedence over the storage of energy as fat in the body. Animals that are not fed enough energy to maintain body weight will use the energy stored in body tissues — including muscle glycogen stores — to meet the energy requirements for work. A thin horse may not be physiologically able to exercise strenuously because it does not have enough available energy.

To maintain reasonable amounts of body fat in horses in race training and being worked hard, you must increase the energy density in the diet and adjust the amounts of feed proportionally. For thin horses that are exercising, adding fat to the diet results in higher muscle glycogen concentrations than in horses fed conventional diets.[9, 20] Feeding some fat to racehorses helps protect them from fatigue even when their body condition is reduced.

When selecting a commercial feed, check the amounts of fat and fiber listed on the feed tags. The information will help estimate the energy density of the grain mix. There is an inverse relationship between fiber and the expected digestible energy content (Table 3); knowing this can help you choose concentrates that are a better buy per unit of energy.

Lower fiber feeds usually contain more energy than higher fiber feeds. If you feed good-quality hay, there is no need to spend more money on additional fiber in a bagged horse feed.

Some commercial feed manufacturers produce fat-supplemented diets. If a feed tag lists a fat concentration of 8 percent, in most cases about 4 to 5 percent additional fat has been included.

TABLE 3.
Relationship of crude fiber to expected digestible energy in conventional and fat supplemented grain mixes.

	DIGESTIBLE ENERGY (MEGACALORIES PER POUND)	
Fiber %	Concentrate diet (3-4% fat)	Fat-supplemented diet (7-8% fat)
2	1.62	1.72
4	1.55	1.65
6	1.45	1.55
8	1.35	1.45
10	1.25	1.35
12	1.15	1.25

At any given level of crude fiber, a grain mix with 5 percent supplemental fat will have up to 8 percent more energy than a similar feed with no supplemental fat. This supplemental fat affects the relationship between crude fiber and expected digestible energy content by about 0.10 megacalories or 100 kilocalories per pound of feed. Of identical amounts of two concentrates — one with supplemental fat and one without — the you with the supplemental fat will contain significantly more energy, meaning that you can feed less on a daily basis.

To be able to meet the nutritional needs of racehorses, you need not only to know the amount of energy in a feed, but also to recognize the caloric needs for training and racing. Horses that are calorie-deficient cannot run at the same intensity as those with enough energy in the diet and stored in the muscles.

When a horse's body weight is reduced significantly, it often depletes its body energy reserves so that it has too few calories to perform at a high level for an entire race, regardless of the length of that race. The goal should be to achieve sufficient body condition in the horses to maintain muscle glycogen reserves, but not so much as to cause thermal stress.[20]

Although racehorses must have adequate body condition to do their job, excess body fat causes thermal (heat) stress on the horse. Regardless of body condition, feeding a fat-supplemented diet reduces the thermal stress on horses.[18, 21] Thus, it is important that you maintain the horses in lean

condition but not "ribby."[21] Feed them a fat-supplemented diet with adequate carbohydrates and other nutrients. With proper training, the horse's performances are likely to improve, with fewer injuries and less fatigue.

Protein

While some attention to protein is important, it generally should not be the most critical consideration for racehorses. Stables sometimes overfeed protein because of the misconception that the percentage of crude protein in the grain or concentrate mix must be raised as a horse's level of activity increases.

Horses do require a small increase in protein in the diet for optimum production and work performance.[4] But having a high concentration of protein in a mature racehorse's diet can do more harm than good. For racehorses in training, it is important to have a balance of amino acids in the diet. To receive the proper supply of these amino acids, they need a source of high-quality protein in the regular diet.

Although the effects of exercise on the amino acid needs of an equine athlete are not completely understood, stables should consider protein intake in relation to energy intake. A properly balanced diet will provide enough protein at increasing levels of work, provided that the horse's energy requirement is being met through additional feed intake (Table 2).

In studying the nutritional effects of increased exercise on horses, researchers have found that when fed a diet that has a constant calorie:protein ratio, horses retain more nitrogen during the conditioning period than at rest. After conditioning is achieved and the work level reduced, the horses still retain more nitrogen than when not working. Exercising horses in a high state of condition retain more nitrogen than sedentary horses, but the additional nitrogen usage is comparatively small.[8] Although it is unclear whether they use the retained nitrogen for muscle synthesis or it is lost in sweat, exercising horses do require some small increase in protein, particularly during conditioning.[4]

Changes in muscle composition have been measured in conditioned horses fed varying amounts of protein.[3] The study found that conditioning changes the diameter of certain muscle fibers and helps the muscles synthesize protein. Also, horses fed higher protein diets retain somewhat more nitrogen, but not much more.

