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FEEDING THE PERFORMANCE HORSE

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In recent years more research attention has been directed toward the equine athlete. New information is becoming available and new concepts are being formed. One obvious reason to focus on the physiology and nutrition of the performance horse centers around the observation that physical performances of horses have improved very little over the last 50 years. In race horses for example, racing times over common distances have improved some, but the magnitude of improvement has been relatively small compared to that seen in the human athlete. This is in spite of efforts by horse breeders to breed performance and race horses with greater athletic ability. 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 continuously for the human athlete. Further, too many horses continue to succumb to crippling injuries brought on by acute fatigue.

There have been just enough successes from feeding well balanced diets and implementing improved training regimens, which have been reported in the popular press, that horse owners and trainers often resort to "hear-say" techniques in an attempt to improve the performance of their horses. Unfortunately, many recommendations made in the popular press are not based on carefully controlled research, and a period of trial and error soon leads to the realization that "magic" products or practices do not significantly improve athletic performance. In defense of the horseman, searches for short term improvements in the performance of their horses are a result of inadequate research information in past years. Therefore, horsemen resort to using any information they can find to try to improve fitness in their horses.

A higher level of performance can be expected from horses that are properly conditioned and fed a balanced diet containing the fuel and nutrients necessary to do the work. A horse that is "dead fit" and fed a good ration will run as fast as he can if he has any "heart". The term "heart" in a horse may in fact be closely related to how fit the horse actually is and the type of diet the horse is fed to maximize athletic potential. If the horse has the available energy and nutrients it takes to utilize that energy, there is good reason to believe the horse will voluntarily run faster, jump higher, stop harder or otherwise perform at a higher level than when the horse has insufficient fuel and other nutrients to perform these tasks.

Significant new research has been conducted within the past few years on the high-performance horse, and from this research more productive feeding recommendations can be made than were possible in the past. Recent research indicates that the fuel supply available in the muscles of the horse, and the ability to utilize that fuel, can be altered by the inclusion of different ingredients in the diet and using appropriate feeding management and training regimens. It is likely that in the future, use of research information along with sound, solid management practices for feeding horses will be used by those people who are successful at achieving the highest level of performance from their horses.

Energy

One significant challenge in feeding the equine athlete is to acquire and maintain ideal body condition[a] for the specific type of performance while providing an adequate supply of fuel to support performance at a certain level of work. Therefore, the primary nutrient of concern is energy, which allows the horse to maintain optimum body condition while performing at either a light, moderate or heavy work load. These work levels represent a generalized accounting of daily activity and help estimate the change in energy needs as compared to maintenance (table 1). English or western pleasure and equitation horses are examples of athletes that characteristically perform at a light work load. These horses usually receive limited riding and seldom ever go into an anaerobic state, usually requiring only 25% more energy than nonworking horses. Timed event horses, hunters, jumpers and many cattle-working horses perform at a moderate work load and may require 50% more energy than an idle horse. However, from time to time some of these horses may work at a more intense level. Race horses, cutting horses and polo ponies often require two times as much energy as a nonworking horse. So, one significant aspect of the horse's diet is whether or not the diet supplies sufficient energy to allow the horse to complete the assigned work!!

The high-performance horse may be required to perform both aerobic and anaerobic work while competing in a particular event. Some knowledge of the extent to which a horse depends on aerobic vs. anaerobic metabolism systems is important in order to know what types of diets should be fed and what energy substrates should be made available. For example, long-distance endurance horses can very effectively utilize more slowly released energy sources such as fat, while the short duration, high-velocity horse will perform most of its work in an anaerobic fashion using carbohydrates. However, it is interesting that recent research indicates that racehorses and cutting horses also benefit from added fat in the diets, through a mechanism that results in muscle glycogen (carbohydrate) storage. It is critically important that the short duration performing horse have sufficient, readily available energy in the form of carbohydrate, and particularly stored energy in the form of muscle glycogen, in order to meet the sudden quick energy demands of anaerobic work.

