
# Department of ANIMAL RESOURCES

# College of AGRICULTURAL ENGINEERING SCIENCES

# University of SALAHADDIN-ERBIL

# Subject: RUMINANT NUTRITION

# Course Book – *YEAR 3*

**Lecturer's name Dr. Suzan Muhamad Nur(Asst. Prof.)**

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**BSc, MSc, PhD**

**Practical by: Dr. kanyaw Ismail Mahmud & Mrs.Mhabat Ibrahim**

**Academic Year: 2023-2024**

# Course Book

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| **1. Course name** | **RUMINANT NUTRITION** |
| **2. Lecturer in charge** | **Dr. Suzan Muhamad Nur Muhamad BSc, MSc, PhD**<br>**Dr. Nawzad Muhammad Aziz BSc, MSc, PhD** |
| **3. Department/ College** | **Animal Resources/ Agricultural Engineering Sciences** |
| **4. Contact** | **Mail:**<br>**Tel.** |
| **5. Time (in hours) per week** | **Theory: 2**<br>**Practical: 3** |
| **6. Office hours** | **Sunday, Tuesday and Wednesday ( 8.5 to 12 AM.)** |
| **7. Course code** | |
| **8. Teacher's academic profile** | **Dr. Suzan Muhamad Nur BSc, MSc, PhD**<br>**Dr. Nawzad Muhammad Aziz BSc, MSc, PhD**<br>**(Practical): Dr. kanyaw Ismail Mahmud (BSc, MSc, PhD )& Mrs. Mhabad Ibrahim (BSc, MSc)** |
| **9. Keywords** | |

**10. Course overview:**

Proper nutrition is essential for the health & productivity of all animals and is the basis of successful production systems.

Nutrition is the science of providing nutrients to animals in adequate amounts and in forms that the animals will consume.

Nutrition is the study of how the body uses the nutrients in feed to sustain life and for productive purposes. Nutrition is a very complicated science. We must study the nutrients themselves and also look at how animals consume, digest, absorb, transport, metabolize, and excrete them.

Feeds and feedstuffs are chemically complex mixtures of substances that contain the nutrients an animal needs. The digestive tract breaks down those complex materials to their constituent parts so the nutrients can be absorbed and metabolized by the body.

Breakdown of food by the digestive system in preparation for absorption is called digestion (The physical, chemical, and enzymatic means the body uses to render a feedstuff ready for absorption) and is accomplished in three ways:

1- The physical or mechanical actions of chewing (mastication) and muscular action of the digestive tract (peristalsis).

2- The chemical action of hydrochloric acid(HCL), which is used by the stomach to denature proteins and bile that is used in the small intestine to help digest fats.

3- The action of enzymes, which increase the speed of the breakdown of the chemical bonds in foods by the addition of a water molecule (hydrolytic enzyme). Enzyme

(proteins capable of catalyzing reactions associated with a specific substrate)

Enzymes can be produced by the digestive tract and accessory organs (liver, pancreas), or by microorganisms living in symbiosis with the animal. Enzymes are biological catalysts that speed the rate at which a particular reaction reaches equilibrium. Many enzymes are found in the system and are needed for faster and more efficient digestion.

The type of digestive system an animal has dictates what the animal can successfully use as feed. The more complicated the feed (like forage), the more complicated the digestive tract. Thus, the ruminant system is designed to retain feed for several days, which is a long time compared to the few hours that a feed is held in a carnivore's simple tract.

General concept of how to use the correct chemical analysis and benefit from Proximate Analysis of feedstuff - general guidance on how to use nutrition lab., repetition in chemical analysis, Sampling of feedstuffs for analysis and how to save samples before analysis, Determination of Moisture , Ash, Silica, Crude fat, Crude fiber, Crude Protein, and calculating the proportion of soluble carbohydrates in food samples and making rations for farm animals.

**11. Course objective (Theory):**

1- Define nutrition and understand the reasons for studying nutrition.

2- Describe the general uses of nutrients in the body.

3- Describe the methods of the breakdown of food.

4- Classify digestive systems according to stomach type of diet consumed.

5- Describe the steps of digestion.

6- Explain the importance of the complex stomach of the ruminant and its `benefits to the animal.

7- Feeding Standards for maintenance, growth, reproduction and lactation

**12. Student's obligation**

Students should attend the lectures (theory and practical) and participate in all quizzes during the course, also monthly examination and home work with reports required.

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## 13. Forms of teaching

The forms of teaching include data show, power point also white board for explaining the subjects which needs more explanation and mathematical solutions.

## 14. Assessment scheme

Theoretical (65%) + Practical (35%)

Theoretical (65%)

15% (Monthly Examination)

50% (Final Examination)

**15. Student learning outcome:**

During this semester the student should learn the reasons for studding ruminant nutrition, and how nutrients are used in the animal body, methods of breakdown of feeds in the animal digestive system.

Also learn how digestive systems are classified according to stomach type of diet consumed, steps of digestion.

