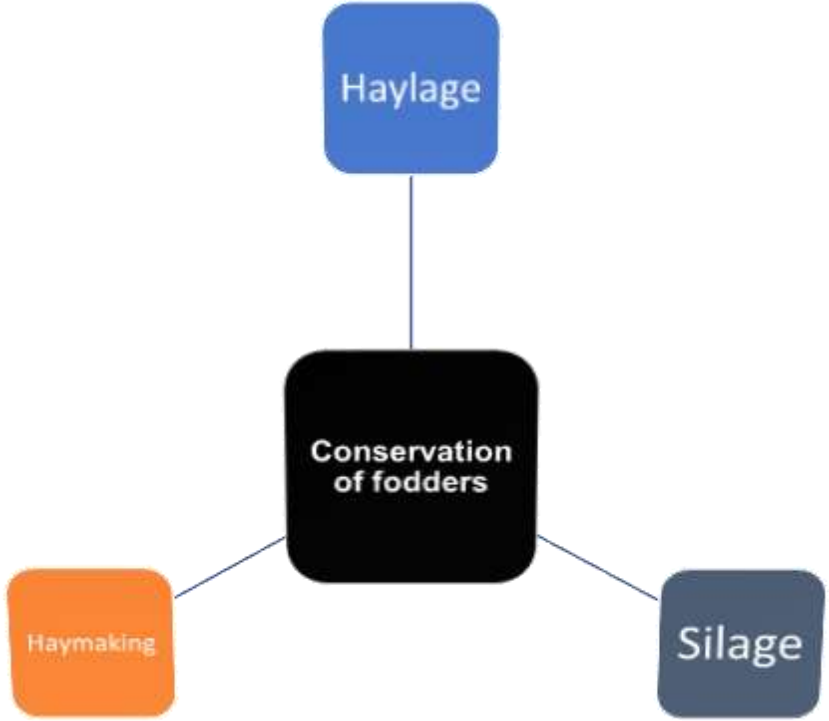
UPSC CSE Subjective
For Veterinary Science

ANIMAL NUTRITION

UNIT 5

- **Conservation of fodders. Storage of feeds and feed ingredients. Recent advances in feed technology and feed processing and Anti nutritional and toxic factors present in livestock feeds, Feed analysis and quality control, Digestibility trials – direct, indirect and indicator methods, Predicting feed intake in grazing animals.**


