



Unit 1

Fundamentals of Animal Nutrition, Classification of fodder and Anti-Nutritional Factors

1. Introduction of Animal Nutrition
2. Nutritional Terms and Their Definitions
3. Nutritional Aspect of Carbohydrates, Proteins, and Fats
4. Classification of Feed and fodder
5. Anti-Nutritional Factors in Feeds

1. Introduction of Animal Nutrition

1. **Father of Nutrition** - Antoine Laurent de Lavoisier
2. Designed **animal calorimeter** for detecting body heat- Laplace
3. **Starch equivalent** system of energy given by Kellner.
4. Constructed **respiration calorimeter** also developed **Net energy system** of evaluating Feed Armsby
5. Developed the **fibre estimation** method Van Soest
6. **Vitamin K** discovered by Henrik Dam
7. **Vitamin A** discovered by McCollum and Davis
8. Developed the use of weight to the **0.75 power** Max Kleiber

1.2 Importance of Nutrients in Animal Production and Health

Nutrients are essential for growth, reproduction, maintenance, and overall well-being of animals. nutrients are two type-

Macronutrients

- **Carbohydrates:** Primary energy source. Found in grains, cereals, and forages.
- **Proteins:** For growth, repair, and maintenance of body tissues. Sources are soybean meal, fish meal, and legumes.
- **Fats:** Concentrated energy source; essential for cell membrane integrity. Common sources are oilseeds and animal fats.
- **Water:** Vital for digestion, nutrient transport, waste excretion, and temperature regulation.

Micronutrients

- **Vitamins:** Essential for various biochemical functions.
 - **Vitamin A:** Important for vision, reproduction, and immune function.
 - **Vitamin D:** Necessary for calcium absorption and bone health.
 - **Vitamin E:** Antioxidant that protects cell membranes.
 - **Vitamin K:** For blood clotting.
- **Minerals:** Required for structural and regulatory functions.
 - **Macrominerals:** Calcium, phosphorus, potassium, sodium, and magnesium.
 - **Microminerals:** Iron, zinc, copper, selenium, and iodine.

1. building nutrient of animal body is **(UKPSC, 2024)**

- a) **Protein**
- b) Fat
- c) Minerals
- d) Carbohydrate

2. Assertion (A): Plants and animals benefit each other as members of food chains and ecosystems.

Reason (R): When animals die and decompose, they enrich the soil with nitrates that stimulate plant growth.

JKPSC - 2020

- A) A & R are true and R is the correct explanation of A**
- B) A & R are true and R is the not correct explanation of A
- C) A is true but R is false
- D) A is false but R is true

3. Fat is included in the diets of livestock during heat stress because **JKPSC - 2019**

- 1) **The heat of digestion of fat is less**
- 2) **The heat of nutrient metabolism is less**
- 3) The calorific value of the fat is higher
- 4) **Source of fat soluble vitamins**

Which of the above statements is/are correct?

- A) 3 and 4
- B) 1, 2 and 4**
- C) 3, 1, and 4
- D) 1, 2 and 3

4. Who developed the starch equivalent value of feed **(JKPSC2019)**

- (A) Atwater
- (B) Morrison
- (C) Armsby
- (D) Kellner**

5. The chief energy source of cattle ration is: **(JKPSC2012)**

- (A) Protein
- (B) Carbohydrate**
- (C) Minerals
- (D) Vitamins

7. Which of the following is a fat soluble vitamin

(PPSC 2021)

- (A) Vitamin B1
- (B) Vitamin B2
- (C) Vitamin C
- (D) Vitamin E**

8. Starch equivalent based energy system was given by

(RPSC 2013)

