

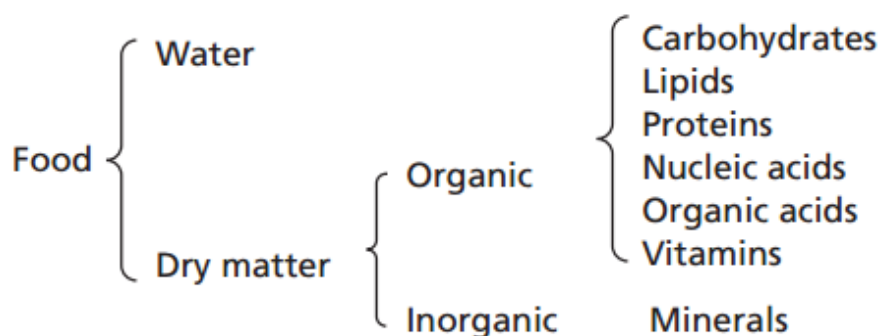
## Water and Its functions

### Water

The water content of the animal body varies with age. The newborn animal contains 750–800 g/kg water but this falls to about 500 g/kg in the mature fat animal. It is vital to the life of the organism that the water content of the body be maintained: an animal will die more rapidly if deprived of water than if deprived of food. Water functions in the body as a solvent in which nutrients are transported about the body and in which waste products are excreted. Many of the chemical reactions brought about by enzymes take place in solution and involve hydrolysis. Because of the high specific heat of water, large changes in heat production can take place within the animal with very little alteration in body temperature.

Water also has a high latent heat of evaporation, and its evaporation from the lungs and skin gives it a further role in the regulation of body temperature. The animal obtains its water from three sources: drinking water, water present in its food, and metabolic water, this last being formed during metabolism by the oxidation of hydrogen-containing organic nutrients. The water content of foods is variable and can range from as little as 60 g/kg in concentrates to over 900 g/kg in some root crops. Because of this great variation in water content, the composition of foods is often expressed on a dry matter basis, which allows a more valid comparison of nutrient content.

**The main components of foods, plants and animals are:**



### **Role of water**

Water constitutes the major component of both cells and the extra-cellular environment. It does in fact sustain life. Proteins, minerals and small organic molecules are present within it in small concentrations which are controlled extremely precisely through a series of mechanisms unique to each compound.

Plasma is an exchange medium between cells and the extra-cellular environment and between cells themselves. It has a number of roles:

1. transport of nutrients (glucose, amino acids, minerals, vitamins)
2. transport of gas, in particular oxygen which is necessary for oxidation react within cells and carbon dioxide which is the product of these reactions.
3. transport of wastes towards those organs (kidney, liver) responsible for the elimination.
4. transport of hormones, which are regulatory compounds, from the gland which they are produced to target organs
5. regulation of cellular homeostasis, as cellular integrity depends upon control of those parameters (osmolality, pH) within the environment which surrounds them.
6. Within cells, water also serves to allow for exchanges between organelles, particularly between mitochondria and cytosol. Metabolism of water and minerals.

### **Functions of Water:**

1. Water is an essential constituent of the animal body.
2. It is an essential part of foodstuff. It makes the food soft and palatable.
3. It helps in regulating body temperature.
4. It helps in absorption and transportation of nutrients to different parts of the body.
5. It is an essential constituent of almost all the juices and secretion of the body.
6. It helps in the excretion of waste product in the form of urine, faeces and perspiration from the animal body.
7. It acts as a solvent of many constituents of body nutrients. All the biochemical and physiological reactions take place in liquid medium.

**8.** It provides shape to the body cells and essential for cell nutrition. The metabolic water produced inside the body help in transportation of nutrients inside the body cells.

**9.** During the period of hibernation, metabolic water keeps the animal alive.

**10.** It helps in maintaining the acid-base balance of the body.

**11.** It helps in hearing by the ears and visions by the eye.

**12.** It acts as a cushion for tissue cells and nervous system and protects the various vital organs against shocks and injuries.

### **Absorption of water**

#### **A- Fluid fractions of the body (% of body wt.)**

In Holstein cow consuming hay and lactating:

**Intake** - **53 L** of drinking water/water in feed, and **3 L** of metabolic water/day.

**Elimination** - **19 L** of water in feces, **11 L** in urine & **12 L** in milk, and vaporize **14 L** of water each day.

