

Composition of Animal body and Plants

Unit- I of Animal Nutrition

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Nutrients:

The **chemical compounds** present in food which are **required by an organism to maintain its normal physiology** (survive, grow, produce and reproduce etc..)

There are six main groups of **nutrients**

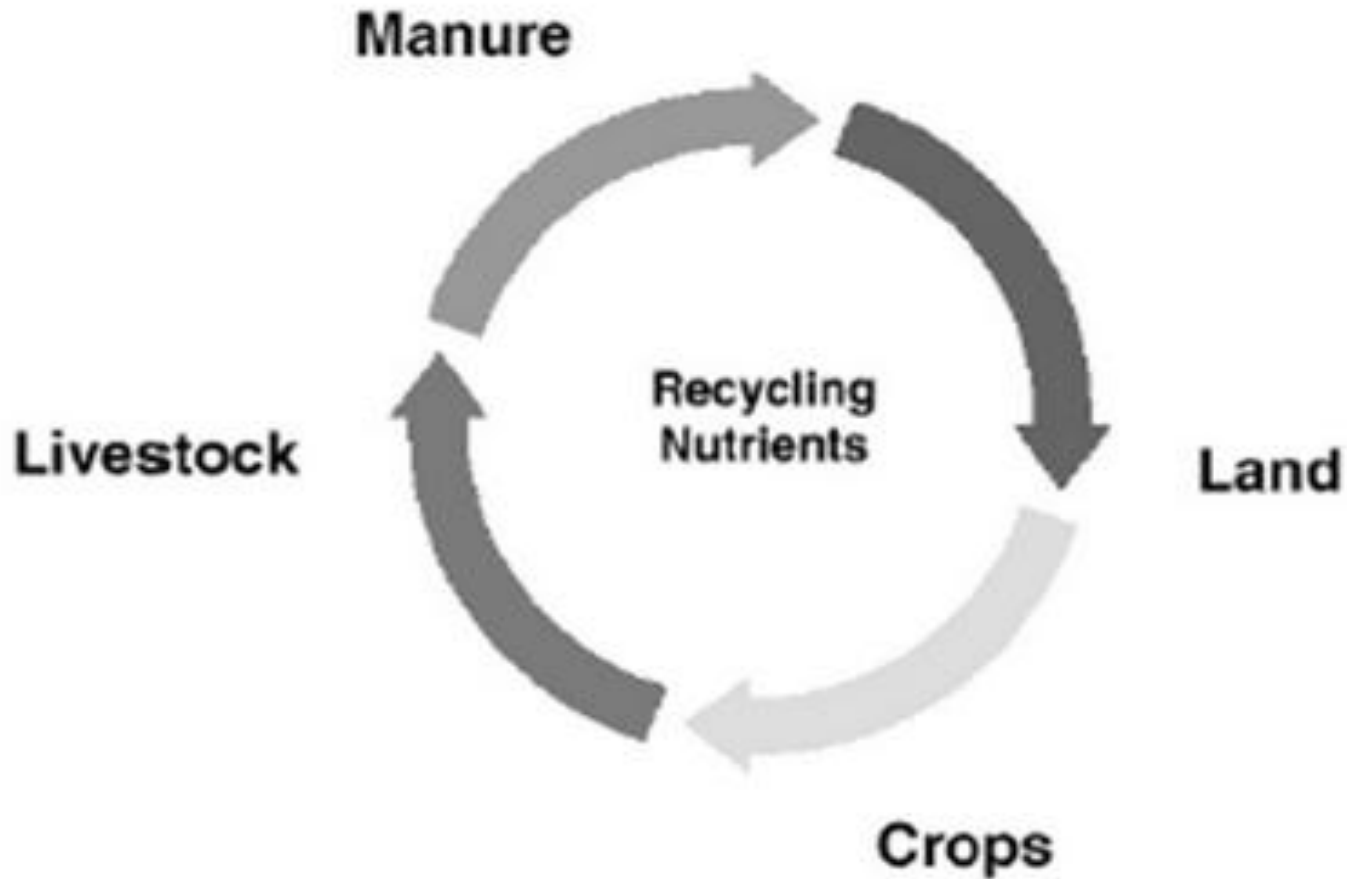
- 1) Protein
- 2) Carbohydrates
- 3) Fats
- 4) Vitamins
- 5) Minerals
- 6) Water