- (1) Morrison
- (2) Armsby
- (3) Kellner**
- (4) Dubois

9. A water soluble vitamin which is deficient in the egg: (OPSC, 2021-22)

- (A) Ascorbic
- (B) Thiamin
- (C) Cobalamin**
- (D) Riboflavin

10. Which one of the following has the most cofactors per 100g reduced during its metabolism? (OPSC, 2021-22)

- (A) Carbohydrate
- (B) Protein
- (C) Fat**
- (D) Vitamins

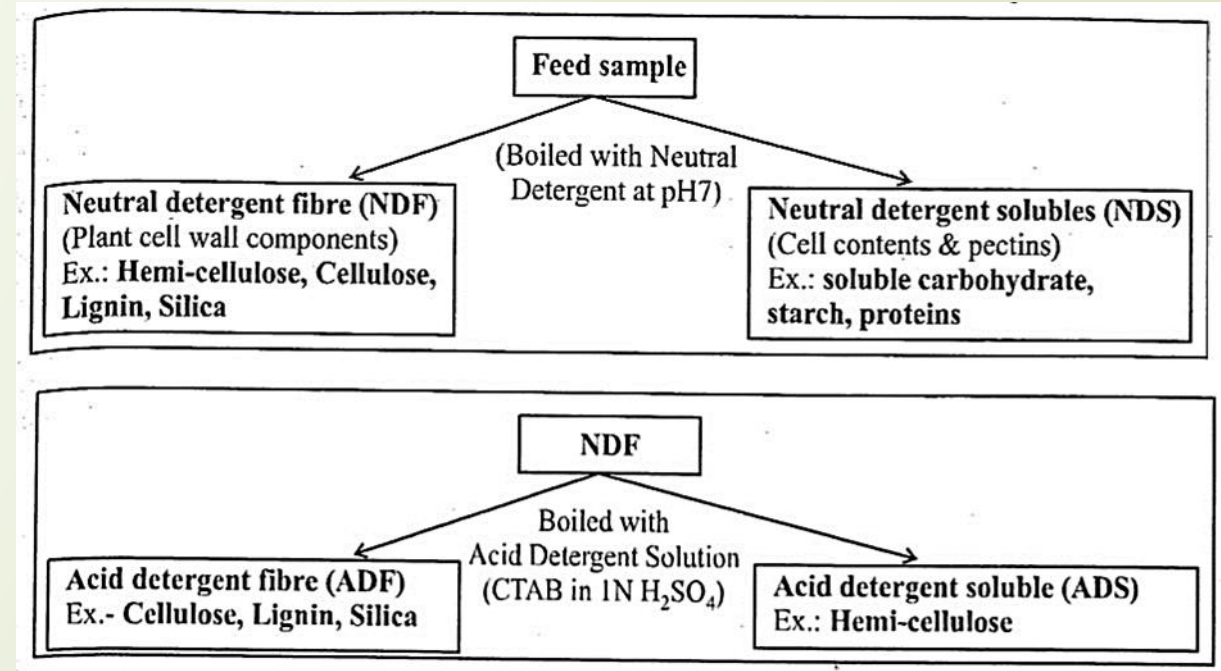
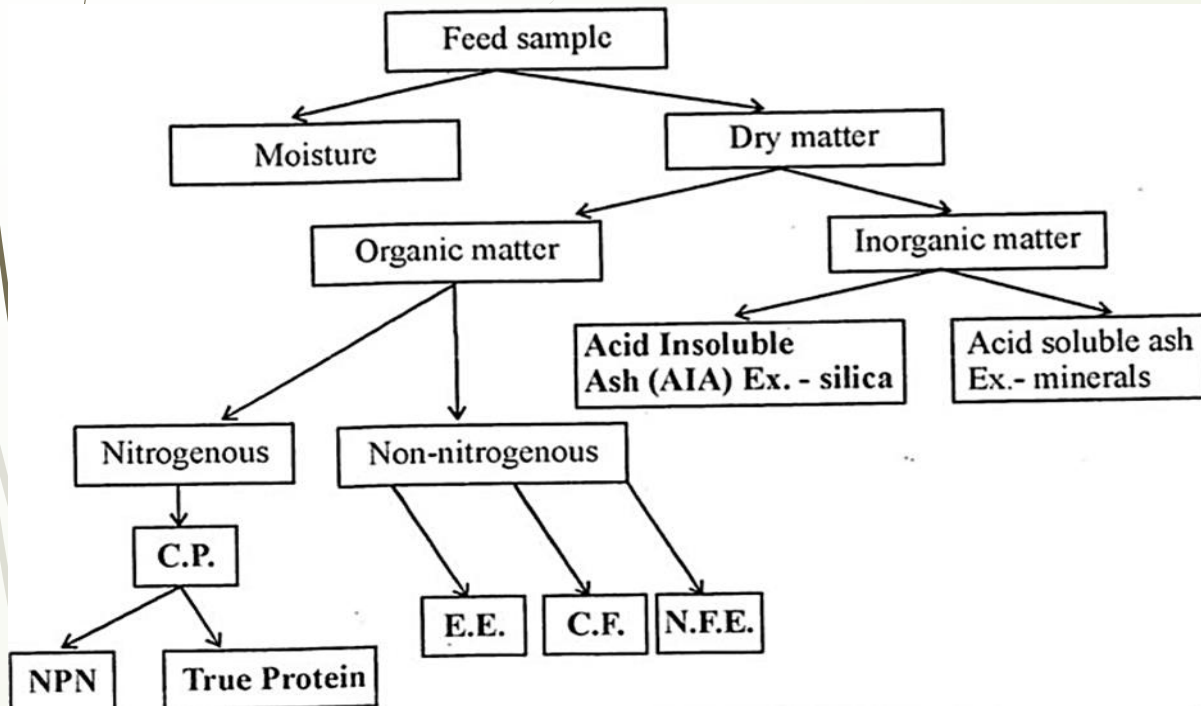
11. Which of the following elements contains the maximum percentage of animal body weight? opsc 2021-22