Energy must be provided in a reasonable amount of daily feed that can be safely consumed by the equine athlete. Depending on level of activity and energy concentration of the diet, this intake of forage and concentrate will range from 1.5% to 3.0% of body weight daily. Most horsemen are very accustomed to the use of concentrates as a supply of soluble carbohydrates for energy.

Table 1. Approximate daily nutrient requirements of performance horses (1,100 pound mature weight)

Class	Digestible Energy (Mcals)	Crude Protein (pounds)	Calcium (grams)	Phosphorus (grams)	Vitamin A (IU's)
Mature Horses					
Light Work	20.5	1.8	25	18	22,000
Moderate Work	24.6	2.2	30	21	22,000
Intense Work	32.8	2.9	40	29	22,000
Two-Year Olds (In-training)	26.3	2.5	34	19	20,000

From NRC (1989)

[a] For more information on body condition, refer to the publication entitled "Conditioning Race and Performance Horses." The Condition Scoring System is also explained in publication B5025, "Nutritional Management of Pregnant and Lactating Mares."

Cereal grains such as oats, barley, corn and sorghum can be mixed together in a variety of ways to produce concentrates of differing energy concentration. Grain feeds provide energy that can be used directly or stored in the muscles and liver in the form of glycogen. Blood glucose and glycogen contribute directly to the energy needs of horses, especially those that are working anaerobically (heart rate > 150 beats/minute). Anaerobic exercise takes place in many different types of horses. Cutting horses and race horses rely primarily on anaerobic energy production when actually cutting a cow or running a race.

Topliff et al. (1983) found that the stored glycogen concentration in the muscles of exercising horses can be increased dramatically by manipulating the diet and exercise regimen. When animals are fed inadequate amounts of carbohydrates and put into high levels of training, they deplete their muscle glycogen stores and become unable to work at a high level. Conversely, when those animals are fed high-energy diets with high amounts of available carbohydrate, and are exercised in a fashion that allows storage of muscle glycogen, work performance can be enhanced.

Horses that perform at moderate and intense levels of activity have very high requirements for energy. While the work they do often requires a combination of aerobic and anaerobic metabolism, those horses frequently have trouble obtaining sufficient energy from conventional concentrates. Research has shown that fat can be utilized as part of the total dietary energy source to provide a more concentrated supply of energy in an amount of feed that can be safely consumed. Fat or oil can be incorporated into a grain mix and increased to 10% of the concentrate without negatively affecting dry matter or fiber digestibility. Meyers et al. (1987), Webb et al. (1987), Scott et al. (1992) and Oldham et al. (1990) found that adding fat to the diets of horses in race and cutting training improved muscle glycogen storage and work performance. This was due to a "glycogen sparing" effect of feeding fat. Therefore, the daily quantitative supply of energy is important, but it is equally important to supply significant amounts of that energy in a form to promote synthesis and storage of muscle glycogen in horses that are expected to do short term, high-velocity, anaerobic work.

Several factors need to be considered when fat supplemented diets are to be fed. First of all, horses need time to adjust to fat utilization and this adaptation time can be as much as three weeks. Secondly, a fat-supplemented diet will provide more energy, so total daily feed intake must be decreased if the work level and body condition are to remain the same. Horseowners who intend to topdress fat or oil on the feed should begin with a small amount of added fat and increase amounts gradually, keeping an eye on eating behavior and general well being. And thirdly, on-the-farm supplementation of fats/oils requires a reassessment of the total dietary nutrient balance (see section on protein), especially for young, growing horses that receive exercise.

It should be emphasized here that energy requirements for work take precedence over the storage of energy as fat in the body. Therefore, animals that are not fed sufficient energy to maintain body weight will mobilize energy stored in body tissues to meet energy requirements for work. If a horse isn't fed sufficient energy to meet energy requirements, the horse will metabolize energy stored in body tissues, including muscle glycogen stores, in an attempt to maintain body weight. Therefore, the very thin horse may not be physiologically capable of strenuous exercise because of an inadequate supply of available energy. So, to maintain reasonable levels of body fat in horses that are being worked hard it is important to increase the energy density in the diet and adjust the amounts of feed proportionally. Jones et al. (1991) and Scott et al. (1992) found that adding fat to the diet of exercising horses resulted in muscle glycogen concentrations that were higher in thin horses than when they were fed conventional diets. Therefore, feeding some fat to equine athletes helps protect them from fatigue even when their body condition is reduced.