Soil- Plant- Animal relationship

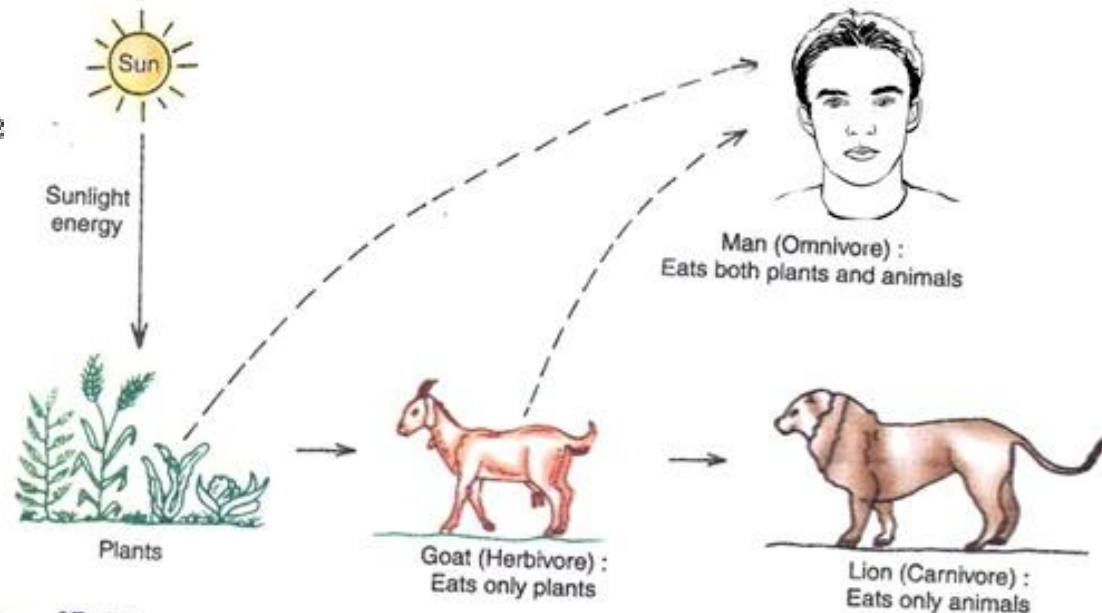
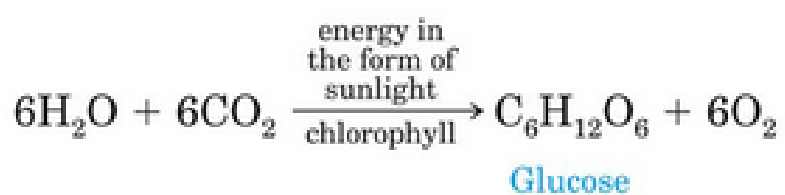
Soil - **Soul Of Infinite Life**

“All **flesh** is **forage**”

