

EXCRETION

4

CHAPTER

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EXCRETION

Excretion is the elimination of metabolic waste products from the body.

WASTE PRODUCTS

- **Nitrogenous Waste Products.** They are the **major waste products** which are formed during breakdown of extra amino acids, nucleic acids and alkaloids. The important nitrogenous waste products are urea, uric acid, creatine, creatinine and ammonia.
- **Non-nitrogenous Waste Products** - Oxalic acid, lactic acid.
- **Excess Chemicals** - Excess minerals, drugs, pigments, vitamins, hormones, cholesterol, etc.
- **Bile Pigments** - Bilirubin, biliverdin and urochrome.
- CO₂
- Excess water.

EXCRETION IN HUMAN BEING

A pair of kidney is the main excretory organ in human.

◆ Structure and Function of Kidney in Human :

- There are two bean shaped, dark red coloured kidney placed just below the stomach, one on each side of the mid dorsal line.
- The depression is called hilus from where the ureter originates and the renal artery and renal vein go in and out here.

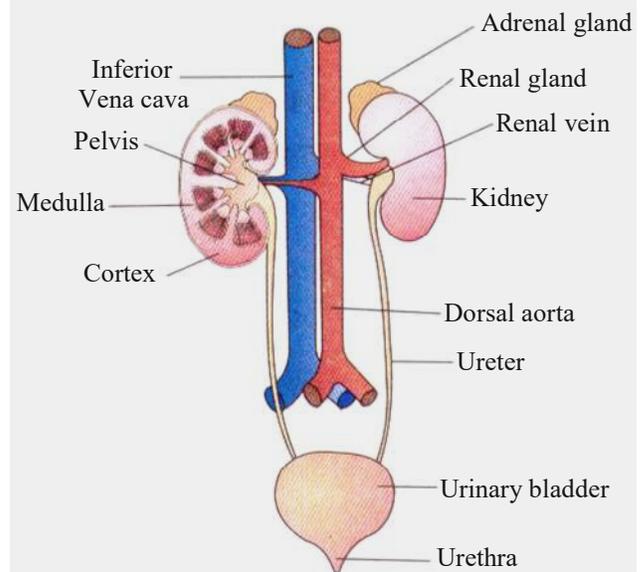


Figure : HUMAN URINARY SYSTEM

- Ureter entering through hilus expands. Medulla on inner side has cone like structure called renal pyramids. Each kidney contains about one million nephrons. The functional unit of the kidney is the nephron.

➤ STRUCTURE OF NEPHRON

- Each nephron consists of a round malpighian body formed by **Bowman's capsule** filled with capillary net work afferent and efferent arterioles. Afferent means incoming, Efferent means outgoing called **Glomerulus** or **Malpighian corpuscles**. The malpighian tubule is divided into 3 parts forming a shaped convoluted tubule.

(A) The proximal tubule - Nearest Bowman's capsule.

(B) Henle loop - It is a 'U' shape thin tube like structure.

(C) Distal tubule - Join collecting tubule.

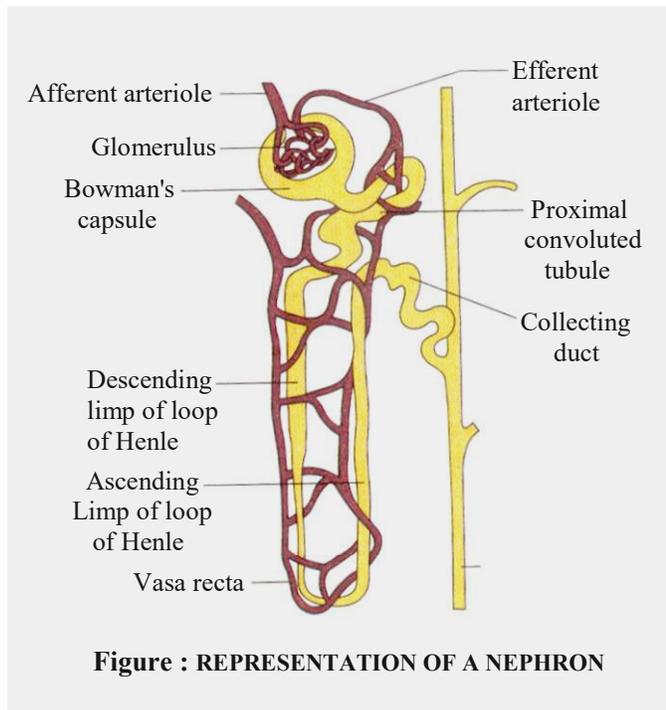


Figure : REPRESENTATION OF A NEPHRON

The ascending limb of Henle's loop again gives second convoluted tubule opening into collecting tubule and finally into larger tubule known as **duct of Bellini**, which opens into the pelvis of ureter at the apex of renal pyramids. The entire kidney tubule is surrounded by blood capillaries called vasa recta.