While it is important to maintain equine athletes in adequate body condition to do their job, excess body fat causes thermal stress on the horse (Webb et al., 1990). Potter et al. (1990) found that regardless of body condition, feeding a fat-supplemented diet reduced thermal stress on horses. Thus, if horses can be maintained in lean condition, fed a fat-supplemented diet with adequate carbohydrates and other nutrients, and trained properly, perhaps performances can be improved, fatigue can be delayed and injuries can be reduced in equine athletes.

When selecting commercial feeds, it is important to evaluate both crude fat and fiber levels shown on the feed tag. These can be a big help in estimating the energy density of the grain mix. There is an inverse relationship between fiber and the expected digestible energy content (table 2), and this knowledge can help horse owners select concentrates that are a better buy per unit of energy. Today some commercial feed manufacturers produce fat-supplemented diets. So, if a feed tag lists a crude fat level of 8%, then in most cases about 4% to 5% additional fat has been included. This supplemental fat affects that relationship between crude fiber and expected digestible energy content by about .10 megacalories per pound of feed. So, the same amount of concentrate will provide a significantly greater amount of energy if that concentrate contains a source of supplemental fat.

Caloric expenditure for a given amount of exercise should be the central focus when meeting the nutritional needs of performance horses. Horses that are calorie deficient cannot perform at the same level as horses that have sufficient energy in the diet and stored in the muscles. In those situations where horses' body weights are reduced to abnormally low levels, they frequently deplete their body energy reserves such that they do not have sufficient calories to perform at a high level. Consequently, horsemen should be concerned about maintaining sufficient body condition in horses to maintain muscle glycogen reserves, but not so much to cause thermal stress. Horses should be fed sufficient calories, regardless of the source of those calories (Younglove et al., 1993), to meet their requirements for the work they do and to sustain themselves in sufficient body condition to offset the energy expenditures of not only aerobic, but particularly anaerobic metabolism.

Table 2. Relationship of Crude Fiber to Expected Digestible Energy in Conventional and Fat-Supplemented Grain Mixes

If the feed tag indicates Crude Fiber (%) of	Then, the digestible energy (Mcal/lb) of the feed will be approximately	But, if the feed also contains 4-5% added fat, (tag shows 7-8% fat) then the digestible energy will be approximately
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
(and 3% to 3.75% fat)		

Protein

It is important to recognize that requirements for protein, vitamins and minerals are influenced by the energy required for various levels of work. Overfeeding of protein is common in the performance horse industry, and too often the nutritional value of diets for horses and description of their nutritional needs are described in terms of percentage of protein in the diet. One misconception is that the percent crude protein content of the grain or concentrate mix should be increased rather dramatically as a horse's level of activity increases. It is true that a horse does require a small increase in the amount of protein in the diet for optimum production and work performance, but it is not true that the most important consideration in the horse's diet is a high level of protein, particularly in the mature hard-working performance horse. Obviously, if horses are still growing, their protein requirements will be higher than they are at maturity. But the protein requirements of the mature horse are comparatively low, 10% of the diet or less, depending on the level of feed intake. A balance of amino acids is important, but the total amount of protein required to maintain the mature horse in working condition is relatively low compared to the protein requirements of the lactating mare and the young, growing horse.

