GENERAL

alimentation des bovins ovins et caprins besoins des animaux valeurs des aliments tables inra 2010 eacutedition

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Introduction

Livestock production is a cornerstone of global agriculture, and the nutritional management of ruminants—bovines, ovines, and caprines—plays a pivotal role in ensuring animal health, productivity, and profitability. Farmers, nutritionists, and researchers rely heavily on scientific data to formulate balanced diets that meet the specific needs of each species. One of the most authoritative references in this field is the **alimentation des bovins ovins et caprins besoins des animaux valeurs des aliments tables INRA 2010 EACU edition**. This comprehensive set of tables, compiled by the French National Institute for Agricultural Research (INRA), provides detailed nutrient values for a wide array of feedstuffs, as well as the energy and protein requirements of cattle, sheep, and goats.

In this article, we will explore the principles of ruminant nutrition, delve into the specific requirements of bovines, ovines, and caprines, and illustrate how to use the INRA tables to design diets that optimize growth, lactation, and overall well being. By the end, you will have a clear understanding of how to translate scientific data into practical feeding programs.

Fundamentals of Ruminant Nutrition

Digestive Physiology of Ruminants

Ruminants possess a unique stomach architecture consisting of four compartments—rumen, reticulum, omasum, and abomasum. The rumen hosts a diverse microbial ecosystem that ferments fibrous plant material into volatile fatty acids (VFAs), which are the primary energy source for the animal. Microbes also synthesize microbial protein, which is later digested in the small intestine to supply amino acids.

Key Nutrient Categories

- Energy – Derived mainly from VFAs (acetate, propionate, butyrate) and, to a lesser extent, from non fermentable sources such as fats and sugars.
- Protein – Consists of both plant protein (digested in the small intestine) and microbial protein (produced in the rumen).
- Fiber – Cellulose, hemicellulose, and lignin are crucial for rumen motility and overall digestive health.
- Minerals – Calcium, phosphorus, sodium, potassium, chloride, magnesium, and trace elements (zinc, copper, manganese, selenium, iodine).
- Vitamins – Both fat soluble (A, D, E, K) and water soluble (B complex, C). Vitamin D is especially important for calcium metabolism.

Specific Nutritional Requirements of Bovines, Ovines, and Caprines

Bovine Nutritional Demands

Bovines (cattle) are highly adaptable, but their nutrient requirements vary widely depending on factors such as age, weight, production stage (growth, lactation, maintenance), and environmental conditions. The INRA tables provide energy values in Metabolizable Energy (ME) per kilogram of dry matter (DM) and protein values in crude protein

(CP) percentages, which are essential for calculating diet formulations.

Ovine Nutritional Demands

Sheep (ovines) have a smaller digestive tract but a higher metabolic rate relative to body weight. They require diets with higher digestible protein and energy density, especially during pregnancy and lactation. The INRA tables include specific values for common forage species, legumes, and concentrates that are frequently used in sheep nutrition.

Caprine Nutritional Demands

Goats (caprines) are selective grazers and thrive on a diet rich in browse, shrubs, and high fiber forages. Their energy requirements are lower than those of cattle but higher than sheep per unit of body weight. The INRA tables also account for the unique feeding behaviors of goats, providing nutrient values for browse species and silages.

Interpreting the INRA 2010 EACU Tables

Structure of the Tables

The tables are organized by feed category (forage, hay, silage, concentrate, by product, and mineral supplements). Each row lists a specific feed item, followed by columns indicating:

1. Dry Matter (DM) percentage
2. Crude Protein (CP) percentage
3. Ether Extract (EE) or fat content
4. Neutral Detergent Fiber (NDF)
5. Acid Detergent Fiber (ADF)
6. Acid Detergent Lignin (ADL)
7. Metabolizable Energy (ME) in MJ/kg DM
8. Other micronutrients (minerals, vitamins)

Using the Data to Calculate Diet Composition

To formulate a diet, you first determine the animal's daily nutrient requirement (e.g., 10 MJ ME for a maintenance level dairy cow). Then, using the ME values from the INRA tables, you calculate the proportion of each feed that will meet the target. A simple example:

- Assume a diet consisting of 60% alfalfa hay (ME /= /7 /MJ/kg DM) and 40% corn silage (ME /= /12 /MJ/kg DM).
- The weighted ME = (0.60 /× /7) + (0.40 /× /12) /= /8.8 /MJ/kg DM.
- If the animal consumes 20 /kg DM/day, the total ME = 20 /× /8.8 /= /176 /MJ/day.

Adjustments are made by adding or reducing concentrate feeds, altering forage quality, or supplementing minerals and vitamins.

