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# Formulating Rations for Horses

*Equine Section, Department of Animal Sciences*



Formulating rations for horses may be accomplished by some rather basic mathematical calculations or by a series of complex procedures to formulate least-cost rations by computer. The most accurate method would be to consider the requirements for all nutrients—protein, energy, minerals and vitamins—in making the calculations. In practice, however, it usually is not necessary to be concerned with calculations of exact needs of all individual minerals and vitamins, since adequate amounts of trace minerals commonly are assured through inclusion of a trace mineralized salt in the ration. Other nutrients, such as the B vitamins, often are present in natural feedstuffs, or may be synthesized by bacteria present in the intestinal tract of the horse. The nutrients of major concern in horse ration formulation are energy, protein, calcium, phosphorus and vitamin A.

A “balanced ration” is a combination of feed ingredients furnishing the various nutrients in proportions, forms and amounts that will, without waste, properly nourish a given animal for a particular purpose for 24 hours. In formulating a horse ration, remember that the basic ingredients of the ration—normally a forage, such as hay and/or pasture, plus a grain mix—must provide the needed energy and, at the same time, part or all of the required protein, minerals and vitamins. Since energy and protein are required in greatest amounts, it is common practice to balance the ration with respect to these nutrients and then to provide the necessary mineral and vitamin supplementation.

Following are tables listing the approximate nutrient requirements for various classes of horses and the approximate composition of some commonly-used horse feeds. This information can be used in formulating rations adequate for the various classes of horses.

## To formulate a ration for your horse, you must:

1. Determine the class of your horse (see Table 1).
2. List the nutrient concentrations needed in the ration for your class of horse (see Table 1).
3. List the feeds which are available to you, or which you wish to use in the ration (see Table 2).
4. From the digestible energy composition of the forage to be used in the ration, decide the percentages of forage and grain mix to be used (see Table 3).
5. Calculate the amounts of nutrients which will be provided by the forage, and subtract these from the total requirements listed in step 2, above. The remaining nutrients must be provided by the grain mix.
6. Calculate the amounts of the concentrate feeds (grains, soybean meal, etc.) needed to provide the remaining nutrients in the following order: **A.** Digestible energy; **B.** Crude protein; **C.** Calcium; **D.** Phosphorus; and **E.** Vitamin A.

## Example Ration Calculation

**Type of horse:** Yearling

**Feeds available** (see Table 2):

Mixed timothy-clover hay  
Oats  
Corn  
Soybean meal  
Dicalcium phosphate  
Ground limestone

	%	DE mcal/ lb	CP %	Ca %	P %	Vit. A IU/lb
Total requirements	100	1.20	12.00	.50	.35	800
To be furnished by forage	.45	.41	4.28	.27	.08	675
To be furnished by grain mix	55	.79	7.72	.23	.27	125

Calculate the concentrations of nutrients which must be in the grain mix—55% of the ration (amount to be furnished by grain mix divided by .55).

**Concentrations needed in grain mix:**

DE = .79/.55 = 1.44 mc cal/lb  
 CP = 7.72/.55 = 14.04 %  
 Ca = .23/.55 = .42 %  
 P = .27/.55 = .49 %  
 Vit A = 125/.55 = 227 IU/lb

Next, calculate feeds needed to provide the DE required in grain mix (see step 6.A., on page 1):

DE required in the grain mix = 1.44 mc cal/lb. Since this is higher than the DE of oats, but lower than that of corn (see table 2), a mixture of these two grains can be used as follows:

Corn contains 1.55 mc cal/lb or DE  
 Oats contain 1.35 mc cal/lb or DE  
 Required in grain mix: 1.44 mc cal/lb

**Calculation:**

Let: X = corn and 1 - X = oats  
 Then: 1.55X + 1.35(1-X) = 1.44  
 1.55X + 1.35 - 1.35X = 1.44  
 .20X + 1.35 = 1.44  
 .20X = 1.44 - 1.35  
 .20X = .09  
 X = .09/.20  
 X = .45 or 45% corn required

**Thus:** 45% corn plus 55% oats contain 1.44 mc cal/lb DE. (NOTE: Since other ingredients having lower amounts of DE will also have to be added to supply needed protein and minerals, extra corn may be used at this point, suggest that 50% each of corn and oats be used.)

