

GCSE

FACT FILE

Agriculture and Land Use

Animal Nutrition

Unit 2: Animals on the land

For first teaching from September 2013

For first award in Summer 2015

FACT FILE

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culture
and
land use

Animal Nutrition



Learning Outcomes

At the end of this unit students should be able to:

- Identify and describe the functions of the key parts of the ruminant, monogastric and avian digestive tracts;
- Explain what dry matter intake (DMI) means and relate it to nutritional needs;
- Evaluate the differences between maintenance rations and production rations;
- Describe and explain how various food sources, forage, fibre (roughage), concentrates and minerals are used; and
- Explain how the nutritional requirements of animals vary, depending on species, sex, breed, age and stage of pregnancy.

Monogastric Digestive Tract

Structure

A stomach with only a single compartment, e.g. pigs, chickens, and humans.

1. Mouth

- gathers and chews feed using tongue and teeth;
- salivary glands moisten feed to aid in swallowing; and
- saliva begins the carbohydrate breakdown with salivary amylase.

2. Oesophagus

- tube from mouth to stomach that is open at the mouth end; and
- separated from stomach by the oesophageal sphincter (valve).

3. Stomach

- muscular gland-lined sac that receives ingested food from the oesophagus and carries out both physical and chemical digestion, and
- primary secretions: pepsin - enzyme that digests protein; hydrochloric acid - that aids in protein digestion and kills ingested micro-organisms.

4. Small Intestine (includes duodenum and ileum)

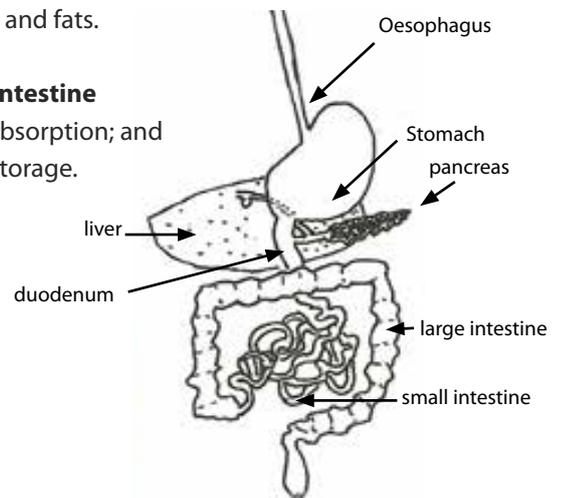
- enzymatic digestion and absorption;
- completes digestion of proteins and carbohydrates;
- all digestion of fats takes place here; and
- absorption of the products of digestion in ileum.

5. Pancreas

- Produces enzymes that break down carbohydrates, protein and fats.

6. Large Intestine

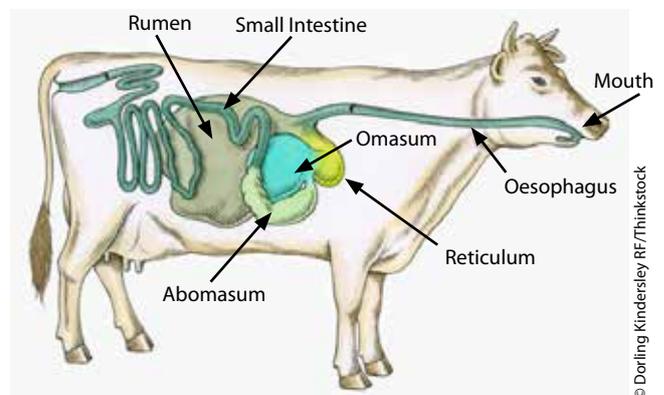
- water absorption; and
- waste storage.



Ruminant Digestive Tract

Main difference with the monogastric digestive tract is that there are three preliminary compartments before the true stomach, (or abomasum).

- Reticulum;
- Rumen; and
- Omasum.



1. Reticulum

Flask-shaped, a 'honeycomb' appearance. Moves ingested food (ingesta) into the rumen and the omasum. Causes the regurgitation of ingesta during rumination, and acts as a collection compartment for foreign objects.

2. Rumen

Large fermentation chamber.

Contains many micro-organisms (mainly bacteria) that secrete the enzymes necessary to break down cellulose.

Textured surface, lined with projections (up to 1 cm long), termed rumen papillae. The rumen, along with the omasum, absorb the by-products of bacterial fermentation. These by-products are volatile fatty acids (VFAs).

3. Omasum

The omasum, contains numerous laminae (tissue leaves) that help grind ingesta. These folds assist in the removal of fluid from the ingesta as it passes to the abomasum.

Abomasum 'True Stomach'

Corresponds to the stomach of the non-ruminant. Secretes gastric juices which aid digestion. pH range of 2.0 to 2.5. Low pH helps initial protein breakdown, and kills the bacteria which have spilled over from the rumen.

Avian Digestive Tract

Structure

Main parts include:

- oesophagus (which includes a crop in some birds);
- stomach (proventriculus & gizzard);
- small intestine; and
- large intestine. The large intestine then empties into the cloaca.

Important accessory structures include the beak, salivary glands, liver, & pancreas.

Mouth

- no teeth - no chewing;
- glands which secrete saliva - wets the feed to making it easier to swallow;
- enzymes in saliva start digestion; and
- tongue pushes the feed to the back of the mouth and swallowed.

Oesophagus

- flexible tube that connects the mouth with the rest of the digestive tract; and
- it carries food from the mouth to the crop and from the crop to the proventriculus.

