AMALAN LADANG: PENGEJUARAN TERNAKAN
(Farm Practice: Livestock Production)
SHW 3003

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Selangor Darul Ehsan
PENGENALAN KURSUS

a. Maklumat Kursus

Jabatan : Jabatan Sains Haiwan
Nama Kursus : Amalan Ladang: Pengeluaran Temakan
Kod Kursus : SHW 3003
Jam Kredit : 1 (0+1)


b. Maklumat Penulis

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        : anjas@putra.upm.edu.my (Dr. Anjas Asmara)
c. Objektif Kursus

Pelajar dapat:

1. mengenal pasti cara mengurus ternak (C4, LS)
2. mempamerkan teknologi penyelenggaraan ladang ternak untuk meningkatkan keberkesanan pengurusan (P5, CTPS, KK)
3. menerangkan kepentingan pemakanan dan sumber makanan dan infrastruktur ladang ditekankan (A3, CS)

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d. Sinopsis Kursus

Kursus ini merangkumi pengurusan asas ladang ternakan ruminan dan poltri.
(This course encompasses basic ruminant and poultry farm management practices)

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e. Kandungan Kursus

Kursus ini merangkumi pengurusan ternakan ruminan (lembu, kambing, bebiri dan rusa) dan poltri (ayam penelur dan pedaging) yang meliputi aspek pemakanan, infrastruktur dan peralatan ladang.
### Jadual 1: Tajuk Unit dan Cadangan Jam Kuliah Diperuntukkan

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### f. Panduan Tugasan / Amali

Perhatian: Secara umumnya panjang laporan tugasan/amali individu adalah tidak melebihi 5 mukasurat (tidak termasuk kulit) dan panjang kerja kumpulan antara 5-10 mukasurat tidak termasuk lampiran (jika ada). Kesemua laporan hendaklah ditaip, selang dua baris (double spacing) pada kertas berukuran A4 menggunakan font Arial saiz 12. Laporan yang dihantar hendaklah dijilid. Tajuk dan maklumat lengkap mengenai tugasan akan dimaklumkan pada perjumpaan bersema.

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**Penilaian kursus berubah daripada semasa ke semasa bergantung kepada pensyarah/pengajar kursus semasa**

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h. Rujukan


j. Penerangan mengenai ikon dalam modul

Untuk memudahkan pelajar memahami dengan lebih mudah kandungan modul ini beberapa ikon telah digunakan. Ikon-ikon ini bertujuan untuk memudahkan ingatan pelajar mengenai struktur modul. Di bawah disenaraikan ikon-ikon tersebut berserta dengan maksudnya.

**Objektif**
Objektif modul, unit atau topik

**Pengenalan**
Sama ada pengenalan unit, topic atau sub-topic

**Rujukan**
Bahan rujukan yang boleh dijadikan panduan tambahan dalam kursus tersebut

**Soalan dalam teks**
Soalan-soalan yang disisipkan oleh penulis semasa membincangkan sesuatu topic

**Isi-isi penting**
Kumpulan isi-isi penting yang terdapat dalam unit, atau topic

**Soalan penilaian kendi**
Soalan yang disediakan oleh penulis untuk menolong pelajar mengetahui tahap kefahaman terhadap topic yang dibincangkan

**Penerhatian/Pemandangan**
Mengenai topic yang telah dikaji oleh beberapa sarjana atau maklumat daripada hasil kajian

**Semak jawapan latihan**
Jawapan berdasarkan latihan-latihan yang disediakan di setiap unit

**Kesimpulan**
Kesimpulan yang boleh dibuat berdasarkan unit atau topic yang dipelajari
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UNIT 1
LIVESTOCK INDUSTRY IN MALAYSIA

Introduction

This module is designed to give an overview of the livestock industry in Malaysia. Poultry and pig farming represent by far the major proportion of the livestock industry in terms of output value. The 2010 ex-farm production value of chicken and duck eggs was estimated to be RM2,358.62 million and poultry meat output are estimated to be in the region of RM5,776.21 million while the pig industry contributes about RM2073.62 million during that year. These sub-sectors are operated largely in a commercially oriented manner and are largely managed as private or public limited companies.

The ruminant sector lags far behind with the majority of cattle, goat and sheep still owned by individual farmers who rear these animals as part of their overall rural agricultural activities. The total ex-farm output value of beef and milk is estimated to be about RM847.11 million and RM127.29 respectively and mutton about RM67.66 million in 2010.

The main potential for cattle rearing appears to be in oil palm plantations where there is ample edible herbage available for grazing but the interest to participate by plantation companies are very low due to the buoyant palm oil prices. The country is a net exporter of chicken meat and eggs and is about just self sufficient in pork requirements. On the other hand the level of self sufficiency for beef, mutton and dairy products are low at 28.65, 10.58 and 4.88 percent respectively. The main requirements are filled by imports.
Learning outcomes

At the end of this unit, students able to:

1. Present the current status of the livestock industry in Malaysia
2. Know the roles of the government in facilitating the livestock industry to be competitive in both domestic and international market.
3. Identify the sectors which are above the self sufficiency levels.
4. Understand the total ex-farm output value of both the ruminant and non ruminant sectors.

Main points

1. The livestock Industry in Malaysia
2. Ruminant Industry
3. Non Ruminant Industry
6. Improve Efficiency of Ruminant Industry
7. Maintain Competitiveness of Non-Ruminant Livestock Industry
TOPIC 1: THE LIVESTOCK INDUSTRY IN MALAYSIA

The livestock industry especially ruminants is currently still a small scale industry and has the potential to be developed to ensure national food supply and reduce meat imports. Among the issues and challenges faced in the development of this industry are the lack of quality breeds, high feed prices and lack of expertise and manpower. The transformation of the livestock industry will be focused on the commercial livestock industry, the production of quality livestock breeds, the expansion of Good Animal Husbandry Practices (GAHP) and the production of quality livestock feed formulations at competitive prices. In addition, aspects of R & D in terms of animal disease control and efficiency of livestock systems will be emphasized.

The 2010 population of cattle, buffalo, goat and sheep are estimated to be 912,000, 126,000, 545,000 and 134,000 respectively. Traditionally these species are farmed as a side activity of small holder farmers.

The animals are grazed on any available herbage on public roadsides, along the bunds of irrigation canals and among rubber or fruit orchards of the small holders. Some of the cattle are milk breeds reared on the fringes of towns for local raw milk supply.

TOPIC 2: RUMINANT INDUSTRY

More recent innovations have been the grazing of cattle under palm oil trees as an integrated activity. The increasing number of cattle in this form of farming is, however, only compensating the reduction of smallholder cattle rearing due to urbanization of traditional villages.
TOPIC 3: THE NON-RUMINANT INDUSTRY

Non-ruminant industries including poultry, pork and eggs that have already achieved a high level of self-sufficiency will be further developed so that the competitiveness and sustainability of the industries can be improved.

3.1: The poultry industry

The most advanced of the livestock sector, the poultry industry is the most commercialized and integrated in its production system. The industry has been in a continuous transformation mode towards adopting the most modern production technology and feeding available. There are increasing use of environmentally controlled closed housing and automation of feeding and egg collection systems.

The industry relies almost entirely on imported genetic resources and the major commercial breeds are reared at the grand parent and parent stock level. The industry is well supported by commercial feed mills supplying compound feeds based on imported corn and soyabean meal are increasingly handled in bulk form.

3.2: The swine industry

The Peninsular part of the country is self sufficient in the supply of pig meat. The swine industry underwent a significant restructuring in the aftermath of the Nipah virus epizootic in 1998/99 that resulted in the closure of many farms.

A total of 950, mostly small farms, were closed. In 2010 there are 816 farms in operation carrying a standing population of nearly 1.8 million. The export of live pigs to Singapore has ceased since 1999 but the expansion of the remaining farms has enabled the country to sustain its self sufficiency.
The industry is trying to cope with the environmental pollution issues due to the country's rapid urbanization and has to continuously upgrade its waste disposal system.

Pig meat is mostly consumed as fresh unprocessed pork.

The industry is still trying to persuade the government to support the development of pig farming areas (PFAs) and in situ development of environment friendly farms as PFAs.

**TOPIC 4: LIVESTOCK INDUSTRY PROSPECTS, 2011-2020**

Demand for meat is expected to increase from 1.4 million metric tonnes in 2010 to 1.8 million metric tonnes by 2020 with a growth of 2.4% per annum. Demand for eggs also increased by 3.3% per annum from 468 thousand metric tonnes to 649 thousand metric tonnes, while demand for milk is expected to increase by 3.2% per year from 1.4 billion litres to 1.9 billion litres. Per capita consumption of meat, eggs and milk are expected to increase in the same period.

Meat production is projected to increase from 1.6 million metric tonnes in 2010 to 2.1 million metric tonnes by 2020 with a growth of 2.7% per year (*Chart 5-1*). Egg production is also expected to increase from 540 thousand metric tonnes to 773 thousand metric tonnes with a growth of 3.6% per year (*Chart 5-2*), while milk production is projected to increase from 67 million litres to 118 million litres with a growth of 5.8% per annum in the same period (*Chart 5-3*).
Export markets for this industry are expected to continue to grow in Singapore, particularly for eggs and live chickens, while the United Arab Emirates (UAE) and Brunei for the meat and eggs preparation.

TOPIC 5: STRATEGIES OF LIVESTOCK INDUSTRY, 2011-2020

Strategies that have been identified to develop the livestock industry are as follows:

- improve the efficiency of the ruminant industry;
- maintain the competitiveness of non-ruminant livestock industry;
- increase the production of animal feed;
- strengthen the effectiveness of disease control and expand the safe slaughtering and processing practices;
- develop other livestock industries;
- balancing domestic supply and imports; and
- development of a more structured livestock industry.
TOPIC 6: IMPROVE EFFICIENCY OF RUMINANT INDUSTRY

The development of the ruminant industry will focus on increasing efficiency and environmentally friendly practices through the following efforts:

- transformation of beef cattle and goat entrepreneurs to medium and large scale levels;
- strengthen the livestock farming activities in the target areas, the National Feedlot Centre and satellite farms;
- encourage the private sector, GLCs and government agencies such as FELDA, the Rubber Industry Smallholders Development Authority (RISDA) and Federal Land Consolidation and Rehabilitation Authority (FELCRA) to get involved in integrated beef and dairy cattle farming activities in the oil palm plantations and feedlots;
- increase meat production based on intensive livestock farming practices and intensify the practice of zero waste by utilizing by-products to strengthen the supply chain and reduce pollution;
- increase the productive population of ruminants through more effective breeding services, including the use of reproductive biotechnology and active participation of the private sector as breeding service providers;
- increase the production of high quality breeds through restructuring of the breeding system including the use of farms owned by the Department of Veterinary Services for nucleus herd and the use of integrated systems and breedlot for the multiplier herd; and
- production of high quality breeds of local cattle and goats through research in public-private partnership.

TOPIC 7: MAINTAIN COMPETITIVENESS OF NON-RUMINANT LIVESTOCK INDUSTRY

Non-ruminant livestock areas will be maintained. Livestock farming activities will be further strengthened by encouraging the use of modern technology and comply with
good animal husbandry practices such as using enclosed pens and automation. The use of effective microorganisms (EM) will be promoted as natural biological control agents.

7.1: Increase Livestock Feed Production

Animal feed production in the country will be encouraged to meet the growing demands of the industry through the following efforts:

- provide incentives to encourage livestock farmers and the private sector to produce fodders and use local ancillary materials for ruminant feed formulation;
- strengthen R & D activities related to animal nutrition, particularly the use of local raw materials in the formulation of non-ruminant animal feed to support the national livestock feed production; and
- emphasis on production of quality feed formulation at competitive prices.

7.2: Strengthen the Effectiveness of Disease Control and Expand the Safe Slaughtering and Processing Practices

Efforts will be undertaken to achieve the national Foot and Mouth Disease (FMD) free status through vaccination programme while the Brucellosis and Tuberculosis through the culling programme. Efforts will be intensified to maintain disease-free status of Avian Influenza (HPAI) and Nipah Virus through surveillance programmes (surveillance) on poultry and pigs in the country. Disease-free zones, including the disease enclosure areas will be created to control diseases such as FMD and Newcastle disease, especially in certain areas with the potential to meet export requirements. The development of the livestock industry will be implemented in accordance with guidelines of World Organization for Animal Health.
The effectiveness of disease control including cross-border and zoonotic diseases will be strengthened through the enhancement of surveillance, vaccination, disease diagnosis and early preparation programmes. In this regard, the extension services will be enhanced in line with the development of the livestock industry. Cooperation between departments with private veterinary practitioners will be encouraged to provide services in disease control programmes. Therefore, mechanisms to encourage the private sector to provide livestock animal health services will be created.

Central slaughtering plants will be established to ensure halal, clean and safe slaughter while reducing pollution in urban areas. Small scale slaughtering practices in wet markets and rural areas will be terminated in stages. The private sector will be encouraged to develop and manage the slaughtering plants according to the guidelines, criteria and conditions stipulated by the government as well as providing meat inspection and quality control services in accordance with certified standards.

7.3: Develop Livestock Industries

Production of other livestock such as quail, turkey, rabbit and deer will be encouraged to increase supply to meet local market demand. Quail production will be enhanced by development of breeding farms according to zones to supply chicks to commercial operators.

7.4: Domestic and Imported Supplies

The importation of livestock products including meat and milk to meet demand from consumers and processing industries will be streamlined to encourage industrial growth. The coordination will take into account the trade procedures approved by WTO. Marketing of livestock products will be strengthened through the establishment
of distribution and auction centres and use of communication technologies as sources of market information.

7.5: Developing a More Structured Livestock Industry

The livestock industry particularly the ruminant industry will be developed and more organized by creating an agency either by the Government or GLC. This agency will coordinate all programmes and projects including the supply of foreign cattle, processing, promotions and marketing involving FELDA, FELCRA, RISDA, GLC, the private sector, livestock farmers, local feed suppliers and other parties in the supply chain.

Conclusions

1. Poultry and pig farming represent by far the major proportion of the livestock industry in terms of output value.
2. The ruminant sector lags far behind with the majority of cattle, goat and sheep still owned by individual farmers.
3. The main potential for cattle rearing appears to be in oil palm plantations.
4. The country is a net exporter of chicken meat and eggs and is about just self sufficient in pork requirements.

Additional References

1. The Livestock industry in Malaysia: Moving Forward in The Next 3-5 Years Austrade Symposium: maha 2008


5. Federation of Livestock Farmers’ Association of Malaysia.

Exercise 1 / Activity 1
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Discussion 1
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3.
Answers to Exercise 1

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Answers to Discussion 1

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UNIT 2
BASIC ANIMAL NUTRITION

Introduction
This module is designed to provide information on some animal nutrition basics and an appreciation for proper livestock nutrition; six basic classes of nutrients that must be considered in formulating diets; water, protein, carbohydrates, fats, vitamins and minerals; knowledge of nutritional requirements and techniques used in formulating and balancing rations, unique physiology and metabolism of different animals' different types of feed ingredients, utilization of roughages in ruminant feeding and use of agro-industrial by-products in ruminant feeding.

Learning outcomes
At the end of this unit, students able to:
1. Describe nutrition
2. Understand the basic animal nutrition
3. Differentiate the requirement needed between ruminant and non ruminant
4. Formulate ration of ruminant and non ruminant livestock
5. Understand the utilization of roughages in ruminant feeding
6. Identify the local agro industrial by-products
Main points

1. Classes of nutrients
2. Classification and use of feed
3. Digestion in livestock animals
4. Utilization of roughages in ruminant feeding
5. The use of agro industrial by-products in ruminant feeding
6. Nutritional disorders in ruminant animals
7. Urea utilization in livestock feeding
8. Nutritional Disorders in ruminant animals

TOPIC 1: CLASSES OF NUTRIENT

Nutrition can be defined as the process by which an organism obtains food which is used to provide energy and materials for its life sustaining activities. Food consists of various components which carry out varied functions as required by the body. These different components are called the nutrients. The different types of nutrients are carbohydrates, fats, proteins, vitamins and minerals, which carry out different functions. Carbohydrates, lipids and proteins are macronutrients because they are the energy sources for the production of heat and also other organic functions. Minerals, vitamins and water are micronutrients because though they are not energy sources, their absence or deficiencies cause specific diseases and abnormalities in man.

Energy production, carbohydrates, fats and to some extent protein store energy and are metabolized to give energy. Proteins and minerals are responsible for synthesis of materials for growth and maintenance of tissues. Vitamins and minerals are responsible for regulating and coordinating the various activities of an organism along with enzymes (proteins).
Nutrition is a process that organisms digest and utilized the nutrients from food for maintaining life, repairing body tissues, growing and producing products.

Nutrient is a food constituent that aids in the support of life. It may be a single element such as iron or copper, or it may be a large, complex chemical compound composed of many different units, such as starch or protein.

Animal nutrition is a science to study a relationship between nutrient intake and animal life and production.

1.1 Role of nutrients
Most of the nutrients are organic molecules. The organic molecules are primarily made of carbon, hydrogen and oxygen. In addition, they may contain nitrogen, phosphorus, calcium, magnesium, iron, etc. depending on the function. Minerals are the inorganic components of food.

A number of factors can make an understanding of livestock nutrition very confusing. Many (most) feedstuffs or ingredients in a ration contain more than one of the six basic nutrients. For instance, a kernel of corn contains all six basic nutrients:

- Water -- 13-15% when dried for storage
- 20-35% field moisture at harvest or if stored as high moisture corn
- Protein -- 7-9% crude protein is a typical value
- Carbohydrate -- mainly in starch portion of the kernel
- Fat -- mainly in the oil portion
- Vitamins
- Minerals

Commonly used feed ingredients may vary considerably in the content of the six basic nutrients. The example of corn from above demonstrates that the water content can vary widely, as can other perimeters. Some varieties of corn contain high levels of specific nutrients, such as lysine or oil.
The unique physiology and metabolism of different animals enables some to utilize some feed ingredients to their benefit while other animals of a different species cannot.

- Non-protein nitrogen sources can be converted to amino acids and from amino acids to protein by ruminants and hindgut fermenters; monogastric animals cannot utilize these feedstuffs.
- Fiber (roughages - hay, grasses) can be broken down by ruminants and hindgut fermenters to provide an energy source; monogastric animals cannot utilize these feedstuffs.
- Some feed constituents are essential for certain species, but not for others. Proline and glycine are essential amino acids and must be added to poultry diets; other species can synthesize them from other amino acids.

There are "linkages" or relationships between different basic nutrients.

- Selenium (a mineral) is linked to Vitamin E; they share many "duties" in the body and one can often be substituted for the other.
- Fats, carbohydrates and proteins can all be used to provide energy to the body and can be additive in meeting the energy requirements of an animal. (Protein will be converted to energy producing subunits if fed in excess of its basic metabolic needs.)
- Calcium and Phosphorus must be fed at the appropriate "ratio" for maximal utilization and to prevent interference with other mineral metabolism.

No single feed ingredient can supply all 6 basic nutrients an animal needs to survive and be productive.

- One must "balance" the ratio of different feed ingredients to meet the individual animal's needs.
- The nutrient needs of animal are varies depending upon the species, age, stage of lifecycle, etc.
In addition to meeting an animal's basic nutrient requirements, a diet must also meet
the “3 P's” to be useful as a livestock feed.
  o **Palatable** -- must be edible, accepted, and eaten by the animal
  o **Profitable** -- if the livestock producer cannot make a profit feeding
    certain ingredients, he/she won't be in business very long.
    Approximately 75% of the out-of-pocket costs in livestock production is
    feed costs.
  o **Productive** -- animals eating the diet must be productive. The **least
    cost ration** may just barely meet the animal's nutrient requirements, but
    not allow the animal to function at its most productive level. The
    **optimal ration** is the ration that can be produced for the least cost for
    the benefit returned in animal performance (growth, productivity,
    longevity, reproductive performance, etc.)

1.2 Classes of nutrient - Water
The Most Critical Nutrient!
  o Functions in transport, chemical reactions, temperature maintenance,
    lubrication, etc.
Water deprivation --> dehydration --> electrolyte imbalance --> death
Requirements vary from one species to another. For example, the desert rat requires
very little, while the dairy cow may require 25-29 gallons/day.
Management problems leading to lack of water
  o bad taste (high sulfur content)
  o don't know how to use or cannot find waterer
  o stray voltage at water source

1.3 Classes of nutrient - Carbohydrates (CHO)
Functions
  o energy source
  o building block for other nutrients
  o dietary excess stored as fat
Two main components of carbohydrates
  o Crude fiber (cellulose mainly)
  o Nitrogen-free extract (soluable sugars, starches)
Differences between monogastric, hindgut fermenter and ruminant
  o Ruminants and hindgut fermenters have microorganisms in the rumen or hindgut that can break down crude fiber (cellulose) into useable products; monogastrics cannot utilize most crude fiber.
  o All livestock are capable of breaking down the soluble sugars and starches.
Management Problems
  o poor quality feedstuffs
  o improper ration balancing

1.4 Classes of nutrient - Fats (lipids)
Functions
  • energy (stored at higher conc./g than CHO)
  • Source of heat, insulation, body protection (cushioning)
  • Essential fatty acids (immune function, CLA-anticancer link?)
Sources
  o Oils (soybean oil, corn oil, fish oil)
  o By product fats (lard or tallow from livestock rendering)
    • provides cheap energy source
    • reduces dust in feed manufacturing and animal feeding
    • increases feed palatability

1.5 Classes of nutrient - Proteins
Most expensive ingredient in ration, need decreases as animal matures
Source of Essential Amino Acids (number, type and level of amino acids required varies with animal species)
Functions -- basic structural unit, needed in metabolism, hormone, antibody and DNA production

When fed in excess, converted to energy, fat

Monogastric vs. ruminant
- True protein is composed of amino acids
  - Crude protein contains both true protein and other nitrogenous products (non-protein nitrogen)
  - Non-protein nitrogen can be converted by rumen bacteria to true protein (cheaper source of protein for the ruminant animal)

1.6 Classes of nutrient - Minerals
Two classes
- Major minerals -- Ca, P, Na, Cl, Mg, K, S
- Minor (Trace minerals) -- Co, Cu, F, I, Fe, Mn, Mo, Se, Zn
  - The need for supplementation of minor minerals such as Se and F varies with the region

Functions -- skeleton, protein synthesis, oxygen transport, fluid and acid-base balance in body, enzyme reactions

Mineral/mineral and vitamin/mineral interactions
- Ca - Vitamin D
- P - Vitamin D
- Co - Vitamin B12
- Se - Vitamin E

Both deficiencies and excesses can lead to disease

1.7 Classes of nutrient - Vitamins
Two classes
- Water soluble -- B & C
- Fat soluble -- A, D, E, K
Functions -- most vitamins have multiple functions in body involving metabolism, enzyme reactions, etc.
Requirements increase with age. Both deficiencies and excesses lead to disease

TOPIC 2: CLASSIFICATION AND USE OF FEED

2.1 Classifications of Feeds
- Air dry roughages contain more than 18% crude fiber and less than 60% total digestible nutrients (TDN)
- Air dry concentrates generally contain less than 18% crude fiber and more than 60% TDN.
- Feeds that have more than 80% dry matter (DM) are air-dry, while higher than 80% they are called high moisture feeds.