In addition, the importance of complex stomach of the ruminant and its benefits to the animal.

Finally, the student will learn feeding standards for maintenance, growth, reproduction, lactation and ration formulation.

**16. Course Reading List and References:**

1- Animal Nutrition (2011). Mc Donald, P.; R. A. Edwards; J. F. D. Greenhalgh; C. A. Morgan; L. A. Sinclair, and R.G. Wilkinson. 7th ed. Prentice Hall.

2- Feeds and Feeding (2004). Perry, T. W.; A. E. Cullison and R. S. Lowery. 6th ed. Prentice-Hall, New Jersey.

3- Feeds & Nutrition Digest (1990). Ensminger, M. E.; J. E. Oldfield, and W. W. Heinemann. 2nd ed. Ensminger Publ. Co.

4- Introduction to Animal Science (2006). Damron, W. S., 3rd ed. Pearson, Prentice Hall.

5- - Chemical composition and nutritional value of feed materials in Iraq (1978). Kazim Ali Khawaja, ElhamAbdullah al-Bayati, Samir Abdul Ahad Mate.

| **17. The Topics:** | **Lecturer's name** |
|---|---|
| Nutrition definitions and terms<br>Chemical composition of plants and animals: | Dr .Suzan Muhamad Nur Muhamad<br>&<br>Dr. Nawzad Muhammad Aziz |
| Composition of Plant and Animal, Water, Dry matter and its composition | |
| Carbohydrates<br>Classification of carbohydrates, Monosaccharide's, Disaccharides, Polysaccharides & Lignin | |
| Digestion and Metabolism of Carbohydrates | |
| Proteins, nucleic acids and other nitrogenous compounds. Digestion and Metabolism of Proteins | |

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| Lipids<br>Classification of Lipids, Fats, glycolipids, Phospholipids, Waxes & Steroids Digestion and Metabolism of Lipids | |
| Energy metabolism | |
| Vitamins, Minerals<br>Fat and water-soluble vitamins<br>Function of minerals, Trace and Major elements | |
| Classification of Digestive Systems | |
| Enzymes, Digestion in mammals | |
| Microbial digestion in ruminants and other herbivores | |
| The Nutrient Requirements(energy and protein) of Animals, Feeding standards for: Maintenance, growth | |
| The Nutrient Requirements (energy and protein) of Animals, reproduction ,lactation. | |
| Ration Formulation | |
| **18. Practical Topics**<br>1- Proximate analysis of feedstuff, General on how to use nutrition laboratory, Some notes on an analysis of micronutrients, Repetition in the laboratory,Laboratory equipment and glassware used in the laboratory of nutrition.<br><br>2-Sampling for analysis by the food as well as how to take samples. Conditions to be met to obtain a representative sample.Sampling.Preparation of samples for analysis of fo<br><br>3-Determination of Dry Matter (DM) or moisture:<br><br>Principle / Equipment / Calculations<br><br>The objective of estimating moisture<br><br>4-Ether Extract (EE) (Crude Fat) Determination<br><br>5-Determination of Ash.<br><br>6-Estimate silica: -<br><br>A general knowledge about silica.<br><br>Prepare the extract of the ash samples to estimate dietary | Dr. kanyaw Ismail Mahmud &Mrs.Mhabad Ibrahim |

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| silica.Procedure. Calculations to estimate with some examples.<br><br>7- A visit to the feed factory: In order to inform students the feed ingredients as well as how to make pellets.<br><br>8- Crude Fiber Determination (CF)<br><br>9-Crude Protein Determination (C.P)<br><br>10- Determination of Nitrogen Free Extract (NFE) | |

**19. Examinations:**

***Q1. Compositional:***

**A- What are the principles of ruminant nutrition?**

Answer:

1- Ruminants are adapted to use forage because of microbes in their rumen.

2- To maintain ruminant health and productivity, feed the rumen microbes, which in turn will feed the ruminant.

3- Ruminant nutritional needs change depending on age, stage of production, and weather.

4- Adequate quantities of green forage can supply most —if not all—the energy and protein a ruminant needs.

5- Forage nutritional composition changes depending on plant maturity, species, season, moisture, and grazing system.

6- Supplementation may be necessary when grass is short, too mature, dormant, or if animal needs require it (i.e., high-producing dairy animal).

7-Excessive supplementation may reduce the ability of the rumen microbes to use forage.

**B- what is main classification of Carbohydrates?**

**Answer:**

Carbohydrates are classified into three main classes:

A/Monosaccharides

B. Disaccharides: They give two monosaccharide units on hydrolysis, which may be the same or different. For example,

1. Lactose (milk sugar) which hydrolyses into two molecules of glucose and galactos.
2. Sucrose (found in most plants, cane and beet sugar) which hydrolyses into two molecules of glucose and fructose:
3. Maltose it is obtained from the hydrolysis of starch. Which hydrolyses into two molecules of glucose.