For mature racehorses receiving average-quality grass hay (7 to 8 percent crude protein), enough additional protein is provided if they are fed a 12 percent crude protein grain or concentrate mix. However, a higher percentage of crude protein may be warranted in two situations: when hay quality is suspect, and when supplemental fat is being top-dressed onto the concentrate. Although adding fat or oils increases the energy density concentration in the feed, it dilutes the protein. If fat is added at 5 to 10 percent of the grain mix, the concentrate should contain about 14 percent crude protein. This is especially important for 2-year-old racehorses that are still growing.

It is useless to feed high-protein feeds to mature racehorses. Giving a horse more protein than it requires creates metabolic stress on the horse and is an unnecessary expense for the racing facility.

Vitamins

Vitamin needs are not as well defined in horses as in other species. Nevertheless, vitamin supplementation is of great interest to many racehorse owners, to the extent that vitamins are often grossly overfed in the horse industry.[5]

Excess vitamin supplementation does not improve performance and, in fact, may be toxic and dangerous. If a horse's diet is well balanced and contains enough vitamins to meet its needs, over-supplementation of vitamins will not enhance its physiological performance in training or in a race.

Vitamin A: Horses obtain significant amounts of the fat-soluble vitamins A, D, E and K from top-quality fresh hays. In an athlete, vitamin A helps maintain normal eating behavior and respiratory health. However, excessive vitamin A may eventually contribute to bone weakness.

Reputable feed manufacturers balance concentrate rations by supplementing vitamin A, often in a vitamin premix. Race stables mixing their own feed should usually add vitamin A at about 1,500 to 2,000 international units (IUs) per pound of feed (see tables 4, 5 and 6 as examples).

Vitamin D: Dietary requirements for dietary vitamin D in horses have not been identified. Horses that receive normal exposure to sunlight and that are fed sun-cured hay will have enough vitamin D for calcium homeostasis and mineral absorption.

This vitamin is usually supplemented in commercial horse feeds at no more than 10 percent of the concentration of vitamin A. Excessive vitamin D can cause calcification of soft tissues.

Vitamin E: Vitamin E has received increased attention for its possible role in reducing tissue damage and as an antioxidant. Most feed manufacturers already provide supplemental vitamin E (Tables 4, 5 and 6). If it is not added to the commercial diet of racehorses, vitamin E will need to be supplemented to provide at least 45 IU per pound of feed.

Vitamin K: Because Vitamin K is synthesized and ab-sorbed in a horse's large intestine, there is no dietary requirement for it. Adequate amounts of this vitamin are produced by anaerobic bacteria of the hindgut.

Although vitamin K has been added to the diets of performance horses to treat or prevent exercise-induced pulmonary hemorrhage (bleeders), its influence on "bleeding" has yet to be documented by equine research.

Racehorses can utilize calories from a combination of carbohydrate and fat sources to better perform anaerobic work with delayed onset of fatigue.

B-vitamins: Of all nutrients used in the horse industry, B-vitamins are the least understood yet most widely used, if not abused. Like vitamin K, the B-vitamins are synthesized in and absorbed from the large intestine. Stables often incorporate B-vitamins into feeding programs to promote "blood building." However, excesses of water-soluble vitamins such as B_{12} are quickly voided in the urine and do not increase packed cell volume or hemoglobin concentration. Instead of over-supplementing these B-vitamins, you should rely more heavily on conditioning and exercise to improve blood volume and oxygen-carrying capacity.

Some B-vitamins affect equine performance and may need to be added to a horse's diet if conditions warrant. Research indicates that exercising horses may need supplemental vitamin B_1 (thiamin) beyond what they would normally synthesize in the intestine.[25] Horses at the race track sometimes develop a lethargic, depressed condition known as "track sour." This condition is characterized by a dullness in attitude, general unthriftiness and slowed performance. Loss of appetite is one symptom of a thiamin deficiency.