- (A) Nitrogen**
- (B) Hydrogen
- (C) Iron

2. Nutritional Terms and Their Definitions

1. **Dry Matter (DM):** The portion of feed remaining after removing water content.
2. **Crude Protein (CP):** Measure of protein content in feed, calculated from nitrogen content.
3. **Crude Fiber (CF):** Indigestible cellulose, lignin, and hemicellulose.
4. **Ether Extract (EE):** Portion of feed soluble in ether, representing fat content.
5. **Nitrogen-Free Extract (NFE):** Readily digestible carbohydrates such as sugars and starches.
6. **Ash:** Inorganic residue after burning feed, representing total mineral content.
7. **Acid Detergent Fiber (ADF):** Measures cellulose and lignin, indicating the less digestible portion of the feed. Higher ADF = Lower digestibility.
8. **Neutral Detergent Fiber (NDF):** Measures hemicellulose, cellulose, and lignin, indicating the total fiber content. Higher NDF = Lower feed intake potential, but necessary for rumen health.
9. **NDF-ADF = Hemicellulose**

Importance of Nutrients in Animal Production and Health



1. In Van Soest method of Forage analysis, the hemicellulose is determined as (RPSC 2019)

- (1) **NDF-ADF**
- (2) ADF-Lignin
- (3) ADF-Cellulose
- (4) None of these

2. Which of the following is absorbed in omasum? opsc 2018-19

- (A) **Water**
- (B) Volatile fatty acid
- (C) Both of the above
- (D) None of the above

3. NDF stands for: opsc 2021-22

- (A) Non Degradable Fibre
- (B) **Neutral Detergent Fibre**
- (C) Non Digestible Fibre
- (D) Nitrogen Digestible Fibre

4. What % of the dietary true protein escapes ruminal digestion? opsc 2021-22

- (A) 30
- (B) **40**
- (C) 50
- (D) 60

5. Which of the following terms represents the portion of feed that remains after removing the water content?

- A) Crude Protein (CP)
- B) Crude Fibre (CF)
- (C) **Dry Matter (DM)**
- D) Ether Extract (EE)

6. What does the Ether Extract (EE) in feed analysis measure?

- A) Protein content
- B) Indigestible cellulose
- C) Fat content**
- D) Ash content

7. If a feed has a high Acid Detergent Fibre (ADF) content, it indicates:

- A) Higher digestibility
- B) Lower digestibility**
- C) Higher intake potential
- D) Increased protein content

8. The term 'Nitrogen-Free Extract (NFE)' in feed analysis refers to which component?

- A) Crude fibre
- B) Indigestible carbohydrates
- C) Readily digestible carbohydrates**
- D) Fat content

9. Which of the following methods was developed by Van Soest in 1960 for forage analysis?

- A) Proximate composition
- B) Detergent method**
- C) Calorimetry
- D) Nitrogen balance study

10. How much water is produced during the metabolism of 1 gram of fat?

- A) 0.4 grams
- B) 0.6 grams
- C) 1.1 grams**
- D) 1.5 grams

3. Nutritional Aspect of Carbohydrates, Proteins, and Fats

CLASSIFICATION OF CARBOHYDRATES

▶ 1. Monosaccharides-

- ▶ Trioses, Tetroses, Pentoses (e.g. Ribose, Xylose, Arabinose), Hexoses (Glucose, Galactose, Fructose)

▶ 2. Disaccharides-

- ▶ Lactose (Galactose and Glucose by beta 1-4 linkage)/ Milk sugar
- ▶ Maltose (Glucose and Glucose by alpha 1-4 linkage)/ Malt sugar
- ▶ Sucrose (Glucose and Fructose by alpha 1-4 linkage)/ Table sugar/ Non reducing sugar
- ▶ Cellobiose (Glucose and Glucose by beta 1-4 linkage)

▶ 3. Trisaccharide-


- ▶ Raffinose (Galactose, Glucose and Fructose)

▶ 4. Polysaccharide-

- ▶ Arabinose, Glycogen (alpha 1-4 & alpha 1-6 glucose), Starch, Cellulose (beta 1-4 glucose), Dextrin, Inulin
- ▶ Mix Polysaccharide- Hemicellulose (beta 1-4 xylose), chitin, Pectin, Mucilage
- ▶ Complex polysaccharide- Glycolipids, Glycoproteins

CLASSIFICATION OF AMINO ACID

- **1. Aliphatic amino acid**
- Monoamine- Monocarboxylic (Neutral): Glycine, Alanine, Serine, Valine, Leucine, Isoleucine
- Monoamine-Dicarboxylic (acidic): Aspartic acid, Glutamic acid
- Diamino-Monocarboxylic (Basic): Lysine, Arginine,
- **Sulphur containing**: Methionine, Cystine, Cysteine
- **2. Aromatic Amino acid**: Phenylalanine, Tyrosine
- **3. Heterocyclic**: Proline, Histidine, Tryptophan

