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PHYSIOLOGY OF NUTRITION & DIGESTION OF VIBRATES A STUDY WITH REFERENCE TO RATS

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Introduction

Biology, Botany, and Zoology... Biology is the science of living things. It has two sub-divisions, namely, Botary which deals with plants and Zoology which is the study of animals. The subject of Zoology embraces not only those animals which are living on the earth at the present time but also those which lived in the past and have now disappeared or have become extinct. It deals with animals of the whole world whether they are found on land, in water or in the air. It includes man himself.

Importance of Zoology

The intimate relation that exists between man and animals is generalty not so well recongnized. It is beyond the seope of this book to go into a detailed account of the various aspects of that relation, but a brief outline of the various ways in which animals influences human life may be given here.

An important factor, bearing on the relation between man and animals, is that man himself, biologically speaking, is an animal. He is, thus an integral part of the animal kingdom. A child is keenly interested in living animals around him, and especially those, like the dog and the cow, which more or less resemble him. He finds in their behaviour a similarity with that of his own. The way two dogs fight over a piece of bread or a cow fondles her calf is fundamentally like human behaviour under similar conditions. Human interest in animals, therefore, is due to natural ties.

Objective of the paper

The Objective of this paper is to present an analytical study of Nutrition of Vibrataes with special reference to 'Rat' which has been classified under the genus 'Rattus' and species 'rattus, norvegius'.

Limitations of the paper

This paper is limited to the study of Nutrition system of rats.

Systematic Position of Rats

In the beginning it will not be our of place to present some zoological data on rattus

Rattus rattus :- (black rat) and Rattus norvegicus (brown rat) are the two common species of the several other species of rat. The black rat is smaller than the brown one. It is classified as above for the following reasons.

Chordata: Presence of notochord and pharyngeal gill-slits in the embryonic condition and dorsal hollow neural tube.

Vertebrata: Notochord replaced by vertebral column. Cephalization has formed a definite head. Central nervous system enlarged to form the brain enclosed in a cranium. For this reason vertebrata are also known as **Craniata : A** ventral muscular heart has developed. Presence of paired kidneye. Haemoglobin is present in erythrocytes.

Gnathostomata: Mouth is bounded by definite jaws.

Tetrapoda: Presence of two pairs of limbs supported by endoskeleton. Lungs for respiration.

Amniota: The embryo is enveloped with a membrane called as amnion. The amnion encloses a cavity filled with amniotic fluid. It serves as a protective device for the embryo.

Mammalia: (1) Skin clothed with hair, presence of sebaceous and sweat glands. (2) Mammary glands to nourish the young ones. (3) Different types of teeth-heterodont dentition, teeth embedded in alveolar ockets hence thecodont. Diphyodont-two sets of teeth manely milk and permanent set. (4) Lower jaw formed of a pair of dentary bones only. (5) Usually seven cervical vertebrace present. (6) Four chambered heart with a single left aortic arch. (7) External ear or pinna present. (8) Presence of diaphragm separating the thoracic and abdominal cavity. (9) Homoiothermous-Body temperature is maintained nearly constant. (10) Viviparity except in monotremes.

Placentalia: The young one develops in the uterus and ios nourished for a considerable time by means of placenta. Young one is born in advanced state.

Rodentia: Canine teeth are absent, chisel-shaped incisors with persistant growth. Rodents are also described as gnawing mammals.

Rattus morvegicusalbicane used in labourateries for experiments is the alhino mutant of brown rat.

Physiology of Nutrition of Rats

Rat is primarily a herbivorous animal but by practive it has become omnivorous to some extent. Such animals can easily find their food under varied conditions.

Food : The food taken by an organism, in whatever form it may be, is meant for building up protoplasm, for the supply of energy required for the life activities and to provide material to make good the loss of the body substance. Chemically the food contains carbohydrates, fats, proteins, minerals, water and vitamins.

Carbohydrates are the organic compounds containing carbon, hydrogen and oxygen in the proportion of 1 : 2 : 1 respectively. Starches, sugars, cellulose etc. are the common examples of carbohydrates. They provide the main source of energy; they undergo a slow combustion and release energy looked up in their molecules. They are thus the fuel foods.

Fats have same chemical elements as carbohydrates i.e. carbon, hydrogen and oxygen. They however contain less proportion of oxygen. Fats also are oxidised like carbohydrates to produce energy; they produce more energy. Fats occur in solid condition whereas fats in liquid form are named as oils.

