

ENZYME-ACTIVITIES OF FISHES.

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First of all we will tell what is a digestive enzyme and what is its function.

An enzyme is an organic catalytic agent found in, or isolated from living matter. These catalytic agents are very numerous and it is to them that the activity of living protoplasm in a chemical sense is due. A catalyzer is usually considered to alter the velocity of a reaction but not to initiate it. It does not enter into the reaction.

Some of the enzymes are easily isolated from cells; they are exocellular; such are the various digestive enzymes. — Among these, we will mention pepsin, trypsin, amylase, invertase, maltase and lipase. These are generally found in the digestive tube of fishes.

What is the function of these various enzymes? They are hydrolytic enzymes; that is to say they catalyze the hydrolysis of the substrate. Pepsin and trypsin act on proteins; they are therefore proteolytic enzymes. Pepsin splits proteins to proteoses and peptons; trypsin splits proteins to proteoses, peptones, polypeptids and amino-acids. But pepsin will act in an acid medium, trypsin in an alkaline medium. The activity of most enzymes is largely dependent upon the exact acidity or alkalinity of the medium.

Amylase, invertase and maltase act on carbohydrates. Amylase converts starch to maltose; invertase converts sucrose to glucose and fructose; maltase converts maltose to glucose.

Lipase act on fat; it splits fats to fatty acids and glycerol.

Which organs of the fish secrete the various enzymes? The digestive system of the fishes is composed of the intestine, the stomach and the œsophagus. The stomach is ended by a pyloric sphincter. There are usually no glands in the œsophagus but there are a great number of them in the stomach. Numerous pyloric appendages are found in many fishes. The

number of the appendages varies from 1 to 900. For a long time it was believed that the pancreas did not exist in most of the fishes. Yet this is not true; many fishes possess a pancreas. Certain authors claim that the pyloric appendages serve as a substitute for the pancreas. Later on it was demonstrated that a pancreas and pyloric appendages are often present in one same fish.

Fishes have also a gall bladder and a liver which is strongly lobbed.

The stomach secretes an acid, the nature of which is not well determined. Certain investigators claim it to be an organic acid, others chlorhydric acid.

The investigators pretend the digestion of albuminoid matter in the stomach always to be of peptic nature. Yet our experiments proved that the extracts of the stomach of « *Merlangus vulgaris* » digest fibrin in an alkaline or neutral medium and that the proteolyse in an acid medium is insignificant. This means that the proteolytic properties of « *Merlangus vulgaris* » belong to the tryptic kind. The extracts of the stomach of « *Scyllium canicula* » have very strong proteolytic activities; but in this case the proteolyse occurs in an acid medium and is of peptic nature. This agrees with the general theory.

The influence of the temperature on the activity of pepsin is not the same in fishes as in mammals. Pepsin of fishes digests at low temperature relatively better than mammiferous pepsin.

There exists no agreement concerning the enzymes contained in the pancreas. Very likely the pancreas contains amylase. We found weak proteolytic and amylolytic activities in the pancreas of « *Scyllium canicula* ». Certain authors say that it is difficult to separate the liver from the pancreas; therefore it is possible that the glycogen contained in the liver and its splitting by enzymes of the liver lead to erroneous results in the determination of amylase in the pancreas.

The enzymatic activity of the pyloric appendages and of the intestine is better known.

The extracts of the appendages digest fibrin in alkaline and neutral medium. We found that the pyloric appendages of « *Merlangus vulgaris* » digest fibrin not only in an alkaline or neutral medium, but also in a slight acid medium. They are

able to split starch. The intestine has proteolytic and amylolytic activities. The extract of the intestine of « *Merlangus vulgaris* » digests fibrin in a neutral or alkaline medium; the extracts of the intestine of « *Scyllium canicula* » needs an acid reaction.

To summarize we may say that proteases (pepsin and trypsin), carbohydrases and also a lipase are generally present in fishes. The digestion in fishes is very much similar to that in mammals. The main difference lies in the histological structure. Among fishes the differences in the development of the digestive systems and in the enzymatic secretion are due to differences in food.

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