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- **Ketogenic Amino Acids:** Leucine, Lysine
 - **Glucogenic & Ketogenic Amino Acids:** Isoleucine, Phenylalanine, Tyrosine, Tryptophan, Threonine
 - **Glucogenic amino acid:** Rest all other

 - **Essential amino acid: (By W.C. rose)-** Can not synthesise in body
 - **Pig: Lysine**
 - **Poultry: Glycine**
 - **Sheep: Methionine**
 - **Cat: Taurine**
 - **Critical amino acid:** Low in practical diet e.g.- Lysine, Methionine



CLASSIFICATION OF FATTY ACID



Saturated Fatty acid- butyric acid, caproic acid, lauric acid, Palmitic acid

Unsaturated Fatty acid- Palmitoleic acid, Oleic, linoleic, Linolenic, Arachidonic acid

Essential fatty acid in cat-
Arachidonic acid and in pig &
Poultry- linoleic acid

ROLE AND REQUIREMENT OF WATER, METABOLIC WATER




Vital for digestion, nutrient transport, waste excretion, and temperature regulation.



Metabolic water is produced internally during the metabolism of nutrients, particularly carbohydrates, proteins, and fats.



Energy Metabolism: For every gram of **carbohydrate**, **protein**, and **fat** metabolized, approximately **0.6**, **0.4**, and **1.1 grams of water** are produced, respectively.

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1. Which is an example of heterocyclic amino acid?
(1) Proline (2) Glycine (3) Aspartic acid (4) Lysine
 2. Which is the only naturally occurring ketohexose?
(1) Glucose (3) Galactose
(2) Fructose (4) Mannose
 3. Which volatile fatty acid is responsible for milk fat synthesis in cows?
(1) Propionic acid (3) Buteric acid
(2) Acetic acid (4) None of the above
 4. The major end products of rumen carbohydrate digestion in buffaloes are: **(UK, 2024)**
 - a) **Volatile fatty acids**
 - b) Glucose
 - c) Sucrose
 - d) Maltose
 5. Protein that contains phosphorous in its structure is: **(UK, 2024)**
 - a) Hemoglobin
 - b) Xanthene oxidase
 - c) Catalase
 - d) **Casein**

6. A carbohydrate commonly known as dextrose: **opsc 2021-22**

(A) Glucose

(B) Galactose

(C) D-Glucose

(D) Sucrose

7. The number of molecules of ATP produced by the total oxidation of acetyl CoA in TCA cycle is: **opsc 2021-22**

(A) 08

(B) 10

(C) 12

(D) 16

8. Sulphur containing amino acid is: **opsc 2021-22**

(A) Leucine

(B) Methionine

(C) Valine

(D) Asparagine

9. Which one is not polysaccharides? **opsc 2021-22**

(a) Raffinose

(B) Dextrins

(C) Inulin

(D) Cellulose

10. Which is not classified as Basic amino acid ? **opsc 2021-22**

(A) Arginine

(B) Valine

(C) Histidine

(D) Lysine

4. Classification of Feed and fodder

Feeds and Fodders

1. Common Feeds and Fodders, Classification & Importance

• **1.1 Why Classify?**

- Grouping of similar feedstuffs
- Facilitates ration formulation
- Allows for substitution based on price and availability

1.2 Basis for Classification :

Physical characteristics (Bulkiness): Roughages & Concentrates

Chemical characteristics: Proximate principles (6):
Moisture, Crude Protein (CP), Crude Fiber (CF), Ether Extract (EE), Total Ash, Nitrogen-Free Extract (NFE)

Roughages vs Concentrates

S.no	Item	Roughage	Concentrate
1	Crude Fiber	CF>18%	CF<18%
2	TDN	TDN<60%	TDN>60%
3	Energy Content	Low	High
4	Digestibility	Low	High
5	Function	Bulk	Energy
6	Example	Straw, hay, silage	Grains, meal, cake

Classification of Roughages

A. By Moisture Content :

Dry Roughages: Less than 15% moisture (e.g. hay, straw, chaff)

Green/Succulent Roughages: 80-85% moisture (e.g. fresh grass, tree leaves, silages, roots, tubers)

B. By Type :

Legume Roughages: High protein, used for production (e.g. berseem, lucerne, cowpea)

Non-Legume Roughages: Lower protein than legumes (e.g. maize, bajra, sorghum, oat)

C. By Nutritional Value :

Non-Maintenance Type: Less than 3% DCP (e.g. straw, stover)

Maintenance Type: 3-5% DCP (e.g. non-leguminous cereal fodder)

Production Type: More than 5% DCP (e.g. legume fodders)

