

Unit C: Meeting Nutritional Needs of Animals

Lesson 3: Meeting Energy and Protein Requirements

Student Learning Objectives:

Instruction in this lesson should result in students achieving the following objectives:

1. Identify the energy requirements of cattle.
2. Identify the protein requirements of cattle.

Recommended Teaching Time: 1 hour

Recommended Resources: The following resources may be useful in teaching this lesson:

Naseri, Alimuddin. *Animal Nutrition Training Manual*. www.atnesa.org/docs/Alimuddin-Naseri-Animal-Nutrition-Manual.pdf

List of Equipment, Tools, Supplies, and Facilities:

- Writing surface
- PowerPoint Projector
- PowerPoint Slides
- Transparency Masters

Terms: The following terms are presented in this lesson (shown in bold italics and on PowerPoint Slides 2):

- Carbohydrates
- Crude fiber
- Feed units milk production
- Lipid
- Nitrogen-free extract
- Non-protein nitrogen

Interest Approach:

Begin a discussion with the class about energy needs. How do they feel when they are low in energy? What do you do to remedy this feeling? Guide them to answering by eating something. What types of food help? Guide them to answering something high in sugar or starch. Transition into the first objective by asking the students what they think we could feed cattle that would help to boost the cattle's energy level.

SUMMARY OF CONTENT AND TEACHING STRATEGIES

Objective 1: Identify the energy requirements for cattle.

Anticipated Problem: What are the energy requirements for cattle?

(PowerPoint Slide 3)

- I. Energy contents of a feedstuff can be divided into two groups.
 - A. Carbohydrates—**Carbohydrates** are sugars and starches derived from cereals, tubers, roots, and other substances such as cellulose and lignin from plant cell walls, vessels, and woody tissues.
 1. Energy from carbohydrates provides the requirement for maintenance and production.
 2. If there is a surplus of energy, it is stored as body fat.

(PowerPoint Slide 4)

3. Carbohydrates are composed on crude fiber and nitrogen-free extract.
 - a. Crude fiber—**Crude fiber (CF)** is difficult to digest but very important for the functioning rumen and production of milk. Feed should contain high amounts of crude fiber.
 - b. Nitrogen-free extract—**Nitrogen-free extract (NFE)** consists of sugars, starches, and sugar-like substances. These are much easier to digest than CF.

(PowerPoint Slide 5)

- B. Lipids (fats) or Ether Extract (EE)—**Lipids** also provide energy, as much as 2.25 times more than from carbohydrates.
 1. Fat soluble vitamins A, D, E, and K are found in the lipid portion. Because of these vitamins, feed must have some fat. However, if excess exists, feed intake will be decreased and the rumen function will be disturbed.
 2. Roughages are known to have low fat content. Those feedstuffs derived from oilseeds (soy, cotton) are more desirable.

(PowerPoint Slide 6)

- C. Energy requirements for dairy production are expressed in **Feed Units Milk production (FUM)**. The FUM of a feedstuff is a figure which indicates how much kg barley equals the amount of net energy for milk production in 1 kg of feedstuff. As a rough rule, a 600 kg cow producing 15 liters per day requires for maintenance 5013 FUM and 460 FUM for producing 1 kg milk. For each 50 kg weight plus or minus 600 kg a correction has to be made: for FUM +/- 300 / 50 kg weight.

(PowerPoint Slide 7)

1. For calculating the requirements for FUM, use the following equation:
$$FUM = (\text{maintenance} + \text{milk production}) = (5013 + 440 M + 0.7293 M^2)$$
2. For practical use, we can approach the FUM calculation by the next equation $FUM = 5000 + 460 M$

(PowerPoint Slide 8)

3. In the equations above M is the milk production in kg per day expressed in kg Full Cream Milk (FCM). FCM milk has a fat content of 4% per kg.
4. To calculate the FCM amount for milk with a deviation in fat content, use the following equation:
$$\text{FCM 4\% fat} = (0.4 + 0.15F) * m$$

F = Fat content %
m = real milk production

Use TM: 3-1 and TM: 3-2 to aid in the discussion of energy requirements for cattle. Be sure to place special emphasis on the different types of feedstuffs available in Afghanistan and used to feed cattle for optimal production of milk and meat.

Objective 2: Identify the protein requirements for cattle.

Anticipated Problem: What are the protein requirements for cattle?

(PowerPoint Slide 9)

- II. Proteins are the building blocks in an animal. It is required for growth, maintenance, reproduction, and lactation.
 - A. Every animal must have a constant supply of protein to maintain good health. If this requirement is not met, calves will be smaller at birth and slower growing. Other negative effects from protein deficiency include:

(PowerPoint Slide 10)

1. Low milk production
2. Less protein in the milk
3. Loss of body weight in early lactation
4. Increased risk of infections and metabolic diseases
5. Low fertility

(PowerPoint Slide 11)

- B. Crude protein is comprised of true protein and inorganic nitrogen salts, and other substances.
- C. Nitrogen in a feed that does not come from protein is considered ***non-protein nitrogen (NPN)***. This nitrogen is degradable.

(PowerPoint Slide 12)

1. Ruminants can utilize NPN efficiently. This allows producers to use less expensive forms of nitrogen. One such feedstuff is urea. There are precautions, however, when using non-protein nitrogen. NPN can only be used in low level production systems with high amounts of poor quality roughage. If NPN is used in a high level production system, the animal will steal protein as an energy source, resulting in a protein deficiency.