Proteins contain carbon, hydrogen, oxygen, nitrogen and usually phosphorus and sulphur. Proteins form a large part of the solids in protoplasm. They make up most up most of the active tissues of the body; hence they are called tissue builders.

Vitamins are also absolutely essential for the normal maintenance of health and growth of the animals. They are necessary in very small quantities and are taken up along with food. Various salts of sodium, potassium, calcium, magnesium and iron are present in the organs and tissues. They are also useful in many metabolic processes. Water forms a large proportion of the composition of protoplasm and is essential as a means of transportation of food, oxygen and wastes.

Nutrition: The processes by which food is obtained, preapred and built up in the body substance are grouped together under the term nutrition. It includes.

1. Selecting and getting the food material in the alimentary canal - ingestion.
2. Preparation of the food to be treated chemically.
3. Breaking down the complex and insoluble food into simpler substances which are soluble and diffusible - digestion.
4. Absorption of the digested food.
5. Conversion of the absorbed food into protoplasm - assimilation, and
6. Throwing out the undigested and waste material egestion.

Digestion : Food taken in is not immediately useful to the parts of the body. Some of the substances are not soluble; others like some proteins may be soluble but are not diffusible. It is therefore necessary to convert the complex insoluble food into simple soluble and diffusible form. This is done by digestion. It consists of a process of hydrolysis in which the molecular size of the food substance is progressively reduced until it becomes diffusible. Such changes are brought about by enzymes or ferments. Different kinds of food materials are acted upon by specific enzymes.

Ingestion : The rat gnaws its food. With the help of incisors it cuts small portions of food; these are siezed by the movable lips and transferred to the mouth cavity. The tongue moves the food in such a manner that fresh pieces of food are brought for grinding between the molars. During this process the food is thoroughly mixed with saliva brought in by the salivary ducts. The chewing of food and mixing it with saliva turn the food into a pulpy mass, the food bolus. It can now be easily pushed into the oesophagus.

Saliva : It is a thin alkaline fluid containing a large amount of mucus and an enzyme ptyalin. This enzyme turns insoluble starch into soluble sugar.

Steps of digestion in the mouth.

following are the steps of nutrition

1. The food is mechanically cut into smaller fragments with the help of teeth.
2. It is mixed with saliva which lubricates it.
3. Some mineral matter is dissolved.
4. The food is moistened by saliva for taste and swallowing.
5. With the help of ptyalin saliva turns insoluble starch into soluble sugar.

By all these actions the solid food is turned into a sort of pulp, the food bolus. The tongue pushes it by its backward movement into the oesophagus. The tongue at this time

naturally presses the epiglottis so as to close the glottis leaving no chance for the food to enter into the trachea.

Peristalsis : The wall of the oesophagus produces characteristic movements. The circular muscles in the wall contract behind the food mass and relax in front of it. Such waves of contractions are called as peristalsis. These waves move along the entire length of the food tube. The food bolus is thus driven to the stomach.

Stomach : The food remains in the Mouth cavity and the oesophagus for a short time. The action of ptyalin is naturally slight. Even after the food enters the stomach, the action of ptyalin continues. It goes on till a change in the chemical condition of the food occurs. The food remains in the stoach for a long time and many changes take place.

Steps of digestion in the stomach :

following are the steps of digestion in the stomach

1. The presence of food in the stomach stimulates its mucous membrance; it secretes a hormone, gastrin which activates the gastric glands.
2. The strong peristaltic movements of the stomach toss the food to and fro and churn it. The food cannot pass into the duodenum as the phloric valve is closed. As a result of churning the food is mechanically broken into small fragments and and soft particles are separated.
3. These movements also produce a little heat, this breaks down fats into smaller droplets.
4. The food is mixed thoroughly with the gastric juice.

Chemical digestion in the stomach - The gastric glands secrete a digestive fluid, the gastric juice. It is acidic in nature as it contains dilute hydrochloric acid. The juice also contains two enzymes, pepsin and renin. The hydrochloric acid in gastric juice plays an important role.

a. The acid penetrates the food bolus and brings about a change in the medium. The food entering the stomach is slightly alkaline due to saliva. The action of ptyalin continues till the food become acidic.
b. The acid stops the action of ptyalin.
c. It kills bacteria and other micro-organisms that may be present in the food or in the stomach.
d. It dissolves some of the mineral matter from food.

e. It activates the enzyme pepsin. It acts on acid-soluble proteins. It brings about the hydrolysis of proteins to peptones and proteoses. This reaction takes place in an acid medium.
f. Proteins + pepsin in an acid medium Peptones
g. Renin curdles milk forming casein. Renin is plentiful in the young when they are feeding on milk, but in adults it may be absent.