Calculate the amount of soybean meal needed to increase the corn-oats mix to the required level of CP (step 6. B., on page 1).

Soybean meal contains 45% CP  
 The 50% corn-50% oats mix contains 10.5% CP  
 Required in the grain mixture 14.04% CP

**Calculation:**

Let: X = soybean meal and 1 - X = corn-oats mix  
 Then: 45X + 10.5(1-X) = 14.04  
 45X + 10.5 - 10.5X = 14.04  
 34.5X + 10.5 = 14.04  
 34.5X = 14.04 - 10.5  
 34.5X = 3.54  
 X = 3.54/34.5  
 X = .1026 or 10.26% soybean meal required

**Table 1. Nutrient Concentrations Needed in Horse Feed Mixes (as Fed)**

Class of Horse	Digestible Energy mc cal/lb*	Crude Protein %	Calcium %	Phosphorus %	Vit. A activity IU/lb**
Maintenance (Mature)	.90	8.0	.27	.18	650
Gestation	1.00	10.0	.45	.30	1400
Lactation	1.20	12.5	.45	.30	1150
Creep Feed	1.40	16.0	.80	.55	800
Weanling	1.25	14.5	.60	.45	800
Yearling	1.20	12.0	.50	.35	800
Long Yearling	1.10	10.0	.40	.30	800
2 Yr. Old (Lt. Tng.)	1.20	9.0	.40	.30	800
Mature Horses:					
Light Work <sup>1</sup>	1.00	8.0	.27	.18	650
Moderate Work <sup>2</sup>	1.20	8.0	.27	.18	650
Intense Work <sup>3</sup>	1.25	8.0	.27	.18	650

<sup>1</sup>Ex.: Equitation, western pleasure, bridle path hack, etc.

<sup>2</sup>Ex.: Roping, cutting, barrel racing, jumping, etc.

<sup>3</sup>Ex.: Race training, polo, etc.

\*Megacalories per pound.

\*\*International Units per pound.

**Table 2. Approximate Composition of Some Common Horse Feeds**

Feed	Digestible Energy mc cal/lb*	Crude Protein %	Calcium %	Phosphorus %	Vit. A activity IU/lb**
<b>Forages:</b>					
Alfalfa	1.00	15.0	1.30	.22	3500
Clover	1.00	14.9	1.30	.20	3000
Timothy	.90	8.0	.36	.17	1000
Mixed Timothy-Clover	.92	9.5	.60	.18	1500
<b>Energy Feeds:</b>					
Oats	1.35	12.0	.06	.33	—
Corn	1.55	9.0	.04	.31	500
Barley	1.40	12.0	.04	.33	—
Sorghum grain (Milo)	1.40	9.0	.03	.30	—
Mixed Sweet Feed	1.35	13.0	.90	.75	500
<b>Protein Supplements:</b>					
Soybean Meal	1.50	45.0	.30	.63	—
Linseed Meal	1.30	38.0	.39	.82	—
Commercial Prot. Supp.	1.40	35.0	3.00	2.00	—
<b>Mineral Supplements:</b>					
Dicalcium Phosphate	—	—	23.7	18.8	—
Ground Limestone	—	—	36.1	—	—

**Table 3. Suggested % of Forage and Grain in Horse Feeds**

	When forage contains:			
	— 1.0 mc cal/lb. —		— 0.9 mc cal/lb. —	
	Forage	Grain	Forage	Grain
Maintenance	100	0	90	10
Gestation	75	25	65	35
Lactation	55	45	45	55
Creep Feed	0	100	0	100
Weanling	35	65	30	70
Yearling	55	45	45	55
Long Yearling	70	30	60	40
2 Yr. Old (Lt. Tng.)	70	30	60	40
Mature Horses:				
Light Work <sup>1</sup>	75	25	65	35
Moderate Work <sup>2</sup>	50	50	40	60
Intense Work <sup>3</sup>	35	65	30	70

<sup>1</sup>Ex.: Equitation, western pleasure, bridle path hack, etc.

<sup>2</sup>Ex.: Roping, cutting, barrel racing, jumping, etc.

<sup>3</sup>Ex.: Race training, polo, etc.

**Thus:** Adding 10.26% soybean meal to the corn-oats mix will increase the CP to 14.04% (NOTE: Suggest using 12.00% soybean to offset the diluting effect of the minerals which will be added to supply the needed calcium and phosphorus. Also, the added soybean meal should replace a like amount of oats to avoid diluting the DE content of the mix.)

