Ration Balancing and Feed Analysis

IF YOU HAVE a pet at home, you probably just scoop out a cup or two of food and follow the basic directions on the bag. Your pet may get too fat or too thin if you are feeding too much or too little. Most likely though, your pet is in quite good shape. That is because the feed company has created a balanced ration and completed a feed analysis so that your pet will be fed properly. This is an important step when feeding all animals. In this E-unit, we will explore the steps in ration balancing and feed analysis.

Objectives:

1. Identify the steps in balancing a ration.
2. Explain the importance of feed analysis.

Key Terms:

ash	dry matter	nitrogen-free extract
crude fiber	feed analysis	ration
crude protein	feeding standards	
diet	feedstuffs	

Balancing a Ration

Every animal is fed a ration throughout its lifetime. A **ration** is the total amount of feed an animal consumes in a 24-hour period. It should be designed to meet the nutritional needs of a specific animal at its current age and within its particular environment. Needs of animals change throughout their lives, are affected by the animals' environment, and can even vary among similar animals. A ration determines the diet of an animal. A **diet** is the types and

amounts of feed an animal receives within its ration. A diet may be composed of one or more roughages, concentrates, fats, supplements, and other additives. To balance a ration for an animal, four basic steps should be followed.

IDENTIFY NUTRITIONAL NEEDS

Step 1 is to identify the nutritional needs of the animal. These needs are affected by the animal's age, size, environment, and function. For example, a large mature dog pulling a sled in a cold environment has higher nutritional requirements than a small poodle living in a comfortably warm house. The dog pulling the sled needs food to create energy and warmth, while the couch-potato poodle simply needs to meet maintenance requirements. The nutrient need requirements of animals in their particular situations are called **feeding standards**. These standards are only estimates and may need to be adjusted for unique situations. One animal might need only the average feeding standard to produce enough milk for her offspring; another might need 10 to 15 percent more.

IDENTIFY AVAILABLE FEEDSTUFFS

Step 2 is to identify available feedstuffs to create a ration. **Feedstuffs** are the ingredients used in creating a ration for animals. Feedstuffs include corn, soybean meal, alfalfa hay, oats, sorghum, porcine meal, and many others. Selecting feedstuffs for rations is not based solely on picking them from a chart but also on evaluating the nutrient content and availability of the items.

Nutrient Content

The nutrient content of feedstuffs can be determined by consulting a current feed composition table. Such a table will give the estimated values of the key nutrient requirements in a diet. The values may change slightly because of the varieties of different grains and the growing season in which they were raised. For exact nutrient values, a feed analysis should be performed. Feed analysis will be discussed later in this E-unit.

Availability

Availability is a common issue when balancing a ration. Typically, only feedstuffs that are available in a certain area are used to develop a ration. Transporting a feedstuff over a long distance is not financially feasible if another ingredient that serves the same purpose is readily available within the area.

TABLE 1. Examples of Nutrient Content of Selected Feedstuffs

Feed	Dry Matter	Crude Protein	Fat	Ash	NFE*	TDN**	DE***
	%	%	%	%	%	%	*(Mcal/kg)*
Roughages							
Alfalfa hay (mid-bloom, sun-cured)	91	17.1	3.3	7.8	37.4	52	2.46
Bermudagrass (fresh)	29	4.2	0.6	3.3	13.0	17	0.77
Clover (fresh ladino)	18	4.4	0.9	1.9	8.1	13	0.60
Millet (foxtail, fresh)	29	2.8	0.9	2.5	13.4	18	0.77
Sorghum fodder (with heads, sun-cured)	90	6.2	2.0	8.9	47.4	51	2.24
Wheat straw	90	3.2	1.8	6.9	40.4	40	1.90
Concentrates							
Barley grain (all analyses)	88	11.7	1.7	2.4	67.7	75	3.42
Corn (#2 grain)	87	8.9	4.0	1.2	71.3	80	3.47
Cotton seed meal (solvent)	93	41.2	4.7	6.1	28.9	70	3.27
Oats (grain, all analyses)	89	11.9	4.7	3.1	58.9	69	3.00
Soybean meal (solvent)	89	44.4	1.5	6.4	30.6	76	1.45
Other							
Molasses (black strap)	74	4.3	0.2	9.8	59.7	60	2.68

*NFE = nitrogen-free extract.