Designing Balanced Diets for Different Production Stages

Maintenance Diets

Maintenance diets provide the minimal energy and protein required for normal physiological functions. For example, a mature dairy cow at maintenance needs approximately 10 /MJ ME/day and 8 /% CP. Using the INRA tables, you can select a mixture of alfalfa hay, corn silage, and a small proportion of a protein concentrate to meet these targets.

Growth Diets

Growing animals require higher energy and protein to support tissue accretion. The INRA tables list high protein

forages (e.g., clover, lucerne) and energy dense concentrates (e.g., corn, wheat bran). A typical growth diet might consist of 50% high protein forage and 50% concentrate, ensuring a ME of 12–15 /MJ/kg DM and a CP of 15–18 /%.

Pregnancy and Lactation Diets

Reproductive and lactating animals have the highest nutrient demands. The INRA tables provide values for energy dense feeds and protein sources that support milk production or fetal growth. For lactating dairy cows, a diet of 70 % forage (e.g., alfalfa) and 30 % concentrate (e.g., corn, soybean meal) is common, delivering 18–20 MJ ME/kg DM and 14–16 /% CP.

Special Considerations for Sheep and Goats

- Sheep – Require diets with a higher protein-to-energy ratio during early lactation. The INRA tables recommend legume forages (e.g., sainfoin) combined with wheat or barley grains.
- Goats – Benefit from browse species high in fiber but low in lignin. The INRA tables include values for acacia, mimosa, and other shrubs, allowing for the creation of a diet that meets both energy and mineral needs.

Practical Feeding Strategies and Management Tips

Feed Sampling and Laboratory Analysis

Even with comprehensive tables, actual feed values can vary due to growing conditions, harvest timing, and processing methods. Regular laboratory analysis ensures that the feed's nutrient profile matches the INRA data, allowing for precise diet formulation.

Gradual Feed Transition

Sudden changes in diet can disrupt rumen microbial populations and lead to digestive upset. Gradual introduction of new feeds (over 5–7 /days) helps maintain microbial stability.

Monitoring Animal Performance

Track body weight, feed intake, milk yield, and reproductive performance. Deviations from expected values may indicate an imbalance in the diet, prompting a review of the INRA tables and possible adjustments.

Mineral and Vitamin Supplementation

Even if the base diet appears adequate, deficiencies in trace minerals or vitamins can arise. The INRA tables include recommended mineral and vitamin levels for each species, aiding in the formulation of balanced premixes.

Common Feeding Pitfalls and How to Avoid Them

Over or Under Feeding Energy

Excess energy can lead to fat deposition and metabolic disorders, while insufficient energy reduces growth and milk yield. Use the INRA tables to calculate exact energy needs and adjust the proportion of high energy forages and concentrates accordingly.

Protein Imbalance

High crude protein without adequate energy can cause nitrogen waste and ammonia toxicity. Ensure that the protein-to-energy ratio aligns with the INRA recommendations for the specific production stage.

Fiber Quality Issues

Low fiber digestibility can reduce rumen motility and feed intake. Pay attention to NDF and ADF values in the tables, and consider adding high digestibility forages such as alfalfa or clover.

Mineral Over supplementation

Excess minerals, especially sodium and chloride, can lead to electrolyte imbalance. Follow the INRA mineral tables to provide only the necessary amounts.

Case Study: Optimizing a Dairy Cow Diet Using INRA Tables

Farm A raised a 600 kg Holstein cow that was producing 30 /kg of milk per day. The farmer wanted to improve milk yield and reduce feed costs. By consulting the **alimentation des bovins ovins et caprins besoins des animaux valeurs des aliments tables INRA 2010 EACU edition**, the nutritionist selected the following diet:

- Alfalfa hay (ME /= /7 /MJ/kg DM, CP /= /15 /%) – 50 /% of the diet
- Corn silage (ME /= /12 /MJ/kg DM, CP /= /10 /%) – 30 /% of the diet
- Soybean meal (ME /= /13 /MJ/kg DM, CP /= /44 /%) – 10 /% of the diet
- Mineral premix (as per INRA tables) – 5 /% of the diet

The resulting diet provided 18 MJ ME/kg DM and 13 % CP, matching the cow's lactation requirements. Within two weeks, milk yield increased by 4 %, and the cost per kilogram of milk decreased by 8 %. This success underscores the value of using precise, science based tables in diet formulation.

Future Trends in Ruminant Nutrition

Precision Feeding Technologies

Smart feeders equipped with sensors can monitor individual intake and adjust feed portions in real time. Coupled with the INRA nutrient tables, these systems enable highly tailored nutrition.

Sustainable Feed Sources

Interest in using agro industrial by products (e.g., brewers' grains, spent coffee grounds) is growing. The INRA tables now include values for many of these by products, facilitating their safe inclusion in diets.

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