Although enough thiamin can be synthesized in the gut to meet the needs of most mature horses, it may not be adequate for racehorses in training. Thiamin is part of an enzyme system involved in energy metabolism in horses. Therefore, racehorses requiring high levels of energy could become thiamin deficient if they take in too little thiamin in the diet. Diets of only oats and grass hay may lack the amount of thiamin needed to meet a horse's requirements.

In many reported cases of "track sour" horses, adding brewer's yeast to the diet appears to stimulate the appetite and return the horse to a spirited, energetic attitude with improved work performance. One of the largest components of brewer's yeast is thiamin, among other B-vitamins.

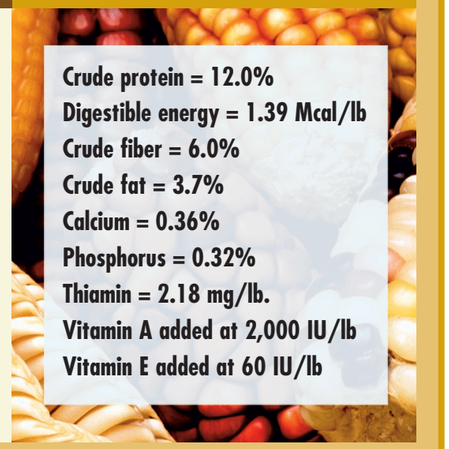
Heavily worked horses receiving traditional diets benefit from having thiamin added to the diet.[25] If the commercial feed has not been supplemented with thiamin, stables should include a good supplement containing the B-vitamins, particularly thiamin, in the diet of racing horses. However, there is no benefit in over-supplementing B-vitamins.

Another B-vitamin, biotin, is often added to enhance hoof growth or strength. Limited clinical reports have claimed some improvement in about one-third of horses receiving biotin supplements.[2] More recent research has demonstrated that d-biotin supplementation reduces the incidence and severity of hoof wall defects, increases hoof wall integrity and reduces the incidence of white line syndrome.[10]

Note: In most cases, it takes from 9 months to more than a year for the benefits of biotin supplementation to become observable. Although more research is needed before exact recommendations can be made about supplementing the diets of horses with poor hooves, providing horses about

TABLE 4.
Example of a traditional ration for a mature racehorse (designed to be fed with a mix of good quality grass hay and alfalfa hay). Note: This feed contains no supplemental fat.

Ingredients	Percent	Pounds/Ton
Cracked corn	45.00	900
Whole oats	42.50	850
Soybean meal	7.50	150
Molasses	3.25	65
Calcium carbonate	0.75	15
TM salt	0.75	20
Vitamin A	+	+
Vitamin E	+	+



Important:
See Table 7 on expected feed consumption, and always introduce new grain feeds gradually. Because this ration contains about 6 percent more energy than straight oats, smaller amounts of this ration will usually maintain similar body condition.

+ Percentages and weights of vitamins A and E will vary, depending on the vitamin premix used.

15 milligrams of biotin a day or about 1.5 parts per million in the diet appears to help.

Minerals

As high-performance athletes, racehorses require a balanced supply of minerals for maintenance of skeletal tissue, muscle contraction and energy transfer. It is much more critical for stables to ensure that the horses have enough minerals such as calcium and phosphorus, relative to the amount of energy they take in, than to be concerned with exact calcium:phosphorus ratios.

However, the total diet of horses being trained or raced should always contain at least as much calcium as phosphorus. Diets with inverted ratios (more phosphorus than calcium) can contribute to weakened bones and subsequent lameness in a stressed horse. Because cereal grains contain more phosphorus than calcium, inverted or improper ratios often occur in the horse industry.

Cafeteria-style and free-choice mineral feeding programs do not meet a horse's requirements for minerals.[19] The only reliable way to achieve mineral balance is through accurate ration formulation.

Recently, Texas A&M researchers studied the mineral requirements of young horses in race training.[13, 15, 22] They found that calcium, phosphorus and magnesium requirements are affected by the combination of growth and exercise.