**TDN = total digestible nutrients (based on ruminant digestion).

***DE = digestible energy.

Source: Information in this table adapted from feed composition tables in M. E. Ensminger and R. C. Perry. *Beef Cattle Science,* 7th ed. Danville, IL: Interstate Publishers, Inc., 1997. (Available from Pearson Prentice Hall.)

CALCULATE THE AMOUNT OF EACH FEEDSTUFF

Step 3 is to calculate the amount of each feedstuff to be used in the ration. This can be done using a sophisticated computer program or using basic math. A computer program allows for the use of multiple ingredients listed in an availability bank. The computer selects the most cost-effective products. The computer program may use all the ingredients in the bank or may use only two or three feedstuffs. With basic math, only preselected ingredients are used to calculate the amount of each product to be included in the ration.

COMPARE THE DEVELOPED RATION WITH THE ESTIMATED NUTRIENT NEEDS

Step 4 is the last and most important step in the process. It will determine how well the animal will do on its provided ration. The step is to compare the developed ration with the estimated nutrient needs of the animal. This is where a check is done to be sure all needs, includ-

ing vitamins and minerals, are being properly met for the animal. If something is deficient in the diet, either a supplement will need to be added or the diet will need to be recalculated using other available feedstuffs.

Feed Analysis

Feed analysis is the process of determining the exact nutrient content of a particular feedstuff or a complete ration. This is done through chemistry and advanced testing within a laboratory. The information is used to make sure that the feedstuff or ration is meeting an animal's nutrient requirements. A ration must not only be palatable and readily available but also suitable for an animal's needs. Feed analysis may eliminate the need for expensive supplements or determine that a small amount of a concentrate should be added to a ration.

AREAS EVALUATED

Seven areas are evaluated in a feed analysis. They are dry matter, crude protein, fat, ash, crude fiber, nitrogen-free extract, and minerals. A basic feed analysis can be viewed by reading the tag of any commercially available ration. All nutrient requirements must be met or exceeded for a ration to be properly balanced.

Dry Matter

Dry matter is the amount of an ingredient within a ration once all the water is removed from the product. It provides a more accurate measurement in which all the weight of the water is subtracted from the ingredient to determine its mass or quantity.

Crude Protein

Crude protein is the nitrogen content of feed multiplied by the constant calculator 6.25. Some diets, such as growing rations, contain high levels of protein, while others, such as maintenance rations, contain lower levels of protein. Crude protein is typically reported as a percentage.

Fat

Fat content is determined in a feed analysis through a chemical process. An ether extract is performed to cause the fat to dissolve. The weight of the remaining products is subtracted from the beginning weight to determine fat content. The amount is also typically reported as a percentage.

Ash

Ash is the remaining product once all flammable material is burnt away at 1112°F (600°C). It has no nutrient value and is calculated only to determine the amount of filler, or unusable material, within a ration.

Crude Fiber

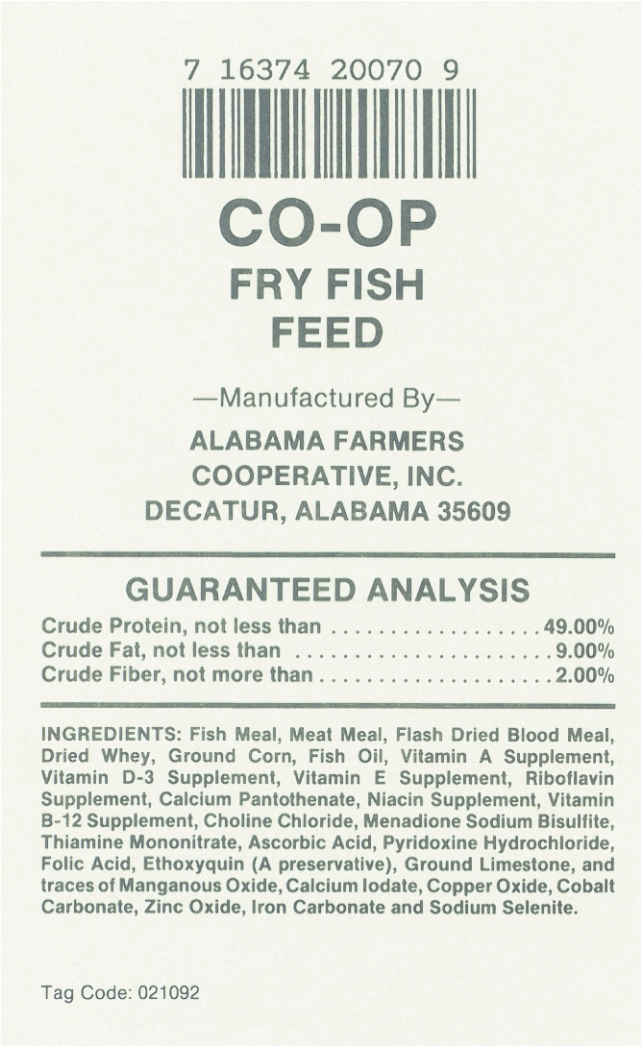
The feed sample is boiled first in an acid and then in an alkali. The residue is weighed and then ashed. The difference between the initial weight of the residue and the weight of the ash is **crude fiber**. It is typically reported as a percentage.

