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Formulating rations with the Pearson square method

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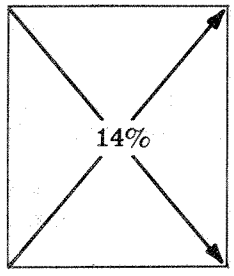
Quick Facts

The Pearson square ration formulation procedure is designed for simple rations.
In order for the square to work, one must follow specific directions for its use.
Nutrient contents of ingredients and nutrient requirements must be expressed on the same basis (i.e., dry-matter or "as-fed").

The Pearson square or box method of balancing rations is a simple procedure that has been used for many years. It is of greatest value when only two ingredients are to be mixed. In taking a close look at the square, one observes several numbers in and around the square. Probably one of the more important numbers is the number that appears in the middle of the square. This number represents the nutritional requirement of an animal for a specific nutrient. It may be crude protein or TDN, amino acids, minerals or vitamins.



Corn represents

$\frac{31.0}{35.0}$ x 100 of the ration or 88.57%

Soybean meal represents

$\frac{4.0}{35.0}$ x 100 of the ration or 11.43%

Check of the calculation:

88.57 lb corn at 10.0% CP = 8.86
11.43 lb SBM at 45.0% CP = 5.14
100.00 lb mixture contains 14.00 lb CP or 14%

In order to make the square work consistently there are a couple of very important considerations.

1. The value in the middle of the square must be intermediate between the two values that are used on the left side of the square. For example, the 14-percent crude-protein requirement has to be intermediate between the soybean meal that has 45-percent crude protein or the corn that has 10-percent crude protein. If we used barley that had 12-percent crude protein and corn that had 10-percent crude protein, the square calculation method would not work because the 14 percent is outside the range of the values on the left side of the square.

2. One also disregards any negative numbers that are generated on the right side of the square. You need only be concerned with the numerical differences between the nutrient requirement and the ingredient nutrient values.

3. Subtract the nutrient value from the nutritional requirement on the diagonal and arrive at a numerical value entitled parts. By summing those parts and dividing by the total, you can determine the percent of the ration that each ingredient should represent in order to provide a specific nutrient level. Always subtract on the diagonal within the square in order to determine parts. Always double check your calculations to make sure that you did not have a mathematical error. It also is very important to work on a uniform basis. I would recommend using a 100-percent dry-matter basis for nutrient composition of ingredients and requirements and then converting to an as-fed basis after the formulation is calculated.

Using More Than Two Ingredients

One also can mix more than two ingredients using the Pearson square. For example, prepare a 15-percent crude-protein mixture consisting of a supplement, 60-percent soybean meal (45-percent crude protein) and 40-percent meat and bone scrap (50-percent crude protein) and a grain mixture containing 65-percent corn (9-percent crude protein) and 35-percent oats (12-percent crude protein), the following steps would be taken.

Since only two components can be used in the Pearson square method, the ingredients are com-

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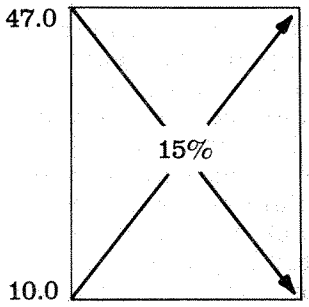
bined first as follows:

60% SBM x 45% crude protein = 27.0
40% Meat and bone scraps x 50% = 20.0
Protein in supplement mixture 47.0%

65% corn x 9.0% = 5.85
35% oats x 12.0% = 4.20
Protein in grain mix 10.05

Supplement mixture



Grain mixture

37.0

5 parts x 60% = 3.0 parts SBM
5 parts x 40% = 2.0 parts meat and bone scraps
32 parts x 65% = 20.8 parts corn
32 parts x 35% = 11.2 parts oats
37.0

$\frac{3.0}{37.0}$ = 8.11% SBM

$\frac{20.8}{37.0}$ 56.21% corn

$\frac{2.0}{37.0}$ 5.41% meat and bone scraps

$\frac{11.2}{37.0}$ = 30.27% oats

Check:
8.11 lb SBM at 45% CP = 3.65 lb
5.41 lb MBS at 50% CP = 2.70 lb
56.21 lb corn at 9% CP = 5.06 lb
30.27 lb oats at 12% CP = 3.64 lb
100.00 lb contains 15.05 lb or 15% CP

Expressing Feed Composition

The crude-protein value of a feed or the percentage of any other component (e.g., calcium or phosphorus) can be expressed several ways. The two most common methods of expression are on an as-fed basis or dry-matter basin. The following procedure can be used to calculate composition on a dry-matter basis.

Crude protein value on an as-fed basis divided by dry-matter content of the feed times 100 equals the crude-protein content on a dry-matter basis. If alfalfa hay was used as an example, the crude-protein value was determined to be 17 percent on an as-fed basis. On a dry-matter basis, the crude-protein value of the hay then would be calculated as follows:

17÷0.91 (moisture content of 9 percent) times 100 equals 18.7 percent crude protein.

To determine the total digestible nutrient (TDN) content of the above alfalfa on a dry-matter basis, the same procedure would be followed, 50 percent (TDN value on an as-fed basis) divided by 0.91 (dry-matter content of the feed) times 100 equals 54.9 percent TDN on a dry-matter basis.

Likewise, the crude-protein content or the TDN value also could be expressed on the basis of any given dry-matter level. For example, if one wanted to use a 90-percent dry-matter basis, one would use the following calculation. Given a TDN value of 76 percent and a dry-matter content of 86 percent (14 percent H^2O), what would be the TDN-value of this feed on a 90 percent dry-matter basis?

$\frac{76 \times .90}{.86}$ = 79.5% TDN on a 90% dry-matter basis

Ration Composition Calculations

If one knows the dry-matter composition of a specific ration and one wants to determine what that composition will be on an as-fed basis for mixing, then one would make the following calculations:

	Ration dry-matter composition	Ingredient % dry matter		Ration as-fed composition %
Corn silage	70	35	$\frac{70}{.35} = 200$ $\frac{200}{233} \times 100 =$	84.84
Alfalfa	30	90	$\frac{30}{.90} = \frac{33}{233}$ $\frac{33}{233} \times 100 =$	14.16

Conversely, if one knows the "as-fed" composition of the ration and the dry matter of each ingredient, then one can determine the ration dry-matter composition in the following manner:

	Ration as-fed composition	Ingredient % dry matter		Ration dry-matter composition
Corn silage	65	35	65 x .35 = 22.75	$\frac{22.75}{54.25} \times 100 =$ 41.94
Alfalfa	35	90	35 x .90 = $\frac{31.50}{54.25}$	$\frac{31.50}{54.25} \times 100 =$ 58.06