➤ MECHANISM OF URINE FORMATION

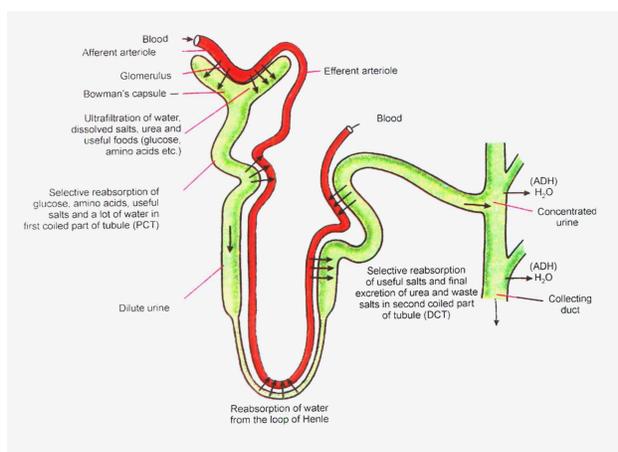
It has four steps - ultra filtration, selective reabsorption, secretion and concentration.

(i) Ultra Filtration. Blood flows inside glomerulus under pressure due to narrowness of efferent arteriole. As a result it undergoes pressure filtration or **ultrafiltration**. All small volume solutes (e.g., urea, uric acid, amino acids, hormones, glucose, ions, vitamins) and water are filtered out and enter the Bowmans' capsule. The product is called **nephric** or **glomerular filtrate**. Its volume is 125 ml/min (180 litres/day).

(ii) Reabsorption. Nephric filtrate is also called primary urine. It passes into proximal convoluted tubule. The same is surrounded by peritubular capillaries. The latter reabsorb all the useful components of nephric filtrate, e.g, glucose, amino acids, vitamins C, calcium, potassium, sodium, chloride, bicarbonate and water (75%). Selective absorption also occurs in the region of distal convoluted tubule.

(iii) Secretion (Augmentation). It occurs mostly in the distal convoluted tubule which is also surrounded by peritubular capillaries. Smaller amount of tubular secretion also takes place in the area of proximal convoluted tubule. **Tubular secretion** is active secretion of waste products by the blood capillaries. It cause removal of all the waste products from blood, viz. urea, uric acid, creatinine. Extra salts, K^+ and H^+ are also secreted into urinary tubule to maintain a proper concentration and pH of the urine.

(iv) Concentration of the Urine. 75% of water content of nephric filtrate is reabsorbed in the region of proximal convoluted tubule. Some 10% of water passes out of the filtrate through osmosis in the area of loop of Henle. It is because loops of Henle are immersed in hyper-osmotic interstitial fluid. Further concentration takes place



in the area of collecting tubule in the presence of hormone called **antidiuretic hormone (ADH)** or **vasopressin**. Absence of Antidiuretic hormone produces a dilute urine. Hormone action, therefore, maintains osmotic concentration of body fluids. Deficiency of ADH causes excessive, repeated dilute urination (diabetes insipidus).

The process of passing urine is called **Micturition**.

EXCRETION IN PLANTS

Plants do not produce nitrogenous wastes like urea and uric acid because extra amino acids and nucleotides are not formed. They produce other types of waste products, called secondary metabolites, e.g., alkaloids, tannins, aromatic oils.

(i) **Nitrogenous Waste Products.** They are byproducts of general metabolism. The common ones are alkaloids, e.g., quinine, morphine, atropine.

(ii) **Organic Acids.** They are metabolic intermediates. Some of them are without any other use. Rather on accumulation they may prove toxic, e.g., oxalic acid.

(iii) **Tannins.** They are complex aromatic compounds which are formed as secondary metabolites.

(iv) **Latex.** It is an emulsion of varied composition which is excreted by special tubular cells called laticifers.

(v) **Resins.** They are oxidation products of aromatic oils.

(vi) **Gums.** They are degradation products of cell wall.

◆ Mechanism of Excretion in Plants:

Plants do not have any mechanism to collect, transport and throw out their waste products. They have adopted varied strategies to protect their living cell from waste products.

(i) **Old Leaves.** Waste products are stored in older leaves which soon fall off.

(ii) **Old Xylem.** Resins, gums, tannins and other waste products are deposited in the old xylem which soon becomes nonfunctional e.g. Hard wood.

(iii) **Bark.** Bark consists of dead cells which is peeled off periodically. Tannins and other wastes are deposited in the bark. Incidentally, tannins are raw material for dyes and inks.

(iv) **Central Vacuole.** Most plant waste products are stored in central vacuole of their cells. They are unable to influence the working of cytoplasm due to presence of a selectively permeable membrane called tonoplast.