Although the effects of exercise on protein needs of the athlete are not totally understood, it is apparent that protein intake should be considered relative to the energy intake. A properly balanced diet will provide sufficient crude protein at increasing levels of work, provided the horse's energy requirement is being met through additional feed intake. Hinkle et al. (1981) and Freemen et al. (1988) conducted research on the protein requirements and muscle composition of exercising horses fed varying levels of protein. Freeman et al. (1988) fed a constant calorie:protein ratio, increased the work load of horses over time and found that during the conditioning period horses retained more nitrogen in the body than nonworking horses. After conditioning had been achieved and the level of work was reduced, the horses still maintained higher nitrogen retention than when not working. Hinkle et al. (1981) fed varying amounts of protein to horses which were already in a high state of condition and also found that exercising horses retained more nitrogen than sedentary horses. But the additional nitrogen utilization was comparatively small. Whether the nitrogen retained in these studies was used for muscle synthesis or was lost in sweat is not clear, but it does indicate that there is some small increase in the protein requirement of the exercising horse, particularly during the conditioning period. Freeman et al. (1985) fed conditioned horses varying levels of protein and measured changes in muscle composition. They found that conditioning changed the diameter of certain muscle fibers and the protein synthesis mechanisms of muscle were enhanced by conditioning. Also, the horses retained more nitrogen when fed the higher protein diets, but the magnitude of difference was small.

Performance horses that receive average quality grass hay (7 - 8% crude protein) will be provided sufficient additional protein by feeding a 12% crude protein grain or concentrate mix. At a moderate work load, such horses will, on the average, consume total daily feed (hay + grain) at between 1.75 and 2.5% of horse body weight. There are, however, two situations where a concentrate higher in crude protein may be warranted. The first is in cases where hay quality is suspect. The second is in those feeding programs where supplemental fat is being topdressed onto the concentrate. The addition of fat or oils provides increased energy density, but this practice also dilutes the protein concentration in the feed. In situations where fat is added at 5% - 10% of the grain mix, horses should be fed a concentrate that contains approximately 14 % crude protein. This is especially important for two-and-three-year-old horses that are working. There is no justification for feeding high protein feeds to the mature, equine athlete. The protein a horse receives beyond that required is not an economical energy source and it creates a metabolic stress on the horses. Further, it is an additional unnecessary expense for the horse owner.

Vitamins

Vitamin nutrition in the horse is not as well understood as in other species, and is not as well understood in the horse as energy and protein nutrition. Nevertheless, vitamin supplementation is an area of great interest for many performance horse owners, to the extent that feeding vitamins is often grossly overdone in the horse industry (Gibbs, 1990). The uncalculated over-supplementation of vitamins does not necessarily improve performance and in fact may be toxic and dangerous. If the horse is receiving a well balanced diet containing sufficient vitamins to meet its needs, then over supplementation of vitamins certainly will not enhance a horse's physiological performance.

Vitamins A, D, E and K are fat-soluble vitamins that horses obtain in significant amounts from top-quality, fresh hays. In the athlete, vitamin A serves to help maintain normal eating behavior and health of the respiratory system. However, excessive vitamin A may eventually contribute to bone weakness. Reputable feed manufacturers balance concentrate rations by supplementing vitamin A, often in a vitamin-trace mineralized premix. Horesowners who are having a feed mixed should usually have vitamin A added at approximately 1,500 - 2,000 International Units (IU's) per pound of feed.

Dietary vitamin D requirements for horses have not been identified. Horses that receive normal exposure to sunlight will have sufficient vitamin D for calcium homeostasis and mineral absorption. It is usually supplemented in commercial horse feeds at 10% the concentration of vitamin A.

Vitamin E has received increased attention for its possible role in reducing tissue damage, but its influence on exercise and the muscle of the horse has not been thoroughly researched. The NRC (1989) recommends that diets for working horses contain 80 to 100 IU's of Vitamin E per kilogram of dry matter. This has already been adjusted by many feed manufacturers.

Vitamin K is synthesized in the large intestine of the horse, thus there is no dietary requirement. The production of this vitamin by anaerobic bacteria of the hindgut is considered to be adequate. Vitamin K has been used in performance horses toward treatment or prevention of Exercise Induced Pulmonary Hemorrhage in race horses, but its influence on "bleeding" has yet to be documented by equine research.