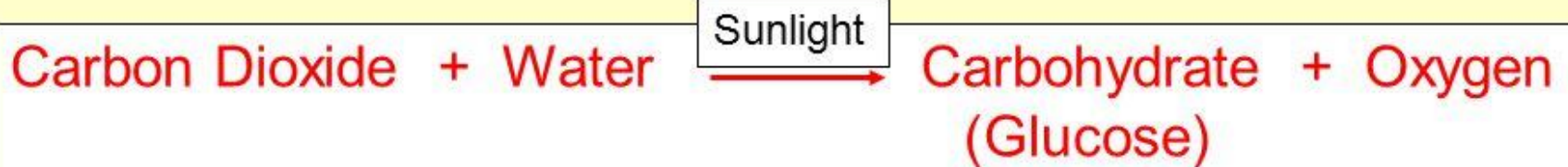
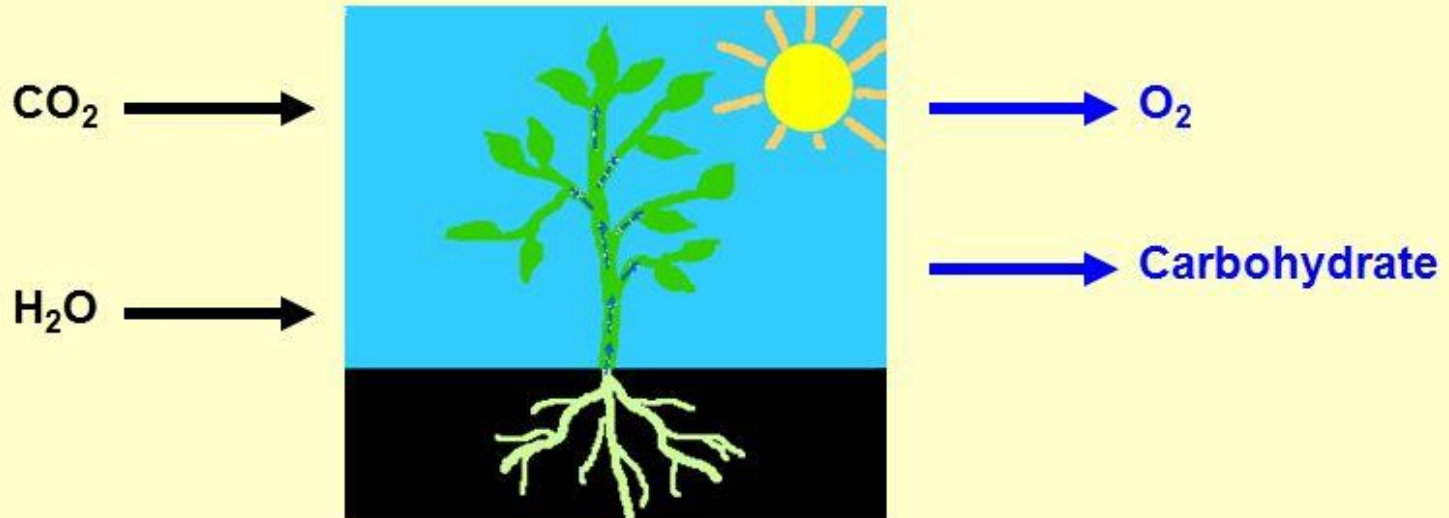


Soil- Plant- Animal relationship

- **Plants synthesize complex substances** from simple substances like CO_2 , N, H_2O etc making use of solar energy.
- They use **carbon dioxide from the air, water and other inorganic salts** from the soil to **synthesize carbohydrates, proteins and fat**.
- **Animals ingest these plants** and utilize this energy for their bodily functions, tissue growth and production.

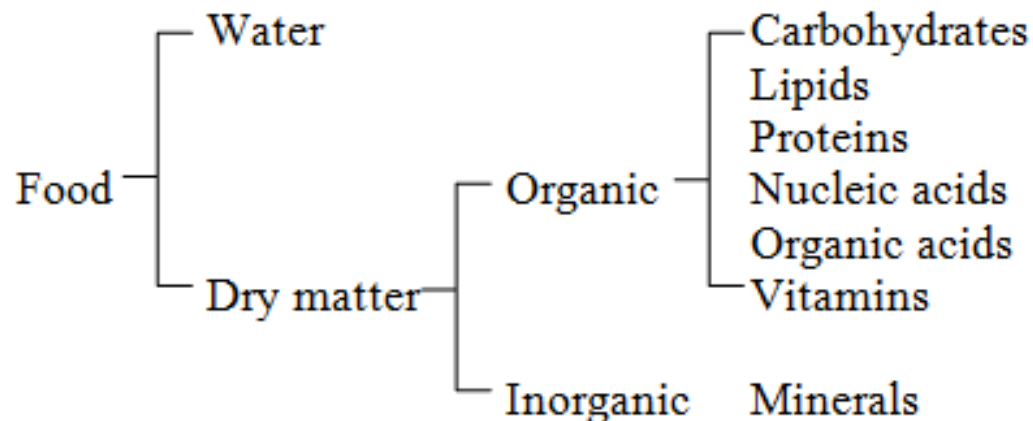


Photosynthesis



Soil- Plant- Animal relationship

- An **important constituent of the animal or plant** body is water.
- The dry matter in both plants and animals is made up of **organic and inorganic matter**.
- **Organic matter** comprises mainly of three important nutrients namely **carbohydrates, proteins and fat**.
- Some minor constituents of organic matter are **vitamins, nucleic acids** and others.
- **Inorganic matter** is made up of various minerals.