Haylage
Conservation of fodders
Haymaking
Silage

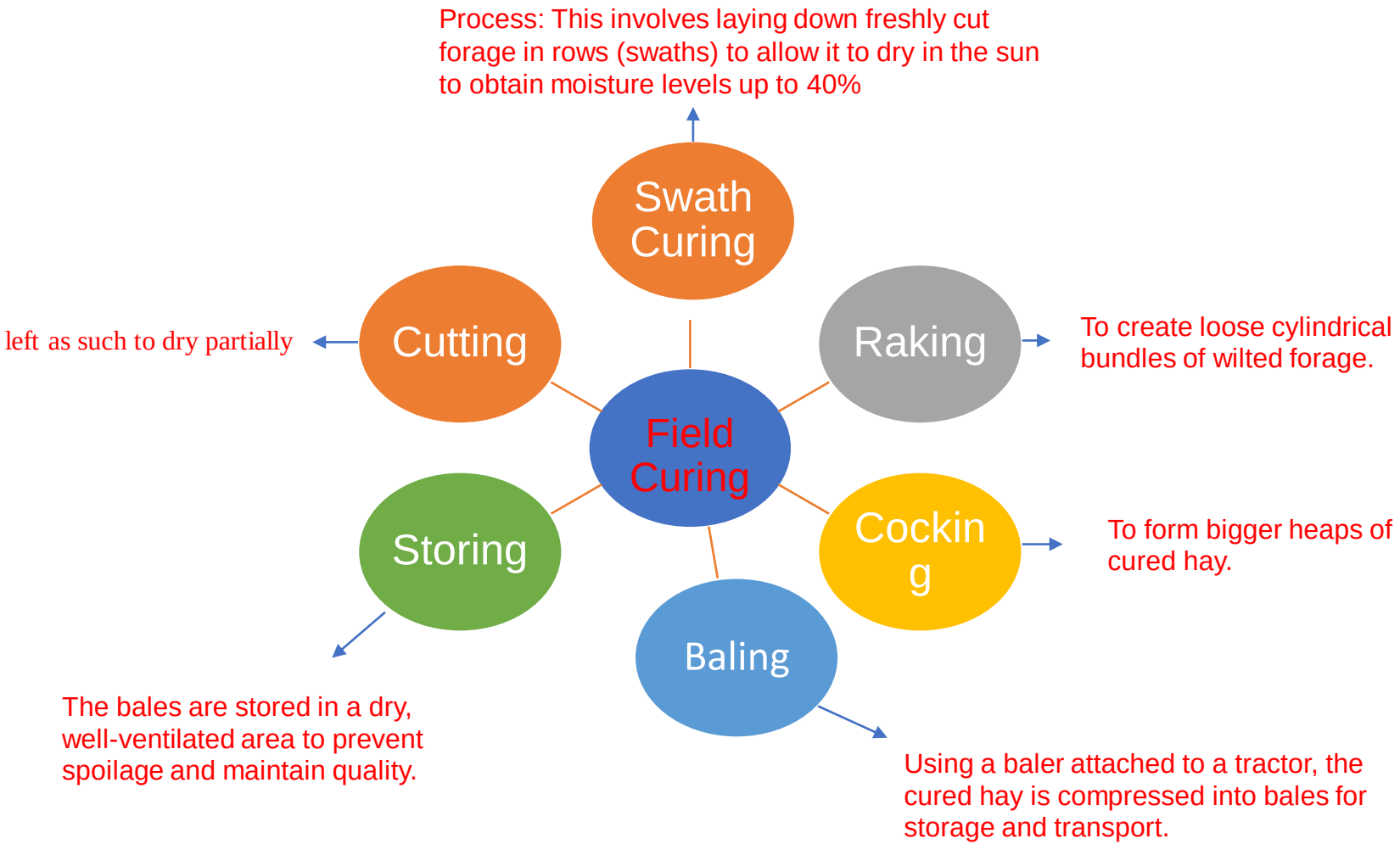
Haymaking is the process of cutting, drying, and gathering grass or other **Haymaking** plants, typically referred to as "hay," to be used as fodder or feed for livestock, particularly cattle, horses, and other herbivorous animals.

Aim of Haymaking

- reduce the moisture content around 12-14%
- less susceptible to spoilage, molds, and microbial degradation
- Allowing it to be stored for extended periods without losing nutritional value.

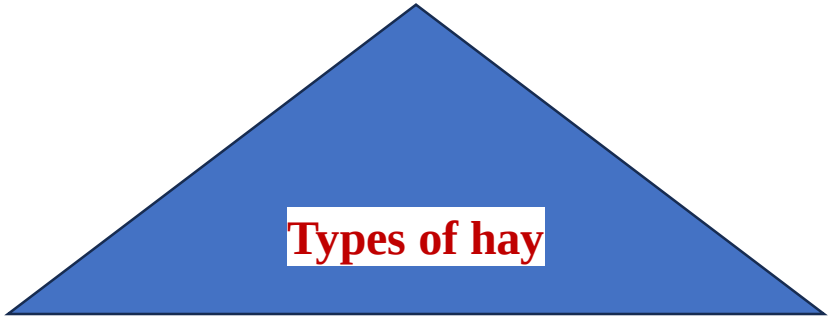
Methods of Drying

1. **Field curing:** sun drying
2. **Barn drying:** using fan/ air duct to reduce moisture to 20-25%.
3. **Artificial drying :** hot air-expensive but superior quality


Process: This involves laying down freshly cut forage in rows (swaths) to allow it to dry in the sun to obtain moisture levels up to 40%
Swath Curing
Cutting
left as such to dry partially
Raking
To create loose cylindrical bundles of wilted forage.
Field Curing
Storing
The bales are stored in a dry, well-ventilated area to prevent spoilage and maintain quality.
Cockin g
To form bigger heaps of cured hay.
Baling
Using a baler attached to a tractor, the cured hay is compressed into bales for storage and transport.