D. By Season :

Rabi Season Roughages: Grown in winter (e.g. oats, lucerne, berseem)

Kharif Season Roughages: Grown in summer (e.g. maize, cowpea, bajra, sorghum)

E. By Life Cycle :

Annual Forages: (e.g. maize, sorghum, berseem, cowpea)

Perennial Forages: (e.g. hybrid napier, para grass, stylo, desmanthus)

Examples & Common Terms Related to Dry Feeds

1. **Forages:** Plant materials used for feeding animals (e.g. hay, straw, silage, pasture)
2. **Roughages:** Feedstuffs with higher fibre content (e.g. husk, shells)
3. **Hay:** Dried product of thin-stemmed crops (e.g. alfalfa hay, timothy hay)
4. **Straw:** Byproduct of cereals/legumes after grain/pulse removal (e.g. wheat straw, gram straw)
5. **Fodder:** Aerial parts including ears/heads (e.g. corn fodder)
6. **Stover:** Aerial parts without ears/heads (e.g. corn stover)
7. **Bagasse:** Leftover of sugarcane after juice extraction
8. **Hull:** Outer covering of beans/peas (e.g. cottonseed hull, soybean hull)
9. **Husk:** Outer covering of grains and legumes (e.g. rice husk, gram husk)
10. **Shell:** Hard covering of nuts (e.g. groundnut shell)

Advantages of Dry Roughages

- Helps satisfy animal hunger
- Maintains dry matter intake (DMI)
- Cheaper source of dry matter

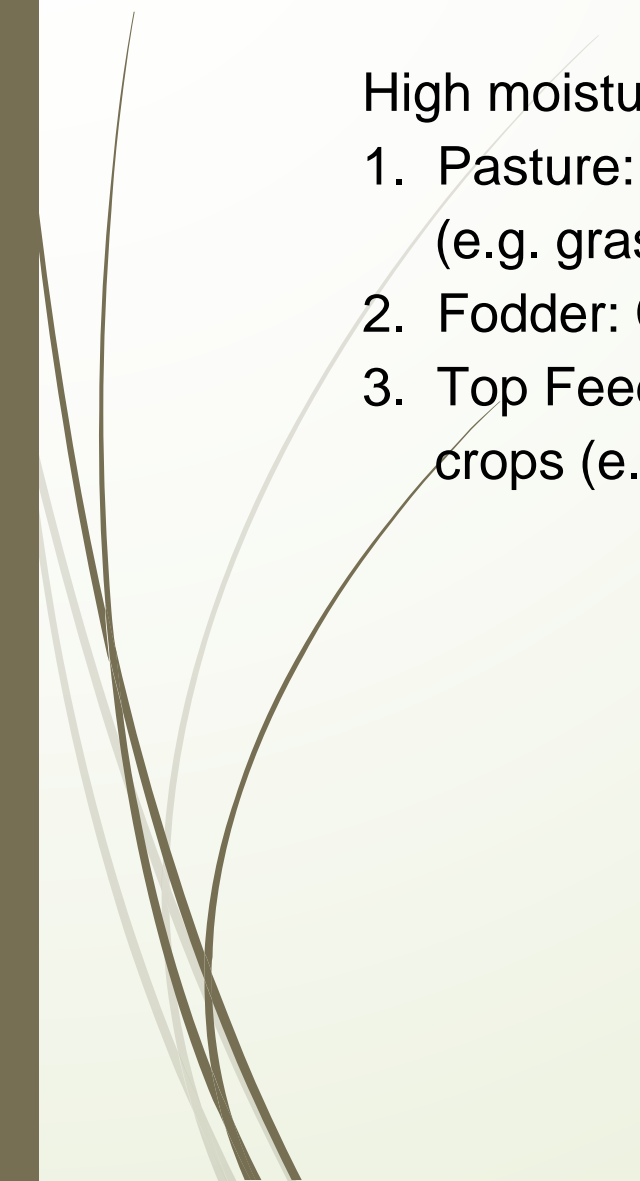
Disadvantages of Dry Roughages

- Poor digestibility due to high lignin content
- Low nutritional value, except for hay (3% CP vs 15-17% in hay)



Green/Succulent Forage and Pasture

High moisture content (80-85%). Types include :

1. Pasture: Natural or cultivated plants used for browsing/grazing (e.g. grasses and legumes)
 2. Fodder: Crops harvested for stall feeding (e.g. maize, sorghum)
 3. Top Feeds: Tree leaves, top cuttings of plants and agricultural crops (e.g. babul, neem, subabul leaves)
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Energy Feeds

- 1.Characteristics : CP: <20%
- 2.CF: <18%
- 3.TDN: 75-80%

1.Main Types:

a) Cereal Grains : Main component: Starch (60-65%)