Young horses in race training are building bone as a part of growth, and they are modeling and remodeling bone in response to exercise. During the initial stages of training, the calcium and phosphorus needs of juvenile horses in training appear to be increased by 30 to 35 percent, and magnesium requirements increased by 80 to 100 percent, over current NRC (1989)[16] recommendations. These increases in mineral requirements in early training are caused by the demands of bone modeling and remodeling.[14]

Thus, during the early stages of training, a 2-year-old horse requires about 130 mg/kg/day of calcium, 70 mg/kg/day of phosphorus and 40 mg/kg/day of magnesium. Juvenile horses in training require total dietary concentrations of calcium of 0.60 percent; phosphorus, about 0.35 percent; and magnesium, 0.2 percent. See tables 4, 5 and 6 for examples of rations with suitable mineral levels.

Electrolytes: During workouts and racing, horses lose significant amounts of electrolytes — sodium, chloride and potassium — in the sweat. Usually it is not difficult to meet the increased requirements for these minerals in horses receiving intense exercise. The majority of these increased requirements can be satisfied by good-quality forage, minerals provided in the concentrate mix and supplemental salts. However, commercially prepared horse feeds do not normally contain enough electrolytes for horses that sweat a lot, particularly in the summer. To compensate for the loss of these electrolytes in the sweat, diets must be supplemented with sodium, chloride and sometimes potassium.[28] Even if a commercial feed contains salt, horses that work hard and sweat profusely will still need about 3 ounces (90 grams) of supplemental salt per day in addition to the salt already in the feed.

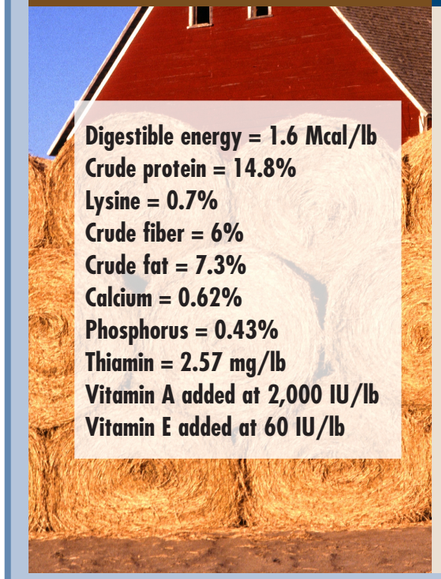
Few studies have been conducted on the use of orally drenched electrolytes. The value of this practice is questionable. Also, there is a chance that adding electrolytes to the drinking water could cause a horse to drink less water, which could result in dehydration. The most effective way to meet the electrolyte needs of horses is to select roughage and concentrates that have a good balance of all the minerals required and to feed them in adequate amounts to meet the animals' energy requirements. Horses that sweat excessively will need additional salt, a total of about 1 percent of the horse's daily ration. Also, give specific attention to meeting the potassium requirement of exercising horses, which may be twice the maintenance requirement, particularly if forages are not of top quality. The potassium requirement for heavily exercised horses is about 1.2 percent of the total diet.[28]

Feeding management

To achieve the highest level of performance with a minimum of digestive disturbances, it is important that feeding is managed well and that rations are balanced. Horses must receive the proper amounts and ratios of nutrients and be fed at regular intervals.

It makes no difference whether a race stable chooses to balance rations by buying formulated, finished feed or by buying the ingredients and mixing them. The critical point is to provide enough nutrients to racehorses to meet their daily requirements and to maintain the ideal body condition for racing. Either approach will work if careful attention is given in the formulation process. Excessive amounts of nutrients must not be fed because it results in nutritional imbalance and metabolic stress on the horse.

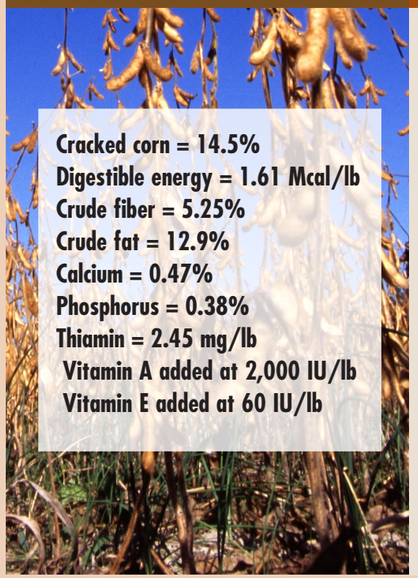
TABLE 5.
Example of a fat-supplemented ration for long yearlings and 2-year-olds in training (to be fed with a mix of grass and alfalfa hay).