As a result of the combined effect of the mechanical and chenical actions taking place in the stomach, the food is turned into a think acidic paste called chyme. By this time the acidity of food has reached such a limit that it stimulates the pyloric valve, and the pyloric sphincter relaxes intermittenty. The contractions of the wall of the stomach now ends the chyme jet by jet into the duodenum. Presence of chyme stimulates the duodenum. Its mucous membrane secretes a hormone, secretin which activates liver and pancreas. It the small intestime the chyme meets three juices, bile from the liver, pancreatic juice from the pancreas and the succus entericus or intestinal juice from the intestine.

Steps of digestion in the small intestine :

a) **Bile -** It has no digestive ferments; it does not take any active part in digestion. it acts in the following way :

(i) It neutralizes the acidity of the chyme. This is mainly done by the sodium bicarbonate. It then turns the food alkaline. This puts an end to the action of pepsin.
(ii) It emulsifies fats i.e. fats are broken into very fine droplets.
(iii) It acts as an antiseptic; it checks the development of bacteria in the chyme.

b) **Pancreatic juice -** This is an alkaline fluid rich in enzymes. It contains three enzymes :trypsingen, amylopsin (diastase) and steapsin (lipase). Trypsinogen by itself is inactive. It is activated by an enzyme enterokinase from the intertinal juice by converting it into trysin. The enzymes from the pancreatic juice act as follows :

(i) Alkali-soluble proteins, peptones, proteoses + trypsin amino acids.
(ii) Starch + amylopsin maltose (sugars)
(iii) fats + steapsin fatty acids and glycerine

(c) **Succus entericus** : This is the intestinal juice. It is also slightly alkline and contains the following enzymes :

(1) enterokinase - activates trypsinogen of the pancreatic fluid and converts it into trypsin.

(2) Peptones + erepsin□ amino acids.

(3) Fats + lipase □ fatty acids and glycerine

(4) Sucrose + invertase □ glucose and fructose

(5) Maltose + maltase □ glucose

(6) Lactose + lactase □ glucose and galactose

As a result of all these enzymatic actions the proteins are reduced to amino acids, carbohydrates to glucose or some such simple sugars and fats are turned to fatty acids and glycerol and the digestion is completed.

Absorption : The digested food passes by diffusion through the wall of the alimentary canal to the blood or lymph stream. This passage of digested food through the lining of alimentary canal to the blood stream or lymph stream is known as absorption. It takes place in the mouth and oesophagus to a very little extent, as the food remains there for a short time. Though the food remains in the stomach for a long time, the digested food does not remain in contact with its walls as it is being churned all the while. the absorption takes place mainly in the small intestine. In the ileus, the absorptive area is greatly increased by the presence of thin walled villi containing blood capillaries and lacteals.

Simple sugars, amino acids and mineral salts pass by diffusion through the cells of the mucous membrane directly into the blood stream. (Fig. 2.8) The fatty acids combine with the alkaline salts of bile and form liquid soaps. They enter the cells in this condition with glycerol. There the soaps are broken down and fatty acids recombine with glycerol to form droplets of fat. This fat is passed on to the lacteals in the villi. From the lacteals the fats are tkaen to the lymphatic system, ultimately reaching the blood stream.

Large intestine : The undigested residue is passed on to the large intestine. As it passcs through the colon, water is absorbed so that the residue becomes more and more soild. It is now the faeces. When more amount of water is absorbed, the faeces appearsliks pellets. Such pellets give a beaded appearance to the rectum. The faeces are given out through the anus periodically; this process is called defaecation. Rat often eats its own faeces; it is therefore called pseudo-ruminating or corpophagus.

Conclusion

The absorbed food is distributed to all the tissues in the body, through the media of blood and lymph. All the tissues receive the materials needed for their maintenance. The substances brought to the cells are synthesized with the help of cellular enzymes to form constituents of protoplasm. The kind of protoplasm would depend upon the protoplasm in which the synthesis occurs. This process of synthesis of protoplasm is known as assimilation.

This is the process of Assimilation.

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