# Exercise 6

**Ration Formulation II – Balance for Three or More Nutrients 15 Points**

This lab exercise progresses from balancing for two nutrients, as in Exercise 5, to balancing for three or more nutrients. This exercise will use swine and dairy examples as these rations are typically more complex and require formulation for multiple nutrients. Many swine producers, for example, purchase protein and major mineral ingredients in quantities large enough to make it economical for them to mix complete rations on the farm. Therefore it is important to be able to formulate rations that complement the grain ingredient(s) with protein and mineral ingredients in such a manner that nutrient requirements of the animal will be satisfied. In addition to previously acquired formulation skills, in this lab you will learn to: 1) rebalance for protein as the final step, and 2) balance rations with certain ingredients "fixed" at certain percentages of the diet.

An important difference between monogastric formulations and the beef and horse diets formulated in Exercise 6 is that the requirements are on an “air-dried” or 90% DM basis. This is because almost any feed that is fed to swine or poultry is “dry” or about 90% DM. Consequently, **you will use the ingredients in Table 3-2 to complete the swine ration formulations**. (Return to using Appendix Table 1 for the dairy formulation.)

Procedure: There are six steps to follow to formulate these rations.

Step 1: Look up the animal's requirements; write them all down

Step 2: Look up the composition of all the feedstuffs you will use in the complete ration and write them down at the top of your worksheet.

Step 3: Balance the ration for crude protein using your energy feed and the protein feed or supplement. Be sure to account for all fixed ingredients.

Step 4: Balance for phosphorus. This is done before balancing for calcium since all the supplemental phosphorus must come from one of the minerals that may also provide part of the calcium needs. \*Let X = amount of mineral supplement and subtract the X from the energy feed; use the amount of protein feed and fixed ingredients from Step 3.

Step 5: Balance for calcium (Let X = lb of mineral used to provide calcium). Use the amount of energy feed, protein feed, fixed ingredients and phosphorus mineral from Step 4. Subtract X from the energy feed.

Step 6: Rebalance for crude protein with adjustment in fixed ingredients to account for phosphorus and calcium minerals used.

## Example

Formulate a diet which contains 14% CP, .50% Ca and .40% P. Use corn, soybean meal (dehulled, solvent extd), dicalcium phosphate (dical) and limestone. The ration must contain the following: 5% dehydrated alfalfa (17% CP), .5% salt, .1% trace mineral premix and 1.0% vitamin-antibiotic premix.

## Step 1: Requirements

CP Ca P Requirement 14% .50% .40%

## Step 2: Ingredient nutrient composition

|  |  |  |  |
| --- | --- | --- | --- |
|  | CP | Ca | P |
| Corn | 10.4 | .05 | .31 |
| SBM, dehulled | 54.8 | .29 | .71 |
| Dical |  | 22.35 | 18.99 |
| L.S. |  | 37.22 | .22 |
| Dehy Alfalfa, mn 17% CP | 17.9 | 1.51 | .25 |
| Salt |  |  |  |
| TM |  |  |  |
| Vit \_ AB |  |  |  |

**Step 3: Balance for crude protein**

Fixed ingredients = Dehy (5) + Salt (.5) + TM (.1) + Vit- AB (1.0) = 6.6 Nonfixed ingredients = 100 - 6.6 = 93.4

x = SBM (93.4 - x) = Corn

14 = (93.4 - x) .104 + (x) .548+ (5) .179

14 = 9.7136 - .104 x + .548 x + .895

3.3914 = .444 x

x = 7.64 = SBM

Corn = 93.4 – 7.64 = 85.76

## Step 4: Balance for P

x = Dical (85.76 - x) = Corn

.40 = (85.76 - x) .0031 + 7.64 (.0071) + 5 (.0025) + x (.1899)

.40 = .266 - .0031 x + .054 + .0125+ .1899 x

.0675 = .1868 x

x = .36 = Dical Corn = 85.76 - .36 = 85.4

## Step 5: Balance for Ca

x = LS (85.4 - x) = Corn

.50 = (85.4 - x) .0005 + 7.64 (.0029) + 5 (.0151) + .36 (.2235) + x (.3722)

.50 = .043 - .0005 x + .022 + .076 + .08 + .3722 x

.279 = .3717 x

x = .75 = LS Corn = 85.4 - .75 = 84.65

## Step 6: Rebalance for CP

Fixed ingredients = 5 + .5 + .1 + 1.0 + .36 + .75 = 7.71

Nonfixed ingredients = 100 - 7.71 = 92.29 x = SBM (92.29 - x) = Corn

14 = (92.29 - x) .104 + x (.548) + 5 (.179)

14 = 9.6 - .104 x + .548 x + .895

3.505 = .444 x

x = 7.89 = SBM Corn = (92.29 – 7.89) = 84.4

## Final Ration

Ration %

Corn 84.40

SBM 7.89

Dehy 5.00

Dical .36

LS .75

Salt .5

TM .1

Vit. AB 1.0 Total = 100

Problem I

Formulate a complete ration for 140 lb growing-finishing pigs (requirement from **7-2a and 7-2e**). To balance for requirements, use corn grain #268, soybean meal (dehulled, solvent extracted #488), dicalcium phosphate (phosphate dibasic P210 #12) and ground limestone P210 #30. The complete ration must contain: 15% barley grain #54, 0.5% salt, 0.1% trace mineral premix, and 1.0% vitamin premix. ***Note: Look up the nutrient concentrations of the ingredients in Table 3-2 …do not use the values used in the example exercise!***

Problem II

Balance a ration for 125 lb growing-finishing pigs. Nutrient requirements: 14% CP, 0.52% Ca, and 0.45% P. Allow 0.5% of the ration for trace minerals and 1% for vitamin-antibiotic premix. The ration must contain 4% corn distillers grains (with solubles, dehydrated #246). To balance for requirements, use a 50:50 mixture of corn grain #268 and wheat grain #548, soybean meal (dehulled, solvent extracted #488), dicalcium phosphate (phosphate dibasic P210 #12), and ground limestone (P210 #30) to balance for requirements (***Tables 3-2).***

Problem III.

Now change from swine to a lactating dairy cow formulation. This will differ in that you will have to return to first formulating for energy – the sequence of nutrients to formulate will be energy, CP and P. Do not worry about rebalancing for Ca and CP when you are done. Also, return to obtaining nutrient composition of the feeds from **(Appendix 2, P621)**

Formulate a ration for 1320 lb dairy cow giving 90 lbs of 3.5% fat milk. The cow has a DMI of 50 lb/day. First use **Table 9-5** to compute the cow’s daily requirements for NEl, CP, and P; then determine the concentration requirement of each based on the DMI. You are to fix corn silage at 12%. Other ingredients to formulate include corn grain, alfalfa hay– mid bloom , soybean meal, and dicalcium phosphate (phosphate dibasic P210 #12) Finally, show your final ration DM basis(%).