2.2 Forms of Feed
- The three forms of feed are dry, green and high moisture.
- Dry feeds are hay, grains oilseed, straw, stover, corn cobs, corn husks, soybean, hulls.
- Green feeds include pasture and green chop.
- High moisture feeds are high moisture grains, haylage, wet byproduct feeds, roots, tubers and silages.

2.3 Roughages
- The two types of roughages are grass and legume.
- Legumes have nodules on their roots that have bacteria which fix nitrogen.
- Legumes include, alfalfa, clovers, birdsfoot trefoil, bean and pea hay.
- Grass roughages include napier, guinea, setaria, Brachiaria species, sorghum, wheat and oat.
2.4 Concentrates

- The three kinds of concentrates include grains, supplements and byproduct feeds.
- Common grains are corn, oats, barley, sorghum and wheat.
- Supplements are protein feeds, minerals and vitamins.
- Supplements are either from an animal or vegetable origin.
- Animal origin supplements include tankage, meat scraps, meat, bonemeal, fishmeal, dried skim milk.
- Vegetable origin protein supplements include soybean meal, soybeans, cottonseed meal, peanut oil meal corn gluten, safflower meal, sesame oil, sunflower meal, linseed meal.
- Urea is a non protein supplements, neither animal nor vegetable origin. Used primarily in feeding ruminants.
- Minerals are generally some combination of calcium and phosphorus with trace minerals added.
- Salt blocks may also have trace minerals added.
- Vitamin supplements are necessary to provide vitamins in a lacking ration.
- Byproduct feeds from the milling and brewing industries are also used in feeding.
- Byproduct feeds include wheat bran, rice bran, wheat middlings, rye middlings, molasses, brewer’s grain, beet pulp, screenings and malt sprouts.

TOPIC 3: DIGESTION IN LIVESTOCK ANIMALS

- nutrients are converted to a form that the cells can use
- nutrients are transported by digestive system
- gastrointestinal tract
- organs that make up the digestive system
- the breaking down of feed into simple substances, which are absorbed into bloodstream and used by the body cells
• Enzymes do most of the job of digestion
• Ruminants “chew their cud” as part of digestion
• Ruminant animals
  • Use a lot of roughage
  • Have a four-part stomach
• Non-ruminant animals
  • Have a simple, one part stomach
  • More concentrates in their ration

3.1 Digestive System of Ruminants
Cattle belong to a class of animals called ruminants. This group includes sheep, goats and deer. Ruminants have a digestive system which allows them to utilize roughages (e.g. hay, grass) as a major source of nutrients. These animals have a large (capacity up to 50 gal.), fluid filled digestive organ at the beginning of the digestive tract called the rumen. The rumen contains a large population of microbes (bacteria and protozoa). Much of the initial digestion of feed is done by microbes in the rumen.

![Diagram of Ruminant Stomach](image)

Figure 1. Ruminant Stomach

These microbes have the ability to break down cellulose and hemicellulose, which are main components of roughages. Rumen microbes also break down other components of the animal’s diet such as protein and starch. The reticulum is a smaller organ which acts as a holding area for feed after it passes down the
esophagus. The omasum is an organ which absorbs water from the digesta (mixture of feed and fluid) before it flows into the abomasum (true stomach). The animal's own digestive enzymes break down food in the abomasum and small intestine. Absorption of these nutrients occurs mainly through the small intestine.

![Diagram of Ruminant Stomach and Flow of Digesta]

**Figure 1. Ruminant Stomach and Flow of Digesta**

When ruminants consume forages, they take fairly large bites and swallow the material with a minimum of chewing. After eating, they stand or lie down to "chew their cud". This involves regurgitating boluses (masses) of forage up the esophagus and into the mouth, where it is re-chewed and then swallowed. This reduces the size of the forage particles and greatly increases the surface area available for microbial digestion.

### 3.2 Ruminant system

- multicompartiment stomach
- ruminant animals are often called "cud chewers"
- no upper front teeth in ruminant mouth
- no enzymes in the saliva
- examples of ruminant animals: cows, sheep, goats
3.3 Rumen Compartments

Reticulum
- has appearance of a honeycomb
- traps dangerous objects and prevents them from proceeding through the rest of the tract.
- Called hardware disease: cow eats wire, nails, staples
- stores, sorts, and moves feed back to the esophagus for regurgitation (throwing up)

Rumen
- functions as a storage vat
- food is soaked, mixed, and fermented
- some absorption of nutrients
- some breakdown of feed through microbial action

Omasum
- grinds roughage

Abomasum
- only true stomach
- functions similarly to a monogastric stomach
3.4 Digestive System of Monogastric

Digestive System of a Chicken

Monogastric (non-ruminant) animals (e.g. pigs, dogs, man) are not able to efficiently digest cellulose

- has only one compartment to the stomach
- process goes through the: mouth
- esophagus
- stomach
- small intestine: duodenum, jejunum, ileum
- large intestine: cecum, colon, rectum
- examples of non ruminant animals: chicken, duck, pig
TOPIC 4: RATION FORMULATION

A properly formulated ration supplies adequate amounts of all nutrients to allow cattle to achieve a desired level of production. Accurate ration formulation requires

i. precise description of the class of cattle (sex, weight, frame size, body condition, desired rate of gain, stage of production)
ii. knowledge of management practices utilized (implant usage, feed additives)
iii. accurate description of the nutrient content of the available feeds

Laboratory analyses of forages are essential for accurate ration formulation. The nutrient content of forages varies greatly depending on the type, stage of maturity at cutting and how well it is preserved. For more information on lab analysis see OMAF Factsheet, "Feed Sampling and Analysis" Agdex 400/60. Nutrient content of grains is not as variable as forages, but lab analysis is recommended. Help in formulating rations is available from your OMAF county office, feed industry representatives and consultants.

4.1 Utilization of roughages in ruminant feeding

Roughages comprise over 50% of all feedstuffs fed to livestock animals especially ruminants. Roughages are plant-based feedstuffs. Technically, forage and herbage are defined as plant materials, with high fiber content, available for consumption by animals. The National Research Council classifies roughage as a feedstuff with a minimum crude fiber content of 18% and a maximum content of total digestible nutrients (TDN) of 70%.

Roughages provide a range of nutrients to animals. They also function to maintain and optimize the efficiency of the GI tract for selected species. Fibrous carbohydrates function to maintain structure, activity, and microbial population of the GI tract, essential for optimal function of the GI tract. Roughages are a link to the efficient utilization of earth's resources. Roughages alone are of minimal value to
humans. However, roughages consumed by selected species provide a means for conversion of relatively low-quality raw materials to relatively high-quality products such as food and fiber that may be used to fulfill human needs.

Roughages may be fed either in a fresh, dried, or ensiled state. Types of roughages used as feedstuffs include grazed roughages (e.g. pasture and range), preserved roughages (e.g. hay and silage), and crop residues and by-products (e.g. Straw, Stover, and Hulls). Roughages are high in fibrous carbohydrates such as hemicelluloses and cellulose. Fibrous carbohydrates are primarily present in the cell wall of the plant cell. As fibrous carbohydrates are associated with the structural components of plants, fibrous carbohydrates are often referred to as structural carbohydrates. Roughages may also contain relatively high amounts of lignin. Lignin content increases with plant maturity.

In a nutrition analysis, the fiber components of roughages may be expressed as crude fiber, acid detergent fiber (ADF), and/or neutral detergent fiber (NDF). Crude fiber contains cellulose and a portion of the lignin. ADF contains cellulose and lignin. NDF contains hemicellulose, cellulose, and lignin. The plant cell contents also contribute to the roughage. The cell contents include such components as non fibrous carbohydrates, proteins, and lipids.

The non fibrous carbohydrate content is comprised of simple sugars (i.e. fructose, glucose, and sucrose), starches, and/or fructosans. The protein component in forages is comprised of both true protein and non protein nitrogen compounds. Protein content varies by roughage; from 2% up to 30% on a dry matter basis. In general, the protein content of legumes is greater than the content of grasses.

The mineral content of roughages is influenced by roughage and mineral content of the soil. In general, compared to concentrates, roughages are higher in calcium, potassium, and micro minerals and moderate to low in phosphorus. Legumes have a higher calcium and magnesium contents compared to grasses. Regarding vitamins,
compared to concentrates, roughages are higher in fat-soluble vitamins. Roughages are also a good source of the B-complex vitamins.

Roughages may contain one or more antinutritional factors such as alkaloids, cyanogenic glycosides, toxic amino acids, and/or mycotoxins. The nutritional value of roughages varies. In addition to other factors such as plant species, the nutritional value of roughages depends on the proportion of cell contents to cell wall components and on the extent of cell wall lignification. Most roughages can be effectively incorporated into at least one type of ration. Effective use of roughage requires matching nutrient requirements of an animal with the nutritional value of roughage. Effective use of roughage also requires appropriate processing and supplementation.

As the population of rumen microorganisms is dependent upon the feedstuffs consumed, the composition of the diet influences the extent and rate of digestion of roughages. Feeding of high-energy feedstuffs has a negative associative effect on the degree of utilization of roughage. A negative associative effect occurs when the addition of one feedstuff negatively influences the utilization of another feedstuff.

One of the primary species responsible for the digestion of roughages is cellulolytic bacteria. The primary end-product of digestion of roughages is acetate. Acetate is a relatively weak acid. The primary end-product of fermentation of high-energy feedstuffs is propionate. Propionate is a relatively strong acid. An additional end-product of microbial fermentation of high-energy feedstuffs is lactate. Lactate is also a strong acid.

Compared to roughages, the digestion rate and extent are higher and the resultant pH of the rumen is lower for high-energy feedstuffs. The lower pH has a negative effect on the microorganisms responsible for digestion of roughages; the cellulolytic microbes are inhibited by a pH of 6.0 or lower. Therefore, the incorporation of high-
energy, high-non fibrous carbohydrate feedstuffs decreases the utilization of roughages.

Management strategies to increase the utilization of roughages include:
i) addition of buffers, such as bicarbonate, to the diet;
ii) increasing particle size of roughage to increase the production of bicarbonate in the animal; and/or
ii) reducing the rate of fermentation of high-energy feedstuffs either by substitution with another feedstuff or applying an alternative method of processing.

As with other feedstuffs, addition of roughages to rations is dependent on the GI tract. As roughages are high in fibrous carbohydrates and microbial enzymes are required for digestion of fibrous carbohydrates, Utilization efficiency of roughages is dependent on the site and extent of microbial fermentation in the GI tract. Roughages are primarily added to the rations of herbivores. The proportion of forage in the ration varies with species and class of animal and also cost of feedstuffs. Based on the relatively high utilization efficiency of roughages in the GI tract and roughages are a source of fibrous carbohydrates to maintain optimal functioning of the GI tract.

Generally, roughages are added to ruminant rations. Although the utilization efficiency is less, roughages are also used in the rations of horses. In the horse, the caecum is the primary site of microbial fermentation. As the caecum is located posterior to the primary site of absorption, horses may practice coprophagy or consumption of feces to increase efficiency of utilization.

For monogastric such as swine and poultry, the low utilization efficiency limits the use of roughages in rations. Roughages can be added to the ration of swine with low nutrient requirements.
TOPIC 5: USE OF AGRO-INDUSTRIAL BY-PRODUCTS/CROP RESIDUES IN RUMINANT FEEDING

5.1 Why this alternative?

One of the principal limiting factors in ruminant production is feed shortage.

- Forages are known to form a greater proportion of the ruminant's diet but availability of these forages in quantity and quality all year round is limited. This is due mainly to seasonal fluctuations, overgrazing and increased land use by man.

- The high cost of conventional feed resources such as cereals and legume grains prohibit their wide-scale use, especially by small scale farmers.

- Furthermore, the competitive demand for these conventional feed resources as food between livestock and man on one hand and between monogastric animals and ruminants on the other hand limits the quantity of these conventional feeds available for ruminant feeding.

- Population pressure and urbanization, will further limit the quantity of grains available for animal feeding.

- In view of the limitations to the use of conventional feeds for livestock feeding, it is best to resort to the use of those feed resources, which are cheap, less competitive and which the ruminant animal can convert to useful products.

5.2 What definition do we then give to the term “Alternative feed resources?”

Alternative feed resources could be regarded as those materials arising from plant and animal origin which are cheap, not competitive and readily available which can be fed to livestock as to overcome problems of feed shortage and high production cost and at the same time ensuring the preservation of animal health, production
yield and product quality. Alternative feed resources abound which can be used in the diet of ruminants. Most of the feeds available to both man and animals primarily come from plant sources. It is rare that a crop plant can be completely used by man, most do yield some residues and by-products which if properly processed may be consumed by farm animals.

Crop residues are the left-over that result from the harvesting of crops while crop by-products are the resultant materials that arise from the processing of crops. Crop residues and agro-industrial by-products have become an increasingly important way of feeding ruminants due to the scarcity of feeds particularly during the long dry season. The usefulness of these by-products often centres upon their being produced on or near to the farm and upon whether they are available at the right time of the year.

5.3 Agro-industrial by-products
Agro-industrial by-products are waste products arising from the processing of crops or animal product usually by an agricultural firm. The resultant products from these industries are considered as waste since they are of little or no nutritional importance to humans. Agro-industrial by-products in the tropics are abundant and varied and represent a substantial resource for increasing animal production. The use of these by-products for supplementary livestock feeding is justified when the forage supply is inadequate for the animals' needs, either in terms of quantity or quality. Agro-industrial by-products in Nigeria vary from primary processing of farm produce wastes to wastes form agro allied industries. Some of these wastes are left unutilized, often causing environmental pollution and hazard. Those that are utilized do not have their full potentials harnessed. Agro-industrial by products which can be of tremendous use in the livestock industry for feeding animals include brewers dried grain (BDG), palm kernel cake (PKC), maize offal (MO), wheat offal (WO) and cassava peels (CP). As grain production remains insufficient to meet human and animal feeding, the alternative is to employ feed ingredients which do not have direct human value. BDG, MO, and WO are by-products of sorghum, maize and wheat processing. They are of
low protein and high crude fibre contents. These are two factors that limit their use in monogastric (poultry and pig) feeding. In contrast however, as due to their ability to digest low quality feeds and roughages, ruminants can utilize these products more effectively than monogastric livestock, and in doing so, they are not competing for human feed resources. The supply of agro-industrial by-products is considerably high but their rate of utilization is dependent on the chemical composition and the species of livestock intended to be fed. Wheat bran/offsals are considered the most common followed by fresh or wet brewers’ grains.

5.4 Constraints to the use of agro-industrial by-products.

Constraints to the use of by-products and crop residues in livestock feeding systems include;
(i) bulkiness - high fibre content
(ii) their location in areas far from where they are needed (accessibility),
(iii) poor nutritive value and
(iv) unsuitability for direct animal use.
(v) Presence of some anti-nutritive/toxic materials that may be harmful to animals when used over a long period.

The issue of the bulkiness and location in areas far from those where the materials are needed has been partially solved by the development of a good network of roads and the opening up of the rural areas for development. As regards the poor nutritive value and non-suitability for immediate animal use, research results have shown that supplementation with molasses, non-protein nitrogen (urea and poultry excrete) and chemical (NaOH) and physical (grinding and pelleting) treatments improve the nutritive value and intake and hence the response of animals to some of these by-products. Physical treatment is considered more useful in improving the nutritive value of these products and it is also a cheaper way of treatment compared to chemical treatments.
Note as highlighted above, that the ways of improving the utilization of agro-industrial by-products include:

- **Use of Chemical treatment** (e.g NaOH). This is especially for cereal crop residues such as rice straws and maize stover
- **Physical treatment** (drying, grinding, pelleting)
- **Supplementation** with molasses, non-protein nitrogen (urea and poultry waste). Adequate supply of nutrients may improve the nutritive value of low quality feeds
- **Ensiling**: The process of conservation of forage under strict anaerobic conditions that would ensure fermentation process. In so doing the fibre in feeds would have been pre-digested thereby enhancing better utilization and release of nutrients.
- **Feed block technology**: this is mainly for those high in moisture content. Several agro-industrial by-products could be mixed together with urea, a binder such as cement and/or quicklime, minerals and vitamins.

### 5.5 Urea utilization in livestock feeding

It has been known for quite a long time that urea can be recycled and used as a source of nitrogen for the rumen microorganisms.

- Urea is used in ruminant feeding both as fertilizer grade as well as feed grade. It can be administered through feed along with other feed ingredients in a compounded ration
- Urea can also be given as liquid nitrogen i.e. it could be dissolved in H2O and offered as drinking water to the animals.
- It could also be constituted as urea-molasses multi-nutrient feed block held together by a binder. The animal by abrasive licks off urea from the block.
Experiments over the years have shown that urea could be utilized as whole ingredient to feed at levels between 1 to 5% which defines a safe utilization level. Although some other studies has recommended higher levels. For instance, Onwuka and Akinsoyinu (1989) recommended 10% level of urea while Leng and Preston (1980) recommended 10 – 15% level. When urea is used as a component of feed block, the level of urea may be as high as 40%.

TOPIC 6: NUTRITIONAL DISORDERS IN RUMINANT ANIMALS

Ruminant animals have been noted to possess capability to utilize or convert waste resources into beneficial products such as meat, milk, hair among others. This is feasible as long as the animal is provided with good housing, feeding and hygiene. A number of nutrient related metabolic diseases have been studied under experimental conditions with ruminant animals. They include dysphagia, abortion, ketosis, enterotoxaemia, milk fever, urinary calculi, toxic plants etc. These diseases are always related to the absence of one or many nutrients from the feed given to the animals. It may be as a result of inadequate feeding of animals resulting in Marasmus otherwise known as malnutrition. This may eventually lead to more complex situation resulting from generalized starvation of the animal. At times, the animal may be fed adequately but with the feed lacking a major nutrient as in Kwashiorkor otherwise known as prolonged insufficient intake of protein. In this case, there is a negative nitrogen balance because the nitrogen output exceeds that of input. The rate of tissue breakdown therefore, becomes accelerated. In some cases, a minor nutrient may be lacking as we have in the following diseases:

6.1. Dysphagia

Ruminant animals during grazing are sometimes being observed to consume or lick materials which in nutritional terms are inert materials. Such could be manifested as the licking of bones, stick, paper eating as well as soil eating. These behavioral
symptoms are traceable to deficiencies of phosphorus in the diet of such animal. Such phosphorus deficiency could be aggravated by an imbalance in calcium: phosphorus ratio (Ca: P) or an excessive demand of the animal for calcium altering the Ca: P ratio from the normal of between 1.5:1. If the situation is not properly aged, the material which is consumed or licked could harm the animal. The disease dysphasia also results in metabolic symptoms similar to those of phosphorus deficiency which include:

i. Muscular weakness
ii. Low fertility and
iii. Low productivity

The practical and effective solution to the menace of dysphagia on the farm is:
- Introduction or inclusion of adequate amount of phosphorus in the diet.
- The Ca:P ratio of ruminant ratio should always be kept between a range of 1.5:1 to 2:1

6.2. Abortion

This is a condition which results in the expulsion of life or dead foetus by pregnant animals. Among several factors, nutrition stands out as a major cause. In pregnancy, the foetus develops over time and this calls for increase calcium, phosphorus and other nutrients. When the feed is unable to supply required quantity of these nutrients, the foetus development is affected and may be expelled. The level of blood glucose is also very important in this condition. When an animal is under-fed, the glucose level in the blood becomes lowered and the animals become depressed. There is an elevated/increased production of estrogen. Arising from this, the foetus could be expelled. This is more frequent when the pregnancy is in second trimester, usually between 90 – 110 days in cows.
6.3. Enterotexaemia

This is a metabolic disorder that is otherwise referred to as over-eating disease or toxic indigestion. It brings about diarrhoea, digestive in coordination (staggering or gait), coma and eventual death of the animal. Enterotoxaemia may result from a change in the feed of the animal resulting in consumption of more palatable and digestible feed by hungry animals. It can also be caused by Ca insufficiency in diet as well as acidosis. The disease can also be built up as a toxic reaction to the microorganism *Clostridium perfringens*. Enterotoxaemia condition can be prevented by frequent feeding of palatable feed such as milk, concentrate and succulent forages as well as hay in small bits at a time.

(a) In other words, offering of large quantity of milk or concentrates to animals at a time should always be avoided.

(b) When changes are to be made to concentrate feed to ruminant animals, a gradual introduction is recommended over a number of days. This is more relevant when urea is to be introduced to the animal at the first time and at high level. In this case, the animal may need a minimum of 3 weeks to adjust. A situation referred to as Lactic acidosis could result when the PH level in the rumen drops to about 4.8 and this only favours a specific class of microorganisms.