#### **B- Water movement:**

The gradient permeability of membranes to water declines almost linearly from the duodenum to ileum.

The movement of water molecules through cell membranes:

**a)** Is related to transfer of mineral elements, nutrients & waste products.

**b)** function is to achieve osmotic & hydrostatic equilibrium.

**C)** Loss of body water:

**1-** Through respiration.

**2-** Through " evaporation " from the skin (but, very little loss via " sweat " in swine, dog and sheep).

**3-** In the feces and urine – "Nitrogenous end products" influence the degree of water loss in the feces & urine among various species:

**a)** Mammals - Excrete N mostly as "urea" (which is toxic to tissues), water is required to dilute urea (which is soluble in water).

**b)** Birds - Excrete mostly as uric acid:

**1-** Excreted in a nearly solid form, minimal loss of water.

**2-** Also, catabolism of protein to uric acid produces/provides more metabolic water than its catabolism to urea.

**3-** Thus, in general, birds: **(a)** have a lower water requirement, and **(b)** are less sensitive to a temporary water deprivation.

**4-** In Camels: body water loss - Lose only .1% of body weight/d vs 4.5% for a donkey.

Camel can vary body temperatures as much as 6°C (34.2 to 40.7) between the night & daytime.

### **Sources of Water:**

**1. Drinking water:** It is consumed by the animals from the outside source.

**2. Feed:** Moisture content of all the feeds supplies the water requirement of the animal.

**3. Metabolic:** Oxidation water: It is the water, which is produced due to metabolism of nutrients. It meets 100 percent of water requirement in hibernating animals and embryo, 5-10 percent in domestic animals and 16-26 percent in desert animals. A 100 g of each fat, carbohydrate and protein metabolism produce 107, 60 and 40g metabolic water, respectively.

**4. Bound water:** The water, which is combined with the constituents of protoplasm by either physical or chemical means. It cannot be separated easily from protoplasm by freezing at low temperature or by evaporation at high temperature or under dry conditions. Bound water is of special interest in connection with the ability of plants and animals to resist at low temperature and drought condition.

### **Water metabolism:**

It includes absorption, homeostasis and excretion.

**1. Absorption:** Absorption takes place from all the parts of **G.I.T.** mainly large intestine. Organs of the digestive tract absorb most of the water ingested by an animal. A number of factors like osmotic relations inside the small intestine and nature of the carbohydrate component of the feed determine the extent to which absorption actually occurs.

Water is most readily absorbed when it is taken alone as beverage, or when taken with food that after digestion forms a solution with osmotic pressure lower than that of blood plasma.

**2. Homeostasis:** It is the maintenance of uniformity and stability of water. Water balance is affected by total intake of water and losses arising from urine, faeces, milk, saliva, sweating and vaporization from respiratory tissues.

**3. Excretion:** Water is excreted from body by evaporation through skin, perspiration through expired air, and through faeces, urine, milk, tear and saliva. Amount lost via various routes are affected by amount of milk produced, ambient temperature, humidity, physical activity of the animal, respiration rate, water consumption and dietary factor.

**Toxic elements in water:** solvent property of water sometime creates problems. Water can dissolve unwanted material. Such water should not be used for drinking purpose.

**Amount of total dissolved solids (TDS):** is a measure of the usefulness of water for animals. A level of less than **3,000** mg/liters TDS can be tolerated by the animals but higher amount is harmful to animals.

### **Factors affecting water requirement:**

**1. Environment:** Increased environmental temperature and humidity enhanced the water requirement in comparison to cold environment because of increased evaporative in hot and humid environment.

**2. Dietary factor:** High fibrous diet like dry roughages increases water requirement than less fibrous diet. Salt and uric acid excretion requires more water. So intake of salt and protein whose end prod to uric acid increases the water requirement. If succulent feed is given to animals than dietary water requirement is reduced.

**3. Animal factor:** Age, stage of growth, level of production, activity, health condition and pregnancy has a direct effect on water requirement. Other factors are salinity and sulfate content of water, temperature of water.

social or behavioral interactions of animals with environment, and other quality factors such as pH and toxic substances affect water requirement and intake. Birds require less water as compared to mammals because uric acid is the end product of protein metabolism in birds as urea in mammals.