- 2.CP: 8-12%
- 3.Fat: 2-5% (mostly unsaturated fatty acids)
- 4.Deficient in lysine and methionine
- 5.Calcium deficient, phosphorus rich (in phytate form)
- 6.Deficient in vitamins D and A (except maize)
- 7.Risk of Subacute Ruminant Acidosis (SARA)
- 8.Key cereals: maize, barley, oats, wheat, millets (sorghum, bajra)

c) Fat:

- 1.Highest energy yield (2.25 times carbohydrates)
- 2.Limitations in ruminants: Not more than 6% of DMI
- 3.May be given in bypass form for high-yielding animals
- 4.No major digestive issues in monogastrics

b) Molasses:

- 1.Instant energy source (sugar)
- 2.Rich in minerals
- 3.CP: up to 5-6%
- 4.Used with urea in ruminant diets
- 5.Can be included up to 10% in concentrate mix
- 6.Higher levels may cause digestive issues

Protein Supplements

- 1.Characteristics : CP: Greater than 20%
- 2.CF: Less than 18%
- 3.Protein Types: True protein or Non-Protein Nitrogen (NPN)

A. Plant Origin :

- 1) Cottonseed Cake
- 2) Groundnut Cake (GNC)
- 3) Soybean Meal (SBM)
- 4) Mustard Cake
- 5) Guar Meal
- 6) Sesame Cake
- 7) Gram
- 8) Guar

B. Animal Origin:

- 1) Fishmeal
- 2) Meat and Bone Meal (MBM)
- 3) Blood Meal (BM)
- 4) Feather Meal
- 5) Hatchery Byproducts

C. Single Cell Protein (SCP) Sources

- 1) Bacteria: Methanomonas methanica
- 2) Yeast: Spirulina
- 3) Algae: Torulopsis utilis



Important Notes :

1. Sesame Cake: Very rich in calcium
2. Soybean Meal (SBM): Low in methionine, often requires synthetic amino acid supplementation
3. Meat and Bone Meal (MBM): Banned in some regions due to **BSE risk**
4. Mustard Cake: Contains erucic acid, limiting inclusion to 10-12% of concentrate mix
5. Blood Meal: Poor digestibility, palatability, and low in calcium and phosphorus

Methods of Making Vegetable Protein

1. Hydraulic/Ghani Method: Produces cake with about 8% fat
2. Expeller Method: Produces cake with about 6% fat, with some bypass protein
3. Solvent Extraction: Produces meals with less than 1% fat using ether or benzene

Non-Protein Nitrogen (NPN) Sources

Definition: Nitrogen in forms other than true protein and peptide

Examples: Urea (46% N), Biuret (35% N)

Function: Increases microbial growth in the rumen

• Urea/NPN Supplementation Guidelines :

- Concentrate Mix: Up to 3%
- Total DMI: Up to 1%
- Total Nitrogen/Protein Need: Up to 33% (one-third)
- Salt: 0.5% of mix
- Straw Treatment: 4%
- Not Beneficial if Total Mixed Ration (TMR) CP is greater than 13%
- Maximum Permissible Level (MPL): 27 g/100 kg body weight or 100 g/day for adult cow, 10 g/day for goats
- Toxicity Treatment: 45 liters cold water followed by 2-6 liters 5% acetic acid

Issues with Urea Supplementation :

Rapid Hydrolysis can lead to toxicity
Requires energy (e.g. starch) for effective utilization

Optimal Starch to Urea Ratio: 10:1 (1 kg starch per 100 g urea)

Optimal N:S Ratio for rumen function: 10:1

Urea Products :

Examples : Uromol, Urea-Molasses Mineral Block (UMMB), Urea-Molasses Liquid Feed

Agro-Industrial By-Products

- Derived from agricultural product processing
- Cheaper than primary feed ingredients
- Rich in fiber and minerals
- Protein Content: 12-14% CP
- Energy Value: Moderate
- Examples : Flour: Finely ground grains used as feed ingredient
- Bran: Outer covering of grains like rice and wheat, rich in phosphorus and fiber
- Rice Polish: Byproduct of rice milling, rich in energy and B-complex vitamins
- De-Oiled Rice Bran (DORB): Used as filler in feed formulations
- Hulls: Outer coverings of beans and peas, like soybean hulls
- Chunni: Broken grains with husk, like gram or dal chunni
- Distillers Dried Grains with Solubles (DDGS): Byproduct of ethanol production, rich in protein and fiber
- Gluten: Protein-rich byproduct from starch extraction in grains



Mineral Supplements

- Categorized into macro-minerals and micro-minerals based on required quantities
- Mineral Mixture (MM): Typically 2% of concentrate mix
- Salt: Usually 1% of concentrate mix, acts as condiment, encourages water intake, helps manage heat stress