Calculated analysis	Ingredients	Percent	Pounds/Ton
	Cracked corn	37.50	750
	Whole oats	35.00	700
	Fat or oil	5.00	100
	Soybean meal	15.00	300
	Molasses	4.00	80
	Calcium carbonate	1.25	25
	Dicalcium phosphate	0.25	5
	Brewer's yeast	1.25	25
	TM salt	0.75	15
	Vitamin A	+	+
	Vitamin E	+	+

Important:
See Table 7 on expected feed consumption and always introduce new grain feeds gradually. This ration contains 15 percent more energy than the ration shown in Table 4 and about 25 percent more energy than straight oats, so smaller amounts of this ration will need to be fed to maintain similar body condition.

+ Percentages and weights of vitamins A and E will vary, depending on the vitamin premix used.

TABLE 6.
Example of a high-fat supplemented ration (to be fed with a mix of grass hay and alfalfa hay).



Ingredients	Percent	Pounds/Ton
Cracked corn	36.25	725
Whole oats	32.50	650
Fat or oil	10.00	200
Soybean meal	15.00	300
Molasses	3.25	65
Calcium carbonate	0.75	15
Dicalcium phosphate	0.25	5
Brewers' yeast	1.25	25
TM salt	0.75	15
Vitamin A	+	+
Vitamin E	+	+

Important:
See Table 7 on expected feed consumption and always introduce new grain feeds gradually. This ration contains 16 percent more energy than the ration shown in Table 4 and over 25 percent more energy than straight oats, so smaller amounts of this ration will need to be fed to maintain similar body condition.

+ Percentages and weights of vitamins A and E will vary, depending on the vitamin premix used.

Tables 4, 5 and 6 show examples of rations that contain differing sources of energy and are balanced for protein, minerals and vitamins. Daily feed intake typically ranges from 2 to 3 percent of a horse's body weight. In some cases, extremely hard-working horses may require feed at 3 percent of horse body weight; such high levels of daily feed must always be provided in two or more feedings per day.

In general, concentrate intake should not exceed 0.75 percent of body weight per feeding, and time intervals between feedings must be the same. If horses can be maintained with concentrate intakes of 1.5 percent of body weight daily or less, they can be fed twice daily at 12-hour intervals. If they require more feed, they should be fed three times daily, at 8-hour intervals.

It is sometimes difficult to maintain appetite and normal feeding regularity in horses that are in race training or at the track. For these horses, it helps to follow these recommendations:

- Use only the highest quality feeds with very high energy density, and try to feed the horses three times a day at regularly spaced intervals around the clock, taking workout sessions into account.
- Do not feed concentrates or hay to racehorses within 3 hours before a workout or race. Although you can offer hay after the workout or race, do not feed concentrates for at least 2 hours after exercise. Offer water free choice after exercise, but make sure that the horses drink slowly, initially, after a workout.
- If the normal feeding time is delayed, reduce the concentrate portion of the next ration at the late feeding, then resume the normal amounts of feed at the next feeding. If feeding is delayed for several hours after a very strenuous workout or because of transport, feed the horse only hay at the next feeding and then offer the normal concentrate allotments at the next regular scheduled feeding. Do not feed any extra concentrate to compensate for feed missed because of travel or other interruption in normal management.
- If a racehorse stable runs out of feed, buy feed in the following priority order:
  1. The same feed if possible.
  2. Similar feed with the same nutrient composition and physical characteristics, especially crude fiber.
  3. If none of those is available, buy good clean oats as a last resort.

For horses that have been in strenuous training during the week with Sundays off, reduce the concentrate feed accordingly on the off day. When combined with some free exercise, this reduction can help prevent metabolic disorders caused by feeding high-concentrate feeds in the absence of exercise.

Reduce the concentrates to about half the normal amount and increase the hay allowances. This practice will help prevent feeding-related muscular problems, azoturia (Monday morning disease) and the feeding-related "tying-up" syndrome.

Riders should take adequate time to warm up the horses before strenuous work and cool them down after strenuous work.

Summary

Nutrition is one of the most important aspects of overall development and management of horses. Feeding horses of economic significance is an everyday responsibility.