The nutritive value of mixed hay depends upon the type of legume and non legume crops used in mixed hay

Mixed hay

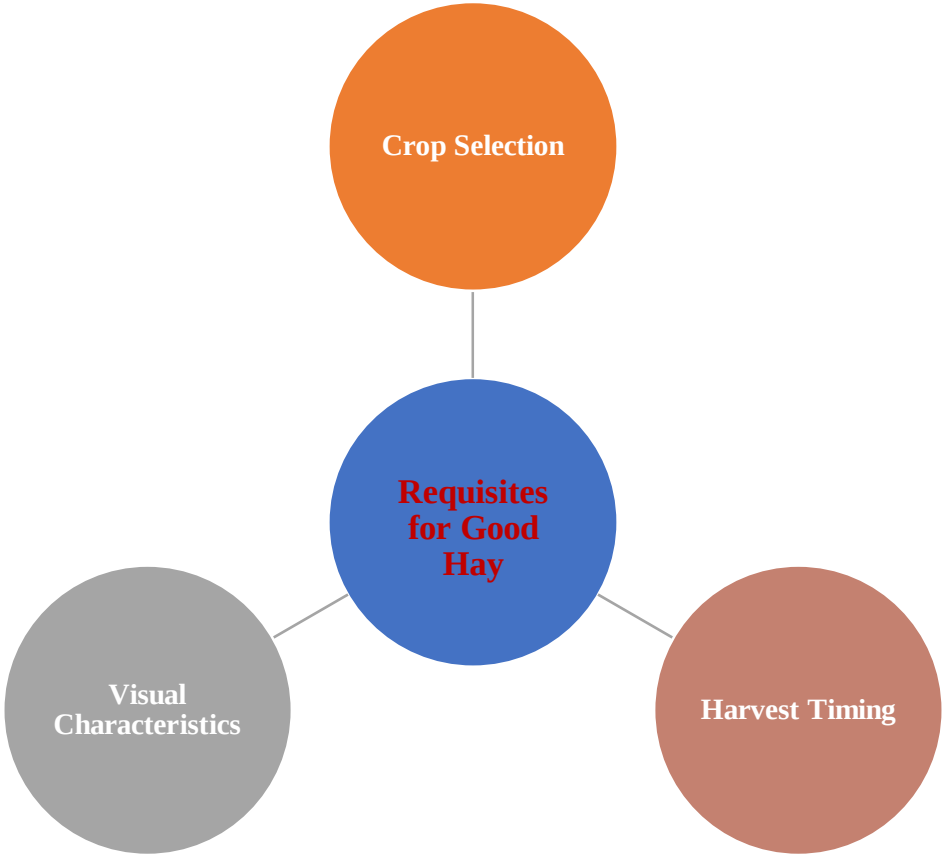


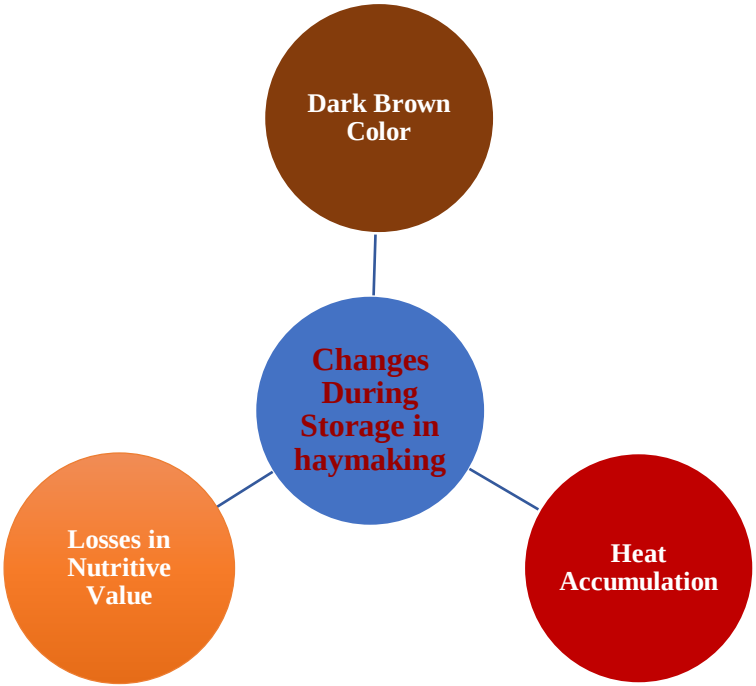
Legume hay

It has got a higher TDN and DCP and is rich in protein & minerals. Crops –Lucerne, Cowpea, Berseem.

Non – legume hay:

It is less palatable and has less amount of protein, vitamins and nutrients than legume hay but rich in carbohydrates. Crops – Oat, barley, Bajra, sorghum and grasses


Crop Selection