6.4. Ketosis

This is a nutritional condition in which there is an increase quantity of ketone bodies in the blood of animals. Such ketone bodies include acetone, aceto acetic acid, B-hydroxybutyril acid. When their levels increase in the blood or milk, the metabolic disorder is referred to as Ketosis. Ketosis can also be associated with increase level of non-esterify fatty acids in the plasma since these are known to be the precursors of Ketone bodies. This condition is very common in dairy goats and cows that are high yielding, in which case it is referred to as LACTATION KETOSIS. Pregnancy ketosis
also occurs in pregnant cattle, sheep and goat that are carrying multiple fetuses. Ketosis could be controlled and prevented by intravenous administration of glucose and renocurticotropic hormone or gluco-corticoid steroids.

6.5. Milk fever

This is otherwise referred to as 'parturient paresis' because it manifests soon after parturition, as an increase in the blood flow to the mammary gland. In high yielding animals, milk fever could be caused by a drop in calcium level. Consequently, the disease could easily be treated by introduction of calcium into their diets. It could also be treated through administration of vit. D. Milk fever is not common where milk production is less intensive.

6.6. Urinary calculi

This disease is associated with stone formation along the urinary tract which endangers or brings about infection of the urinary tract. With the formation of stone there is the blockage of the urinary tract. It is more noticeable in confined animals than those which graze from time to time. This condition occurs more in males and can be associated with high feed phosphorus relative to Ca:P content of the feed. The ideal Ca:P is 1:5:1 for ruminant animals and when this is not conformed with the tendency is for the animals to start building up little stones progressively along the urinary tract. Thus, the best antidote against urinary calculi is a balanced Ca:P ratio particularly in zero-grazed animals.

6.7. Urea toxicity

This disease refers to in ability of ruminant animals to cope with excess level of urea in their feed supplements arising from which large quantities of ammonia is produced resulting in brain derangement. It could also occur or manifest when such a feed
does not possess sufficient quantity of readily available energy to cope with the rate of ammonia release. To prevent this disease, therefore

(i) The urea level of feeds must be reduced or kept at minimum (ii) Acid infusion into the rumen has been used in many cases to counter the effect of urea toxicity.

6.8. Toxic plants

Much as it is being advocated that ruminant animals should always be grazed on forage for economic production, one needs to note that some plants are very toxic and can instantly result in death of animals. Such reaction is usually derived from the content of anti metabolite or toxins in the leaves of plants. Under normal condition, these toxic constituents are used as protective mechanisms by the plants themselves. The outstanding examples are:

- Hydrocyanic acid (HCN) contained in the leaves of high cyanide variety of cassava.
- Tannins found in almond leaves
- Tannins found in sorghum
- Nitrate and Nitrite in some leaves as well as oxalate and phytate. These toxicants influence the bio-availability of Ca, P, Mg, Cu, Zn, Mn, Co etc i.e. Minerals. Cases have been cited of goats that died within 3 hours after consuming cassava leaves.

Such effects can however, be overcome through.

- Wilting or partial drying
- Inclusion of sulphur to assist in detoxification
- When some of the effects are noticed which may include foaming in the mouth or prostration, palm oil could be administered to assist in reducing the surface tension of the rumen environment.
6.9. Bloat
Bloat is the manifestation of accumulation of gas in the reticulo-rumen due to the rate of gas elimination falling behind the rate of gas production. In legume bloat for example, the primary abnormality responsible for inefficient gas elimination is excessive frothing of the gastric contents. Some frothing of the reticulo-rumen contents always occurs when succulent legumes are ingested, but this foam is not always of the required consistency or sufficient in amount to cause bloat. Occasionally, however, the frothing is of such magnitude that there is a large increase in the volume of stomach contents and a change in their physical characteristics, and bloat results. Gas elimination is impeded by the trapping of gas in the foamy digesta, by interference with the access of free gas to the cardiac, and probably by reflex inhibition of oesophageal components in eructation. In the bloating animal, frothy digesta may enter the oesophagus only to be swallowed again; in effect, the foam is returned in the stomach until the former collapses.

Conclusions

1. Feed consists various components called nutrients
2. The different types of nutrients are carbohydrates, fats, proteins, vitamins and minerals,
3. The three forms of feed are dry, green and high moisture.
4. Ruminant animals use a lot of roughage and have a four part stomach
5. Non-ruminant animals have a simple, one part stomach and more concentrates in their ratio.
6. A properly formulated ration supplies adequate amounts of all nutrients.
7. Urea can be recycled and used as a source of nitrogen for the rumen microorganisms
8. Nutritional disorders in ruminants are always related to the absence of one or many nutrients from the feed given to the animals.
**Additional References**


**Exercise 1 / Activity 1**

1. 
2. 
3. 
Discussion 1
1.
2.
3.

Answers to Exercise 1
1.
2.
3.

Answers to Discussion 1
1.
2.
3.
UNIT 3
IDENTIFICATION OF GRASSES AND LEGUMES

Introduction

This unit provides information on some important characteristics of pasture grasses, features of grasses and legumes, arrangement of spikelets into a flower head or inflorescence, species of grasses and legumes, the roles of legumes in mix pastures.

Learning outcomes

At the end of this unit, students able to:

1. Differentiate the differences characteristics of grasses and legumes
2. Identify species of improved grasses and legumes.
3. Identify species of palatable weeds
4. Differentiate features of grasses and legumes
5. Understand the role of legumes in grass-legume mixed pastures
Main points

Topic 1. Background
Topic 2. Grasses structure
Topic 3. Species of grasses
Topic 4. Species of legumes

TOPIC 1: BACKGROUND

Nutrition can be defined as the process by which an organism obtains food which is used to provide energy and materials for its life sustaining activities. Food consists of various components which carry out varied functions as required by the body. These different components are called the nutrients. The different types of nutrients are carbohydrates, fats, proteins, vitamins and minerals, which carry out different functions. Carbohydrates, lipids and proteins are macronutrients because they are the energy sources for the production of heat and also other organic functions. Minerals, vitamins and water are micronutrients because though they are not energy sources, their absence or deficiencies cause specific diseases and abnormalities in man. Energy production, carbohydrates, fats and to some extent protein store energy and are metabolized to give energy. Proteins and minerals are responsible for synthesis of materials for growth and maintenance of tissues. Vitamins and minerals are responsible for regulating and coordinating the various activities of an organism along with enzymes (proteins).
1.1 Grasses
Family - Poaceae

The grasses: chiefly herbaceous but some woody plants including cereals; bamboo; sugarcane. Synonyms: Gramineae, family

The basic unit of grass growth is a tiller. A tiller comprises leaves (usually around 3), emerging from a leaf sheath, and roots. A bunch grass plant is a collection of tillers e.g. ryegrass, orchard grass, smooth brome grass. Sod-forming grasses also produce above-ground 'creeping' stems (stolons) e.g. Brachiaria decumbens, Brachiaria humidicola and Brachiaria ruziziensis grass, or under-ground stems (rhizomes) e.g. Guatemala grass. The growing point of the tiller is at ground level - and generally protected from mowing or grazing.

1.2 Grasses suitable as ruminant feed
- Comprise of herbaceous materials that are easily grazed and digested
- Fulfills nutrient requirements
- No toxic constituents
• Able to regenerate after cutting or grazing
• Continuous growth habit
• Spreads by rhizomes or stolons, rapid ground coverage

1.3 Why grasses are able to re-grow after being cut or grazed?
• Produce fresh shoots (tillers) that replaces cut portion.
• Non-reproductive shoots have growing points at base of plant that are not damaged by cutting or grazing.
• Rhizomes and stolons are not affected by cutting or grazing.

1.4 Important Characteristics of Pasture Grasses
• Growth habit – upright, creeping, rhizomatous
• Utilization – grazed, cut and carry, both
• Ecological adaptation – dry areas, wet areas, sandy
• Propagation – by seeds or vegetative only
• Nutritive value – protein, digestibility, minerals
• Toxic components
• Compatibility – can be grown with legumes?

1.5 Features of Poaceae
• Either annuals or perennials.
• Alternate leaves with extended blades and clamping sheath
• Stems, or culms, are normally hollow and round, and enclosed by leaf sheaths.
• All species have parallel leaf venation.
TOPIC 2: GRASS STRUCTURE

2.1. Stem
Grass Stems - are mostly hollow, cylindrical and interrupted at intervals by swollen joints or nodes. Stems are rarely branched above the ground and are called culms.

Some grasses have stems which creep along the surface of the ground and give rise to new shoots (TILLERS) at their nodes. The horizontal stems are called stolons.

2.2. Leaf
The leaf blade is usually long and narrow, with parallel sides and veins and tapering to a pointed or blunt tip. At the junction of the sheath and blade there is a small membranous flap of tissue called the ligule. This is sometimes just a fringe of hairs.
Leaf Venation

Venation is the pattern of veins in the blade of a leaf. The veins consist of vascular tissues which are important for the transport of food and water. Leaf veins connect the blade to the petiole, and lead from the petiole to the stem.

Ligules

Ligule: a thin membrane or a row of hairs at the junction of leaf blade and sheath

2.3. Flower

The flower is usually bisexual. It consists of an ovary containing 1 ovule (the female part). The ovary is usually surmounted by two feathery stigmas and is surrounded by three stamens. Each stamen (the male part of the flower) consists of an anther and a filament. The flower is protected by two sets of scales. The first set consists of the lemma and the palea which enclose the flower. This whole structure is called a floret
One or more florets may be arranged on an axis (the rachilla), with all of the florets being protected by a second set of scales at the base called glumes. The glumes enclose the florets before they are mature. The whole unit is called a spikelet. The Lemmas (of individual florets) and/or the glumes, may have bristle-like extensions called awns arising from them.

**Arrangement of spikelets into a flower head or inflorescence**

When the spikelets are borne on stalks on branches from the main axis, the flower-head is called panicle.

If the spikelets are stalked directly on the main axis, then the flower-head is a raceme.
Where there are no stalks, and the spikelets are seated on the main axis itself, the flower-head or ear is known as a spike.

Different forms of inflorescences

A: Panicle (Bluegrass, bentgrass)

B: Raceme (bahiagrass)

C: Spike (perennial ryegrass)
2.4. Roots

2.5 How grasses grow

New growth in grasses occurs in three different ways, from three different meristems or zones of growth. New tillers grow from axillary buds at the base of the plant, new leaves grow from apical meristems inside the stems, and intercalary meristems are secondary zones of growth at the base of the internode, sheath and blade. These are growth regions inserted between mature tissues.
TOPIC 3: SPECIES OF GRASSES

- Morphological types
  - Bunch or tufted
  - Stoloniferous

TUFTED

3.1 Elephant (Napier) - *Pennisetum purpureum*

- Origin - Tropical Africa
- Properties
  - Feeding value influenced by the ratio of leaf to stem and age
  - Digestibility 70% for young leaf, declined to less than 55% for old
- Description
  - Tall robust, erect and perennial
- Propagation
  - Vegetative - cutting
  - Cutting - 2-3 nodes and buried
  - Planting distance varies (50 -200 cm x 50 - 100 cm)
- Harvesting
  - Usually offer fresh to animal
  - Can harvest year-round (best at 45 days)
• Yield
  - Expected DM yield 2-10 t/ha for unfertilized or slightly fertilized
  - 20-40 t/ha DM for well fertilized

3.2 Guinea - *Panicum maximum*

- Origin
  - East Africa

- Uses
  - Palatable and good quality
  - Uses as grazed and cut and carry

- Properties
  - In Vitro digestibility 64%, 58%, 54% and 50% at 2, 4, 6 and 8 weeks

- Description
  - An erect or ascending perennial tussock grass
  - Tall - 1 - 3 m

- Growth
  - Poor seed production, as low as 50 kg/ha in wet tropics
  - Seed ripen unevenly

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- Propagation
  - Sowing seed at 2 - 3 kg/ha
  - Vegetatively planting 2 - 3 rooted tillers
- Harvesting
  - Grazed fresh/stall feeding
  - Conserved as silage and hay
- Yield
  - In Malaysia, DM Yield range 16 - 30 t/ha
  - Well managed grass can support 1000 kg/ha/live weight

3.3 Setaria

- Cultivar
  - Setaria sphacelata cv Kazungula
  - Setaria sphacelata cv splendida
- Description
  - Tufted
  - Setaria sphacelata cv splendida - sterile

a. Setaria sphacelata cv kazungula
b. Setaria sphacelata c.v splendida
STOLONIFEROUS

3.4 *Brachiaria decumbens* (signal grass)

- **Origin**
  - East Africa (Uganda, Kenya, Tanzania, Rwanda, Burundi, Zaire)

- **Uses**
  - Permanent pasture - grazed
  - Soil erosion control

- **Properties**
  - Low growing, rhizomatous and stoloniferous
  - Well adapted to the humid and sub-humid tropics
  - Withstand to dry season up to 5 months
  - Toxic to sheep and goat
3.5 *Brachiaria humidicola* (Korovia)

- **Origin**
  - Eastern, Southern Africa

- **Uses**
  - Permanent pasture - grazed
  - Erosion control
  - Ground cover in the tree plantation

- **Properties**
  - Very low N concentration (0.6 - 1.0%) which can severely limit forage intake by ruminant
  - Shade and poor drainage tolerant
  - A prostrate, strongly stoloniferous and rhizomatous perennial
  - No toxicity to sheep and goat
3.6 *Brachiaria ruziziensis* (Ruzi)

- **Origin**
  - From Ruzizi valley in eastern Zaire and Burundi

- **Uses**
  - Permanent pasture - grazing

- **Properties**
  - Palatable and excellent quality
  - Moderately shade tolerant
  - Tufted, Creeping perennial
  - Stem leafy and hairy
  - Soft leaf - Look palatale
3.7. *Brachiaria mutica* (Para)

- **Origin**
  - West Africa and Brazil

- **Agronomy**
  - Grow well under warm, moist conditions
  - Tolerance to waterlogging
  - Seed viability is very low
  - Responsive to fertilizer
  - Established from cuttings
TOPIC 4: SPECIES OF LEGUMES

Family: Leguminoseae
Legume, common name for any plant of the family Leguminosae, which is also called the pulse legume, pea, or bean family.

Botanically, a legume is the characteristic fruit of the pulse family plants. It is a pod which usually splits along two sides, with the seeds attached along one of the sutures.

4.1 Features of Leguminoseae

Numbering about 650 genera and 17,000 species. The leaves are usually compound; the fruit is a legume (a type of pod); and the blossoms may have an irregular butterflylike (papilionaceous) shape. Typically, the flowers have 10 stamens, and the corolla and the calyx are formed of 5 petals and 5 sepals, respectively. Some species have thorny branches.

4.2 Growth habit of legume

Creeping: (Arachis pintoi)
Trailing/Climbing: (Centrosema pubescens)
Upright: (Stylosanthes guianensis)
Tree/Shrub: (Leucaena leucocephala)
4.3 Species of legumes

*Arachis pintoi*  
*Centrosema pubescens*

*Stylosanthes guianensis*  
*Leucaena leucocephala*

a. *Arachis pintoi*
- Origin - Central Brazil
- High tolerant to shade - pasture legume in tree plantation
- Currently used for landscaping
- Propagated by seed and cutting

DM yield 3 t/ha in full sunlight (Malaysia) and 5 t/ha in pure stands 30% shade (Indonesia)
b. Centrosema pubescens (Centro)
   - Originating from South and Central America
   - Has been used as green manure and plantation ground cover
   - N fixer with N concentration ranging 2.4 - 2.7%
   - A vigorous, climbing, perennial herb

c. Stylosanthes guianensis
   - Natural distribution from northern Argentina to Mexico
   - Used as pasture legume, cover crop in plantation and green manure
   - N concentration (1.5 - 3.0%); DM digestibility 60 - 70%
   - Adapted to hot and humid climate
   - Used for grazing/cut and carry

d. Leucaena leucocephala
   - Foliage is fed to ruminant animal as browse or cut and carry or milled for poultry pellet
   - Good digestibility and high protein value
   - Contain amino acid “mimosine” which has antimitotic and depilatory effect on animal

Conclusions

1. The grasses: chiefly herbaceous but some woody plants including cereals; bamboo; sugar cane.
2. Able to regrow after cutting or grazing, Spreads by rhizomes or stolons, rapid ground coverage
3. Produce fresh shoots by tillering that replaces cut portion
4. Either annuals or perennials
5. All species have parallel leaf venation
6. Some grasses have stems which creep along the surface of the ground and give rise to new shoots (TILLERS) at their nodes. The horizontal stems are called STOLONs.

7. If the horizontal stems go underground, they are called rhizomes.

8. The flower of grass is usually bisexual.

9. Botanically, a legume is the characteristic fruit of the pulse family plants, called also leguminous plants. It is a pod which usually splits along two sides, with the seeds attached along one of the sutures.

10. The leaves are usually compound;

11. Nitrogen fixation is very beneficial; it supplies the legume with nitrogen.

12. It can significantly decrease spending on N-containing fertilizers for the subsequent crops.

Additional References


Exercise 1 / Activity 1

1.

2.

3.
Discussion 1
4.
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Answers to Exercise 1
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8.

Answers to Discussion 1
4.
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6.
UNIT 4
GRASS PLANTING

Introduction

This module is designed to provide information on the planting of improved grass species. Generally there are 4 essential steps to be followed for establishing improved tropical pastures; preparation of land, preparation of planting material either by using seed or vegetative material, sowing or planting, and management of the forage crop during establishment period. Pastures usually require a well-prepared seedbed for good germination and establishment. If vegetative planting materials are used a rougher bedding is tolerated. Land preparation can either be done manually or mechanically depending on the size of the area to be cultivated. The most important factor in controlling germination, other than the viability of seed, is the soil moisture conditions before or after sowing or planting. Thus the choice of planting time coinciding with rain is critical. Temperature is unlikely to limit pasture seed germination in Malaysia.

Fertilization is necessary for pasture and fodder establishment. In Malaysia, it is recommended to apply 60 kg N, 30 kg P and 30 kg K for successful establishment of grasses which normally takes about three months. For the legumes and grass-legume mixtures, 30 kg P, 30 kg K and 2000 kg of lime are necessary for the initial growth period before first cutting or grazing commences. Phosphorus and lime, if necessary, are incorporated into the soil before or at planting time.

Planting grass species using vegetative planting materials would require about a ton of the planting material for every hectare of land. When seeds are used, the seeding rate is usually between 2-6 kg per hectare depending on quality and size of the pasture seeds.
Selection of planting materials depends on the size of the land to be planted with and also the availability and price of pasture seed is high and almost frequently has to be imported from other countries; vegetative propagation is preferable for small pieces of land or in the backyard.

**Learning outcomes**

At the end of this unit, students able to:

1. Understand the essential steps to be followed for establishing improved tropical pastures.
2. Differentiate pasture planting using vegetative materials and seeds.
3. Know the fertilizer requirement during establishment.
4. Describe management of the pasture crop during establishment period

**Main Points**

Topic 1: Pasture management;
Topic 2: Land preparation
Topic 3: Methods of planting
Topic 4: Harvesting/cutting pasture and fodder
Topic 5: Fertilizer
TOPIC 1: PASTURE MANAGEMENT

The main factor to consider before undertaking ruminant rearing is feed, where the main components are pasture grass and fodder. Animals need sufficient quality and balanced diet to ensure maximum health, reproduction and production of milk and meat. In order to achieve this, the species of pasture and fodder of high quality and of high yield need to be produced as feed for the ruminants. Critical planning regarding animal feed to increase efficiency for easy management of livestock and to upkeep the quality of production to an economical level should be undertaken.

The objectives in pasture management are to secure maximum quantity of nutritious animal feed, which is distributed as widely as possible throughout the year, and to maintains this high level of production as long as possible.

1.1: The six main pasture and fodder problems;
   1. Forage dry matter yield
   2. Forage quality
   3. Seasonal distribution of forage production
   4. Forage utilization
   5. Stability or resistance of pasture
   6. Economics of production

1.2: Characteristics of high quality pasture and fodder
   i. High yield all the time (i.e. dry matter content)
   ii. High nutrient value especially crude protein content
   iii. High digestibility
   iv. High resilience, can withstand bad conditions like drought, overgrazing but easy to maintain
   v. Fast growth rate
   vi. High leaf to stem ratio
   vii. Can be easily mixed with other species esp. legumes
viii. Economical
ix. Palatable

1.3: List of grasses and legumes

**Grasses**

<table>
<thead>
<tr>
<th>Common name</th>
<th>Scientific name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Signal grass</td>
<td><em>Brachiaria decumbens</em></td>
</tr>
<tr>
<td></td>
<td><em>Brachiaria humidecola</em></td>
</tr>
<tr>
<td>Para grass</td>
<td><em>Brachiaria mutica</em></td>
</tr>
<tr>
<td>Guinea grass</td>
<td><em>Panicum maximum</em></td>
</tr>
<tr>
<td></td>
<td>cv. - Colonio</td>
</tr>
<tr>
<td></td>
<td>cv. - Hamil</td>
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<tr>
<td></td>
<td>cv. - Typica</td>
</tr>
<tr>
<td>Napier grass</td>
<td><em>Pennisetum purpureum</em></td>
</tr>
<tr>
<td>Kazungula grass</td>
<td><em>Setaria sphacelata</em></td>
</tr>
<tr>
<td></td>
<td>cv. kazungula</td>
</tr>
<tr>
<td>Splendida grass</td>
<td><em>Setaria sphacelata</em></td>
</tr>
<tr>
<td></td>
<td>var. splendida</td>
</tr>
<tr>
<td>MARDI Digit/Pangola grass</td>
<td><em>Digitaria setivalva</em></td>
</tr>
</tbody>
</table>

**Legume**

<table>
<thead>
<tr>
<th>Name</th>
<th>Scientific name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Centro</td>
<td><em>Centrosema pubscens</em></td>
</tr>
<tr>
<td>Stylo</td>
<td><em>Stylosanthes guianensis</em></td>
</tr>
<tr>
<td>Puero / Kudzu Tropic</td>
<td><em>Pueraria phaseoloides</em></td>
</tr>
<tr>
<td>Calapo</td>
<td><em>Calapogonium mucunoides</em></td>
</tr>
<tr>
<td>[pilipil]</td>
<td><em>Leucaena leucocephala</em></td>
</tr>
</tbody>
</table>
1.4: The choice of pasture/fodder and legumes to be planted depends on:
   - Type of livestock (cattle, sheep/goat)
   - Topographical conditions and type of soil
   - Usage i.e. for grazing or cutting

TOPIC 2: LAND PREPARATION

The area should be cleared before land preparation. All plants, timber, tree stumps, roots etc. need to be burnt to ashes. If the area is waterlogged, trenches should be dug to drain the water and if the area consists of small mounds and hills, it should be leveled first. Land preparation can be done mechanically for large areas but for small areas, manual labor will suffice. Land preparation is best done on the onset of the dry season.