	Water	Protein	Fat	Carbohydrate	Ash
Green plants					
Berseem	90.0	2.0	0.3	6.3	1.4
Cow pea	80.0	2.5	0.5	15.0	2.0
Maize	75.0	2.0	0.6	21.0	1.4
Pasture grass	84.0	3.6	1.0	10.0	2.4

	Water	Protein	Fat	Carbohydrate	Ash
Cereal grains					
Wheat	13.0	12.0	2.0	71.2	1.8
Seeds					
Groundnut	6.0	27.0	45.0	20.0	2.0
Plant byproducts					
Paddy straw	10.0	3.5	1.5	70.5	14.5
Wheat straw	10.0	3.5	1.5	76.5	8.5
Rice bran	10.0	10.0	15.0	55.0	10.0
Wheat bran	10.0	10.0	3.0	70.0	7.0

Composition of plants

Composition of plants

- Wide variations in composition



Moisture:

- principal constituent of **living plants** is **moisture**.
- moisture content of plants is highly variable.
- Young plants have more moisture content.
- **As the plant mature, the moisture content decreases.**

Composition of plants

Carbohydrate:

- The dry matter of plant contains mainly carbohydrates.
Carbohydrate serves as a structural and reserve material in plants.
- In seeds, carbohydrates occur principally as starch while in stems and to a certain extent in leaves a considerable proportion of carbohydrate is present in the form of structural carbohydrates (cellulose, hemicellulose and lignin).
- The lignin content of plant tissues increases with maturity of the plant.

Composition of plants

- **Protein**
- **Protein** is primarily present in **active tissue** such as the leaf.
- As the **plant mature** there is **migration of the protein from the leaves to the seeds** to serve as a reserve material for germination.
- Young tissues of plant, fruits, and seeds, especially **leguminous, are rich in protein.**

Composition of plants

Fat

- Fat is present at highest level in the seeds followed by leaves and stem.
- Oil-bearing seeds have higher percentage of protein and fat compared to cereals.
- The mineral content of plants is highly variable. It differs with species and plant parts and is also influenced by soil and other environmental factors.
- In plants there are various organic acids (citric, malic and fumaric), which are important for metabolism in the cells of plant.
- Vitamins both fat-soluble and water-soluble are also present in plants.

Composition of plants

Minerals & Vitamins

- The **mineral content of plants is highly variable**. It differs with species and plant parts and is also influenced by soil and other environmental factors.
- Vitamins both fat-soluble and water-soluble are also present in plants.
- Provitamin A
- In plants there are various organic acids (citric, malic and fumaric), which are important for metabolism in the cells of plant.