Requisites for Good Hay
Visual Characteristics
Harvest Timing


Dark Brown Color
Changes During Storage in haymaking
Losses in Nutritive Value
Heat Accumulation

Biochemical Changes During Storage

Carbohydrates

Plant respiration continues after harvest, leading to the **oxidation of sugars** to CO2 and H2O. Organic acids' concentration decreases during wilting.

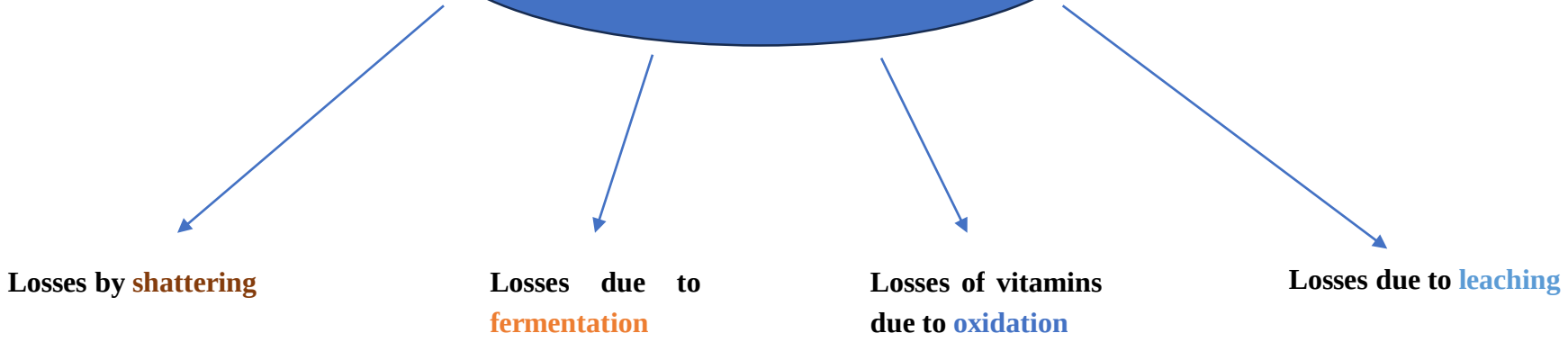
Nitrogenous Constituents

Plant enzymes can **proteolyzed** proteins, resulting in the formation of free amino acids.