Crop

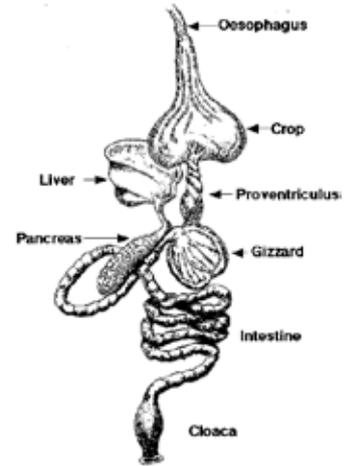
- an out-pocketing of the oesophagus in the neck region;
- used for storage of swallowed feed and water; and
- little digestion occurs here.

Proventriculus

- the oesophagus continues past the crop to connect the crop to the proventriculus;
- the proventriculus (also known as the 'true stomach') is the glandular stomach where digestion begins; and
- hydrochloric acid and digestive enzymes (e.g. pepsin) are added to the feed here and digestion begins.

Gizzard / Ventriculus

- unique to birds (needed as have no teeth);
- referred to as the 'mechanical stomach';
- two sets of strong muscles;
- consumed feed passes into the gizzard for grinding, mixing, and mashing; and
- gizzards are muscular structures with thick walls.



Small intestine

- made up of the duodenum and ileum; and
- digestion and absorption.

Dry Matter Intake

Definition

Dry Matter Intake (DMI) is the amount of food consumed daily by an animal not including water or moisture within the food.

DMI is influenced by:

- Food type (how digestible it is); and
- Animal size.

Why use DMI?

DMI provides a more accurate measure of food intake. Fresh weight (including the moisture in food) is very variable and, in the case of grass, varies depending on how much rain there has been.

Rations

Based on the animal's weight and physiological stage of production:

- growth;
- maintenance;
- gestation; and
- lactation.

A ration is the feed an animal receives over a 24-hour period. A variety of feedstuffs, or basic ingredients, are used in rations, and producers must choose those that best suit their needs.

A ration with all the nutrients an animal needs is a balanced ration.

Rations given to animals can be divided into 2 parts

1. **Maintenance** – a ration that will maintain an animal that is in a resting and non-producing condition and in good health, in the same condition and at the same weight for an indefinite period
2. **Production** – a ration is that part of the daily diet which is given in excess of maintenance requirements and which is available for being converted into energy, as in working horses, or into milk, or into fat or wool or used for growth

Maintenance ration by itself is uneconomical since it gives no gain.

Devising a maintenance ration - clear understanding of what any food will or will not do e.g. wheat straw does not contain enough protein for the maintenance of health in young bullocks but wheat straw in combination with good quality hay will contain enough protein.

Nutritional Requirements

Pregnant/Lactating:

- Specific and increased nutritional needs;
- Pregnant animals need nutrition not only for themselves but also for developing offspring;
- Some agricultural animals commonly give birth to only one offspring (cattle and horses) while others give birth to multiple offspring (pigs, chickens, sheep and goats); and
- Animals that are lactating or nursing their young also need specific nutrients to provide nourishing milk to their offspring.

Age/growth

- Specific to meet the needs of the different growth stages. Young animals need the proper nutrition for growth and development of bones, muscles, and organs;
- Some agricultural animals, such as chickens, grow rapidly. As animals grow, their nutrient needs change, and as they mature, their diets become closer to those of adult animals; and
- Older animals may have health problems related to aging, which could require different nutritional needs, such as vitamin and mineral supplements.

Activity/Breed

Animals that exert large quantities of energy, known as working animals, need additional nutrients.

Working animals are used for some types of work such as pulling heavy loads. Additionally, horses that are used for competitive events require different rations than horses that are ridden only for pleasure.

Production/Species

Many agricultural animal species are raised for meat and products such as eggs, milk, or wool. In order to produce products or have the quality of meat consumers will purchase, proper nutrition is essential.

Food Source and Use

Food Source	Used
Succulents	' Succulent ' means juicy. Succulent plants have unusually thick leaves, stems, or roots that provide water storage.
Fibre	Roughages include feed that is high in fibre (and low in energy), such as grasses, hays, and silages. Prevents constipation
Concentrates	Concentrates include feed that is high in energy (and low in fibre) such as grains. Minerals provide material for growth of bones, teeth, and tissue and also help regulate many of the body's chemical processes.
Minerals	Minerals also help in muscle action and tissue repair. Although mineral intake may account for a small portion of the total diet, it is essential. Macrominerals - needed in larger amounts by the body; microminerals - needed in smaller amounts. Macrominerals include calcium, chlorine, magnesium, phosphorus, potassium, sodium, and sulfur. Microminerals include chromium, cobalt, copper, fluorine, iron, iodine, manganese, molybdenum, nickel, selenium, silicon, and zinc. Minerals are often added to animal feed or fed free choice, which means animals are able to access at any time. For example, salt and mineral blocks are fed free choice where animals are able to lick them anytime they want. Excess minerals in some species can cause toxicity, even leading to death. Producers should always ensure that minerals are given in the appropriate amount to animals.

Learning Activities

Compare and contrast the functions of the key parts of the ruminant, monogastric and avian digestive systems.

Useful Websites

www.dardni.gov.uk/index.htm

www.dardni.gov.uk/ruralni/livestock_dairy/protein_herd.htm

www.ec.europa.eu/food/food/animalnutrition/index_en.htm

Key Terms

Avian	Lactation
Rumen	Omasum
Succulent	Fibre
Gizzard	Ration
Ventriculus	Proventriculus
Maintenance	Monogastric
Production	Macrominerals
Microminerals	
Concentrates	
Oesophagus	
Ruminant	
Reticulum	