2.1: Stages of land preparation
   i. Ploughing
   ii. Harrowing
   iii. Rotovating

2.1.1: Ploughing
These are aimed at cutting and breaking down the earth, turning over the sod completely to expose the earth containing roots of plants and weeds to the sun. This can be done using a 2 or 3 disc plough. This is to ensure complete exposure of the soil containing pests and roots to the sun and to provide ample time to soften and loosen the earth to get a good texture.

2.1.2: Harrowing
This is to break large pieces of soil to smaller piece besides leveling; usually done with a disc harrow at least 2-3 weeks after ploughing.
2.1.3: Rotovating
This is the final stage after combing and breaking down of the soil to smaller pieces, achieved by using a rotovator/ rotary tiller. This is done to achieve a much smaller soil structure especially at the surface, suitable for root growth and development. However, if the soil is already of small texture, this stage is not necessarily done. It is advisable that all left over of wood, tree stumps, roots of trees and plants, stones and rocks are thrown away at every stage of the land preparation and that this work need to be carefully conducted to ensure that:

- the land surface is good with no wood, tree stumps etc as these obstacles can damage farming equipment and cause accidents
- to achieve a suitable soil structure with good air pockets for good circulation and good water holding capacity. These factors are important for healthy root growth and development.
- to get rid of all unwanted weeds.

2.1.4: Liming
Soil with low pH is not suitable for growing grasses including legumes. Most of the land in peninsular Malaysia is acidic i.e. with a low pH. The most suitable pH value required for optimal growth is 5.0 - 7.0. The type of lime normally used is CaMgCO3. Liming depends on the pH value of the soil. At least 3.3 ton metric or 1 ton/ metric per acre of lime is required for an expected rise in pH of 0.5. The use of fertilizer is not encouraged until the acidity is corrected, as acid soil will disturb the absorption of nutrients by the grasses. Liming is done immediately after land preparation is ready, or could be done concurrently during soil rotovation i.e. 2 weeks before planting. Liming could be done using a spinner broadcaster or by hand. Nose and mouth masks should be worn to escape from respiratory problems.

2.1.4: Planting/sowing
Growing of grass is best done during the rainy season. Therefore the rainfall pattern of an area need to be taken into consideration as optimum moisture is required for effective germination and growth. The use of irrigator or sprinkler will help in
maintaining correct moisture without depending too much on the rain. For waterlogged area, drainage is required to drain off excess water.
Seed rates per hectare or distances for planting need to be taken into consideration as these factors will determine good growth and density and preventing growth of weeds.

**TOPIC 3: METHODS OF PLANTING**

There are 2 methods of planting:

i. Using seeds

ii. Using cuttings

**3.1: Planting using seeds**
The species, quality and type of planting determine the quantity of seeds required for a hectare. If the percentage of germination is high, the quantity used will be less.
Below are the seeding rate required for several grasses and legumes (provided the seed is of good quality and properly stored)

<table>
<thead>
<tr>
<th>Type of grass &amp; rate of sowing (kg/hectare)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
</tr>
<tr>
<td>Brachiaria decumbens</td>
</tr>
<tr>
<td>Brachiaria humidecola</td>
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<tr>
<td>Brachiaria mutica</td>
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<tr>
<td>Panicum maximum</td>
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<tr>
<td>Setaria</td>
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<tr>
<td>Legume</td>
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<td>Ipi-iipi</td>
</tr>
<tr>
<td>Centro</td>
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</tbody>
</table>
In a mixed pasture the ratio of grass to legumes should not exceed 40%.

**TOPIC 4: HARVESTING/CUTTING PASTURE AND FODDER**

**4.1: First Cut**
The first cutting/grazing depends on several factors such as the species and fertility of soil of pasture. Too early cutting/grazing will damage the growth of grasses due to the weak root system. Generally it could be done a few days before flowering. This can be predicted by observation i.e. when a small proportion of the grasses in the area start to flower. At this stage the percentage of dry matter and crude protein content are at the highest.

**4.2: Cutting Intervals**
The rate of growth after cutting reaches a much higher optimum level compared to freshly grown grass. The flowering stage is a good sign to determine the time for cutting. Based on experiences and studies conducted, below are resting period or the intervals between each cutting or grazing of several kinds of pasture or fodder that is deemed suitable for practice to ease management.

<table>
<thead>
<tr>
<th>Types of pasture /fodder</th>
<th>Cutting Intervals (weeks)</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Brachiaria decumbens</em></td>
<td>3 - 4</td>
</tr>
<tr>
<td><em>Pennisetum purpureum</em></td>
<td>6 - 7</td>
</tr>
<tr>
<td><em>Brachiaria mutica</em></td>
<td>3 - 4</td>
</tr>
<tr>
<td><em>Panicum maximum</em></td>
<td>4 - 5</td>
</tr>
<tr>
<td><em>Setaria</em></td>
<td>4 - 5</td>
</tr>
</tbody>
</table>
Besides the fertilization factor which is recommended for most types of pasture/legumes with rapid growth is 10-15 cm. The first cutting for Napier grass is 7 cm above the ground, to allow for more growth of new shoots. The next cutting can be done at a height of 10-15 cm above ground.

4.3: Dry Matter yield

Below is the average dry matter yield (ton/hectare/year) of different species of pasture/fodder at 6 weeks cutting interval:

<table>
<thead>
<tr>
<th>Pasture/Fodder</th>
<th>Average dry matter yield (ton/ha/yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Signal grass</td>
<td>16.5</td>
</tr>
<tr>
<td>Para grass</td>
<td>12.1</td>
</tr>
<tr>
<td>Guinea grass cv. Colonio</td>
<td>18.5</td>
</tr>
<tr>
<td>Guinea grass cv. Hamil</td>
<td>20.0</td>
</tr>
<tr>
<td>Napier grass : - Local</td>
<td>25.0</td>
</tr>
<tr>
<td>Kazungula grass</td>
<td>17.0</td>
</tr>
<tr>
<td>Splendida grass</td>
<td>19.0</td>
</tr>
</tbody>
</table>

**TOPIC 5: FERTILIZATION**

Fertilization means increasing or replacing of nutrients required by plants (Nitrogen, phosphorus and potassium) to the soil so that these elements can be taken and used by the plants for optimum growth. Besides that, fertilization is also for

- a continuous high quality and high yield
- a long life
5.1: Types of fertilizer
- Organic fertilizer
- Chemical fertilizer

5.2: Types of fertilization
1. Initial/basal fertilization
2. Maintenance fertilization
Basal fertilization is applied during planting. It is aimed at improving/encouraging root establishment besides producing healthy and vigorous plants.

5.3: Rate of fertilization
Generally the rate that is recommended for pure grass in peninsular Malaysia is:
N:P:K = 60:30:30
60 kg Nitrogen/hectare
30 kg Phosphorus/hectare
30 kg Potassium/hectare
The rate of basal fertilization depends on several factors. Land originating from virgin forest that is recently cleared usually contains high nutrient contents. Only phosphates need to be added to this type of soil to improve root development. The types of fertilizer used are Triple Superphosphate, Christmas Island Rock Phosphate and Ground Rock Phosphate.

The rate of initial fertilization recommended for mixed pastures with legumes are:-
P:K = 30 : 30

<table>
<thead>
<tr>
<th></th>
<th>30 kg. Phosphorus/ha</th>
<th>(65 kg. Triplesuperphosphate/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>P</td>
<td>30 kg. Potash/ha</td>
<td>(50 kg. Muriate of Potash/ha)</td>
</tr>
</tbody>
</table>

73
Liming is necessary to correct the pH of the soil for mixed pastures. If the pH is below that 4.5 the amount required is 2-3 tons per hectare.

**Conclusions**

4. Types of planting materials to use in grass planting.
5. Either annual or perennials
6. Good seed-to-soil contact is essential to maintain adequate moisture near the seeds
7. A properly prepared seedbed is a key step in pasture establishment.
8. A good rule is to plant the seed three to four times as deep as the diameter of the seed.
9. To obtain a good establishment, use seed that is pure, has a high germination rate, and has not been stored for a long period of time.
10. It is important to control weeds during establishment because newly emerged forage seedlings are extremely susceptible to weed competition.
11. Allow plants to become well established before heavy grazing or set stocking.
12. To maximize quality and production, select those management practices that best fit your area, soil, climate, and forage crop.

**Additional References**

Exercise 1 / Activity 1
1. 
2. 
3. 

Discussion 1
1. 
2. 
3. 

Answers to Exercise 1
1. 
2. 
3. 

Answers to Discussion 1
1. 
2. 
3.
UNIT 5
SILAGE MAKING

Introduction

This module is designed to provide information on the valuable role of silage as a pasture management tool; the need to improve pasture utilisation and increase productivity per hectare; capacity to cut earlier in the season and produce a higher quality product compared to hay production; ability to spread the harvesting period over a longer period than for hay; reduced losses of dry matter and quality during field and harvesting operations and reduced susceptibility to adverse weather compared to hay; silage can be a high quality supplement for ‘out of season’ production; ability to grow a variety of crops for silage production (e.g. maize, sorghum, cereals); this diversity can increase farm productivity to levels higher than possible with pasture alone; and suitability of silage for long-term storage of high quality feed for drought or flood reserves; potential to salvage high quality forage from drought.

Technological advances have enabled farmers to more consistently and more easily produce high quality silage to feed to their livestock. These include: advances in knowledge that have improved silage-making practices (e.g. the importance of rapid wilting and ensuring an airtight seal); improvements in silage-making technology (e.g. plastics, inoculants); machinery developments to improve the efficiency of silage production (e.g. mowers, mower conditioners, tedders, precision chop forage harvesters); more storage options (chopped, baled, bulk or individual sealing) that provide producers with greater flexibility of their silage system; improved mechanisation of silage feedout systems which can significantly reduce labour requirements and wastage; and availability of machinery that allows silage to be fed in mixed rations.
Learning outcomes

At the end of this unit, students able to:

1. Define silage
2. Describe the fermentation process in silage making
3. Identify the crops suitable for making silage
4. Select the most suitable silo for silage making in Malaysia
5. Understand the utilization of silage in ruminant feeding
6. Identify the characteristics of good silage.

Main points

Topic 1. Background
Topic 2. Potential Benefits of silage
Topic 3. Crops Suitable for Silage Making
Topic 4. Types of Silo
Topic 5. Methods of silage making
Topic 6. Characteristics of good silage
Topic 7. Advantages of silage making
TOPIC 1: BACKGROUND

Silage is produced by harvesting a forage crop at high moisture content (greater than 50 percent) and subsequently fermenting that crop in pit, tower, bunker, trench or plastic silos. Ideally, this process should occur in the total absence of oxygen.

Silage is the fermented feed, resulting from the storage of high moisture crops usually green forages under anaerobic conditions. The structure in which silage is prepared is called silo. These are airtight to semi-air-tight structures designed for the storage and preservation of high moisture feed as silage.

Over the last several decades, two primary factors have contributed to the increased production of silage. First, silage-making is much less weather dependent than hay-making. Some forage such as corn or sorghum can be direct cut. After mowing, most other forages can be adequately wilted for silage production in less than 24 hours. This greatly reduces the risk of weather damage to the forage crop.

Secondly, production of silage has been relatively easy to mechanize. This makes the practice quite attractive to large-scale livestock enterprises, particularly those that are based on confinement feeding. However, the efficient production of precision-chopped silage requires a much larger financial investment in equipment, relative to costs associated with hay-making or grazing systems.

Regardless of the amount of capital invested, the purchase and subsequent use of expensive silage-making equipment will not improve forage quality. Forages harvested at advanced stages of maturity will always be poor in quality. To make high-quality silage, producers always must start with high-quality forage.
TOPIC 2: POTENTIAL BENEFITS OF SILAGE

The reasons a farmer makes silage will vary between farms and include personal preferences. The main reasons include:

- the need to improve pasture utilization and increase productivity per hectare;
- the valuable role for silage as a pasture management tool;
- reduced reliance on irrigation water and the need to maximize production per mega liter used;
- capacity to cut earlier in the season and produce a higher quality product compared to hay production; ability to spread the harvesting period over a longer period than for hay;
- reduced losses of dry matter and quality during field and harvesting operations and reduced susceptibility to adverse weather compared to hay;
- market demand for consistency of supply and quality of animal product (e.g. milk, meat);
- silage can be a high quality supplement for ‘out of season’ production;
- ability to grow a variety of crops for silage production (e.g. maize, sorghum, cereals); this diversity can increase farm productivity to levels higher than possible with pasture alone; and
- suitability of silage for long-term storage of high quality feed for drought or flood reserves;
- potential to salvage high quality forage from drought or frost affected crops (e.g. canola, winter cereals).
TOPIC 3: CROPS SUITABLE FOR SILAGE MAKING

A. Corn
Corn is an important crop for silage. The crop is cut when the grain is in pasty condition. Being essentially a crop rich in carbohydrates it does not require the molasses as a preservative.

Since the stems are thick, chopping is essential to ensure good packing of cop in the silo. Silage from an immature crop (14% dry matter) is poorer than from a crop with 30% moisture. The largest yields of total dry matter and digestible nutrients are secured when it is planted more thickly than when grow for grain. The silage from the crop at the wax stage will have a higher energy value than silage from immature crop.

B. Sorghum
Sorghum is the most important fodder crop in silage making. It is more drought resistant than corn and can be grown on soil too poor for corn. The dwarf sorghum varieties can be used both for grain and forage. Young sorghum plants may contain a toxic substance called cyanic acid. When in sufficient quantity, cyanic acid may cause death to cattle or sheep. Sorghum is usually not dangerous if harvested when it is approaching maturity. The toxicity is destroyed to a great extent when the crop is ensiled.

The sorghum is ensiled when the seeds are in milk stage. If the plants are immature, the silage will be too sour. Silage of sorghum has slightly lower feed value than fresh sorghum but is better than hay. The additions of urea at the time of ensiling improve the nutritional value.
C. Napier grass

Of all the tropical grasses, Napier grass is the most widely studied as a forage or pasture species. With the introduction of hybrid Napier into cultivation it has become possible to get high yields per unit areas with more fertilizer and irrigation than with ordinary Napier grass.

The silage of Napier grass has slightly lesser crude protein than the fresh crop. The hybrid variety gives better quality silage from common Napier in terms of digestibility.

TOPIC 4: TYPES OF SILO

Silos are the structures in which silage is prepared. Different types of silo are briefly explained below:

i. Tower silos

It is also called conventional upright silo. Tower silos are round, cylindrical and above ground level. The height however, can be increased according to the availability of fodder.

ii. Pit silos

The shape of pit silo is either cylindrical like tower silo or rectangular but inverted into the ground. It resembles a well. However, in most of the pit silos, half of the portion of their length is kept above ground. These silos are suitable in the areas where water table is not high enough to submerge the forage. If silage is to be made annually, it is better to have a concrete floor making provisions for effluents to escape.
iii. Horizontal silos

Two kinds of silos come under this category: trench and bunker silo

a. Trench silos

Trench silo is similar to pit except the farmer usually has greater length in relation to width. The process of ensiling is also more or less similar to that of pit silo.

b. Bunker silos

As a labour saving measure, bunker type of silos above the ground, usually with concrete floors generally attract the attention of farmers. In other aspects, they are same as trench silos.

iv. Stack silos

This is the simplest method of making silage and it is not a container like other silos. The stack should preferably be circular as this reduces wastage and the diameter should be adjusted to the size of the crop. The stack should be built well, keeping the sides as straight as possible and the whole mass should be packed as tightly as can be managed to avoid excessive wastage at the side and at the top.

TOPIC 5: METHODS OF SILAGE MAKING

5.1. Preparation of forage

The crops which can be used for silage making and the different kinds of silo, have been discussed earlier. In addition to using a sound silo of proper size, those: who make good silage, generally harvest the corps at the proper stage of maturity, cut to
proper length, control the moisture content, add an additive or preservative when needed, roll rapidly, distribute forge uniformly in the silo and seal the silo.

The crop for silage making is generally harvested at the flowering stage when it has the maximum amount of nutrients. For maize it is about the early dent stage. Sorghum is harvested at late dough stage at the earliest. Silage materials containing less than 25% dry matter will form a very sour silage juices during storage, incurring a considerable loss of nutrients. Thus, plants for silage making should be allowed to mature till the dry matter content attains 35-40 per cent.

Silage material should be cut to a proper size in order to fit it in silo and ensure good quality of silage. The length varies from a fraction of an inch to over an inch in length. Grass silages require to be finely chopped than maize or sorghum. Wilted and dry forages and forage with hollow stems should be chopped more finely than forage of high moisture content, thus permitting thorough packing and eliminating most of the air pockets. Moisture content of silage material beyond 60-65% is not desirable. In such a condition, it will be costlier to handle, susceptible to decay and loss of juices and nutrients. Due to high acidity a large amount of silage near the wall is spoiled. Fresh grass should be wilted for 3 to 4 hours on a good sunny day. If weather is not dry enough to allow wilting, mix straw (5-20%) with grass, before filling in the silos. A desirable moisture content can be ensured by combining high and low moisture crops. In some cases, ground grains and dried molasses can be also be used as preservatives.

5.2 Addition of preservatives

Preservatives are those materials which are mixed with the silage material to improve the quality. Some important functions of the preservatives are given below.
• They supply nutrients
• Provide fermentable carbohydrates
• Furnish additional acids which are essential for proper fermentation
• Inhibit the growth undesirable types of bacteria and moulds
• Reduce the amount of oxygen present in silos
• Reduce the moisture content of silage if it is too high
• Absorb some acids which might otherwise be lost in seepage
• Increase nitrogen content of the silage

5.3 Some important preservatives

Molasses
When the lactic acid in silage is about 1-2%, the product is invariably well preserved and palatable because the pH value is usually below 4 and there is no butyric acid. About 1-2% sugar is required to produce this amount of lactic acid. The common and cheapest source of sugar for silage making is molasses.

Urea
Adding urea at the rate of 0.5% of fresh forages, has several advantages including a way to feed urea more uniformly throughout the day than when it is fed with concentrates at particular time. The very idea of adding urea is to enrich the silage with nitrogen as cereal forages are mostly deficient in this element.

Limestone
This is calcium carbonate and may be added at a level of 0.5 to 1.0% to maize silage to increase acid production. It neutralizes some of the initial acids as they are formed, allowing the lactic acid bacteria to perform longer and to produce more desirable acids.
Salt
Salt makes the silage more palatable. It does not inhibit bacterial activity. At the most it may speed up the release of juices from the cells by plasmolysis and thus help to provide conditions suitable for fermentation in the early stage.

5.4 Filling the silo

At utmost care should be taken in distributing the silage material uniformly in the silo. The material should be trampled, especially well near the walls of silo. It is believed that keeping the centre higher than the outside while filling the upper part of the silo loosens the tendency of the silage to draw away from the wall as it settles. To avoid a large amount of spoilage at the top, the silage should be leveled off and trampled thoroughly from the upper few meters. It will be better if leveling, trampling, addition of preservatives are done after every 30 cm layer of packing. If the materials are too dry, sprinkle water over each layer.

The filling of the pit should be completed within the least possible time say one or two days. Avoid filling silo when it is raining. To create favourable anaerobic condition inside the silo, adequate compression of the material through trampling is essential. It helps in driving air pockets from the silo which may otherwise spoil the silage.

5.5 Covering and sealing the silo

It is essential to keep off air from the silage materials of silo. An anaerobic atmosphere in the silo is essential for proper fermentation of silage. Therefore, the silo, should be covered with wet straw, sawdust or other materials and plastered with 15-30 cm thick layer of clay soil. If possible, put plastic sheet before plastering with soil. After covering, weights such as paving slabs, concrete posts and wooden logs should be kept for better compression. Finally a thatch of straw or a roof of simple kind should be erected over silo. Check the seal from time to time and if any cracks are seen, seal them. A small hole should be opened in one corner, near the surface of the silage to allow the carbon dioxide to escape.
5.6 Opening the silo

The silage is ready within the three months time beginning from covering of silo. In case of tower and trench silos, excavation should begin from the entire top surface and in case of bunker silo, silage can be taken out from the front side. Some mouldy material is invariably found at the top and also on the sides.

TOPIC 6: CHARACTERISTICS OF GOOD SILAGE

6.1 Colour
Colour of silage serves as an important index of its quality. A good silage has uniform yellowish green colour. A dark brown colour indicates excessive heating and if colour is black the silage is useless and rotten. Too high moisture content imparts deep green to black colour. In the presence of air, moulds develop on silage and the colour of silage becomes black.

6.2 Odour and texture
Good silage has a clean colour without any objectionable smell. Strong smelling silage is not only poorly palatable but also imparts undesirable smell to milk if served to milch animals. The smell of butyric acid, ammonia or musty odour indicates a considerable loss in feed value. Silage of this kind should be avoided if possible. Too high moisture content may cause foul smell in silage. The addition of preservatives or careful wilting may ensure proper fermentation and a more desirable odour. Silage containing stubble and foreign matters or fodder cut at too late a stage will naturally be less palatable and less nutritious.

6.3 Degree of wetness
Silage having high moisture content (75% or more) contains less feed value per kilogram than silage having low moisture. This may be due to the loss of nutrients
through seepage. If juice runs freely when silage is squeezed in the hand, it indicates that the material has very high moisture content.