B-Vitamins are the least understood yet most widely used, if not abused, of all nutrients in the horse industry. Like vitamin K, the B-vitamins are synthesized in and absorbed from the large intestine. Horsemen often incorporate B-vitamins into feeding programs expecting some "blood building" to occur. Excesses of water soluble vitamins such as B_{12} are quickly voided in the urine, with no noticeable impact on blood parameters such as packed cell volume or hemoglobin concentration. Such information, when combined with the increased knowledge of blood volume, strongly points to a need for horsemen to rely more heavily on conditioning and exercise to improve oxygen carrying capacity in the equine athlete.

Some B-vitamins play a valuable role in equine performance and may need to be supplemented in the horse's diet if conditions warrant. There is some industry evidence and limited research data that indicate exercising horses may need supplemental vitamin B_1 (thiamin) beyond what the horse would normally require for maintenance. It is not uncommon to observe horses at the race track that 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. Thiamin can be synthesized in the gut in sufficient amounts to meet the needs of most mature horses, but may not be synthesized nor absorbed fast enough to meet the requirements of the severely stressed, exercising horse. Thiamin is an enzyme co-factor and thus is part of an enzyme system involved in energy metabolism in the horse. Therefore, it is conceivable that horses requiring high levels of energy could become thiamin deficient in the absence of adequate amounts of thiamin in the diet. Diets that are based on oats and grass hay may not have sufficient thiamin to meet the hard working performance horse's requirements for thiamin, and consequently horses fed unbalanced diets could easily become thiamin deficient. It is interesting to note that in almost all reported cases of "track sour" horses, inclusion of brewer's yeast in those horses' diets seems to stimulate appetite and return the horse to a spirited, energetic attitude where work performance is improved. It is also interesting to note that one of the largest components of brewer's yeast is thiamin, among other B-vitamins. Topliff et al. (1981) studied the thiamin requirement of the exercising horse and reported that heavily worked horses receiving traditional diets should receive supplemental thiamin. Since recent research indicates that horses in race training will benefit from adding thiamin to the diet, it is advised that a good supplement containing the B-vitamins, particularly thiamin, should be included in the diet of racing horses.

Biotin is another B-vitamin that is often supplemented for purposes of enhancing hoof growth or strength. Limited clinical reports have claimed some improvement in about one-third of supplemented horses (Comben et al., 1984). More recent research by Linden and coworkers (1993) demonstrated benefical effects of d-biotin supplementation as evidenced by reduced incidence and severity of horn defects, increased tensile strength and improved condition of the white line. More research is needed before exact recommendations can be made about supplementing diets of horses with poor hooves.

Minerals

The performance horse requires a balanced supply of minerals for maintenance of the skeleton, muscular contraction and for energy transfer. The supply of minerals such as calcium and phosphorus, relative to the amount of energy taken in by an athlete, is much more critical than the often stated arguments concerning exact calcium:phosphorus ratios. However, performance horses should always receive a total diet that contains at least as much calcium as phosphorus. Inverted calcium:phosphorus ratios can contribute to weakened bones and subsequent lameness in the stressed horse. Unfortunately, since cereal grains are higher in phosphorus than calcium, inverted ratios are too frequent in the horse industry. Cafeteria-style and free-choice mineral feeding programs are ineffective in meeting a horse's requirements (Schryver et al. 1978), so the only reliable means of achieving mineral balance is through accurate ration formulation procedures.

Hard working horses lose significant amounts of sodium, chloride and potassium in the sweat (Meyer, 1987). The increase in requirements for these minerals from rest to heavy exercise can normally be met without difficulty. Two major supply sources are 1) good quality forage and 2) supplemental minerals provided from trace mineralized salt in the concentrate mix. In the majority of cases, these two sources will adequately satisfy the increased requirements. Young et al. (1989) found that diets of exercising horses must be supplemented with sodium and chloride, and sometimes potassium, to compensate for the loss of these electrolytes in the sweat. Top quality, commercially prepared horse feeds will normally contain sufficient amounts of these and the trace minerals.

The use of orally-dosed electrolytes is a practice that has been investigated only on a limited basis. This practice is questionable and there is always a chance that adding electrolytes to the drinking water could cause a reduction in water consumption. This could cause dehydration and severely affect a performance horse.