Vitamin Supplements

- Categorized based on solubility :
 1. Water-Soluble Vitamins: B-Complex, Vitamin C
 2. Fat-Soluble Vitamins: A, D, E, K
- Vitamin B is synthesized by rumen microbes, green fodder is a good source of vitamins

Additives

- Non-nutritive substances added to improve performance and health
- Examples: Antibiotics, antioxidants, buffers, colors & flavors, enzymes, hormones, medicines

1. Which of the following green fodder is rich in protein content **UTTARAKHAND VO – 2024**

- a) Maize
- b) Oat
- c) Sorghum
- d) Luverne**

2. Following tree leaves are very rich in crude protein and negligible in tannin content

UTTARAKHAND VO – 2024

- a) Mango leaves
- b) Neem leaves
- c) Guava leaves
- d) Moringa leaves**

3. Which one of the following does not serve as a source of phosphorous for the animals

JKPSC - 2019

- (A) Bone meal
- (B) Meat meal
- (C) Limestone**
- (D) Wheat bran

4. The following ingredient can be used as source of protein in animal feed. **(Panjab 2023)**

- (a) Wheat
- (b) Barley
- (c) Maize
- (d) Soya bean Meal**

5. Urea should be incorporated in concentrate mixture at rate of **(Panjab 2023)**

- (a) **2%**
- (b) 1%
- (c) 3%
- (d) 4%

6. One of the following is a source of vegetable protein used for feeding buffaloes: **OpSC 2018-19**

- (A) De oiled rice barn
- (B) Tallow
- (C) Groundnut oil
- (D) Groundnut oil cake**

7. Which of the following is an example for leguminous perennial fodder variety? **OpSC 2013 -14**

- (a) Hybrid Napier
- (b) Lucerne**
- (c) Colonial grass
- (d) Para grass

8. A feedstuff classified as Foughage if it contains **Uppsc 2022**

- (a) More than 3% EE
- (b) Less than 16% crude protein
- (C) Less than 3% lignin
- (d) More than 18% crude fibre**



5. Anti-nutritional factors in Feed

- ❑ Substances present in the diet which by themselves or their metabolic products interfere with the feed utilization, reduce production or affects the health of animal
- ❑ They are often referred to as “toxic factors” because of the deleterious effects they produce when eaten by animals
- ❑ Toxic substances of natural origin can be classified based on their chemical properties and on the basis of their effect on utilization of nutrients

Type of Anti-nutritive substances

According to their chemical properties

Proteins	Glycosides	Phenols	Miscellaneous
Protease inhibitors	Saponins	Gossypol	Antimetals
Haemagglutinin	Cynogens	Tannins	Antivitamin
Enzymes Lipo-oxidase Amino acids Glyco-protein	Glucosinolate		Carbohydrate & fat

Substances Depressing Digestion or Metabolic Utilization of Protein

ANF	Action	Source	Others	Treatment
Protease inhibitors	Inhibit proteolytic activity	Soybean and other beans	2 types; Kunitz: anti-trypsin and Bowman-Birk: trypsin-chymotrypsin inhibitors	Heat treatment
Haem-agglutinin (Lectin/Ricin)	Agglutinate RBC	Soybean, castor bean (ricin) and other legumes	Disrupt cell membrane	Heat treatment
Tannin (Polyphenolic compounds)	Inhibit proteolytic activity	Fodder tree, Sorghum, salseed meal, sunflower meal, mango seed	Astringent in nature, decrease lubrication nature of saliva, decrease fibre digestibility	Detanification (PEG), Physical and chemical methods
Saponin	Decrease surface tension in rumen, hemolysis , protein inhibitor	Legume fodder; Lucerne, soybean, berseem	Tympany/Bloat	Water soaking Add cotton seed oil in diet

Substances Reducing Solubility or Interfering With Utilization of Mineral Elements

ANF	Action	Source	Others	Treatment
Phytic acid	Impairing absorption of minerals like phosphorus zinc,, iron, etc	Cereals, Legumes seeds, oilseeds and nuts	Form complex with minerals and decrease their absorption	Phytase enzyme
Oxalic acid	Form insoluble salts of calcium and magnesium	Beet, spinach , millet, paddy straw , napier grass	Oxalate poisoning	Ruminal degradation, water soaking , calcium treatment
Glucosinolates (goitrogenic)	Depress the synthesis of thyroid hormone	Genus Brassica , Cruciferae family (cabbage, turnips, rapeseed and mustard seed)	Ruminants are less susceptible, Iodine deficiency	Iodine supplementation
Gossypol	Bind with Iron Appetite and weight loss, death due to cardiac failure	Cotton seed	Toxic to simple stomached animals	Addition of calcium and iron salts Heat treatment