Factors affecting chemical composition of plants

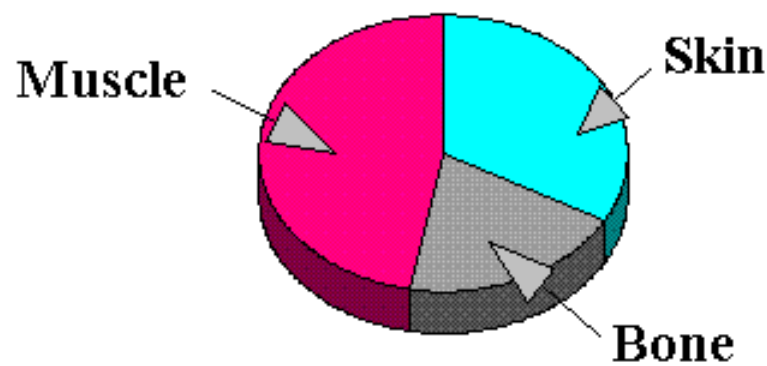
- **Plant factor** - Chemical composition of forage vary because of different genetic material (variety and strain).
- **Agro-climatic condition** - Atmospheric temperature and humidity affect the chemical composition of plants.
- **Cultivation practices** – seed rate, seed treatment, time of sowing, method of sowing, manure and fertilizer, irrigation, weeds and disease control influence growth rate and the chemical composition of plants.
- **Stage of growth** – The content of crude protein, soluble ash is higher just before flowering and goes down at seed formation stage, whereas crude fibre and dry matter content increase as the plant matures. Ether extract goes down progressively at maturity of the plant.
- **Processing and preservation practices** – Different processing methods may change particle size, particle shape, nutrient content and composition of plant materials.

The percentage composition of animal body

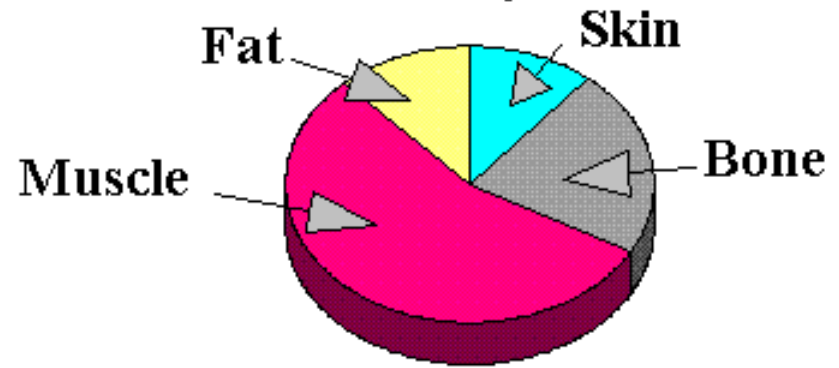
Composition of animals body

Species	As such or fresh matter basis				Water and fat free basis	
	Water	Protein	Fat	Ash	Protein	Ash
Calf (new born)	74	19	3	4.1	82.2	17.8
Steer (thin)	64	19	12	5.1	79.1	20.9
Steer (fat)	43	13	41	3.3	79.5	20.5
Sheep (thin)	74	16	5	4.4	78.2	21.8
Sheep (fat)	40	11	46	2.8	79.3	20.7
Pig (8 kg)	73	17	6	3.4	83.3	16.7
Pig (30 kg)	60	13	24	2.5	84.3	15.7
Pig (100 kg)	49	12	36	2.6	82.4	17.6
Hen	56	21	19	3.2	86.8	13.2
Horse	61	17	17	4.5	79.2	20.8
Man	59	18	18	4.3	80.7	19.3

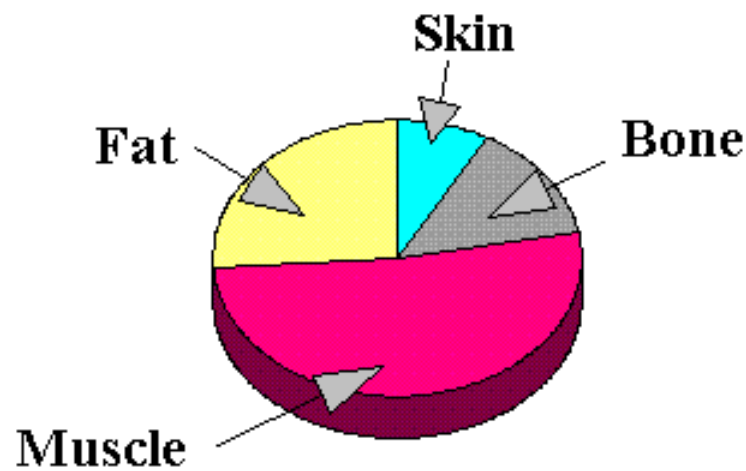
Approximate Changes in Body Composition as Pigs Grow From Birth to Maturity