6.4 Chemical properties

There are many factors which affect the chemical nature of silage. These include type of crop, age of crop, method of ensiling and degree of compaction of silo. The quality of the silage is most readily assessed by determining its pH value. pH value is the measure of reaction of silage. Good silage has pH value 4.2 or less. At this pH level silage contains good amount of lactic acid (3-13%). In general the butyric acid concentration of good silage is less than 0.2%.

TOPIC 7: ADVANTAGES OF SILAGE MAKING

i. Silage can be made all the year round. Thus it can supply green fodder when other sources are not available.
ii. Green fodder can be kept preserved in succulent stage for any length of time.
iii. Grass silage preserves 85% or more of the feed value of the crop, whereas hay making will preserve much less percentage of nutrients.
iv. During and immediately after monsoon, abundant grass is available. During this season hay making is difficult. Thus grass can be preserved as silage.
v. Silage is very palatable feed and slightly laxative in nature.

Conclusions

1. Silage is fermented, with a suitable moisture content that can be fed to ruminants.
2. It is fermented and stored in a process called **ensiling or silaging**, and is usually made from grass crops, including corn (maize), sorghum or other cereals, using the entire green plant.

3. Silage must be firmly packed to minimize the oxygen content, or it will spoil.

4. Cut the crop early when palatability and digestibility are high.

5. Wilt high-moisture forage to decrease juice and dry matter loss and to increase palatability.

6. Exclude air by rapid filling and chopping to produce good compaction and favour desirable fermentation.

7. The type of silo and harvesting equipment allow rapid filling, good preservation and suitable methods of feeding at a reasonable cost.

8. Cut ensiling costs by adopting efficient harvesting techniques that eliminate the need of a preservative.

**Additional References**


Exercise 1 / Activity 1

1.
2.
3.

Discussion 1

4.
5.
6.

Answers to Exercise 1

4.
5.
6.

Answers to Discussion 1

4.
5.
6.
UNIT 6
INFRASTRUCTURE AND FACILITIES IN RUMINANT FARMING

Introduction
This unit discusses components and alternatives to be considered when establishing a beef cattle facility. Generally, beef enterprises are cow/calf, feeder, or a combination of both. Cow/calf enterprises usually have less investment in facilities than do feeder operations. Feeder cattle facilities require more confinement pens, more automation of feeding systems and less need for roofed shelters.

Cattle handling facilities are used to confine cattle safely and efficiently for close observation and to perform routine health and management procedures. Adequate facilities are an essential part of an efficient cattle operation for any producer who wants to improve marketing, cattle health, and production. A well-planned handling facility can help you save money by making easier practices such as preventive health management, pregnancy testing, implanting, controlling parasites, vaccinating, castrating, and dehorning.

Meat goats require minimum shelter in comparison to dairy goats. Goats will seek shelter from rain, preventing them from foraging. During warmer weather, rain may only cause mild discomfort, but in colder temperatures, goats in general should not remain cold and wet for long periods.

The goat ability to withstand adverse weather conditions is strongly related to body condition. Goats in good condition, that is goats that have a fat layer under the skin, can withstand rain and cold weather without much problem if they have access to good quality forage. For example, at the NC State goat farm, replacement does on a
small grain grazing experiment have had no shelter since early March without any health problems. However, these animals were in very good body condition and had access to ample amounts of high quality forage. Young goats, on the other hand, are particularly vulnerable to respiratory infection and to hypothermia if they do not have access to shelter during rainy and cold weather. And it is not uncommon for a combination of cold wind and rain and the occasional snow and sleet to cause losses of young animals. Thus, the necessity for sheltering meat goats probably relates to the expected weather pattern in the area, the nutritional level and body condition of the herd, the physiological stage of the animals (newborn kids, dry does or does in early pregnancy, does in late pregnancy or lactating does) and the class of animals

Learning outcomes

At the end of this unit, students able to:

1. Understand the essential facilities in ruminant farming particularly cattle and goat.
2. Differentiate facilities for the young and adult ruminant.
3. Know the facilities for needed for different species of ruminants.
4. Describe the infrastructure and facilities needed for ruminants.

Main Points

Topic 1: Background
Topic 2: Handling facilities
Topic 3: Choosing a site
Topic 4: Infrastructure and facilities
TOPIC 1: BACKGROUND
The main factor to consider before undertaking ruminant rearing is feed, where the main components are pasture grass and fodder. Animals need sufficient quality and balanced diet to ensure maximum health, reproduction and production of milk and meat.
In order to achieve this, the species of pasture and fodder of high quality and of high yield need to be produced as feed for the ruminants. Critical planning regarding animal feed to increase efficiency for easy management of livestock and to upkeep the quality of production to an economical level should be undertaken.

TOPIC 2: HANDLING FACILITIES
Cattle handling facilities are used to confine cattle safely and efficiently for close observation and to perform routine health and management procedures. Adequate facilities are an essential part of an efficient cattle operation for any producer who wants to improve marketing, cattle health, and production. A well-planned handling facility can help you save money by making easier practices such as preventive health management, pregnancy testing, implanting.

The most obvious positive impact of improved cattle handling facilities would probably be on an operation's returns, including saved costs in labor. Most importantly, a good facility can prevent injury to both workers and cattle. Safe handling also minimizes stress on cattle, which can reduce their weight and ability to fight disease and cause performance problems. Stress can also cause bruising and injuries, which are quality defects. Some aspects of cattle behavior directly affect how cattle handling facilities should be designed.
TOPIC 3: CHOOSING A SITE

The location of working facilities is critical. In some cases, if two to three herds are held a mile or more apart, you may need more than one set of working facilities or a portable unit. The most important points in selecting a site for handling facilities are:

- Easy access.
- Access to utilities (water and electricity).
- Good drainage.
- Security (including biosecurity).
- Neatness to neighbors.
- Expansion.

3.1 Easy access

Normally, a working cattle handling facility requires 1/8 to 1/2 acre of land. Trucks and stock trailers must have easy access to the facility. A circular area that is 130 to 150 feet in diameter where trucks and trailers can circle out is preferred to one in which they back out. You will need access to an all-weather road so you can get to the facility in bad weather. Ideally, handling facilities should be located along a central fence line where several fences and pastures converge so that cattle can become familiar with the facilities and not have to walk long distances to get to them. Fence lines next to the handling facilities should be stronger than standard fencing in order to withstand the additional pressure that occurs when cattle are funneled into the pens.
3.2 Access to Utilities

It is important that cattle have access to water. Cattle need it after they are worked, and you will need it to clean equipment and facilities. You will also need electricity if you:

- Work inside a building.
- Are among the many small herd owners who has an off-farm job and must work the farm at night.
- Treat sick cattle at night (this is common).
- Want or need to track cattle performance (weight gain and health) and store data.

3.3 Good Drainage

The site where you place the facilities must be well drained to avoid mud and sanitation problems caused by standing water. Avoid slopes of more than 5 percent to minimize problems of water pollution caused by manure runoff. The rough concrete floor in the squeeze chute area can be sloped 1 to 2 percent toward an open drainage ditch or runoff storage pond outside the fences.

3.4 Security

Locate your facility in as secure a place as possible in order to help prevent theft, vandalism, and accidental fire. Cattle handling facilities are frequently located away from the farm manager’s residence. If this poses a security problem, provide only one access road. Unauthorized people are less apt to visit if there is no escape route. If possible, make access roads at remote sites visible from a public road or a neighboring residence. You also need to think about good biosecurity management— reducing the chance of infectious diseases being introduced or spread on the farm.
3.5 Nearness to Neighbors

Avoid sites that are directly next to neighbors’ residences, where odor, noise, dust, and flies might be objectionable when you are using the facilities intensively. Expansion—when planning a facility, always leave room for expansion, such as expanding the existing holding pen or adding pens.

3.6 Design Considerations

Well-planned facilities allow cattle to flow smoothly and provide handlers convenient access to them. So cattle can move easily, you need to spend some time mentally following the traffic pattern through the handling area and back to the feedlot, barn, or pasture. Spending a few minutes planning for your facility can save hours later. Try to answer the following questions:

- Are cattle flowing in only one or several directions?
- Will it be easy to pen cattle, or do I need to move gates?
- Will gates swing in the correct direction?

Cattle flow through a corral should be orderly so that sorting, weighing, and treatment will put minimum stress on animals and operators.

TOPIC 4: INFRASTRUCTURE AND FACILITIES

1. Fencing
   a) Biosecurity – SALT Requirement (Skim Akredatasi Ladang Ternakan)
   b) General Security
   c) Confine Animal Movement/Grazing

2. Vehicle Disinfection Dip
   a) Biosecurity – SALT Requirement
   (SALT – Skim Akredatasi Ladang Ternakan)
3. House of Sheds
   
a) Determined Restricted Zones (out of bounds) – can cut off disease transmission by visitors.
b) Intensive and Semi-intensive System.
c) Opened Sided/ Natural Ventilated House.
d) Individual Stall Has Ample Room/ Space for standing, sitting, leg stretching, lying down grooming, eating, drinking comfortable bedding material for long term holding.
e) Isolation (sick) Area – temporary holding, observation / treatment purpose
f) Quarantine House/Shed (New incoming animals) at isolated area (to avoid unnecessary disease carrier contaminating farm).
g) Good Drainage
h) Milking in Shed (Portable Milking Machine) or milking parlour.
i) Good illumination and night lighting
j) Good Comfortable Flooring, easy to clean.
k) Stalls for Pregnant/Parturition/Newborns
l) Specially Design Stalls for Studs
m) Mating/Artificial Insemination Delivery Area.
n) Sufficient personnel moving/Working Space

4. Exercising Yard/Compound
   
a) Natural Ground Around Shed (Goat)
b) Sandy and Gravel (dry) Surface (Cattle)
c) Shed and Drinking Container Provided

5. a) Simple, Portable holding yard for integration or permanently built yard
   b) Separation compartments: multi-gated linked.
c) Travis/Chute – clearance (width) customized

d) Mechanical restraint area

e) Solid/hard non-slip surface

f) Can be equipped with spray-run (deticking)

g) Shaded working area

h) Personnel safety/escape option

i) Portable water container and feeder for overnight confinement

6. Feed Store
   a) Dry feed store
   b) Elevated storage (avoid damp effect)
   c) Rodent control

7. Feed Container
   a) Located outside stall to avoid contamination with urine and feaces
   b) Individual or group feeding
       i) Ample individual head space
       ii) Suitable feeder height

8. Water Container/Source
   a) Portable water container for integration (beef)
   b) Located outside stall to avoid contamination
   c) Manually fill container
   d) Automatic drinker with no blockage/clogging
   e) Water source free of heavy metals and contaminants/toxic materials
   f) Overhead water tank

9. Salt Licker Holder
   a) Height and Location
   b) Permanent Placing for Shed/House
   c) Portable holder for integration
10. General store
   a) Farm tools
   b) Small Implements
   c) Common medication

11. Pasture/Fodder Area
   a) Planted or natural
   b) Cut and carry
   c) Concentrates/Feed supplement

12. a) Approved by authorities - Adopt good practices
     b) Religious/festive obligation (Aqiqah/Korban)
     c) Chilling/freezer facilities

13. Milk Processing
    a) Quality control (start with animal plate and platform test)
    b) Sanitation and Hygiene
    c) Chiller, pasteurizer, homogenizer, packaging
    d) Downstream activity – dadih, flavoured pasteurized milk

14. Waste Disposal
    a) Retention ponds
    b) Solid separator
    c) Manure composting
    d) Packaging of composted manure

15. Carcass Disposal
    a) Dig and buried
    b) Dug out pits – vertical stacked culverts with lid
    c) Site selection pose minimal threat on underground water contamination
16. Farm Implements
   a) Garage/stores
   b) Forage cutter
   c) Trailer
   d) Plough, harrow and rotovator
   e) Post-hole digger, post driver/slammer
   f) Fencing equipments
   g) General items – wheel barrow, hoe, bucket, water hose, high pressure water pump, portable sprayer

17. Animal Management Tools
   a) Manual restraining – ropes, clamps, nose ring etc.
   b) Identification – tattoos, tagging, brandings, ear notching, microchips
   c) Hoof care tools
   d) Disbudding, dehorning tools
   e) Castration, vasectomy tools
   f) Deworming and deticking tools
   g) Deodorizing tool
   h) Estrus synchronization and Artificial Insemination tools
   i) Chinball
   j) Milking equipments
   k) Wool shearing
   l) Docking
   m) Dystocia set

18. Farm Security
   a) Security with/without guard at entry point
   b) Only one farm entry/exit point
   c) One alternative/emergency back exit
   d) CCTV
Conclusions

1. Development of housing and feedlot facilities requires integration of space, shelter, feed, water, waste management and handling facilities with the type of beef operation being considered.
2. Keep the design simple.
3. Alley width is important.
4. Meat goats require minimum shelter in comparison to dairy goats.
5. Kidding during cold months may require shelter for the does and kids to guarantee kid survival.
6. Dairy goats do not require elaborate housing.
7. A supply of fresh, clean water should be available at all times.

Additional References


3. Associations of Alberta Ltd. and Alberta Agriculture, Food and Rural Development, Edmonton, Alberta, Canada

   http://www.cps.gov.on.ca/english/bc1000/bc1000.htm


Exercise 1 / Activity 1

1.
2.
3.

Discussion 1

1.
2.
3.
Answers to Exercise 1

1.
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Answers to Discussion 1

1.
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UNIT 7
FENCING MANAGEMENT

Introduction
This module aims to provide a brief overview of typical livestock fencing. Discussion in this module include the objectives of fencing, types of fencing, equipments needed for fencing and determine the design and layout of the fencing. Observe and study local fence construction. Permanent versus temporary fence is the main division in fence design. Need to have your line as smooth as possible to maximize the effectiveness of the fence.

Learning outcomes
At the end of this unit, students able to:
1. Strain wire
2. Install posts
3. Identify equipments needed in constructing fencing
4. Construct fencing
5. Differentiate types of fencing
6. Discuss the objectives of fencing
Main Points

1. Types of fencing
2. Objectives of fencing
3. Chainlink fencing
4. Electric fencing
5. Build a temporary or permanent electric fence.
6. Materials selection
7. Install the fence, fence charger and ground system.
8. Test the fence

TOPIC 1: LIVESTOCK FENCING

Livestock fencing is very dependent on the type of livestock that you intend to keep inside the fencing. There are many types of fence that will control livestock. This article provides a simple brief overview of typical livestock fencing.

1. Obtain a survey. A legal survey may be required to determine the exact location of a fence. You need to arrange for this first since a wait may be involved.

2. Research fence designs with books and websites. The fence design will depend on the animal and on your personal needs. Observe and study local fence construction. Permanent versus temporary fence is the main division in fence design. Temporary fencing is typically electric fence and can be put up quickly on smooth ground. Permanent livestock fencing is a physical barrier and may or may not have hot wires. It will likely have wood posts made into corner and gate assemblies, line posts that run between and some type of fence wire. There are four types of fence posts in a fence design. CORNER POSTS are used for the corners. A corner post should be the biggest post and
the most securely anchored. For the typical permanent livestock fence you will find treated wooden corner and brace posts as big as 8 inches diameter or as small as inches. Many factors influence the size of your posts. It is best to observe local custom. GATE POSTS are similar to corner posts and support the fence where it meets a gate. BRACE POSTS are next to the corner or gate post and are often just as big and well anchored. LINE POSTS are those between the corner assemblies. All posts need to be treated unless they are of a rot resistant variety like cedar. Treated posts last the longest.

3. Some animals are jumpers, some are diggers, some are bolters, and some are just content to amble around within very meager fencing. Here are some things to consider:

**Clear the fence line.** You need to have your line as smooth as possible to maximize the effectiveness of the fence. If it is not cleared and smooth then you will have to clear it out and smooth it down as best you can along the fence line. You may just need to mow or rake it in the best case. You may need heavy equipment in the worst case.

**Dig holes.** An auger or post-hole digger is used to dig any holes that are required. The posts are buried in a hole that is as deep as is necessary in your area. Corner and brace posts are often filled with concrete in poor soils or carefully tamped soil in good soil. Corner and brace posts will be at least 30 inches deep. Brace posts may be slightly smaller than corners and are set 8 to 10 feet from the corner post and are connected with a horizontal brace and diagonal twisted fence wire to form an H-assembly.

**Install posts.** The H-assembly or corner assembly holds the entire weight and tension of the fence so it must be built sturdily. Line posts mostly hold the wire in place.
Construct H-braces at the ends, corners, and gates. Two H-braces back to back are commonly seen on a livestock fence corner thus using three vertical post, two horizontal braces, and bracing wire. This type of construction is standard and will hold up almost any fence for many years to come.

Search for these H-assemblies when you drive around. You will find all manner of corners out there for you to observe which have held up over the years to various degrees. Considering the value that a fence has, it makes sense to build your corner assemblies up to the highest standard in your area.

Build your corner H-assemblies at the exact corner of the property. A legal survey is sometimes required.

Put up twine to accurately mark the line. Once the corners are installed then you put up a masons twine between them to layout the line posts.

Mark the ground at the fence line using white paint.
Take the twine down.
Put up your fencing wire.

Put up line posts. Line posts are made of wood or steel set at regular intervals. This distance varies widely from fence to fence but I have seen them as close as 10 feet and as far as 50 feet. Closer is better if finances allow. Wooden line posts can be deeply buried where the ground rises or dips to counter the extra strain on the wire. More line posts are required on rough or uneven ground.

1.1. There are numerous types of fencing available. Some examples include:

- Electric fencing (on its own or in combination with other fencing).
  Electric fencing can be the fastest and cheapest to build if you live in the country. It will handle any animal that is trained to the wire. Wire that is electrified is said to be energized.
- Picket fencing - good for small pets in town.
- Barbed wire or smooth wire combination fencing (barbed wire usually runs across top and sometimes at differing levels). Choices of smooth wire include high tensile vs low tensile. Barbed wire is for livestock only.
- High, completely wired in fencing. Woven wire, commonly called farm fence, is a common and effective choice often topped with one or more strands of smooth or barbed wire. Smooth wire is often energized in this case.
- Wooden horse railing - Can be expensive but safe and effective for expensive horses.
- If you have livestock capable of jumping, you will need higher fencing. This will be the case for such animals as goat, deer and kangaroos.
- If you have livestock that is strong, the fence will need to be strong too. Bulls and stallions can easily knock down a fence in a rage, so bear that in mind when selecting a livestock fence, if you are keeping actively breeding strong animals.
- If you have livestock that digs, you will need to build into the ground a way too. This also applies to predators or pests trying to get in - you might want to create a barrier to keep them out. A hot wire or barbed wire near the ground will discourage diggers.

1.2. Determine the design and layout of the fencing. Decide where the fencing is to go and do the measurements. Purchase the necessary fence posts, wire, other elements of the fencing following your measurements.

1.3. Call up about utility lines. Be sure that you know where utility lines go under the ground before you dig or you could be up for a large cost in repairs. Look in the phone book for your region or country; ask for the communications department of your country or call the local municipality if you're not sure where to start.
1.4. Tips

- Always think about the animal you are going to put in when you are deciding what fence to use.
- Always check your work twice when you build.
- Repair breaches in fencing immediately, before you lose stock and before the breach grows.

Warnings

- Call your local utility before digging.
- Get a legal survey before building.

Things You Need

- Post hole diggers or a power auger.
- 1 post hole tamper-(something to help pack the dirt around the post while filling it back into hole around the post)
- Fence puller, also known as fence tightener.
- Fencing Pliers, (optional)
- hammer
- Fencing materials
- wire
- treated or cedar wooden posts for corner assemblies
- wood or steel line posts
- bucket or box full of 1" to 1 1/2" inch long fence staples

TOPIC 2: LIVESTOCK FENCING SYSTEMS

Fences can significantly increase livestock grazing efficiency. The first step in planning livestock fencing is determining the purpose and goals of the fencing program. Proper fencing layout is a powerful management tool in efficient grazing systems. Livestock protection and confinement are not the only reasons to consider fencing. An effective rotational or other intensively managed grazing system can be an affordable way to provide forage to grazing livestock and reduce herd nutrition.
costs year round. Fencing needs vary ending on the type of grazing management 
system and livestock species, class and age. Determine the operation size, number 
of animals, type of forage system, and number of paddocks needed before investing 
in fencing materials and supplies. Many effective fencing options are available to 
livestock producers. Whether used as permanent or temporary confinements, fences 
should be carefully planned and constructed for efficient use, long life, and low 
maintenance.

2.1 Electric fencing

Keep in mind that electric fencing is NOT complicated. However it must be installed 
correctly to work properly. All electric fences consist of three equally important 
items…

1. The fence (posts, wires, insulators & gates)
2. The electronics (fence charger, insulated cable & switches)
3. The ground system (ground rods, clamps & wiring)

**STEP ONE:** Decide whether you want to build a temporary or permanent electric 
fence.

- Temporary electric fences are used to control animals inside a permanent fence, 
  usually consisting of one or two wires attached to plastic or metal rod posts. They are 
easy to install, move, and take down.
• Permanent electric fences are used to fence animals inside a property, fence out predators, and separate breeding animals. Permanent fence usually consists of multiple wires attached to steel "T" posts or wood posts.

• Most people use a combination of permanent and temporary fencing to control animals.

• Another option is to add electric fence wires to an existing nonelectric fence. Attach one or more “hot” wires to existing fence posts or fence wires to keep animals away from the fence.
**STEP TWO: Select the materials.**

- Buy the most powerful fence charger (energizer) you can afford. “Miles of Fence” means nothing, keeping animals under control is your goal. Buy a Five-O-Lite or digital voltmeter to check voltage on your fence regularly. There are three types of fence chargers...

  i. 110-volt plug-in: Most power for the money, often rated in “joules”-the more the better.

  ii. 12-volt battery-powered: Less power for the money, good for remote areas.

  iii. Solar-powered: Least power for the money, good for short fences in remote areas.

- Always use high-quality insulators and energizers are designed for ease of installation and durability. Cheap insulators and incorrect installation are a major cause of electric fence problems. Use insulated cable designed for electric fencing.
• Most temporary fences use small gauge (14 to 17 gauge) steel wire, or polywire or polytape. Metal rod or plastic posts are usually spaced 20 feet to 30 feet apart. Making the fence visible is important, if using steel wire flag the fence with colorful tape.