On more than 55 percent of Texas farms, the single biggest cost of keeping race-bred prospects and racehorses is nutrition.[5] Although feeding racehorses successfully is a challenge, it can be done. The primary focus should be on meeting the energy and other nutrient needs in an amount of feed the horses can eat comfortably.

If a horse's nutritional requirements are met, but not exceeded, its performance will be improved over those horses that are fed imbalanced diets in irregular amounts.

New research information currently available offers new approaches to ration formulation, feeding management and training regimens for racehorses. Adjustments in these areas offer the best opportunity to improve athletic performance, delay fatigue and reduce injuries to the high performance horse.

In the future, stables that use research information and follow sound management practices will consistently achieve the highest level of performance in racehorses. Remember: Indiscriminate feeding of supplements will not result in top athletic performance. Rather, the focus should be on feeding racehorses correctly. It is complicated, but it can be done.

TABLE 7.
Expected daily feed consumption by racehorses and prospects in training (percent body weight)[a].

Type of diet	AGE OF HORSE OR LEVEL OF WORK: Long yearling In training	Two-year-old In training	Racing
Typical nonfat diet			
Concentrate	1.00 – 1.5	1.0 – 1.5	1.50 – 1.75
Hay	1.00 – 1.5	1.0 – 1.5	0.75 – 1.00
10% fat supplemented diet			
Concentrate	0.5 – 1.00	0.75 – 1.0	1.25 – 1.5
Hay	1.0 – 1.5	1.00 – 1.5	0.75 – 1.00

[a]Feed consumption by individual horses may vary further according to the level of activity and energy density of the feeds being fed.

References

1. Anderson, C., G. D. Potter, J. L. Kreider and C. C. Courtney. 1983. Digestible energy requirements for exercising horses. Journal of Animal Science. 56:91.

2. Comben, N., R. J. Clark and D. J. B Sutherland. 1984. Clinical observations on the response of equine hoof defects to dietary supplementation with biotin. Veterinary Record. 115:642.

3. Freeman, D. W., G. D. Potter, G. T. Schelling and J. L. Kreider. 1985. Nitrogen metabolism in the mature physically conditioned horse. II. Response to varying nitrogen intake. Proceedings, 5th Equine Nutrition Physiology Symposium. p. 236.

4. Freeman, D. W., G. D. Potter, G. T. Schelling and J. L. Kreider. 1988. Nitrogen metabolism in mature horses at varying levels of work. Journal of Animal Science. 66:407.

5. Gibbs, P. G. and N. D. Cohen. 2001. Early management of race bred weanlings and yearlings on farms. Journal of Equine Veterinary Science. Vol. 21, No. 6. p. 279-283.

6. Gibbs, P. G. and G. D. Potter. 2002. Concepts in protein digestion and amino acid requirements of young horses. Professional Animal Scientist.

7. Hansen, K. D., F. M. Rouquette, G. W. Webb, G. D. Potter and M. J. Florence. 1987. Performance of yearling horses on pasture and supplemental feed. Proceedings, 10th Equine Nutrition Physiology Society. Ft. Collins, CO. p. 25-30.

8. Hinkle, D. K., G. D. Potter, J. L. Kreider and G. T. Schelling. 1981. Nitrogen balance in exercising mature horse fed varying levels of protein. Proceedings, 7th Equine Nutrition Physiology Symposium. p. 91.

9. Jones, D. L, G. D. Potter, L. W. Greene and T. W. Odom. 1991. Muscle glycogen concentrations in exercised miniature horses at various body conditions and fed a control or fat-supplemented diet. Journal of Equine Veterinary Science. 12(5):287.

10. Linden, J., H. Josseck, W. Zenker, H. Geyer and J. Schulze. 1993. The effect of d-biotin supplementation on hoof condition in Lipizzaner horses. Proceedings, 13th Equine Nutrition Physiology Symposium. p. 58-61.

11. Meyer, H. 1987. Nutrition of the equine athlete. In Equine Exercise Physiology 2. ICEEP Publications, Davis, CA. p. 644.

12. Meyers, H. C., G. D. Potter, J. W. Evans, S. B. Smith, T. S. Taylor and W. S. Barnes. 1990. Physiologic and metabolic response of exercising horses to added dietary fat. Proceedings, 19th Equine Nutrition Physiology Symposium. p. 107.