Substances Inactivating or Increasing Requirements of Certain Vitamins

ANF	Action	Source	Others	Treatment
Anti-vitamin A	Reduces activity of Vitamin A	Raw soyabean	Lipoxygenase enzyme destroy carotene, precursor of vitamin A	Heat treatment for 15 minutes
Anti-vitamin D	Depress Vit D synthesis	Soy protein	Increases vit D requirement by 10 folds	Autoclaving
Anti-vitamin E	Reduces plasma Vitamin E	Raw kidney bean	Deficiency disease due to Vit E	Autoclaving
Anti-vitamin K	Interfere blood clotting mechanism	Sweet clover (Dicoumarol)	Reduce prothrombin	Water soaking and Autoclaving
Anti-pyridoxine	Depress activity of Vitamin B6	Linseed		Water soaking and autoclaving
Anti-niacin	Niacytin, antagonist to niacin	Maize, wheat bran	Perosis and growth depression	Autoclaving



Substances With a Negative Effect on Digestion of Carbohydrates

□ Amylase inhibitors

- Responsible for the impaired digestion of starch
- Found in kidney beans

□ Flatulence factors

- Due to lack of appropriate enzymes (α 1,6-galactosidase), oligo-saccharides are not broken down in small intestine.
- The monomers of these sugars are converted into VFA, CO₂, hydrogen, methane, resulting in flatulence, diarrhea, nausea, cramps and discomfort.

Substances That Stimulate the Immune System

□ Antigenic proteins:

- Macromolecular proteins or glycoproteins capable of inducing a humoral response
- Polyclonal antibodies are secreted in body fluids to eliminate the antigenic protein.
- Feed antigens are exposed continuously to increase the chance that the immune system develops into an acute/chronic hypersensitivity reaction.
- Antigenic globulins of soyabean are glycinin and β - conglycinin.

□ Effect of Feed Antigens

- Increased protein secretion with lowered protein digestibility
- Increased maintenance requirement due to activation of the immune system

□ Inactivation of feed antigens:

- Chemical or enzymatic treatments
- Hydrolysis of proteins utilizing acid or proteases results in products free of antigenic proteins.

Others

ANF	Action	Source	Other	Treatment
Mimosine (tyrosine analogue)	Inhibits thyroxine hormone synthesis	Subabul (leucaena)	Monogastrics are more susceptible	Ferrous sulphate supplementation
Cyanogen (Amygdalin, linamarin)	Hydrolysed into hydrogen cyanide or prussic acid	Sorghum, sudan grass, linseed, cassava root	Ruminants are more susceptible Death due to anoxia	Sodium nitrate and sodium thiosulphate
Nitrates and nitrites	Form met- hemoglobin (brown color)	Contaminated water, hay or straw	Ruminants are more susceptible	High dose of vitamin A supplementation

4. A polyphenol present in cotton seeds which interferes with utilization of metal ions is: **PUNJAB 2016**

- a) Propofol
- b) Gossypol**
- c) Mimosine
- d) Thioglucoside

5. Maximum level of inclusion of maize in poultry ration is **RPSC 2019**

- (1) 50%
- (2) 60%
- (3) 70%**
- (4) 80%

6. Anti-nutritional factor groundnut cake is a present in **RPSC 2013**

- (1) aflatoxin**
- (2) glycogen
- (3) glucosinolate
- (4) None of the above

7. Heat treatment can destroy which anti- nutritive factor found in soybean cake. **Rpsc 2013**

- (1) Glucosinolate
- (2) Aflatoxin
- (3) Trypsin inhibitor**
- (4) Ricin

8. Babul seeds contain an anti nutritive factor


Rpsc 2013

- (1) Tannin**
- (2) Ricin
- (3) Aflatoxin
- (4) Oxalic acid

9. Which of the following is a cyanogenic plant?

Mppsc 2021

- (A) Maize (Zea Mays)
- (B) Wheat (Triticum Aestivum)
- (C) Sorghum (Sorghum Sudanense)**
- (D) Oats (Avena Sativa)

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10. Plants which contain significant amount of saponins are Mppsc 2023
[A] mustard and rapeseed
[B] sorghum and sudan
[C] lucerne and soybean
[D] subabul and sweet clover
11. Which of the following is a "Goitrogenic agent"? OpSC 2021-22 2nd
(A) Gossypol
(B) Glucosinolate
(C) Mimosine
(D) All of these
12. Anti-nutritional factor present in the Subabul leaves is: OpSC 2013 -14 2nd
(a) Mimosine
(b) Lucine
(c) Gossypol
(d) Nimbidin
13. Aflatoxin is most commonly found in the following feedstuff: OpSC 2013 -14 2nd
(a) Maize grain
(b) Rice bran
(c) Groundnut cake
(d) Til cake/sunflower cake
14. The toxic substance present in subabul is: OpSC 2013 -14 2nd
(a) Mimosine
(b) Oxalates
(c) HCN
(d) Saponin