C/ Polysaccharides

**C- What is The Role of Rumen Microorganisms?**

**Answer:**

**1-Production of cellulase (to break down fiber-rich plant material)**

**2- Synthesis of volatile fatty acids (used as energy by the animal)**

**3- Synthesis of vitamins**

**4- Synthesis of microbial protein**

**D- Why the rumen pH near neutral (6-7)?**

**1- Continuous absorption of VFA through the rumen wall.**

**2- Buffered by bicarbonate and phosphate ions in saliva.**

**E- The composition of feeds often expressed on a DRY MATTER BASIS (DM), why?**

**which allows a more valid comparison of nutrient content.**

**F- When Feeding livestock concentrate, we must increase grain slowly over a few days?**

**To allow microorganism to adaptation in the rumen to a new feed.**

**Q2/ Indicate whether each statement is true ( T ) or false ( F ). In order for a statement to be true, it must be completely true. Then correct the false statements.**

1-( F ) The cell walls of plants and animals are highly cellulose. (PLANTS)

2-( F ) Fructose is a Disaccharide found in ripe fruits and honey. (Monosaccharide's)

3-( F ) Glycogen is a common component of many feeds. ( not a common)

4-( F ) Water is not most important nutrient in nutrition. Keeps animal cool carries nutrients throughout the body. ( Most)

5-( F ) Macro-minerals include Iron, Zinc, Copper, Manganese, Selenium, Iodine, Cobalt and Molybdenum. ( Micro-minerals)

6-( F ) Enzymes are carbohydrates capable of catalysing reactions associated with a

specific substrate. ( Proteins)

7-( F ) Carnivores (animals that eats a diet of only plant materials). (Herbivores)

8-( F ) Omasum of a cow is the fourth part of its stomach which is called true stomach. (Third)

9- ( F ) Animals consume water at 1 to 2 times the amount of dry food consumed.(3-8)

10-( F ) If animal water requirements are not met, feed intake will increase. (Decrease)

11-( F ) Saponification is a measure of fats degree of unsaturation. (Iodine number)

12- ( F ) Vitamins are organic substances required by animals in very large amounts for regulating various body processes.( Very small)

13-( F ) Oesophagus, gather and chew feed using tongue and teeth. ( mouth)

14-( F ) In the Small intestine, bacterial activity, water absorption and waste storage. (large intestine)

15-( F ) Pancreatic Secretions pH = 2-3. (7.2- 7.8)

***Q3.*** **Complete the following sentences with missing words:**

1- Cattle, sheep and goats have ability to convert plant carbohydrates and proteins into available _NUTRIENTS_ for human use, making otherwise _UNUSABLE_ land productive.
2- Polysaccharides usually regarded as important source in animal nutrition which include _STARCH_, _CELLULOSE_, _HEMICELLULOSE_.
3- Bile made in liver, stored in _GALL_ bladder, active in the _SMALL_ intestine, emulsifies _FAT_ to _AID_ in digestion.
4- Reticulum is honeycomb lining, no _SECREASION_, and collects _HARDWARE(WIRE &NAILS)_.
5- Abomasum (true gastric stomach), produce proteolytic _ENZYMES_ and _HCl_ which cause pH decrease from _6_ to _2.5_, denature-_PROTEIN_, kills _BACTERIA_, dissolve _MINEARLS_.
6- Microorganisms in the rumen include _BACTERIA_ , _PROTOZOA_ and _FUNGI_.
7- Lignin is not a true carbohydrate. It contains too much _CARBON_, the H and O are not in the right proportion, and some _NITROGEN_ usually is present.

8- Water percentage produced by complete oxidation of Glucose _60%_, Fat _107%_ and Protein _45%_.
9- The majority of the true protein, and non-protein nitrogen compounds (NPN), entering the rumen is broken down to _AMONIA_, which bacteria require for synthesizing their own body _PROTEIN_.

**20. Extra notes:**

Here the lecturer shall write any note or comment that is not covered in this template and he/she wishes to enrich the course book with his/her valuable remarks.

**21. Peer review** **پێداچوونەوەی هاوەڵ**

This course book has to be reviewed and signed by a peer. The peer approves the contents of your course book by writing few sentences in this section.
*(A peer is person who has enough knowledge about the subject you are teaching, he/she has to be a professor, assistant professor, a lecturer or an expert in the field of your subject).*

ئەم کۆرسبووکە دەبێت لەلایەن هاوەڵێکی ئەکادیمیەوە سەیر بکرێت و ناوەرۆکی بابەتەکانی کۆرسەکە پەسەند بکات و جەند ووشەیەک بنووسێت لەسەر شیاوی ناوەرۆکی کۆرسەکە و واژووی لەسەر بکات.
**هاوەڵ ئەو کەسەیە کە زانیاری هەبێت لەسەر کۆرسەکە و دەبیت پلەی زانستی لە مامۆستا کەمتر نەبێت.**