Vitamins

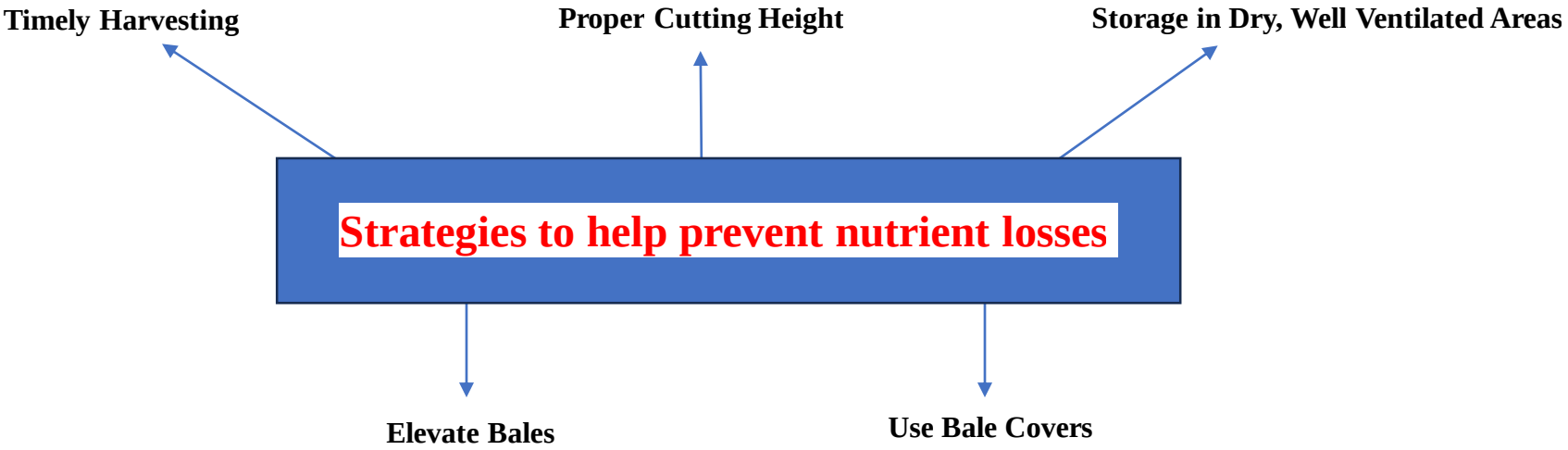
During sun drying, **oxidation can lead to a reduction in carotene** concentration. However, sun drying can also **enhance the vitamin D** content in hay due to irradiation of ergosterol present in green plants.

Nutrient losses during hay making



Total loss estimated in hay making

- Loss of DM – 20-30% in legumes and 10-15%in grasses
- Loss of protein – 28%
- Loss of carotene- 90%
- Loss of energy - 25%


Timely Harvesting
Proper Cutting Height
Storage in Dry, Well Ventilated Areas
Strategies to help prevent nutrient losses
Elevate Bales
Use Bale Covers

Silage

Green succulent fermented material produced by controlled anaerobic fermentation of the green fodder crop retaining the high moisture content. This process of making silage is called ensiling.

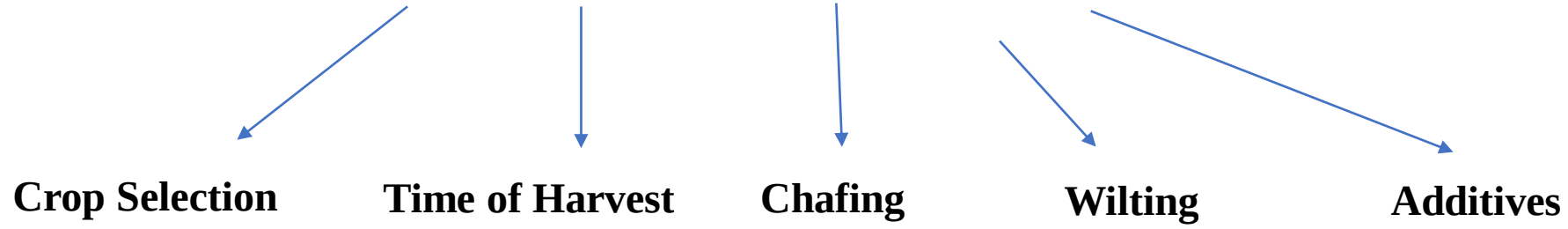
Advantages of Silage Making:

1. **Year-Round Feed Supply**
2. **Weather Independence**
3. **Increased Livestock Capacity**

Disadvantages of Silage Making:

1. **Equipment and Infrastructure:** e.g., choppers, compactors, silos and infrastructure (e.g., silo structures)
2. **Labor-Intensive:** labor-intensive
3. **Fermentation Odor**
4. **Risk of Spoilage:** Inadequate packing or sealing

Factors to Consider in Silage Making



Principles of Fermentation in Silo

Aerobic Phase

(Phase 1)

•Objective: Eliminate oxygen.

•Process: Initial phase where aerobic bacteria break down sugars, producing CO2, water, and heat. This phase lasts a few hours to a couple of days and is critical for setting the stage for anaerobic

Anaerobic Phases (Phases 2-4)

•Phase 2: Lag Phase

•Objective: Break down plant cells.

•Process: Plant cells are broken down by enzymes, providing nutrients for bacteria. This phase lasts 24 to 96 hours and involves hetero-fermentation by bacteria like Enterobacteria.

•Phase 3: Lactic Acid Fermentation

•Objective: Produce lactic acid.

•Process: Lactic acid bacteria (LAB) dominate, producing lactic acid and lowering the pH. This phase is critical for preserving nutrients and preventing spoilage.

•Phase 4: Spoilage Prevention

•Objective: Prevent spoilage.

•Process: Minimize oxygen ingress during feedout by maintaining an airtight silo and using additives to prevent spoilage by undesirable microorganisms

Methods of Preparing Silage:

1. **Chopping**
2. **Moisture Management**
3. **Sealing**
4. **Fermentation**
5. **Fermentation Period**

Improving the digestibility and nutritive value of wheat bran and paddy straw

1. **Chopping and grinding increase surface area** for improved digestion.
2. **Ammoniation** increases protein content and reduces lignin in straw.
3. **Enzyme** supplementation aids in **breaking down complex carbohydrates**.
4. **Steam flaking softens** wheat bran and straw for better digestibility.
5. **Protein supplementation with soybean meal** enhances feed quality.
6. **Sodium hydroxide** treatment **breaks down lignin in** straw.

Reasons and methods for feed processing

1. To alter the particle size (most imp factor)
2. To change moisture content and density of feed
3. To increase nutrient availability and change acceptability (palatability)
4. To detoxify/remove harmful ingredients
5. To improve keeping qualities and to make the storage easy and safe.
6. To make animal production more economical

Processing methods for roughage to improve its utilization by animals

Physical processing of roughages

Dry processing methods

1. **Dehydration**
2. **Baling**
3. **Chopping/ chaffing**
4. **Grinding**
5. **Pelleting**
6. **Cubing/block and wafering**

Wet processing

Soaking

Chemical treatment/processing of roughages

1. **Urea treatment:**
2. **NaOH treatment3%**
3. **Anhydrous NH_3**

Biological processing of roughages

Enzyme treatment: Cellulase

Anti nutritional and toxic factors present in livestock feeds

- **According to-** **Mechanism of Action (MOA)**

1. Substances Depressing Digestion/Metabolism of Protein eg. Protease inhibitor, source: soyabean

2. Substances Depressing Carbohydrate Metabolism eg Amylase inhibitor Source: legumes

3. Substances Interfering With Utilization of Mineral Element eg Gossypol, Source:Cotton seed, bind with iron

4. Substances Inactivating/Increasing Requirements of Vitamins eg anti vit-k , sweet clover (dicoumarol)

5. Substances That Stimulate Immune System. Antigenic globulins of soyabean are glycinin and β – conglycinin.

6. Miscellaneous: Mimosine inhibit thyroxine Source: Subabool

Neutralizing anti-nutritional factors:

1. **Heat treatment**

2. **Enzyme supplementation**

3. **Fermentation**

4. **Blending with other feed raw materials**

5. **Plant breeding for reduced anti-nutritional factors**

6. **Processing**

Feed analysis and quality control

- **Proximate Analysis:** Proximate analysis breaks down feed components into several categories, including:
- **Moisture Content:** Determining the water content of the feed, which affects its stability and shelf life.
- **Crude Protein:** Estimating the total protein content, which is essential for growth and maintenance in animals.
- **Crude Fat:** Assessing the lipid content, which provides energy and fat-soluble vitamins.
- **Crude Fiber:** Measuring the indigestible fiber content, which impacts digestibility and gut health.
- **Ash Content:** Determining the mineral content, which is essential for various physiological processes.

- **Van Soest method:** mainly for roughages because they are rich in fiber fraction. And according to proximate analysis, CF should contain all the cellulose, hemicellulose and lignin. But some hemicellulose and Lignin appear in NFE fraction also. So, Van Soest proposed the classification of feed according to cell and cell wall content.

- **Procedure:**

- **Neutral Detergent Fiber (NDF) Determination**
- **Acid Detergent Fiber (ADF) Determination**
- **Lignin Determination**

- • NDF: Cellulose + Hemicellulose + Lignin

- ADF: Cellulose + Lignin

Methods of Determining Digestibility

Digestibility Trials Using Markers

- External Marker
- Internal Marker

In-vivo Methods

Direct In-vivo

- Feces collection (ruminants) or metabolism trial (feces, urine, milk).

Indirect In-vivo

Compare nutrient intake with fecal excretion using difference method.

Semi In-vivo Method

- **Bag Technique:** Nylon/dacron bags kept in rumen of fistulated animals.
- **VIVAR Technique:** In-vitro artificial rumen.

In-vitro Methods

Tilley and Terry: One or two stage rumen fermentation .

Menke's Gas Production: Measures gas production during feed incubation with rumen liquor.

Digestibility Trials Using Markers

- **Ideal Marker Characteristics**

1. Completely indigestible and non-absorbable
2. Inert, with no pharmacological effects
3. Mixes uniformly with the feed
4. Passes through the tract at a consistent rate
5. Completely voided in feces
6. Chemically determinable in feces
7. Preferably a natural feed constituent

- **Types of Markers**
- Internal Markers: Naturally occurring in the feed, e.g., lignin, silica, acid-insoluble ash.
- External Markers: Not naturally present in the feed, e.g., chromic oxide

- **Digestibility in Poultry**
- Surgical Method: Separate urine and feces.
- Chemical Method: Analyze nitrogen in urine (uric acid) and feces (true protein).
- These methods provide insights into feed efficiency and help optimize animal diets.

Factors that affect the digestibility

A. Animal Factors

1. Species
2. Age
3. Work
4. Individual Variation

B. Plant Factors

1. Chemical Composition:
2. Protein.

C. Feed Preparation and Presentation

1. Particle Size
2. Soaking
3. Processing
4. Ration Composition.
5. Carbohydrates
6. Lipids
7. Minerals

These factors collectively influence the efficiency of nutrient utilization in animals, impacting their health and productivity.

Justify why more than one digestibility trial needs to be conducted during indirect method of digestibility determination of feed:

1. **Variability in Animal Response**
2. **Seasonal and Environmental Variations**
3. **Dietary Composition**
4. **Statistical Validity**

Predicting feed intake in grazing animals:

1. **Animal Based Methods**
2. **Vegetation Based Methods**
3. **Feeding Behavior Methods**
4. **Marker Methods**