At this point, the mixture will contain the following feeds:

Corn	50%
Oats	38%
Soybean meal	<u>12%</u>
Total	100%

The above mixture should now be checked for calcium content (step 6. C. on page 1).

#### Calculation of the calcium content of the mixture:

		Ca%
Corn	.50 X .04	= .02
Oats	.38 X .06	= .02
Soybean meal	.12 X .30	= <u>.04</u>
Total Ca content		.08

Calcium required in the grain mix = .42%  
 Supplied by the corn-oats-soybean meal = .08%  
 Deficiency (mineral to be added) = .34%

Calcium content of ground limestone = 36.1%

Then: .34/.361 = .94% ground limestone needed

**Thus:** For practical purposes, add 1.0% ground limestone (to replace a like amount of oats); and then check the phosphorus content of the mix (step 6. D., on page 1).

#### Calculation of the phosphorus content of the mixture:

		P%
Corn	.50 X .31	= .16
Oats	.37 X .33	= .12
Soybean meal	.12 X .63	= .08
Ground limestone	1.00 X none	—
Total P content		.36

Phosphorus required in the grain mix = .49%  
 Supplied by the above mixture = .36%  
 Deficiency (mineral to be added) = .13%

Phosphorus content of dicalcium phosphate = 18.8%

Then: .13/.188 = .69% dicalcium phosphate needed

**Thus:** For practical purposes, add 1.0% dicalcium phosphate (to replace a like amount of oats), and check the vitamin A content of the mix (step 6. E. on page 1).

#### Vitamin A calculation:

Vitamin A required in the grain mix = 227 IU/lb.  
 Corn contains 500 IU/lb

**Thus:** Corn supplies .50 X 500 = 250 IU and no more is needed.

**Also note:** .5% Trace mineralized salt (Table 4) should be included in the grain mix.

#### Final grain mix:

Feed	%	DE mcal	CP %	Ca %	P %	Vit A IU
Corn	50.0	.78	4.50	.02	.16	250
Oats	35.5	.48	4.26	.02	.12	—
Soybean meal	12.0	.18	5.40	.04	.08	—
Ground limestone	1.0			.36		
Dical. phosphate	1.0			.24	.19	
Trace min. salt	<u>.5</u>					
Totals	100.0	1.44	14.16	.68	.55	250

When the required amounts of nutrients have been met in the grain mix, check the adequacy of the total ration by combining the suggested percentages of forage and grain mix (see Table 3) to see if the requirements of the horse can be met.

#### Calculation for adequacy of total ration:

	%	DE mcal/lb	CP %	Ca %	P %	Vit A IU/lb
Mxd. hay	45	.41	4.28	.27	.08	675
Grain mix	<u>55</u>	<u>.79</u>	<u>7.79</u>	<u>.37</u>	<u>.30</u>	<u>138</u>
Totals	100	1.20	12.07	.64	.38	813
Requirements	100	1.20	12.00	.50	.35	800

All requirements for the yearling are met; the ration is adequate.

**Table 4. Trace Mineralized Salt**

Mineral	Trace mineral content	
	of TM Salt	Amount/lb of Grain Mix*
Iodine	0.007%	159.0 mcg
Iron	0.800%	18.0 mg
Copper	0.500%	11.4 mg
Zinc	1.000%	22.7 mg
Manganese	0.400%	9.1 mg
Selenium	0.002%	45.4 mcg

\*When added at 0.5% of grain mix.

**Table 5. Vitamin Premix for Horses**

Vitamin	Per lb. of premix	Amount per lb of feed — When premix added at: —	
		2 lb/ton	1 lb/ton
Vitamin A	1,000,000.0 IU	1,000.0 IU	500.0 IU
Vitamin D	100,000.0 IU	100.0 IU	50.0 IU
Vitamin E	10,000.0 IU	10.0 IU	5.0 IU
Thiamin	1.2 mg	1.2 mg	0.6 mg
Riboflavin	800.0 mg	0.8 mg	0.4 mg
Panthenic Acid	800.0 mg	0.8 mg	0.4 mg
Vitamin B12	5.0 mg	5.0 mcg	2.5 mcg

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