• Most permanent electric fences use high-tensile smooth wire (12.5 gauge), or heavy-duty polytape or polyrope. Posts are spaced according to terrain and size of fenced area.

**NOTE:** Electric Fences need to be kept clean of vegetation. No matter how powerful your fence charger claims to be, weeds and grass touching the wires will reduce voltage and make your fence less effective.

**STEP THREE:** install the fence, fence charcer and ground system.

• Install an effective ground system with at least three six foot long ground rods, spaced ten feet apart. Use ground rod clamps and galvanized wire or insulated cable
to connect ground rods to each other and to the fence charger. **Without a good ground system your animals won’t get shocked when they touch the fence.**

- Install the fence charger (energizer) under cover, several feet above the ground. Install solar-powered fence chargers in an open area facing south (northern hemisphere). Use insulated cable, rated up to 20,000 volts, to connect the fence charger to the fence. Install cut-off switches to isolate sections of your electric fence.
- Test your ground system.

**Grounding System Test**
1. Create a dead short on the fence line, preferably 300 ft. from the ground rods, or as far as possible if the fence is shorter than that. Lean steel posts on a hot wire as shown to short out your fence.

2. Use a Digital Voltmeter or similar electric fence meter. Place the meter probe on the ground wire or rods. Extend the meter lead wire as far away as possible, attach to a wire probe and insert probe into the soil.

3. If the voltage reading exceeds 300 volts, the grounding system is inadequate and more ground rods should be added. Add rods and recheck until voltage reads 300 or less. Generally you will need one ground rod for each Joule of output from your energizer.

- Install posts, wires and gates. Space wires according to the type of animal you want to control. Gates require extra care to run voltage from one side of the gate to the other. We recommend running insulated cable in plastic pipe under the gate (make sure to seal the ends of the pipe to keep out water. Connect all electrified wires together at gates and corners to increase voltage the length of the fence.
NOTE: Connect the fence charger so it charges the fence from the middle, not the end, if possible.

STEP FOUR: Test the fence.

Before connecting the fence charger to the fence and ground system, turn it on and check the voltage with your digital voltmeter. It should read 5,000 volts +. Now connect the fence and ground system and check the voltage again. If the voltage drops more than 2,000 volts then you have a problem in the fence or your fence charger isn’t powerful enough. Check your fence at the farthest point from the fence charger. Attach one lead of the voltmeter to an electrified wire and touch the other lead to the ground. This will tell you how much voltage, which is the speed the energy is being delivered to your animals. A minimum of 2,000 – 3,000 volts is necessary to contain most animals. A properly constructed electric fence will have 5,000 to 8,000 volts. That might sound like a lot but electric fences emit an extremely short electric pulse that is harmless for animals and people of all ages.

Animal Minimum recommended voltage on fence line*

- Horses 2000-3000 volts
- Cows 2000-3000 volts
- Bulls 3000-4000 volts
- Sheep/Goats 4000-5000 volts
- Nuisance pets 1000-2000 volts
- Pigs 2000 volts
- Wolves/Predators 4000-5000 volts
- Bison/Deer 4000-5000 volts
- Pets 700-1000 volts

NOTE: An electric fence requires regular checks to make sure it is working properly. Check the voltage at least once a day if possible. Walk the fence on a regular basis looking for broken insulators, loose connections and other potential problems.
**STEP FIVE: Introduce animals to the fence.**

Electric fence works because animals are afraid to touch it, but they must learn that touching the fence will shock them. Put animals behind a new electric fence during daylight hours, giving them a chance to see it. If necessary put some hay or grain under the fence to speed up the “learning” process. It usually takes two or three days to train animal to your fence.

**NOTE:** Never turn off an electric fence if animals are behind it.

**2.2. KEEPING ANIMALS OUT**

Electric fences can be used to keep out dogs, predators, deer, and other pests. Fencing animals out requires more wires, posts as well as a more powerful fence charger for higher voltage (5000 volts minimum). Pest/predator fences must be checked constantly. For best results keep the fence completely clear of vegetation for several feet on both sides of the fence.
3.1 Permanent Resources

Before planning the layout of a fencing system, evaluate the resources available (Fig. 1). Use the information to design a fencing layout that maximizes forage efficiency and provides proper rest periods for plant growth and recovery. Permanent resources, such as soil type, slope, and aspect, affect fencing layout plans. Pastures should have similar soil type, slope, and aspect to provide uniform forage production and grazing distribution.

3.2 Semi-permanent Resources

Semi-permanent resources include water and shade. Semi-permanent resources are critical for livestock productivity but can be modified to accommodate the fencing layout.
3.3 Water – Fencing layout should be planned to allow livestock access to adequate water supplies. A continuous supply of clean water is essential for all livestock. Water is a critical nutrient required for a wide variety of body functions in cattle. Adequate, clean water is a key part of rotational grazing systems. Water quality and accessibility are important in maintaining adequate water intake.

When possible, supply clean water in each paddock within a reasonable walking distance. A central water source often produces muddy conditions where livestock congregate. Consider using pipes and portable containers to create mobile water systems and avoid mud. Any fencing design should allow for flexibility in water placement within paddocks to control animal distribution and avoid trampling around the water source. If a single water source is used in a particular paddock, make sure that it can provide the volume of water needed during peak demand.

3.4 Shade – Shade is a major factor to consider when building fences. Shade does not decrease air temperature, but it does reduce animal exposure to the sun’s radiant energy. Adequate shade can reduce respiration rate and body temperature in livestock during the hottest times of the day. Shade also alters the grazing habits of cattle. Cattle with access to shade have shown a 3 percent increase in feed efficiency and a 6 percent increase in weight gain during hot weather.

TOPIC 4: TYPES OF FENCING, FENCE PLACEMENT AND LAYOUT

There are two types of fencing systems: fixed or portable (flexible). Both systems have advantages and disadvantages (Table 1). Both types of fencing systems include a permanent boundary fence consisting of woven or barbed wire or electrified, high-tensile smooth wire to ensure that livestock are restrained on the ranch and excluded from areas such as roads and private property.
Proper fencing is usually a major investment. Therefore, plan fencing layout carefully to save time and money. One of the benefits of a well-designed fencing system is that it can improve grazing efficiency. In continuous grazing, livestock tend to graze the most palatable plants first and leave mature plants until last. Forage selectivity by livestock often leads to concentrated and non uniform manure distribution in the pasture. One of the first management considerations in designing grazing systems is selection and installation of the proper fencing system. Give priority to well built perimeter fences and fences along roads or other areas from which livestock must be excluded, such as cropland.

An effective fencing layout for rotational stocking includes a combination of permanent and temporary fences (Fig. 2). The combination will provide both perimeter security and flexibility for adjusting paddock size with livestock daily nutritional needs and forage availability. The ideal number of fenced paddocks depends on forage species and productivity, performance goals, grazing pressure, rate of plant recovery, economic capability, and livestock characteristics, such as herd size, animal weights, and production levels. Size paddocks to provide consistent days of grazing.

A 30- to 50-day rotation is very common and requires about 10 paddocks if cattle are moved at least once a week. During the spring, when forages grow rapidly and may grow to excess, a quick rotation of about 20 days may be needed to keep plants in a vegetative stage. A faster rotation means larger paddock areas are grazed for shorter periods of time with shorter intervals between grazing.
Conclusions

1. All types of agricultural fencing require regular maintenance to ensure their effectiveness.

2. Fences can be made from a wide variety of materials, depending on terrain, location and animals to be confined.

3. Always keep in mind the species and type of livestock you are wanting your fences to restrict.

4. Check and double check that you are lining up the posts evenly or spacing the wires evenly.

5. Barbed wire, or any wire is dangerous and needs to be handled with care. Make sure you use thick gloves when handling barbed wire, and also make sure that you are handling wire so that you don't poke your own eyes out or your helper's.

6. Livestock fencing is very dependent on the type of livestock that you intend to keep inside the fencing.
Additional References


Exercise 1 / Activity 1

1.
2.
3.

Discussion 1
Answers to Exercise 1

1.
2.

Answers to Discussion 1

1.
2.
UNIT 8
BEEF CATTLE HUSBANDRY

Introduction

This module details various aspects relating to the breeding and herd management of beef cattle. Generally success or failure in the cattle business depends to a large extent upon doing the right things at the right time. Whether this is the result of good training and knowledge, good judgment or intuition, the diligence with which some producers carry out certain management practices skillfully makes them more successful than others.

Learning outcomes
At the end of this unit, students able to:
1. Describe the reproductive life of bulls and cows
2. Gain a greater understanding of beef cattle management from pre-joining until after calving

Main points
Topic 1: Reproductive life of bulls and cows
Topic 2: Pre-joining management
Topic 3: Mating management
Topic 4: Management after mating
Topic 5: Calving management
Topic 6: Management after calving
TOPIC 1: REPRODUCTIVE LIFE

1.1 Bulls

- reach puberty from 8–24 months but is usually about 12 months of age;
- fertility will continue to improve to about 3 years of age;
- not usually mated until they reach 18–24 months of age;
- on the average, a bull can be joined with up to 50 cows;
- the volume of ejaculate per service is approximately 5-8 ml and the sperm concentration should be $12-16 \times 10^8$ sperm/ml semen.

Bulls are normally culled for age when about 5-6 years of age because

- it may increase calving by using more fertile and active younger bulls;
- it assists genetic turnover and thus leads to quicker herd improvement
- it reduces the rate of inbreeding
- bulls become more susceptible to disease (venereal disease) with increasing age;
- bulls fertility slowly reduces after 5-6 years of age.

Therefore, if bulls are introduced at 2 years of age and are culled at 6 years, they have an effective breeding life of 4 years (i.e. 5 mating periods)

1.2 Heifers

1. As with bulls, heifers reach puberty at about 12 months of age depending on:
   i. breed
   ii. plane of nutrition
   iii. environmental factors
   iv. health status (diseases)

2. A better guide to determine puberty is through bodyweight rather than age. It is understood that the puberty of the heifers is reached at 250 kg – 300 kg. However, the weight stated above is breeds dependent.
3. Puberty is characterized by the occurrence of heat or estrus and the shedding of a fertile egg from the ovary
4. The estrus cycle will be repeated for every 21 days except during
   - periods of pregnancy
   - during early lactation, i.e. lactational anestrus
   - periods of inadequate nutrition when her condition falls below a certain leve
5. The heat period lasts for an average of 18 hours in cows and 15 hours in heifers
6. More females come on heat during the night than the day, especially during the late afternoon on dusk and the early morning at dawn.
7. The gestation period for cattle is 283 days (approximately 9 months) but it may range between 274-291 days.
8. The cow must return to estrus after calving in order to be rejoined and become pregnant again.
9. The period between calves is known as calving interval
10. Ideally, the cow will produce a calf every year or 365 days.
11. To achieve this, the cow must get in calf within 82 days of calving assuming that she was pregnant for 283 days.
12. Preferably a cow should come into heat 60 days after calving, this then gives her two heat periods to get in calf within the 82 days.
13. Ideally, a cow should come into heat 28 to 42 days after calving but this is difficult to achieve.

1.3 Signs of a cow on heat
   i. The cow on heat (in estrus) may attempt to mount other cows
   ii. The cow on heat stands to be mounted by other animals
   iii. The vulva is slightly enlarged (swollen) and reddened
   iv. There is a clear mucus discharge from the vulva
   v. The inner surface of the vulva is reddened and moist
   vi. The cow will show a sign of general restlessness
1.4 Signs of approaching parturition (birth)
   i. relaxation of the pelvic ligaments in the rump area;
   ii. enlargement of the vulva;
   iii. enlargement of the udder and teats
   iv. discharge from the vulva
   v. general restlessness such as walking away from the rest of the herd, laying
down and then getting up and so on.
   vi. Birth should not take longer than 4 hours after the appearance of the first
water bag.

1.5 Cows are normally culled for age because:
   i. after a certain age, her productivity declines (at 8 years fertility begins to fall)
   ii. it allows greater genetic turnover and therefore a quicker improvement herd
quality.
   iii. in the majority of cases, cows are culled when they reach a certain age
regardless of their reproductive ability
   iv. however in other cases, cows are not culled while they are calving each year
irrespective of age
   v. the decision on which method to adopt is up to the individual cattle producer

TOPIC 2: PRE-JOINING MANAGEMENT

2.1 Bulls
   1. If possible, bulls should be kept in good strong condition on a good plane of
nutrition.
   2. Overfat or poor condition bulls have a reduced ability to work.
   3. Bulls are an integral part of the breeding program and steps must be taken to
ensure that they possess high levels of libido and maintain high levels of
fertility through the provision of a good level of nutrition.
4. About two months before joining, bulls should have a physical and semen examination to ensure reproductive soundness.
5. At this time, bulls could also be vaccinated against diseases that could adversely affect conception rates.
6. The influence of a bull is significant in a herd as the bull contributes half of the genes for the performance of each calf and the bull also leaves more calves in the herd than does any cow.
7. As much as 80-90% of the genetic improvement in a herd may come from selecting better bulls.

2.2 Females
There are two parts of the breeding herd for females cattle, i.e. the main breeder group and the heifer group.

Heifer pre-joining management
1. The young female (heifer) is susceptible to disease of the reproductive tract than the older breeder because she has yet to be exposed to such diseases and therefore has lack of immunity against the diseases.
2. The heifer also is prone to the effects of inadequate nutrition resulting in interruptions to the estrus cycle and is less likely to survive during pregnancy and lactation.
3. A high plane of nutrition will not only allow heifers to attain their minimum joining weight but will also enable them to commence cycling early.
4. The minimum joining weight should be between 300 to 350 kg if high conception rates are to be achieved by heifers.
5. Heifers should be segregated (isolated) as closer attention can be given by the cattle producers so that the objective selection on weaning weight, post weaning growth rates and fertility can be gauged.
6. Structural soundness and temperament can also be taken into consideration.
7. Approximately 20% of breeders in the main herd are replaced by these heifers each year.
8. This allows numbers in the main breeders in the main herd to be maintained to make up deaths and those cows that are culled.

9. Approximately 6 weeks before mating, heifers may be vaccinated to prevent from reproductive diseases.

Main breeder herd

1. It must be remembered that most cows have a calf at foot when re-joined after calving.

2. Cows must have adequate time after calving to return to estrus and to have a high conception rate.

3. Nutrition is the factor which has most affect on when a cow will return to estrus after calving and also on her conception rate.

4. Cows should be on or placed on a rising plane of nutrition during the last trimester of pregnancy so that they are improving in condition at calving and also allow normal growth of the fetus so that a strong and healthy calf is born.

5. Ideally, the cow should gain weight both before and after calving if she is to go back in calf early.

TOPIC 3: MATING MANAGEMENT

3.1 Types of mating programs

There are basically 2 types of mating programs

i. controlled (seasonal) mating

ii. continuous mating

Controlled mating

i. Controlled mating is where the bulls are restricted generally to a 6-12 week period with the cows. This method is suitable in intensive and semi-intensive farming systems.
ii. This practice can give advantageous to both cows and calf resulting in faster growing calves, cows calving in strong position and cows being mated on a rising plane of nutrition.

iii. As mating occurs over limited period (usually 3 months), weaning management and other husbandry practices are simplified because of uniformity of calf age.

iv. Outside of mating season, bulls can be kept close at hand to ensure specialized care such as parasite control and supplementary feeding when necessary.

v. More uniform groups of cattle are available for marketing.

**Continuous mating**

i. Continuous mating is where the bulls are allowed to remain with the cows all year round.

ii. This practice is usually adopted in the extensive cattle raising areas.

iii. Good heard control is not possible on many farms because they are not sufficiently well developed (fenced).

**TOPIC 4: MANAGEMENT AFTER MATING**

**4.1 Bulls**

Ideally, bulls are separated from the main herd so that attention can be maintained to ensure that all bulls are kept in a state of a good health until the next joining season.

**4.2 Females**

i. The high plane of nutrition during mating should be maintained in early pregnancy (6 weeks) because it may help to prevent embryonic losses and in
the case of heifers, it allows them to continue grow but they should not be allowed to be overfat.

ii. The heifers should be on high plane of nutrition until about the 6 month of pregnancy to allow them to grow.

iii. A moderate plane of nutrition should be provided for mature cows.

iv. It is good practice during this period to do pregnancy diagnosis.

4.3 Pregnancy diagnosis

i. This can be carried out by rectal palpation. The operator inserts his/her arm into the cow’s rectum and signs of pregnancy are sought by feeling the reproductive organs through the intestinal wall.

ii. The pregnancy diagnosis should be undertaken two months after the bulls have been removed from the herd.

iii. Pregnancy diagnosis allows selection of non-pregnant cows for culling in lieu of culling for age.

iv. It gives some estimate of the calving rate which may be useful information to have in deciding on management procedures to be undertaken.

v. Helps in simplify management in that extra supervision at calving time can be undertaken and helps in special treatment such as supplementary feeding at strategic periods.

TOPIC 5: CALVING MANAGEMENT

1. Intensive supervision by daily inspection of pregnant cows in small paddocks maybe given where the calving period is controlled. However this practice is usually not practical in the extensive system.

2. The aim of supervision is to reduce the calving losses from dystocia (difficulty in giving birth) particularly in heifers.

3. Extra supervision should be observed in heifers at 2-3 times daily (preferably in the early morning and in the late afternoon).
4. Assistance should be given if calving is not completed within 4 hours of the appearance of the first water bag.

5. Although both of the cow and calf may survive as a result of the assistance given, they should be identified for later culling.

6. Some losses of calves can be expected at calving; and although it varies considerably between herds, the average loss is usually about 5% from birth to the end of first week.

7. These losses are usually from dystocia, starvation and navel infections and congenital abnormalities.

8. Calf birth weights vary considerably due to several factors, however, in general:
   - Tropical breeds weigh 28-30 kg.
   - British breeds weigh 30-32 kg
   - European breeds weigh 40-45 kg

**TOPIC 6: MANAGEMENT AFTER CALVING**

1. Although it is said that once a normal calf is born and gets onto its feet it will usually survive, some losses can be expected.

2. These losses from 8 days until weaning are probably in the order of 2% and usually resulted from scours, infections and various abnormalities.

3. Cows feed requirement increase dramatically after calving and are in the order of two times that of a dry non-pregnant cow in order to ensure increased milk production and consequently, higher calf growth rate.

4. A high level of feeding at this stage will allow cows to increase in weight resulting in earlier return to heat and a higher conception rate.

5. The replacement heifers, now called first calf (or lactation) heifers, are again more prone to the problems than older breeders due to the stress placed on them during the production of their first calf and the fact that they are still growing.
6. For these reasons, it is probably a good practice, although not essential, to keep them isolated and given special care until weaning when they can be included in the main breeder herd.

7. Another consideration during this period is a practice generally referred to husbandry operation.

8. It implies marking/branding of the calves and other husbandry practices such as earmarking, vaccination, castration and, sometimes, dehorning.

9. These practices is preferably to perform when the cattle are as young as possible because:
   - young animals are easier to handle and to restrain;
   - young animals loss less blood and suffer less pain than older cattle;
   - they suffer less setbacks in production than older stock;
   - there is less danger both to the animals and to the operators.

6.1 Branding

- For identification purposes to indicate ownership.
- The positions for brands on cattle are either on the neck area, rump, shoulder, thigh and twist.

Methods of branding

1. Fire-branding
   - is the most common and probably the best method;
   - branding irons are heated in some sort of fire;
   - the correct temperature of the branding iron for branding is indicated by the dull red glow of the branding iron while in the fire; and then as it is removed from the fire, it returns to the normal dark colour of the metal of the branding iron;
   - Advantages of fire-branding includes it is a relatively cheap method and quick and simple method;
   - The disadvantage of fire-branding is that the area of the brand on the hide is not suitable for leather production.
2. Freeze-branding
   - special branding irons usually made of copper and rounded on the edges are placed in either a mixture of dry ice and methyl alcohol (methylated spirit) at -72°C OR in liquid nitrogen at -196°C;
   - the branding irons are allowed to cool in the refrigerant until bubbles from the branding irons are produced at the same rate as from the refrigerant;
   - this indicates that the correct temperature has been reached;
   - the area to be branded is clipped to remove excess hair and then this area is wetted with methylated spirit;
   - the branding iron is then applied to this area with a firm pressure for 30-60 seconds depending on the animal
   - a swollen imprint of the brand is left on the abdominal for approximately two days after branding and let slowly subsides.
   - this method is rarely used for branding beef cattle because:
     a) it is too time consuming;
     b) difficult to restrain the animal so the brand can be held in place for such a long period;
     c) it is an expensive method to use
     d) it does not show up on light coloured cattle;

3. Earmarks:
   - is a permanent form of identification and generally used because it is easier to recognized than a brand;
   - different shapes from different positions on the edge of the ear are removed with the aid of earmarking pliers.

4. Tattooing:
   - another form of permanent identification that placed on either ear;
   - normally one ear has the tattoo indicating ownership and the other ear indicating the identification number of the animal;
• a tattoo is normally formed by:
  a) cleaning the area to be tattooed with methylated spirit;
  b) rubbing a special tattooing ink into this area;
  c) using the tattoo pliers to make small cuts in the skin of the ear to form
     the tattoo;
  d) again rubbing the tattooing ink into these small cuts resulting in a
     permanent tattoo.

5. Temporary identification
• Usually used as backup identification method. Not a permanent method.
• Various techniques are available such as neck chain/strap, paint branding, ear
  tags and ankle straps.

6.2 Castration
• It is a method used to prevent testosterone from entering the blood supply of
  the male’s body as well as preventing the production of sperm by removal or
  impairment of the function of the testes.
• It can be done using open method using surgical procedures and closed
  method (bloodless) using emasculation and elastraction.
• The reason for castrating male cattle include:
  a) castrated male cattle (steers) are easier to handle and to manage than
    are bulls;
  b) steers fatten or finish more readily than bulls;
  c) steers produce a more desirable carcass, especially when older, than
    do bulls because bull meat tends to be tougher and has a stronger taste
    which consumers find undesirable.

