Navigating to a Balanced Ration

Part 2: Balancing for Protein

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In Navigating to a Balanced Ration Part 1: Balancing for Energy (Winter 2017), we explained, 1) why a balanced ration should be fed to sheep and goats, 2) the nutrient requirements for animals of differing weights and stages of production, and 3) the importance of and an example of a feed/forage analysis. We also provided an example of using the Pearson Square to balance for energy (TDN). At the end of the article, we pointed out that just balancing for energy is not enough. We must also balance for the second largest nutrient required -- crude protein.

Importance of Crude Protein

To complete a balanced ration, we must determine if our forage and concentrate mixture meets the animals' crude protein requirements. Failure to meet these requirements, particularly in the last third of gestation, can result in several severe problems. For example, when females are shorted on protein late in gestation, newborns may be born weak and unable to rise and nurse even after being cleaned by their mother. Mortality can be high even with producer intervention. Secondly, colostrum quality may also be compromised. Adequate protein in the mother's diet is essential for the production of the immunoglobulins put into the colostrum and passed to the newborn in the first 24 hours of life. When dietary protein is inadequate, immunoglobulin production will be decreased and the newborn may not receive adequate transfer of passive immunity to disease. The newborn is dependent on this passive transfer for disease protection during the first few weeks of life. When it fails, increased sickness and mortality rates can result. Even in the survivors, growth rate will be significantly decreased.

Review

Before we begin the process of balancing for protein, let's review the scenario from Part 1: Balancing for Energy. Our scenario was balancing a ration for a 66-lb replacement female that required the ration dry matter to be 15.8% crude protein and 65% TDN.

We also provided the crude protein of our hay based on a forage analysis:

The female was fed hay, as well as a purchased concentrate supplement that was **24% protein and 80% TDN** on a dry matter basis.

From the calculations in the Part 1, we learned the **hay/concentrate mixture for the 66-lb female needed to be 68% hay and 32% concentrate, on a dry matter basis,** to meet her energy needs.

Calculating Crude Protein

Now, we must determine the crude protein content of our mixture and compare this to the animal's needs.

Table 1: Nutrient Requirements for Small Ruminant Replacement Females, % of Ration Dry Matter					
Weight, lb	DMI, lb	CP %[a]	TDN %[a]	Calcium %[a]	Phosphorus %[a]
66	**2.6**	**15.8**	**65**	**.54**	**.23**
88	3.1	12.8	65	.42	.19
110	3.3	9	57	.33	.15
132	3.3	9	57	.3	.15
154	3.3	9	57	.3	.18

[a]Percent of ration dry matter.

Table 2: Example Forage Analysis, Percent		
	As Received Basis	Dry Matter Basis
Moisture	12.0	
Dry Matter	88.0	100
Crude Protein	12.5	**14.2**
RDP, % of CP		55
TDN	51	**58**
Calcium	.44	.50
Phosphorus	.26	.30

Step 1: Multiply the crude protein percentage of the hay (14.2% from hay analysis; Table 2) by the percent hay in the mixture (68%).

Hay 14.2% crude protein X 68% = 9.5% crude protein

Step 2: Multiply the crude protein from the concentrate (24% crude protein from concentrate) by the percent concentrate in the mixture (32%).

Concentrate 24% crude protein X 32% = 7.6% crude protein

Step 3: Add the two percentages to obtain the percent crude protein of the mixture.

Hay crude protein 9.5% + concentrate crude protein 7.6% = 17.1% crude protein

Our hay and concentrate/supplement mixture is 17.1 % crude protein. Comparing this with the animal's needs of 15.8% of ration dry matter (Table 2) means that we are meeting the crude protein needs and our ration is balanced. The only step left is to meet the vitamin and mineral requirements and this can be done by providing free choice access to a high quality commercial vitamin/mineral supplement.

Troubleshooting

In real life, the hays we feed may not be as high in crude protein content as the one in our example. When that is the case, what do we do?

Let us assume that our hay tested 10% crude protein on a dry matter basis. Now, we follow the same procedure as shown above.

Step 1: Multiply the crude protein percentage of the hay (10%) by the percent hay in the mixture (68%).

Hay 10% crude protein X 68% = 6.8% crude protein

Step 2: Multiply the crude protein from the concentrate (24% crude protein from concentrate) by the percent concentrate in the mixture (32%).

Concentrate 24% crude protein X 32% = 7.6% crude protein

Step 3: Add the two percentages to obtain the percent crude protein of the mixture.