In summary, the most effective way to meet the mineral needs of exercising horses is to select roughage and concentrates that have a good balance of all the minerals required and feed those in adequate amounts to meet the energy requirements of the animal. Horses that sweat excessively may need additional salt, added at approximately 1% of the horse's daily ration. Also, specific attention should be given to meeting the potassium requirement of exercising horses, which may be twice the requirement at maintenance.

Feeding Management

Optimum feeding management is important to achieve the highest level of performance. Whether horse owners choose to balance rations by purchasing ingredients and mixing them, or whether they choose to buy formulated, finished feed makes absolutely no difference. The critical point is providing the nutrients to horses in sufficient amounts to meet their daily requirements. Either approach will work if careful attention is given in the formulation process. Three example performance horse rations are shown in tables 3, 4 and 5. They contain differing sources of energy and are balanced for protein, minerals and vitamins. Performance horse owners should keep in mind that daily feed intake should range from 1.5 to 2.5% of horse body weight. In some cases, extremely hard working horses may require feed at 3% of horse body weight and high levels of daily feed must always be provided in two or more feedings per day. Expected feed consumption for horses with differing levels of activity is shown in table 6. A formula for using a tape measure to estimate a horse's weight can be found in the publication entitled "Conditioning the Performance Horse".

Whatever method is chosen to provide the animals' nutritional needs, it is critically important that the feeding management principles be applied in order to maintain a high level of performance in horses with a minimum of digestive disturbances. Detailed feeding management practices are provided in the publication entitled "Feeding Management Points for Texas Horse Owners" by Householder et al. (1993).

It is sometimes difficult to maintain appetite and normal feeding regularity in horses that are used in various performance events such as showing, rodeoing, racing, etc. However, some specific recommendations for these horses are as follows:

1) Try to handle and work horses quietly and easily during transit and in the stall areas.

2) Use only the highest quality feeds with very high energy density and try to feed the horses 3 to 4 times per day at regularly spaced intervals around the clock, taking working sessions into account.

3) Hard working horses shouldn't be fed within 2 hours before or for 1 to 2 hours after strenuous exercise.

4) The rider should take adequate time for warming the horse up before strenuous work and take some time to warm the horse down after strenuous work.

5) If the normal feeding time is delayed, then the concentrate portion of the next ration should be reduced at the late feeding, and then resume the normal quantities of feed at the next feeding. If feeding time is delayed for several hours after a very strenuous workout the horse should be fed only hay at the next feeding and then offered the normal concentrate allotments at the next regular scheduled feeding. It is important that no extra concentrate be fed to compensate for feed that might have been missed due to travel or working at the previously scheduled feeding.

6) If a horseman runs out of feed on the road, feed should be purchased in the following priority order:

a) The same feed if possible.
b)Similar feed with the same nutrient composition and physical characteristics.
c) If none of those are available, purchase good clean oats.

7) Horses that have been in strenuous training during the week with Sundays off should have their feed reduced accordingly on the off day. When combined with some free exercise, this can help to prevent metabolic disorders resulting from feeding high concentrate feeds in the absence of exercise. This is best done by reducing the concentrates to approximately half the normal amount and increasing the hay allowances. This will help prevent feeding related muscular soreness problems, azoturia and the "tying-up" syndrome.

In summary, feeding the high-performance horse successfully is a challenge, but 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 comfortably eat. If the nutritional requirements are met accurately, performance will be improved over those horses that are fed imbalanced diets in irregular amounts. As new research information becomes available, new approaches to ration formulation, feeding management and training regimens for high-performance horses will be developed. It seems obvious that adjustments in these areas offer the most likely opportunity to improve athletic performance, delay fatigue and reduce injuries to the equine athlete.

Table 3. Example performance horse ration (designed to be fed with good quality grass hay or grazing).