Nitrogen-Free Extract

Nitrogen-free extract, or NFE, is the percentage of material that remains after subtracting the percentage of water, crude protein, fat, ash, and crude fiber from the constant number 100. This basically identifies what is left in a ration after all the preceding components have been calculated.

Minerals

Minerals are reported last on a feed analysis. They are important in meeting an animal's nutritional needs. A ration can contain many different minerals.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CO-OP
FRY FISH
FEED

—Manufactured By—
ALABAMA FARMERS
COOPERATIVE, INC.
DECATUR, ALABAMA 35609

GUARANTEED ANALYSIS
Crude Protein, not less than 49.00%
Crude Fat, not less than 9.00%
Crude Fiber, not more than 2.00%

INGREDIENTS: Fish Meal, Meat Meal, Flash Dried Blood Meal, Dried Whey, Ground Corn, Fish Oil, Vitamin A Supplement, Vitamin D-3 Supplement, Vitamin E Supplement, Riboflavin Supplement, Calcium Pantothenate, Niacin Supplement, Vitamin B-12 Supplement, Choline Chloride, Menadione Sodium Bisulfite, Thiamine Mononitrate, Ascorbic Acid, Pyridoxine Hydrochloride, Folic Acid, Ethoxyquin (A preservative), Ground Limestone, and traces of Manganous Oxide, Calcium Iodate, Copper Oxide, Cobalt Carbonate, Zinc Oxide, Iron Carbonate and Sodium Selenite.

Tag Code: 021092

FIGURE 1. Example of a feed analysis for a commercially available ration.

Summary:

A ration is the total amount of feed an animal consumes in a 24-hour period. It should be designed to meet the nutritional needs of a specific animal at its current age and within its particular environment. Needs of animals change throughout their lives, are affected by the animals' environment, and can even vary among similar animals. A ration determines the diet of an animal. To find the exact content of a ration, a feed analysis should be performed. This reveals the amount of dry matter, crude protein, fat, ash, crude fiber, nitrogen-free extract, and minerals in the ration. It can be used to determine whether the ration meets an animal's needs.

Checking Your Knowledge:

1. What are feeding standards?
2. List the four steps in balancing a ration.
3. Selecting feedstuffs for rations is based on what two factors?
4. List the seven areas evaluated in a feed analysis.
5. How is the fat content calculated in a feed analysis?

Expanding Your Knowledge:

Set up an interview with a nutritional consultant from a local feed company. Take your copy of this E-unit with you to discuss the key points in ration balancing and feed analysis. Talk to the professional about selecting ingredients or feedstuffs for developing a ration in your area. Have the consultant help you identify readily available feedstuffs. Ask to see feed analysis tags from various products within the company. This expert will expand your knowledge and maybe even match a product to an animal you are feeding. From the information you gather, prepare a short presentation to your teacher and classmates.

Web Links:

Proper Rabbit Maintenance Diet
http://www.bio.miami.edu/hare/diet.html

Holmes Laboratory
http://www.holmeslab.com/

Feed Composition for Cattle and Sheep
http://www.ext.colostate.edu/PUBS/livestk/01615.html