Hay crude protein 6.8% + Concentrate crude protein 7.6% = 14.4% crude protein

Comparing the mixture value of 14.4% crude protein to the animal's need of 15.8% crude protein (Table 2) reveals a shortage of 1.4% dry matter crude protein. A protein supplement will be necessary.

Soybean meal would be the common protein supplement used as its crude protein value is 49.9%. Going back to the Part 1: Balancing for Energy, a second Pearson Square is needed to balance the hay/concentrate mixture with soybean meal to reach a 15.8% protein ration (Table 1).

Step 1: Place the protein values of the hay/concentrate mixture and soybean meal from the scenario above on the left diagonals of the square.

14.4
(Hay/Concentrate Mixture %)

49.9
(Soybean Meal %)

Step 2: Place the required protein value in the center of the square.

14.4
(Hay/Concentrate Mixture %)

15.8
(Required % crude protein)

49.9
(Soybean Meal %)

Step 3: Subtract across the diagonal, placing the differences on the right diagonals.

14.4 (Hay/Concentrate Mixture %) – 15.8 crude protein required= 1.4
49.9 (Soybean Meal %) - 15.8 crude protein required= 34.1

14.4 (Hay/Concentrate Mixture %) 34.1

15.8

49.9 (Soybean Meal %) 1.4

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Step 4: Add the values on the right diagonals and this is the total parts of the complete ration.

34.1 + 1.4= 35.5 total parts

14.4 (Hay/Concentrate Mixture %) — 34.1

15.8

49.9 (Soybean Meal %) — <u>1.4</u>

35.5 total parts

Step 5: Divide each number on the right diagonal by the total parts in the ration to determine the percentage of the mixture composed of the hay/concentrate mixture and the soybean meal.

34.1 ÷ 35.5 = 96%
1.4 ÷ 35.5 = 4%

14.4 (Hay/Concentrate Mixture %) — 34.1÷ 35.5 = 96%

15.8

49.9 (Soybean Meal %) — <u>1.4</u>÷ 35.5 = 4%

35.5 total parts

Now we know that soybean meal will be 4% of the final mixture and the hay/concentrate will be 96% of the final mixture.

Step 6: To determine what we will feed we must determine the pounds of dry matter that each feed ingredient contributes to the total. This is done by multiplying the pounds of daily dry matter consumed (Table 1) by the percentage each ingredient contributes to the total (calculated in Step 5). <u>Always calculate the protein supplement first.</u>

Daily dry matter 2.6 lb (Table 1) X 4% (Step 5)= .11 lb soybean meal dry matter

Step 7: Subtract the soybean meal protein supplement dry matter from the total consumed.

2.6 lb (total consumed) – .11 lb (Soybean meal dry matter) = 2.49 lb hay/concentrate mix

Step 8: Remember from the first Pearson Square that our hay concentrate mixture is 68% hay and 32% concentrate. Multiply the pounds of dry matter remaining **(Step 7)** by the percent hay and concentrate from the first Pearson Square (68% hay and 32% concentrate).

2.49 X 68% = 1.69 lb hay dry matter
2.49 X 32% = .80 lb concentrate dry matter

Step 9: Now, convert pounds of dry matter to an as fed basis so we will know how much of each ingredient to actually feed. We do this by dividing the pounds of ingredient dry matter (1.69 hay, 0.80 concentrate) by the percent dry matter of the ingredient. Hay is 88% dry matter. The concentrate mixture is assumed to be 90% dry matter and soybean meal is 89% dry matter.

Hay = 1.69 lb ÷ .88 (Table 2) = 1.92 lb
Concentrate = .80 lb ÷ .90 = .89 lb
Soybean meal = .11 lb ÷ .89 = .13 lb

Putting It All Together

In whole numbers, the producer would feed 2 lb of hay, .9 lb of the purchased concentrate and .15 lb of soybean meal to the 66 lb female daily to have a balanced ration.

Remember

Providing a balanced ration to our animals in any state of production will ensure that they do the best their genetics will allow. This will optimize production and minimize the cost.

Dr. John Johns, *received his Bachelors in Science form Western Kentucky University and earned his Masters Degree and Ph.D. from Michigan State University. Dr. Johns taught at the University of Kentucky as an Extension Professor from 1974 until his recent retirement. Upon retirement from the University of Kentucky, Dr. Johns has joined his expertise with the Burkmann nutrition family.*