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3.1.

OSMOREGULATION

INTRODUCTION → There is an intimate relationship between the animals and their environment. Water and salts from the medium diffuse into the body of animals and vice-versa. This diffusion however must be regulated since the animal tissues should have their optimum concentration of water and salts. This regulation is termed as osmoregulation. Any marked variation in the water and salt concentration of the cell will interfere with the normal functioning of the cells. Animals, whose body fluids have the same concentration as that of the surrounding medium (isotonic) do not face the problem of osmoregulation as long as they live in such a medium. ~~Most marine organisms have their body fluids isotonic with sea water.~~ On the other hand, animals which live in a medium of lower salt concentration (hypotonic) have to face the difficulty of hydration and hence they have evolved special mechanisms to get rid of the excess water that has entered their body and diluted their body fluids. In a similar way, animals which live in a medium of high salt concentration (hypertonic) have to evolve regulatory mechanisms by which excessive loss of

water from the body is prevented. In terrestrial animals water is lost by evaporation and hence mechanisms to conserve water are developed in them. HOBER (1902) first coined the term osmoregulation to the collective activity of variety of mechanisms used by organisms to control water movements and water volumes.

TYPES OF OSMOREGULATION →

1. EURYHALINE POIKILOSMOTIC TYPE → The animals, which can withstand a wide range of salt concentrations the aquatic medium are called eury-haline species. Aquatic animals whose external osmotic concentration varies according to the external environment are called poikilosmotic.

2. STENOHALINE HOMEOSMOTIC TYPE → The animals, which survive only within a narrow range of salinities and are bound to constant salt content environment are called stenohaline species. Animals which maintain a constant osmotic concentration of body fluids in a changing external concentration are called homeosmotic.

3. EURYHALINE HOMEOSMOTIC TYPE → Thes animals which can withstand a wi range of salt concentration in the aquatic medium are called euryhali species. Animals which maintain a constant osmotic concentration of the fluide in a changing external salini concentration are called homeosmo

OSMOREGULATION IN DIFFERENT MAMM

1. MAMMALS IN GENERAL → Mammals ha most well-duveloped mechanism to deal with the problem of osmoregulat They obtain water from food and drin by drinking. They also obtain some amount of water from metabolism. On the tongue of several mammals, the water receptors have been identified.

Thirst is a complex phen -menon which involves stimulation of brain, osmoreceptors, generally tissue dehydration and to less extent the dryne of mouth.

Mammalian skin has got low permeability for water, however, many mammals use water evaporation either by sweat glands or by panting, as a mean of temperature regulation. Mammals hav a control over urine concentration i.e. their urine concentration may vary

according to the physiological state of the body for example. i.e. - man, in normal condition, the urine concentration is about 0.65 osmolar and the maximum urine concentration in thirsty man is reported to be 1.45 osmolar. It was seen that the mammals which can produce the most concentrated urine, have longest loop of Henle.

In the homoiothermic terrestrial animals like mammals, regulation of water and salts is completed by the regulation of body temperature. In these animals, the constancy of body temperature is maintained by the production of sweat and by its subsequent evaporation. But this results in the loss of both water and salts which in turn reduces the blood volume of the animal. If this decrease of blood volume exceed beyond a certain limit, heatstroke result At this critical stage, thirst is a cause through the autonomous nervous syste However, too much intake of water r results in the production of more ur and in the process of eliminating th urine some salts are also lost. Hence the blood concentration is upset. This diuresis checked at the critical point

by the secretion of an anti-diuretic hormone from the posterior lobe of pituitary gland.

In normal mammals like the dogs, water is mainly lost through the mouth and tongue. Since the water is salt free, the blood concentration is increased. If such animals are fed on salties food they suffer more from this alkalosis.

2. MARINE MAMMALS → Marine mammals have blood little more concentrated than that of land mammals. Some mammals utilize fishes as their chief food material from which they obtain large amount of water. They produce a concentrated urine.

3. DESERT MAMMALS → Camel has ability to retain water for a number of days. It is believed that camel can store water in the rumen. It is now established that the camel's rumen does not contain water but it contains a great deal of fluid, mixed with fermenting food particles, just as do the rumens of other animals that chew the cud ruminants. It is now established that camel does not store water hence they must carefully conserve

what they take up. A camel lets its temperature rise upto about 41°C before he sweats enough to prevent a further rise. Further more in early morning, the camel's temperature may be low as 34°C which gives him the advantage of low concentrated urine production. They can loose 40% of body water without any serious damage. This tolerance does enable the camel to go without water for much longer periods than other mammals.

Most animals, living in extremely dry habitats, depend upon metabolic water for their life activities. Fats, carbohydrates and proteins can yield such metabolic water. In the eggs of birds and reptiles, the fats contained in the yolk are decomposed to form water and this water is utilized for the development of the embryo. Hibernating animals like the hedgehog also depend on the metabolic water formed by the decomposition of fats. The hump of the camel contains stored fats which can be converted into metabolic water when other sources of water are not available. The kangaroo-rat (Dipodomys) of the Arizona desert als

depends upon the metabolic water ...
ved from the food.

REGULATORY MECHANISM OF OSMOREG...
HORMONAL CONTROL OF OSMOREGULATI...
1. NERVOUS CONTROL → In all vertebr...
there is a hormonal regulation for
water and electrolyte balance. The
-chanism of hormonal control operat
at the level of surface membrane
such as the level of kidney and sk
on the special gland of extra secre
-tion and depends on the harmo
of neuro-hypophysis and adrenal
cortex.

2. HORMONAL CONTROL →
(2) ROLE OF PITUITARY → Arginine and
vasopressin are the main water
balancing factors in the land ver
-brates. Their action is reducing th
flow of urine, hence, they are usual
called ADH or Anti-diuretic Hormo
Flow of urine is reduced by ADH by
two means, firstly, by reducing the
filtration due to constriction in the
glomerular arteries, secondly, by inc
-easing the tubular reabsorption of
water. ADH thus regulates the water
balance of the body.

(iii) ROLE OF ADRENAL CORTEX → Mineralocorticoids control mineral metabolism in the organism, primarily the sodium and potassium levels of blood plasma. Aldosterone is the most active of this group. It facilitates reabsorption

of sodium and chloride in the renal tubules, which raises the sodium chloride content of the blood, lymph, tissue fluid. At the same time it reduces reabsorption of potassium in the renal tubule which increases loss of potassium and lowers its level in the organism.

The increased concentration of sodium chloride in the blood and tissue fluid due to aldosterone causes a rise in their osmotic pressure leading to retention of water in the organism and contributes to an increase in arterial pressure. Intensified sodium reabsorption can give rise to alkalosis.

A deficiency of mineralocorticoids has an opposite tendency. Reabsorption of sodium in the renal tubules decreases and the organism suffers such a loss of mineral that changes incompatible with life take place in the internal environment and death occurs a few days after removal of the adrenal cortex. The life of an adrenalectomized animal can only be maintained by introducing large amounts of sodium or mineralocorticoids. For that reason mineralocorticoids are known as "life

saving hormones."

CONCLUSION → In addition, some of metabolic hormones have indirect effect on ionic and osmotic balance. The parathyroid hormone effects the calcium and phosphorous balance in the body. A complex group of interacting hormones maintains the balance of water and electrolytes with the neurohypophysis and the adrenal cortex play dominant role in the vertebrates.