(PowerPoint Slide 13)

- D. Crude Digestible Protein (DCP) requirements are expressed in grams. As a very rough rule, a 600 kg cow requires for maintenance 390 grams protein and 63 grams protein for producing 1 kg milk.
 - 1. For each 50 kg live weight plus or minus 600 kg a correction has to be made: for DCP +/- 25 / 50 kg weight.

(PowerPoint Slide 14)

- 2. For calculating the requirements for DCP we can use the following equation:
$$DCP = (\text{maintenance} + \text{milk production}) = [(3.33 G + 1000) * 0.13] + 63 M$$
$$G = \text{live weight}$$
$$M = \text{kg FCM}$$
- 3. For practical use we can approach the DCP calculation by the next equation
$$DCP = 390 + 63 M$$

Use TM: 3-3 and TM: 3-4 to review the discussion on protein requirements for cattle. Be sure to discuss the specific feedstuffs used in Afghanistan that are high in protein and fed to cattle for their optimal performance.

Review/Summary: Focus the review and summary of the lesson around the student learning objectives (**PowerPoint Slide 15**). Call on students to explain the content associated with the objectives.

Application: Application can involve the securing of specific types of feedstuffs used in feeding cattle. If students are not able to visit a local cattle producer to see the different types of feed fed to cattle then samples of the different feed could be brought to class so the students can take note of their special characteristics.

Evaluation: Evaluation should focus on student achievement of the objectives for the lesson. Various techniques can be used, such as student performance on the application activity. A sample written test is included.

Answers to Sample Test:

Matching

1. F
2. D
3. B
4. A
5. C
6. E

Fill-in-the-blank

1. Protein
2. Non-protein nitrogen
3. Crude protein
4. Body fat
5. A, D, E, and K

Short Answer

Any three of the following:

- Small birth weight
- Slow growth
- Low milk production
- Less protein in the milk
- Loss of body weight in early lactation
- Increased risk of infections and metabolic diseases
- Low fertility

Meeting Energy and Protein Requirements

Name: _____

Matching: Match each word with the correct definition.

- | | |
|-------------------------------|--------------------------|
| a. Carbohydrates | d. Lipid |
| b. Crude fiber | e. Nitrogen-free extract |
| c. Feed units milk production | f. Non-protein nitrogen |

- _____ 1. Nitrogen in a feed that does not come from protein.
- _____ 2. Provide energy, as much as 2.25 that from carbohydrates.
- _____ 3. Difficult to digest but very important for the functioning rumen and production of milk.
- _____ 4. Sugars and starches derived from cereals, tubers, roots, and other substances such as cellulose and lignin from plant cell walls, vessels, and woody tissues.
- _____ 5. Energy requirements for dairy production.
- _____ 6. Consists of sugars, starches, and sugar-like substances.

Fill-in-the-blank: Complete the following statements.

1. _____ are the building blocks in an animal.
2. Ruminants can utilize _____ efficiently.
3. _____ is comprised of true protein and inorganic nitrogen salts, and other substances.
4. If there is a surplus of energy, it is stored as _____.
5. Fat soluble vitamins _____ are found in the lipid portion.

Short Answer: Answer the following question.

List 3 negative effects from protein deficiency.

ENERGY REQUIREMENTS

- Energy
 - Carbohydrates
 - Crude fiber
 - Nitrogen-free extract
 - Lipids

ENERGY REQUIREMENTS

➤ Feed Units Milk production (FUM)

- How much kg barley equals the amount of net energy for milk production in 1 kg of feedstuff
- 600 kg cow producing 15 liters per day requires for maintenance 5013 FUM and 460 FUM for producing 1 kg milk
- For each 50 kg weight plus or minus 600 kg, a correction must be made.
- $FUM \pm 300 / 50 \text{ kg weight}$.
- $FUM = (\text{maintenance} + \text{milk production}) = (5013 + 440 M + 0.7293 M^2)$
- For practical use, we can approach the FUM calculation by the next equation $FUM = 5000 + 460 M$
- In the equations above M is the milk production in kg per day expressed in kg Full Cream Milk (FCM). FCM milk has a fat content of 4% per kg.
- To calculate the FCM amount for milk with a deviation in fat content, use the following equation.
- $FCM\ 4\% \text{ fat} = (0.4 + 0.15F) * m$
- F = Fat content %
- m = real milk production

PROTEIN REQUIREMENTS

- Proteins are building blocks
- Deficiencies
 - Low milk production
 - Less protein in the milk
 - Loss of body weight in early lactation
 - Increased risk of infections and metabolic diseases
 - Low fertility
- Crude protein
 - True protein
 - Inorganic nitrogen salts
- Non-protein nitrogen

PROTEIN REQUIREMENTS

- Crude Digestible Protein (DCP)
- 600 kg cow requires for maintenance 390 grams protein and 63 grams protein for producing 1 kg milk.
 - For each 50 kg live weight plus or minus 600 kg a correction has to be made: for DCP +/- 25 / 50 kg weight.
 - For calculating the requirements for DCP we can use the following equation:
 - $DCP = (\text{maintenance} + \text{milk production}) = [(3.33 G + 1000) * 0.13] + 63 M$
 - G = live weight
 - M = kg FCM
 - For practical use we can approach the DCP calculation by the next equation
 $DCP = 390 + 63 M$