Ingredients	Percent	Pounds/Ton	Calculated Analyses
Cracked Corn	45.00	900	**Crude Protein = 12.0%**
Whole Oats	42.50	850	**Digestible Energy = 1.39 Mcal/lb.**
Soybean Meal	7.50	150	**Crude Fiber = 6.0%**
Molasses	3.25	65	**Crude Fat = 3.7%**
Calcium Carbonate	.75	15	**Calcium = .36%**
TM Salt	1.0	20	**Phosphorus = .32%**
Vitamin A	+	+	**Thiamin = 2.18 mg/lb.**
Vitamin E	+	+	**Vitamin A added at 2,000 IU's/lb.**
			Vitamin E added at 60 IU's/lb.

* Important: See table 6 on expected feed consumption and always introduce new grain feeds gradually. This ration contains approximately 6% more energy than straight oats, so smaller amounts of this ration will usually maintain similar body condition.

Table 4. Fat-supplemented performance ration for hard working horses (to be fed with grass hay)

Ingredients	Percent	Pounds/Ton	Calculated Analysis
Cracked Corn	40.00	800	**Crude Protein = 14.0%**
Whole Oats	37.50	750	**Digestible Energy = 1.50 Mcal/lb.**
Animal Fat	5.00	100	**Crude Fiber = 5.7%**
Soybean Meal	12.25	245	**Crude Fat = 8.25%**
Molasses	2.00	40	**Calcium = .42%**
Calcium Carbonate	.75	15	**Phosphorus = .38%**
Dicalcium Phosphate	.25	5	**Thiamin = 2.57 mg/lb**
Brewer's Yeast	1.25	25	**Vitamin A added at 2,000 IU's/lb.**
TM Salt	1.0	20	**Vitamin E added at 60 IU's/lb.**
Vitamin A	+	+	
Vitamin E	+	+	

* Improtant: See table 6 on expected feed consumption and always introduce new grain feeds gradually. This ration contains 8% more energy than the ration shown in table 3 and 13% more energy than straight oats, so smaller amounts of this ration will usually maintain similar body condition.

Table 5. High fat-supplemented performance ration for hard working, heavily stressed horses (to be fed with grass hay)

Ingredients	Percent	Pounds/Ton
Cracked Corn	36.25	725
Whole Oats	32.50	650
Animal Fat	10.00	200
Soybean Meal	15.00	300
Molasses	3.00	60
Calcium Carbonate	.75	15
Dicalcium Phosphate	.25	5
Brewer's Yeast	1.25	25
TM Salt	1.00	20
Vitamin A	+	+
Vitamin E	+	+

Calculated Analysis

Crude Protein = 14.5%
Digestible Energy = 1.61 Mcal/lb.
Crude Fiber = 5.25%
Crude Fat = 12.9%
Calcium = .47%
Phosphorus = .38%
Thiamin = 2.45 mg/lb.
Vitamin A added at 2,000 IU's/lb.
Vitamin E added at 60 IU's/lb.

* Important: See table 6 on expected feed consumption and always introduce new grain feeds gradually. This ration contains 14% more energy than the ration shown in table 3, 7% more energy than the ration shown in table 4 and 19% more energy than straight oats, so smaller amounts of this ration will usually maintain similar body condition.

Table 6. Expected Daily Feed Consumption by Performance Horses (% body weight)[a]

	Level of Work		
Type of Diet	Light[b]	Moderate[c]	Intense[d]
Typical Non-Fat Diet			
Concentrate	.50 - 1.0	1.0 - 1.5	1.50 - 1.75
Hay	1.00 - 2.0	1.0 - 1.5	.75 - 1.00
Total	1.75 - 2.0	2.0 - 2.50	2.50 - 3.00
5 - 10% Fat-Supplemented Diet			
Concentrate	.5 - .75	.75 - 1.0	1.0 - 1.25
Hay	1.0 - 2.00	1.00 - 1.5	.75 - 1.25
Total	1.5 - 1.75	1.75 - 2.0	2.25 - 2.50

[a] Feed consumption by individual horses may vary further according to level of activity and energy density of the feeds being fed.
[b] Examples are english/western pleasure, equitation, etc.
[c] Examples are ranch work, roping, cutting, timed events, jumping, etc.
[d] Examples are endurance riding, race training, polo, etc.

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