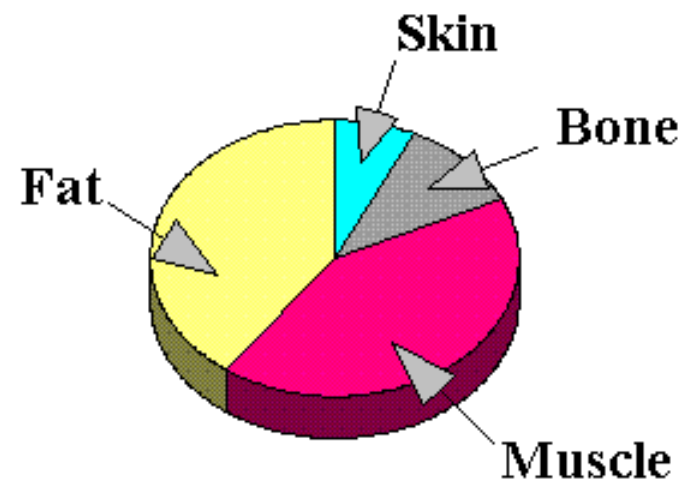
Newborn



Weanling



Mid-growth



Mature

Composition differences between animal and plants

S.No.	Parameters	Animal	Plant
1.	Major constituent	Water	Water
2.	% dry carbohydrate	1	75
3.	Reserve energy as	Fat	Carbohydrate (Starch)
4.	Structural component	Protein and mineral	Carbohydrate (Cellulose, hemicellulose)
5.	As source of protein	Good	Poor (except oil seeds)
6.	Mineral content	Constant to species	Variable
7.	Variation in composition	Less	Wide

Composition of animals body

- **Water: Protein: Ash= 19:5:1 (74-76%:20-22%: 3-5%)**
- **Level of water and fat varies inversely and quite variable**
- Body composition of a **moisture free and fat free body is practically constant**
i.e. 80% protein and 20% ash; however higher level of protein have been reported for pig, rat and hen depicting relatively smaller size of skeleton

Water

- Water content of animal body is **variable and decreases as age increases.**
- For example,
 - A cattle embryo contains -- 95% water
 - A new born calf contains -- 75-80% water
 - 5 months old calf contains -- 66-72% water
 - Mature animal contains -- 50-70% water
- The distribution of water within the body is not uniform.
- Blood plasma contains 90-92%,
- heart, kidney and lungs – 80%; muscles – 75%,
- bones – 45% and tooth enamel only 5% water.

Water content of animal body also depends on nutritional status of the animal.

Composition of animals body

- **Fat**

- Fat is the **most variable of all components**.
- Fat content of animal body **increases with age**. Fat is usually found in adipose tissues, which is present under the skin, around kidney, around intestine and other internal organs.

- **Protein**

- It is the major constituent of dry matter in muscles, soft tissue, liver, heart, kidney, lungs, intestines, etc.
- **Muscles contain nearly 75-80% protein**.
- Protein is also present in hair, nails, feathers, hooves, skin, wool, tendons and bones. Protein along with some inorganic elements is responsible for the structure of the animals.

- **Carbohydrates**

- only around **1% of the total animal body**.
- being constantly **formed and broken down** and serves a multitude of functions.
- It is usually present as **glucose or glycogen** in liver and muscles.

Composition of animals body

- **Inorganic elements**
- Animal body contains many minerals.
- Amount vary which depend on the function of the particular part of the body. Concentration of some minerals in animal body is as follows:
 - Calcium - 1.3%, Phosphorus - 0.7%
 - Sodium - 0.16%, Potassium - 0.19%
 - Magnesium - 0.04%, Sulphur - 0.15%
- **Calcium** is the mineral that occurs in **largest amount in the body** and is almost entirely present in **bones and teeth**.
- Phosphorus is present in bones in close association with calcium.
- Phosphorus is also present in association with proteins, fats and other inorganic salts.
- **Ca and P** are **major inorganic component** of body and represent **70% of body ash**.
- Na, K and Cl are present in inorganic form in various fluids. Other minerals form component of tissues, fluids or enzymes.

Questions & Discussion