13. Neilsen, B. D., G. D. Potter, L. W. Greene, E. L. Morris, M. Murray-Gerzik, W. B. Smith and M. T. Martin. 1998. Response of young horses in training to varying concentrations of dietary calcium and phosphorous. Journal of Equine Veterinary Science. 18(6):397-404.

14. Nielsen, B. D., G. D. Potter, E. L. Morris, T. W. Odom, D. M. Senor, J. A. Reynolds, W. B. Smith and M. T. Martin. 1997. Changes in the third metacarpal bone and frequency of bone injuries in young Quarter Horses during race training observations and theoretical considerations. Journal of Equine Veterinary Science. 17(10):541-549.

15. Nolan, M. M., G. D. Potter, K. J. Mathiason, P. G. Gibbs, E. L. Morris, L. W. Greene and D. Topliff. 2001. Bone density in the juvenile racehorse fed differing levels of minerals. Proceedings, 17th Equine Nutrition Physiology Symposium. p. 33.

16. NRC, 1989. "Nutrient Requirements of Horses." National Academy of Sciences. Washington, D. C.

17. Oldham, S. L., G. D. Potter, J. W. Evans, S. B. Smith, T. S. Taylor and W. S. Barnes. 1990. Storage and mobilization of muscle glycogen in exercising horses fed a fat-supplemented diet. Journal of Equine Veterinary Science. 10(5):1-5.

18. Potter, G. D., S. P. Webb, J. W. Evans and G. W. Webb. 1990. Digestible energy requirements for work and maintenance of horses fed conventional and fat-supplemented diets. Journal of Equine Veterinary Science. 10(3):214-218.

19. Schryver, H. G. et al. 1978. Voluntary intake of calcium by horses and ponies fed a calcium deficient diet. Journal of Equine Medical Surgery. 2:337-340.

20. Scott, B. D., G. D. Potter, L. W. Greene, P. S. Hargis and J. G. Anderson. 1992. Efficacy of a fat-supplemented diet on muscle glycogen concentrations in exercising. Thoroughbred horses maintained in varying body conditions. Journal of Equine Veterinary Science. 12(2):105-109.

21. Scott, B. D., G. D. Potter, L. W. Greene, M. M. Vogelsang and J. G. Anderson. 1993. Efficacy of a fat-supplemented diet to reduce thermal stress in exercising thoroughbred horses. Proceedings, 13th Equine Nutrition Physiology Symposium. p. 66.

22. Stephens, T. L., G. D. Potter, K. J. Mathiason, P. G. Gibbs, E. L. Morris, L. W. Greene and D. Topliff. 2001. Mineral balance in juvenile horses in race training. Proceedings, 17th Equine Nutrition Physiology Symposium. p. 26.

23. Topliff, D. R., G. D. Potter, T. R. Dutson, J. L. Kreider and G. T. Jessup. 1983. Diet manipulation and muscle glycogen in the equine. Proceedings, 8th Equine Nutrition Physiology Symposium. p. 119.

24. Topliff, D. R., G. D. Potter and J. L. Kreider. 1983. Exercise physiology in horses – fitness vs. fatness. Proceedings, Texas A&M University Horse Short Course. p. 1.

25. Topliff, D. R., G. D. Potter, J. L. Kreider, G. T. Jessup and J. G. Anderson. 1981. Thiamin supplementation for exercising horses. Proceedings, 7th Equine Nutrition Physiology Symposium. p. 167.

26. Webb, S. P., G. D. Potter and J. W. Evans. 1987. Physiologic and metabolic response of race and cutting horses to added dietary fat. Proceedings, 10th Equine Nutrition Physiology Symposium. p. 115.

27. Webb, S. P., G. D. Potter, J. W. Evans and G. W. Webb. 1990. Influence of body fat content on digestible energy requirements of exercising horses in temperate and hot environments. Journal of Equine Veterinary Science. 10(2):116-120.

28. Hoyt, J. K, G. D. Potter, L. W. Greene and J. W. Evans. 1989. Mineral balance in resting and exercised miniature horses. Journal of Equine Veterinary Science. 15(7):310.

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Chester P. Fehlis, Director, Texas Cooperative Extension, The Texas A&M University System.

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