(v) **Root Excretion.** Some waste substances are actually excreted by the plants in the region of their roots.

(vi) **Detoxification.** The toxic oxalic acid is detoxified by formation of calcium oxalate which gets crystallized into needles (raphides), prism (prismatic crystals), stars (sphaeraphides) and crystal sand. Excess of calcium is also precipitated as calcium carbonate crystals, e.g. cystolith.

(vii) **Salt Glands.** They excrete excess salts obtained from the habitat.

EXERCISE # 1

A. Single Choice Type Questions

- Q.1** Useful materials filtered out in nephric filtrate are mostly reabsorbed in the area of -
(A) Bowman's capsule
(B) Distal convoluted tubule
(C) Loop of Henle
(D) Proximal convoluted tubule
- Q.2** Contractile vacuole of *Amoeba* takes part in -
(A) Locomotion
(B) Digestion of food
(C) Ingestion of food
(D) Osmoregulation
- Q.3** Tannins are deposited in -
(A) Bark (B) Old xylem
(C) Sieve tubes (D) Both A and B
- Q.4** Every plant cell has a dump for waste products. It is -
(A) Cytoplasm (B) Central vacuole
(C) Golgi apparatus (D) Lysosome
- Q.5** Basic filtration unit of kidney is -
(A) Ureter (B) Glomerulus
(C) Urethra (D) Collecting tubule
- Q.6** Dilution of concentration of urine is determined by availability of -
(A) Hormone thyroxine
(B) Hormone thymosine
(C) Hormone ADH
(D) Both A and B
- Q.7** Excretion means -
(A) Removal of substances present in excess
(B) Formation of those substances that have some role in the body
(C) Removal of such substances that have never been part of the body
(D) All of the above
- Q.8** Ureotelic animals are those that eliminate the nitrogenous wastes predominately in the form of -
(A) Uric acid (B) Ammonia
(C) Amino acids (D) Urea
- Q.9** A mammal excretes nitrogen in the form of -
(A) Ammonium ions (B) Amino acids
(C) Urea (D) Uric acid
- Q.10** Which one of the following sets of animals produces the same substances as their chief excretory product ?
(A) Cockroach, camel and lizard
(B) Man, dog and camel
(C) Amoeba, ant and antelope
(D) Fowl, fish and frog
- Q.11** A Malpighian tubule empties urine into the
(A) Gut (B) Coelom
(C) Lymph (D) Ureters
- Q.12** Kidneys are not only organs of excretion. Their work is supplemented by -
(A) Liver (B) Heart
(C) Large intestine (D) Skin
- Q.13** The conversion of protein waste, the ammonia into urea occurs mainly in -
(A) Kidney (B) Lungs
(C) Liver (D) Intestine
- Q.14** The Bowman's capsule functions as a
(A) Filter
(B) Suction pump
(C) Egestion
(D) All of the above
- Q.15** Which of the following is the part of kidney ?
(A) Pelvis (B) Ileum
(C) Fibula (D) Henle loop
- Q.16** The basic unit of a vertebrate kidney is the -
(A) Ureter
(B) Nephron
(C) Malpighian tubule
(D) Islets of langerhans
- Q.17** Excess of water in urine resulting from kidney failure is known as -
(A) Ureotelic
(B) Uricotelic
(C) Diabetes Mellitus
(D) Diabetes insipidus

EXERCISE # 2

A. Very Short Answer Type Questions

- Q.1 Define excretion ?
- Q.2 What are waste products ?
- Q.3 What is excretory system ?
- Q.4 What is the function of ADH ?
- Q.5 What is unit of human kidney ?
- Q.6 What is glomerulus ?
- Q.7 Name the components of a Malpighian capsule.
- Q.8 Name the structure which absorb glucose in nephron.
- Q.9 Define micturition.
- Q.10 What is Bowman's capsule ?
- Q.11 Name a waste product of plants which is used as medicine.
- Q.12 Where is urine stored in the body ?
- Q.13 Write the name of membrane of vacuole.

B. Short Answer Type Questions

- Q.14 Enumerate functions of kidney.
- Q.15 Name the various waste products produced in human beings.
- Q.16 Name the different waste products by plants.
- Q.17 How are plants able to manage their waste products ?
- Q.18 Write a short note on ultra filtration.
- Q.19 Write a short note on secretion.

Q.20 Describe the mechanism of urine formation.

Q.21 Describe the mechanism by which human beings are able to regulate the concentration of urine.

C. Long Answer Type Questions

Q.22 Describe the various components of urinary system of man.

Q.23 Explain the structure of nephron with the help of a labelled diagram.

Q.24 Draw a diagram of the human urinary system and label in it
(i) Kidney (ii) Ureter (iii) Urinary bladder
(iv) Urethra.