6.3 Dehorning
• The aim of dehorning is to remove a 6 mm ring of skin and hair at the base of
  the horn along with the horn itself, to ensure that the horn is producing cells at
  the base of the horn are removed.
• Failure to remove all the horn tissue and the horn producing cells will result in
the development of a scur or false horn.
• Dehorned cattle are generally quieter and bully each other less
• Less bruised carcasses and fewer damaged hides occur during handling and
transport of dehorned cattle to market.
• There are some disadvantages resulted from dehorning such as a setback in
production and also there is a chance of losing animals due to infection
entering the wound.

6.4 Vaccination
• Calves should be vaccinated with various vaccines to protect them from
various diseases that may be prevalent in the areas in which they are being
raised.
• Most vaccines are administered subcutaneously so no blemishes can result on
the carcass.
• It is desirable to vaccinate calves when they reach at least 6-8 weeks of age.
This is because up to this age, young animals are protected from many
diseases and infections by immunity that they receive from their mother's first
milk or colostrum during the first 24 hours of life.

6.5 Weaning management
• The practice of weaning serves to remove the calf from its mother permanently
so that the cow will cease lactating and the calf can fend for itself wholly as a
grazing animal.
• This practice removes the stress of lactation from the cow, which allows her to
retain her strength and condition so she can successfully produce another calf.
• Calves can be weaned down to approximately 4 months of age without
markedly affecting subsequent performance and without special treatment.
• It is usually necessary to supplement feed calves that are weaned less than 4
months of age to prevent a large setback in production.
• In most production systems in the tropics, weaning of calves at 6 months of age is common.

Conclusions

The basis for making comparisons between herds needs to be carefully defined and take into account mating duration. It is wise to use and understand separate pregnancy targets (to cows mated) and weaning targets (to cows wintered). In conclusion beef cows must consistently produce a high ratio of their own live weight as a calf at weaning while also contributing effectively to pasture supply and quality management of pastures.

Additional References

Exercise 1 / Activity 1

1.
2.
3.
Discussion 1
1.
2.
3.

Answers to Exercise 1
1.
2.
3.

Answers to Discussion 1
1.
2.
3.
UNIT 9
DAIRY CATTLE HUSBANDRY

Introduction
Dairy farmers are in the business of producing food. They aim to ensure that the safety and quality of their raw milk will satisfy the highest expectations of the food industry and consumers. On-farm practices should also ensure that milk is produced by healthy animals under acceptable conditions for the animals and in balance with the local environment. Therefore, it is necessary to provide a farmer-orientated guide to practices that are achievable all over the world covering those areas that are essential to manage. The approach taken in this guide is to:

• highlight relevant areas on dairy farms that need to be managed;
• identify the objectives in dealing with each of these areas;
• identify Good Animal Practices (GAP); and
• suggest control measures that can be implemented to achieve the objectives.

Learning outcomes
At the end of this unit, students able to:

1. Identified the factors involved in maintaining animal health
2. Describe the requirements of dairy cattle.
Main points

Topic 1: Animal health;
Topic 2: Milking hygiene;
Topic 3: Animal feeding and water;
Topic 4: Animal welfare
Topic 5: Environment

TOPIC 1: ANIMAL HEALTH
Animals that produce milk need to be healthy and an effective health care program should be in place.

Characteristics of Good Dairy Breeds
A good dairy cow should be able to do the following:

- Give at least 10 litres of milk per day
- It should produce one calf every 12 months
- It should be able to milk for ten moths
- It should be dry for only 2 months every 12 months
- It should be able to conceive (become pregnant again) 3 months after delivery.
- It should be able to milk for 7 months when pregnant
- It should be able to breed at the age of 18 months

The guiding objective for good dairy farming practice is that milk should be produced on-farm from healthy animals under generally accepted conditions. To achieve this, dairy farmers need to apply GAP in the following areas:

- animal health;
- milking hygiene;
- animal feeding and water;
- animal welfare
- environment

1.1 Prevent entry of disease onto the farm
- Only buy animals of known disease status and control their introduction onto the farm
- Ensure cattle transport on and off the farm does not introduce disease
- Have secure boundaries/fencing
- If possible, limit access of people and wildlife to the farm
- Have a vermin control program in place
- Only use clean equipment from a known source

1.2 Have an effective herd health management program in place
- Use an identification system that allows all animals to be identified individually from birth to death
- Develop an effective herd health management program focused on prevention that meets the farm’s needs as well as regional and national requirements
- Regularly check animals for signs of disease
- Sick animals should be attended to quickly and in an appropriate way
- Keep sick animals isolated and separate milk from sick animals and animals under treatment
- Keep written records of all treatments and identify treated animals appropriately
- Manage animal diseases that can affect public health (zoonoses)

1.3 Use all chemicals and veterinary medicines as prescribed
- Use chemicals according to directions, calculate dosages carefully and observe appropriate withholding periods
- Only use veterinary medicines as prescribed by veterinarians and observe specified withholding periods
• Store chemicals and veterinary medicines securely and dispose of them responsibly

TOPIC 2: MILKING HYGIENE
Milk should be harvested and stored under hygienic conditions. Equipment used to harvest and store milk should be suitable and well maintained.

2.1 Ensure milking routines do not injure cows or introduce contamination to milk
• Uniquely identify individual animals
• Ensure appropriate udder preparation for milking
• Ensure consistent milking techniques
• Separate milk from sick or treated animals
• Ensure milking equipment is correctly installed and maintained
• Ensure a sufficient supply of clean water

2.2 Ensure milking is carried out under hygienic conditions
• Ensure housing environment is clean at all times
• Ensure milking area is kept clean
• Ensure the milkers follow basic hygiene rules

2.3 Ensure milk is handled properly after milking
• Ensure milk is cooled in the specified time
• Ensure milk storage area is clean and tidy
• Ensure milk storage equipment is adequate to hold milk at the specified temperature
• Ensure unobstructed access for bulk milk collection
TOPIC 3: ANIMAL FEEDING AND WATER

Animals need to be fed and watered with products of suitable quality and safety.

3.1 Ensure animal feed and water are of adequate quality
- Ensure the nutritional needs of animals are met
- Ensure good quality water supplies are provided, regularly checked and maintained
- Use different equipment for handling chemicals and feed stuffs
- Ensure chemicals are used appropriately on pastures and forage crops
- Only use approved chemicals for treatment of animal feeds or components of animal feeds and observe withholding periods

3.2 Control storage conditions of feed
- Separate feeds intended for different species
- Ensure appropriate storage conditions to avoid feed contamination
- Reject mouldy feed

3.3 Ensure the traceability of feedstuffs bought off the farm
- All suppliers of animal feeds should have an approved quality assurance program in place
- Maintain records of all feed or feed ingredients received on the farm (specified bills or delivery notes on order)

TOPIC 4: ANIMAL WELFARE

4.1 Animals should be kept according to the following principles:
- Freedom from thirst, hunger and malnutrition
- Freedom from discomfort
- Freedom from pain, injury and disease
- Freedom from fear
- Freedom to engage in relatively normal patterns of animal behaviour
4.1 Ensure animals are free from thirst, hunger and malnutrition

- Provide sufficient feed (forage and/or fodder) and water every day
- Adjust stocking rates and/or supplementary feeding to ensure adequate water, feed and fodder supply
- Protect animals from toxic plants and other harmful substances
- Provide water supplies of good quality that are regularly checked and maintained

4.2 Ensure animals are free from discomfort

- Design and construct buildings to be free of obstructions and hazards
- Where relevant, provide adequate space allowances and clean bedding
- Protect animals from adverse weather conditions and the consequences thereof
- Provide housed animals with adequate ventilation
- Provide non-slippery floors

4.3 Ensure animals are free from pain, injury and disease

- Have an effective herd health management program in place and inspect animals regularly
- Protect against lameness
- Lactating animals should be milked regularly
- Do not use procedures and practices that cause unnecessary pain
- Follow appropriate calving and weaning practices
- Have appropriate procedures for marketing calves
- When animals have to be killed on-farm, avoid unnecessary pain
- Avoid poor milking routines as they may injure cattle
TOPIC 5: ENVIRONMENT

Milk production should be managed in balance with the local environment surrounding the farm.

5.1 Have an appropriate waste management system.
   - Ensure wastes are stored to minimize the risk of environmental pollution
   - Manage pastures to avoid effluent runoff by spreading farm manures in accordance with local conditions

5.2 Ensure dairy farming practices do not have an adverse impact on the local environment
   - Contain dairy runoff on-farm
   - Use chemicals (fertilizers, agricultural and veterinary chemicals, pesticides, etc) appropriately to avoid contamination of the local environment
   - Ensure overall appearance of the dairying operation is appropriate for a facility in which high quality food is harvested

5.3 Have an appropriate waste management system.
   - Ensure wastes are stored to minimize the risk of environmental pollution
   - Manage pastures to avoid effluent runoff by spreading farm manures in accordance with local conditions
Conclusions

1. Dairy farming needs a hard working, determined and patient person. Dairy cattle have to be fed, watered, cleansed, their health monitored continuously and milked everyday at specified times. Milking intervals must be kept constant (adhered to).

2. A dairy farmer must have basic training in bookkeeping and keep records on the running of the dairy and artificial insemination (A.I.). Dairy cattle have to be loved and treated carefully for if a farmer treats them roughly, they will retain their milk, which will result in mastitis.

3. Unproductive cattle should be culled, as it would be costly to keep them on the farm. There should be constant supply of milk, therefore dairy cattle oestrus (heat) should be desynchronised and 75% of the herd should be in milk at any given time.

4. Milking machines must be serviced regularly to ensure efficient and effective operations failing which the cow's udder will be lost through inflammation of the udder given the high pressures. Strict hygiene should be kept at all times in the open cow sheds (kraals) in the milking parlour and the cows should be kept clean.

5. Dairy cattle should be stall-fed and not to move distances grazing because the energy they use to move long distances grazing could be used for milk synthesis.
Additional References


Exercise 1 / Activity 1

1.
2.

Discussion 1

1.
2.

Answers to Exercise 1

1.
2.

Answers to Discussion 1

1.
2.
UNIT 10
SMALL RUMINANT MANAGEMENT

Introduction
Small ruminant production is a very significant component of livestock production throughout the world and more especially in the developing countries. Sheep and goats have adaptive capacities to survive and produce in difficult environments be they arid, high altitude or extremely cold. Generally small ruminants are efficient converters of forage feeds whether they are farmed in temperate, arid or semitropical conditions. Perhaps their greatest advantage relative to large ruminants is their low cost, small size, their suitability to small holdings and in many of the developing countries, their triple purpose use for meat, milk and fibre. Noticeable in the world trends in livestock numbers over the past twenty years is the steady increase in sheep and goat numbers; sheep numbers are in excess of one billion head and goat numbers globally are now approaching half a billion head. Increasing numbers, encouraging in some respects, is not enough. The fundamental change must be increased efficiency of production be that biological efficiency, structural/organizational efficiency or more effective use of basic feed resources.

Learning outcomes
At the end of this unit, students able to:

1. Describe the reproductive life of rams/bucks and ewes/does
2. Gain a greater understanding of small ruminant management from pre-joining until after lambing/kidding
Main points

Topic 1: Reproductive life of male and female sheep/goats
Topic 2: Pre-joining management
Topic 3: Management at mating
Topic 4: Management after mating
Topic 5: Management of the parturition female
Topic 6: Management after lambing/kidding

TOPIC 1: REPRODUCTIVE LIFE

1.1 The ram/buck
   i. In males, puberty is the time when complete separation of the prepuce and the penis occurs and motile spermatozoa are first detected in the ejaculate.
   ii. Puberty is the age at which sheep/goats first become capable of sexual function. Puberty normally occurs between 4-7 months of age
   iii. However, full reproductive competence may not occur until 15 months of age.
   iv. A ram/buck can serve 40 to 50 females in a season (6-8 weeks).
   v. A good male is capable of 20-40 services/day.

1.2 The ewe/does
   i. Puberty in ewes may occur as early as 4 months of age at liveweights around 27 kg; however, this is rare:
      • usually ewes/does are older and heavier at puberty
      • most ewes/does reach puberty by 12 months of age
      • in general, the heavier the ewe/does, the earlier the onset of puberty
ii. Once puberty is reached, the ewes and does display a polyestrus (repeated reproductive cycles) pattern of reproductive activity.

iii. The estrus cycle, defined as the number of days between two consecutive periods of estrus (heat), is on average 17 days in ewes and 21 days in does.

iv. The duration of estrus is variable in that it is shorter in younger ewes and does but longer in older animals. Normal duration will be 24 to 36 hours.

v. There are no obvious signs of estrus in the ewe/doe therefore a ram/buck must be present to detect heat.

vi. If the male animal is present, the female will:
   - often seek him out and follow him before she will permit service
   - turn her head towards him as he approaches
   - sniff and bleat to him
   - elevate and fan her tail
   - allow him to mount

vii. Often the behaviour of the male is a better guide to estrus cycle in the female in that the male may/will:
   - paw the ground with his front feet while beside the ewe
   - rub his head and shoulders along the side of the ewe
   - thrust his head under the ewe’s flank
   - sniff the urine of the ewe
   - ‘Flehmen reaction’ – ram stands rigidly, neck extended, head held horizontal to the ground and upper lip is raised or curled.

viii. The gestation period in ewes does averages about 150 days ranging from 145 to 155 days.

**TOPIC 2: PRE-JOINING MANAGEMENT**

2.1 The ram/buck

i. Each year it will necessary to introduce new younger rams to replace older males which have been culled and any males that have died.
ii. The males should be kept in good body condition but not fat because fat males have higher body temperatures during hot conditions and this can cause infertility because high temperature will interfere with normal sperm production. Apart from that, fat males have less mating drive or libido.

iii. If they become too fat, it may be necessary to restrict their nutrition and let them get plenty of exercise as the graze as this can lose excess of their fat gradually.

iv. Problems can also result from under nutrition where the male's condition becomes so poor that it results in lower sperm production (thus lower fertility) and lowered sex drive.

v. Generally, it is recommended to give the males in forward store condition better nutrition two months prior to mating to ensure high fertility and libido but once again care should be taken to prevent them from becoming too fat.

vi. The males should undergo a thorough examination of their reproductive organs by palpation.

2.2 The ewe/doe

i. All females should be examined for soundness prior to mating with particular attention should be paid to the udder and teats.

ii. Females with defective udders, abnormally large teats, blind teats and cut teats from shearing should be culled because the chance of them rearing a lamb is reduced.

iii. Females fed with good nutrition have more evolutions. The females should be on a rising plane of nutrition and increasing their liveweight about 6 weeks prior to, and continuing throughout, the joining seasons. This is known as the 'flushing' effect.

iv. They should not be too fat as this can results in lowered conception rates.

v. Other husbandry and heath aspects should also be undertaken like control of external and internal parasites using suitable insecticides and dewormer.
TOPIC 3: MANAGEMENT AT MATING

3.1 Joining (mating) time

i. The timing of mating is a crucial management decision in most of the temperate countries. In tropical countries, the joining can be done throughout the year.

ii. In temperate countries, the farmers generally joined their animals during autumn. During this season, the lambing percentages are higher as a result of estrus activity will be at peak with practically all ewes having a regular estrus cycles. Apart from that, the ovulation rates and fertility of ewes tends to be higher.

iii. During autumn, the temperatures are more suitable for mating particularly in relation to fertility of the ram as high temperatures often result in lowered fertility. Besides that, higher losses of embryos could occur during the implantation stage if the female is subjected to high temperature.

iv. Lambing/kidding will occur when the worst of the winter is over (i.e August-October in Australia and New Zealand).

3.2 Age of joining

i. Generally, both males and females are approximately 18 months old at first joining.

ii. However, probably more important than age is that these animals are well grown.

iii. Breeding stock are normally cast for age 5 – 6 years

iv. With respect to age, there are suggestions that young males should be put in with mature females and vice versa as experience of the mature animals may improve conception rates.
3.3 Rams/bucks percentages

i. Rams/bucks percentage is the number of rams to use per 100 ewes to ensure optimum fertility.

ii. Usually 2-3% of the males are used, i.e. 2-3 rams for every 100 females.

iii. However, factors such as age (young males), nutrition, paddock size, and temperature can influence the percentage of males to be used.

iv. Under unfavorable conditions, the males may have to be increased to 4-5%. By increasing male percentages when adverse conditions exist (especially poor nutrition in large paddocks) you may improve the contact between males and females.

3.4 Nutrition

i. The higher level of nutrition required prior to joining should be maintained throughout the mating period to ensure high levels of fertility in both males and females as well as higher ovulation and implantation rates in females.

ii. Good nutrition also increase flocking behaviour and increases the likelihood of contact.

TOPIC 4: MANAGEMENT AFTER MATING

4.1 Rams/bucks

i. After mating, the males should be returned to the male paddock.

ii. Frequent supervision and attention should be maintained to ensure that all rams are kept in a state of good health until next joining season.

4.2 Management of the pregnant ewe/doe

i. Implantation of fertilized egg occurs 11-12 days after mating and rapid growth of the embryo then begins and nutrition is very important.
ii. Malnutrition is the most likely cause of embryonic losses; thus the high level of nutrition given to females during mating should be maintained for at least 3 weeks after mating.

iii. Following this stage is the fetal stage and the growth of the fetus is slow. Therefore, during the first 2/3 of pregnancy (up to 14 weeks) the nutritional requirement of the female is similar to that of a maintenance diet.

iv. During the last 1/3 of pregnancy the fetus grows very rapidly and more than triples its weight, thus, nutrition must be increased during this period by about 50%.

Ewe/doe and lamb/kid survival

i. If nutrition is too high, losses of heavy lambs/kids and also the mother may occur because of difficult births (dystocia). Apart from that, losses of the mother and consequently lambs/kids may also result from pregnancy toxaemia and/or milk fever.

ii. If there is under-nutrition, losses from pregnancy toxaemia may occur and light lambs/kids are produced and their chances of survival are reduced because they are more prone to exposure of heat and cold stress. Their vigour is reduced as is the females maternal instinct and this can result in losses from mismothering and starvation.

Milk production

i. If females are overfed, they are more likely to suffer from milk fever resulting in losses of both mothers and newborns.

ii. Under-nutrition results in delayed onset of lactation after lambing for some hours, which can affect lamb survival and reduce milk production, which results in poor lamb growth rates.
TOPIC 5: MANAGEMENT OF PARTURITION FEMALES

i. The lambing/kidding period will coincide with the mating period with approximately 5 months (150 days) time between them.

ii. The objective of the mating program is to have all lambs/kids born in the shortest possible time as this resulted in uniform newborn size and age; thus, simplifying lamb/kid marking as well as contributing to a shortened lambing supervising period.

iii. The maternity paddocks/pens should be well fenced to prevent predators, well sheltered and having grazing suitable to meet the nutritional requirement of the females.

5.1 Lambing/kidding difficulties

i. At times, it is necessary to help females where labour has been protracted. These dystocias are usually due to malpresentation (lamb/kid is not in the correct position) and oversized lambs/kids.

ii. You should first see the front legs and nose or head of the lamb if it is a normal birth. In this case, delivery can be expected within 15 minutes.

iii. If the ewe/doe is still laboring after 30 minutes, you should seek professional assistance.

iv. If helps is to be given:

   1. Hygiene, lubrication and care are most important when assisting ewes/does during parturition.
   2. Prepare a bucket of clean, warm water with soap and get some disinfectant, a good lubricant such as Vaseline and towels.
   3. Wash your hands and arms and wash the vulva and surrounding area of the ewe /doe.
   4. Wear latex gloves if available. There are some diseases that can pass to humans from assisting in birth.
   5. Determine if the lamb/kid is being presented normally with the muzzle between the two forelegs (one slightly in front of the other).
6. If this is not the case, push the lamb back inside the birth canal and attempt to arrange the lamb/kid in the correct position.
7. Gently draw the lamb/kid out by hand or by using a cord attached to the fetlocks. Occasionally, it may be necessary to kill the lamb/kid and remove it in parts to save the mother.
8. If the lamb is alive. It should be placed near the mother’s head so that she may lick it dry.
9. The mother should be given an injection of long acting antibiotic and intra-uterine pessaries for infection.
10. A close watch should be kept on these animals for the first days after birth.

TOPIC 6: MANAGEMENT AFTER LAMBING

6.1 Lamb/kid growth
   i. Body growth begins at conception.
   ii. The developing fetus grows slowly during the first 2/3 of pregnancy with rapid growth occurring over the last 1/3 (50 days) providing nutrition is adequate.
   iii. With good nutritional conditions, growth of the newborn lamb will continue rapidly after birth until puberty is reached, which occurs with the most breeds at about 30 kg liveweight.
   iv. Throughout the period of birth to puberty, growth is most rapid during the early lactation (suckling) period, probably the first three weeks, and gradually slows down as adulthood is reached. Therefore, good nutrition of the mother is of the utmost importance during this period if the lamb/kid is to get a good start in life.
   v. The lamb/kid is totally reliant on the ewe/doe for nutrition via the milk in its first three weeks as there has been no rumen development in the lamb/kid.
   vi. This level of nutrition should be maintained from 3 – 8 weeks after parturition as the lamb/kid is undergoing a transition phase from non-ruminant to
ruminant. The young lamb/kid will consume increasing amounts of feed other than milk as the rumen and its microorganisms begin to function normally.

vi. After 8 weeks of age, the lamb/kid begins functioning as an adult sheep with the milk supply being less important.

6.2 Lamb/kid marking

i. The marking may entail the following operations, in order:
   a. vaccination
   b. earmarking
   c. castration of male lambs/kids
   d. tail docking (only in sheep)

ii. It is best to mark lambs/kids at an age as young as possible because young lambs/kids are less affected and wounds heal more quickly than older animals.

6.3 Weaning

i. As already stated, at about 8 weeks of age the rumen is sufficiently well developed to allow the lamb/kid to cope with a full diet of pasture.

ii. Weaning allows a lactating ewe/doe to ‘dry up’ and will allow her to build up her body reserves and hopefully reduce the lactational anestrus period and consequently, allow her to be mated again.

iii. If nutrition is not improved at this age (i.e. weaning to 12 months), reduced growth rates and increased susceptibility to internal parasite infection can be expected in weaners.

iv. External parasite control should also be carried out at this time especially in sheep.

v. Weaners are often drenched and moved to clean paddock because they are very susceptible to worms at this stage.
Conclusions

Associated with the efficiency of meat production is the need for build up of numbers and meat production to meet national requirements. This also facilitates improved breeding programs and selection to promote the efficiency of reproduction and meat production. Reproductive rate is the all important factor, and the build up of numbers is associated with the following components:

- Age at first mating
- Productive life span of males and females
- Annual mortality in the breeding flock
- Number of young females reared per 100 breeding females. This is influenced in turn by proportion of breeding females failing to reproduce, incidence of multiple births, frequency of parturition, and mortality rate up to first mating.

Additional References

Exercise 1 / Activity 1

1.
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Discussion 1
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Answers to Exercise 1
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Answers to Discussion 1
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UNIT 11
POULTRY MANAGEMENT

Introduction
In this section of the module the key areas to consider when assessing the standard of a poultry farm include the site, the layout, the housing system and the state of repair of housing and equipment. Consideration of all of these factors is necessary if the owner or potential owner is going to maximize returns from the investment. Quite frequently there is little choice over these factors, because the farm under consideration is already established. However, the site, layout and housing system in most cases influences the relative value of the farm.

Learning outcomes
At the end of this unit, students able to:

1. Describe a suitable site for the establishment of a poultry farm
2. Identify the factors that should be considered in planning the layout of a poultry farm
3. Describe the common systems of housing poultry
4. Describe routine husbandry and important management practices
Main points

Topic 1: Poultry farm management
Topic 2: Routine husbandry practices
Topic 3: Important management practices

TOPIC 1: THE POULTRY FARM MANAGEMENT

1.1 The poultry farm site
   i. There are a number of factors to consider when selecting a site for the establishment of a poultry farm. These fall into two broad categories:
      • those related to the sociological needs of the owner; and
      • those related to the performance of the enterprise.
   ii. Those relating to the sociological needs of the owner need no further consideration. Those related to the performance of the enterprise include:
      • isolation from other poultry
      • proximity to market for the produce
      • the quality of the land and its relative value
      • availability of water, its cost and quality
      • availability of poultry food and freight costs
      • availability of electricity; and
      • access roads

1.2 The poultry farm layout
   i. The layout of the poultry farm plays an important part in its management. Key consideration includes:
      • how the layout affects health management
      • how the layout affects staff supervision
ii. As a general rule, poultry farms should occupy an area large enough to ensure that all poultry houses are separated by at least the minimum recommended distance and that all houses are the recommended minimum distance from boundaries, residences and, water courses.

iii. The recommended distances are:
   - from boundaries, water courses and dwellings 100 meters
   - between poultry houses – stock of different age 100 meters
   - between poultry houses – stock of the same age 25 meters

iv. Other factors of importance to be considered are as follows.
   - The entry to the layer farm should be such that the egg pick-up vehicle and abattoir vehicle enter directly to the egg room and layer shed.
   - Shed orientation should be with the long axis running true east to west.
   - A security fence should enclose the area in which the sheds are located to keep out natural predators of poultry. The fence should be at least 25 meters from the nearest poultry house

1.3 Poultry housing systems

i. The proper housing poultry plays an important part in the success or failure of the venture. The modern poultry house frequently contains a high level of technology that allows the manager to maintain a wide range of production-related data and to operate equipment for feeding the birds, collecting the eggs and controlling the environment.

ii. The poultry house serves two main functions:
   - to provide shelter and services; and
   - to confine stock

iii. Shelter or protection from a harsh environment, predators and other potentially harmful situations is very necessary. Key services are the provision of food and water. The house should be designed to facilitate the daily inspection of all birds – considered necessary to ensure that the welfare needs are being met.
iv. The confinement of the stock is necessary to minimize the spread of disease by allowing birds from different flocks to intermingle. As a general rule, older birds are carriers of disease and may pass these diseases onto more susceptible younger birds. Confined birds are also easier to manage.

v. There are number of poultry housing systems. These range from quite extensive systems (free-range) where large areas of land are required to maintain the birds at low stocking density to very intensive system where large numbers are housed in small areas at high stocking densities.

TOPIC 2: ROUTINE HUSBANDRY PRACTICES

i. The day-to-day cage of poultry revolves around a series of routine activities depending on the age of the birds concerned. In this context, the key age group are:
   - young chickens up to approximately 4 weeks of age
   - growing stock from approximately 4 to 20 weeks
   - adult poultry

ii. All poultry should be placed in clean houses. The daily routine should be organized to:
   - ensure that the bird’s welfare needs are catered for
   - ensure that feeder systems and drinker systems are working normally
   - ensure that the environment control systems are set correctly and are operating efficiently
   - check litter condition in litter houses
   - look for any general maintenance needs that may have developed

2.1 Young chickens

i. The management of chickens during the period to approximately 4 weeks of age is usually referred to as brooding period.
ii. In the case of commercial poultry farming the manager removes the hen from the scene and broods the chickens by mechanical means.

iii. In order to be effective in this situation, it is necessary to place a lot of importance on attention to detail and to satisfy the key requirements of the chickens:
   - security; regulated temperature; food needs; water needs
   - light needs; space needs; need for good quality air and need for high standard of general husbandry

iv. It is important to realize that the day-old chicken that arrives on the farm has already undergone a number of stressful procedures and will be subjected to more as it is introduced to its quarters and settled in.

v. This means that the care must be of a very high standard with attention to detail being the utmost importance to ensure that stress is kept to minimum.

2.2 Growing stock

i. Once the chickens have completed the brooding phase, their need for close supervision diminishes.

ii. An inspection early and late in the day to check welfare is all that is necessary.

iii. Other than that, it is necessary to carry out vaccination procedures, weighing to monitor live weight, flock uniformity and maintenance needs.

iv. Broiler chickens require more attention than do layer type growing stock. By the time they reach 4 weeks of age high temperatures are of more concern than low.

v. In addition, they have grown to where they cover a significant area of the floor and their animal heat production is quite high.

vi. As a consequence, it is necessary to inspect the chickens several times a day until they are dispatched to the abattoirs to ensure that the desirable conditions are maintained and to make any adjustments necessary.
2.3 Adult poultry

i. In addition to the need to ensure that their welfare general maintenance needs are catered for, the management of adults involves the collection and processing of eggs for disposal to the egg marketing authority or directly to the market.

ii. Where the birds are housed in cages, eggs are collected once per day, usually in the afternoon. If they are collected too early a significant number will be laid after collection and will be left out overnight with a consequential loss in quality.

iii. If the birds are housed in systems other than cages, eggs should be collected at least two and preferably three times per day to ensure the nests do not become overloaded with eggs, in which case a large number may be damaged.

iv. As soon as the eggs are collected they should be sorted into clean first quality eggs, dirty eggs and cracked eggs. The dirty eggs are then cleaned, and when dry, the first quality and cleaned, undamaged eggs are sprayed with a pharmaceutical oil as an aid to preservation. They are then placed in cool storage (10 to 15°C) to preserve them.

v. They should be sent to market at least twice per week, preferably more frequently.

TOPIC 3: IMPORTANT MANAGEMENT PRACTICES

There are some husbandry practices that are normally used to influence the performance of poultry. While these are not requisites for the welfare of the birds, they are important if the manager is to achieve maximum performance from stock.

Examples of these practices are:

- the management of light intensity and day length; and
- the management of bird average liveweight and flock uniformity
3.1 Management of light intensity and day length

i. Day length is an important trigger in nature’s control of some animals. Poultry respond to changing day length by varying growth rate and egg production.

ii. Remember too that egg production is reproduction; but there is no need for the females to mate with the males for the females to lay infertile eggs.

iii. Light intensity is important that it influences the level of activity of the birds and the degree of response to light.

iv. Light intensity is the brightness of light and is measured in lux using a light meter as used by a photographer.

v. Young chickens are usually given an intensity of 40 or more lux for the first three days of their life to encourage them to seek food and water more actively.

vi. From day 4 to 14 light intensity should be progressively reduced to that for growing.

vii. Birds in closed-house system will perform at intensities as low as 2 lux. When birds are housed in very low light intensities, it is necessary to increase that intensity during inspection time.

viii. As for the day length management, the light, as a signal, passes along the optic nerve to the hypothalamus of the brain.

ix. The hypothalamus has the ability to remember changes in day length, providing the intensity is high enough. As a result, the hypothalamus produces minute quantities of chemicals called releasing factors that target the pituitary gland.

x. This gland, often called the master gland because of the place it plays in controlling many body functions, respond by producing certain hormones.

xi. The hormones produced in the pituitary gland target certain glands including those associated with growth and reproduction or egg production.

xii. The greater the day length the greater the amount of releasing factors produced and the greater the amount of hormones produced.
3.2 Flock average live weight and uniformity

i. An important aspect of the management of commercial poultry is the regulation of flock average live weight and flock uniformity.

ii. Under a good standard of management, layers and breeder stock will increase in live weight at too fast a rate. The additional weight is caused by excess fat and this, in turn, will lead to inefficient performance.

iii. Average live weight is measured by weighing a sample of birds in the flock. It is not feasible to weigh all birds in poultry flocks under most circumstances and a sample is used. To be a suitable sample, it should be unbiased and should be large enough.

iv. The uniformity of any flock is also an indicator of the standard of management. When a flock lacks uniformity, it usually indicates that something is wrong with management.

v. It may be parasites, other sub-clinical disease, poor quality food, overcrowding or some other management factor.

vi. The relative uniformity of a poultry flock is measured by weighing each bird in the sample individually and calculating the number of birds, expressed as a percentage, that is, within plus or minus 10% of the average or mean live weight.

vii. When a flock is identified as lacking in uniformity, the manager should attempt to identify the cause and eliminate it.

Conclusions

1. The success or failure of a poultry farm is dependent to a significant degree on such factors as the site, the farm layout and the system of housing. These aspects must be analysed in order to assess the real value of the enterprise.
2. Routine husbandry practices are designed to ensure that the welfare needs and the activities such as vaccinations, litter management, live weight and uniformity management, egg collection and processing, and general maintenance and any other needs are carried out in a timely and efficient manner and ensuring goods and services are supplied in a timely manner.

Additional References

Exercise 1 / Activity 1
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Discussion 1
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Answers to Exercise 1

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UNIT 12
LIVESTOCK SLAUGHTERING MANAGEMENT

Introduction

Livestock slaughtering management starts when the animals is delivered by dedicated trucks and received into the holding yards from where it is either processed directly or held for up to several days in the holding yards. The animals enter the facility and are properly restraint before they are bled. The hides are then removed from the carcasses followed by the internal organs, heads and hooves (offal). The undigested contents from the first stomach (paunch) are also removed. The carcasses may then be sectioned. Either the whole carcass or the sections are stored in cool rooms prior to being transported off-site.

Learning outcomes

At the end of this unit, students able to:

1. Discuss the major forms of loss that could be occurred during pre-slaughtering handling
2. Describe the principles of slaughtering and the importance of meat inspection
3. Describe the approaches involved in preservation of meat
Main points

Topic 1: Pre-slaughter handling
Topic 2: Slaughter
Topic 3: Meat Inspection
Topic 4: Preservation of meat

TOPIC 1: PRE-SLAUGHTERING HANDLING

There are many causes of loss of the total livestock and meat industry which result from a lack of appreciation of the importance of proper pre-slaughter care of the animals. The effect can be on the quantity and quality of the meat produced.

The major forms of loss are:
1. Loss of live or carcass weight.
2. Reduction in meat quality due to stress.
3. Loss of weight and quality due to bruising.
4. Hide and skin damage.

Many of these losses may be reduced by care and attention during pre-slaughter handling.

1.1 Loss of live or carcass weight

i. The liveweight losses are more relevant to the livestock producer (liveweight selling etc.), while carcass weight losses are more relevant to the meat processor. This situation depends on the method of sale e.g. for direct consignment selling carcass weight losses are important to the producer, because they are paid on the carcass weight which gets to the end of the slaughter floor.
ii. Liveweight losses are mainly due to defecation, urination and the small amount of moisture lost with respiration.

iii. Carcass weight losses are due to moisture loss from the carcass tissues (mainly from muscle) when the animal is deprived of water during the pre-slaughter period.

1.2 Reduction in meat quality due to stress

i. This is another very important issue in the livestock and meat industries. At the time of slaughter the animal has certain store of energy material known as glycogen in the muscles.

ii. After death this glycogen is broken down by the muscle own enzymes to release energy (which is used for muscle contraction during rigor mortis).

iii. The by-product of this breakdown is lactic acid. As the lactic acid builds up in the muscle, the pH of the muscle falls, normally to about pH 5.5

iv. Now, if the animal is stressed before slaughter it will use up more of the glycogen reserves in the muscle resulting less lactic acid produced after the slaughter.

v. This muscle pH will not fall to the same extent, and changes to the meat quality will appear. These changes are:
   - Reduced storage life, because meat has a higher pH.
   - Changes in muscle colour, to a darker colour due to changes to the muscle surface.
   - The possibility of tougher meat.

vi. There are a number of stress, namely:
   - Nutritional stress, where the animal may be deprived of blood for a period prior to slaughter.
   - Psychological stress due to the new environment, method of handling, mixing of groups, etc.
   - Exercise stress, from long periods of standing in holding areas, transport, moving from pen to pen, fighting, etc.
• Environmental stress, from undesirable weather conditions.

Not all of these types of stress can be eliminated, but the aim should always be to minimize these stressors as much as possible.

1.3 Loss of weight and quality due to bruising.

i. Bruising is a very significant problem in beef and less of a problem in the mutton (sheep) industry.

ii. Under the meat inspection guidelines, it is stated that all bruise tissue must be removed from the carcass before the carcass is passed for human consumption. The reasons for this are:
   • aesthetics, bruised tissue looks undesirable.
   • keeping quality, bruised tissue is much more susceptible to spoilage.

iii. The losses which derived from bruising depend on several general factors, namely-the area affected by the bruise (and thus requiring to be trimmed) is often much larger than the area which received the original injury.

iv. Most bruises occur in the more expensive part of the carcass.

v. Trimming of bruises reduces cost carcass grade and the value of affected cuts, and sometimes adjacent cuts.

vi. Trimming takes time and extra labour on the slaughter floor.

vii. The causes of bruising can be divided those associated with the animal and external factors.

viii. The animal factors such as horns, temperament, weight and sex while the external factors are handling facilities (design and facilities), method of handling, selling method, transport (type, distance, method of driving) and abattoir facilities.

1.4 Hide and skin damage

i. Quality of the hide depends very much on the number and type of defects.
ii. Common defects for hides are brands, external parasites, scratches and dressing faults.

**TOPIC 2: SLAUGHTER**

Slaughter is a very important subject which is often overlooked or avoided, but it should receive proper consideration.

2.1 Principles of slaughtering

i. Use clean, healthy animals.  
   Abattoir is not the place to dispose of severely ill or dead or dying animals. One of the major functions of ante-mortem inspection is to take out of the system those animals considered to be unsuitable for slaughter. The aim of the meat industry is to produce the highest possible quality of meat, and this cannot be achieved if the animals at the start of the system are not suitable. Animals with some disease conditions and with some level or dirt are still allowed to be slaughtered.

ii. Minimize pre-slaughter stress to produce the highest quality meat.

iii. Use a humane and effective method of killing the animal
   There is general agreement that the method of killing should be as humane and least stressful on the animal as possible. The method should be as effective as possible and achieve the objectives of quick and easy handling of the animal and carcass; minimize struggling and movement; and remove as much as blood as possible from the body during killing.

iv. Minimize the contamination of edible parts.
   This involves care and attention during skinning and evisceration so that the visible contamination with dirt, faeces, hair, wool, etc is reduced to a minimum, which results in less microbial contamination.

v. Maintain the quality of the edible product.
This may be achieved in a number of ways such as avoiding confusion between edible and inedible material; prompt and efficient refrigeration of the edible material; and correct disposal of inedible and condemned material.

TOPIC 3: MEAT INSPECTION

i. Meat inspection is a very important part of the meat processing industry. Its main objective is to ensure that the meat that goes through the human consumption is free from important diseases, parasites and chemical residues, meets certain quality criteria and has been processed and handled in a correct manner.

ii. Meat inspection procedures are divided into ante-mortem and post-mortem.

iii. The ante-mortem involves examination of the animal prior to slaughter to ensure that it is not severely diseased, stressed or emaciated and is in a fit state for slaughter.

iv. Animals following ante-mortem inspection are classed as either “fit for slaughter”, “suspect” which require extra attention at post-mortem inspection, or “condemned” in which case their bodies are either incinerated or used for meat and bone meal.

v. Post-mortem inspection involves the examination of carcass the examination of the carcass, head and viscera concentrating on the visual inspection on all surfaces and examination of the regional lymph nodes.

vi. Carcasses and carcass parts are then classed as “fit for human consumption”, "condemned" for pet food, "condemned" for meat and bone meal, or "condemned" and incinerated.

vii. The meat inspection nowadays is concerned with the detection of drug and chemical residues in meat and contamination with harmful bacteria such as certain strains of E.coli and Salmonella.
TOPIC 4: PRESERVATION OF MEAT

The main aim of all method of preservation is to inhibit microbial spoilage, reduce, if possible, deterioration from non-microbial sources, and to maintain or perhaps enhance the important properties of meat appearance and palatability. However, by far the most important of these aspects is the inhibition of microbial spoilage. Thus the different methods of preservation, although differing superficially, are alike in that they employ environmental conditions which discourage the growth of microorganisms. These methods may be grouped into three main categories:

a. Temperature control
b. Moisture control
c. Lethal or growth inhibiting agents.

4.1 Temperature control

Chilling

i. This involves holding meat or chilling at a temperature above freezing point (-2°C), but at a sufficiently low temperature to minimize or prevent the growth of the majority of types of organisms. Thus the temperature most used is in the range 0°C to 2°C.

ii. The growth of almost all the mesophilic microorganisms (medium temperature bacteria/fungus)) is inhibited at this temperature.

iii. The rate of cooling off the carcass or meat in a chiller is a most important consideration and depends on the following factors;
   - Temperature difference between the meat and the air in the chiller.
   - The thickness of surface fat
   - The depth of flesh
   - The air circulation
   - The humidity of the air in the chiller
iv. From microbiological point of view, it would be preferable to have low humidity and thus a dry environment at the meat surfaces in order to inhibit the microbial growth.

v. However, this will lead to excessive dessication of the meat surfaces which could result in weight losses of up to 5% to 8% of the original weight as well as affecting the appearance of the meat. Thus the usual practices is to use relative humidity of 85% to 95%, with the actual humidity used depending on the air speed, types of meat, length of storage required, and the temperature of storage.

Freezing
i. When muscle is frozen a portion of the tissue water separates the ice.

ii. At -3°C, 70% of the muscle water was present as ice; at -5°C, 82% and at -10°C, 94% separated out as ice.

iii. There are thus two reasons why microorganisms are unable to grow on frozen meat and these are:
- drying or dessication of the meat surface due to high degree of ice formation resulting in a small amount of free water
- inability of microbial enzymes to function at low temperatures, combined with ice crystal formation within the microbial cells.

iv. Freezing does not kill all microorganisms on meat. The low temperature attained kills a proportion of the microbial cells, due to mainly to ice crystal formation and rupturing, but the growth of the survivors is severely inhibited.

v. The organisms that survive initial freezing show a slow death rate so the number of viable organisms decline gradually with storage time.

4.2 Moisture control
i. The methods of moisture control for preservation of meat products may be broadly divided into those that involve direct removal of moisture and those
that tie up the available moisture, thus making it unavailable to microorganisms.

ii. Direct removal of moisture can be processed by sun-drying or freeze-drying of the meat.

iii. The tying up of the moisture can be processed by using permitted curing agent such as sodium chloride, sugar, sodium nitrate and sodium nitrite.

4.3 Lethal or growth inhibiting agents

i. Radiation – Ultraviolet lamps are used in particular situations where germicidal effect is required. The radiations are absorbed strongly by the nucleic acids in the microbial cells, and mutation and death results.

ii. Antibiotics – Theoretically, it would be useful preservative agents for meat products in combination with some other system such as chilling. However, this method is banned in most countries because it could develop bacteria resistant and the possibility of allergic reactions by a small proportion of the human population to a specific antibiotics e.g. Penicillin.

iii. Gasses – the use of increased levels of certain gases, such as CO₂ and ozone in sealed containers of meat is a method employed, in conjunction with refrigeration, where extended storage life is required e.g. ship journeys of 6 to 8 weeks. The recommended concentration of CO₂ is in the range of 10% to 30% for most meats.

iv. Acidic conditions – In certain meat products e.g. salami, the minced meat to make the salami is inoculated with bacteria culture from Lactobacillus or Leuconostoc species. These bacteria multiply in meat, produce lactic acid and other acids and thus lower the pH to 4.2 to 5.0. The lower pH has a definite preservative effect.

v. Chemicals – Apart from the chemicals mentioned under curing, the only chemical preservatives allowable for meat are sorbic acid, acetic acid and sulphur dioxide.
Conclusions

Pre-slaughter handling conditions are very essential factors which contribute to carcass and meat quality defects; therefore it should not be overlooked. When handling animals prior to slaughter, considerations should be made in terms of the kind, species, breed, and age. In addition the way animals are handled in the farm, during transportation, at the market and in the lairage expose them to various stresses. Improper pre-slaughter handling can cause the death of animals, carcass damages, reduction in live weight, pale soft exudative and dark firm dry meats. Poor pre-slaughter handling is also a compromise of animal’s welfare.

Additional References

Exercise 1 / Activity 1

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Discussion 1
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Answers to Exercise 1
1.
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Answers to Discussion 1
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