Anatomy and Physiology of the Digestive System

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Introduction

The capture, processing and reduction of prey into nutrients is the function of the digestive system which can be thought of as a series of interconnected tubes through which food passes, each with specialized anatomical and phys-iological features, and associated secondary organs that provide the means of mechanical and chemical digestion, absorption of nutrients, and the final elimination of undigested materials

Beginning anteriorly, these organs are the mouth and oropharynx with its teeth, gillrakers and other structures for the initial capture and ingestion of food, the esophagus, the stomach, the intestine with its associated digestive organs: the liver, pancreas, and gall bladder, and last the rectum, or in some fish a spiral valve.

- The operation of the digestive system is under direct and complex control systems of hormones related to food ingestion and movement through the gut. The production of these hormones makes the intestine the largest endocrine organ in the body

Teeth

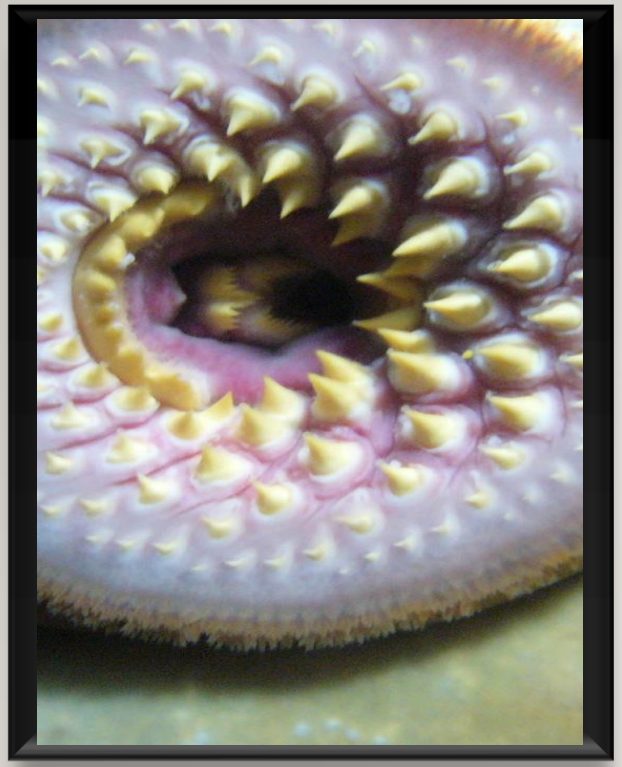
Living Agnathan fishes possess conical, rasping tooth-like structures made of keratin, the same structural protein found in human hair and nails, on their tongue, rather than enamel covered, bony teeth typical of other vertebrates.

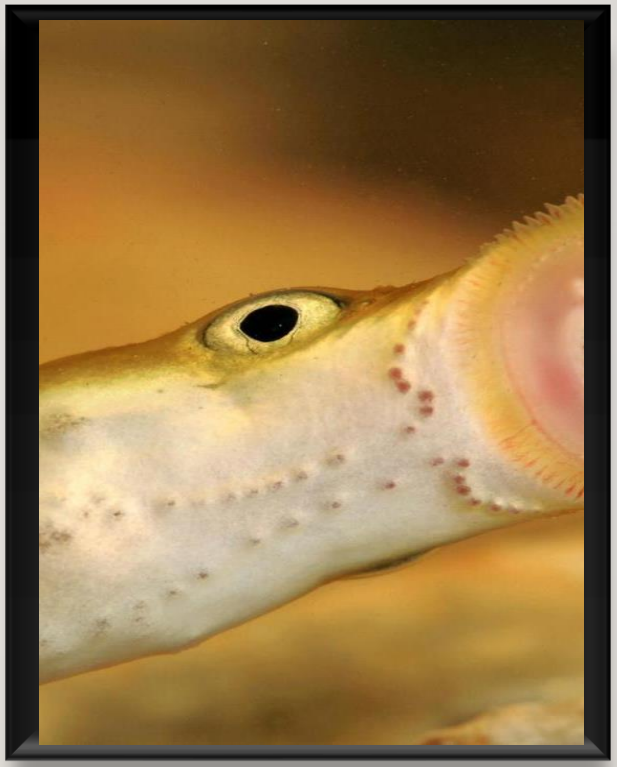
1- The lamprey has similar teeth around its mouth

2-They also have no identifiable esophagus or stomach.

3-The intestine is straight with little regional differentiation

Pharyngeal teeth located on, above, and below the pharyngeal arches are important for shearing or crushing prey. They often occur in fish that other- wise lack teeth, such as carps, minnows, and suckers; however, many families such as parrot fish, cichlids, and drums possess pharyngeal teeth in addition to well developed jaw teeth.





THE DIGESTIVE TRACT

The digestive tract of fishes is divided into four regions: the foregut (esophagus and stomach, if present), mid-gut hindgut, and rectum.

ESOPHAGUS

Is a short muscular tube connecting the orophar-ynx with the stomach. Often the esophagus can expand to accommodate almost anything a fish can get in its mouth.

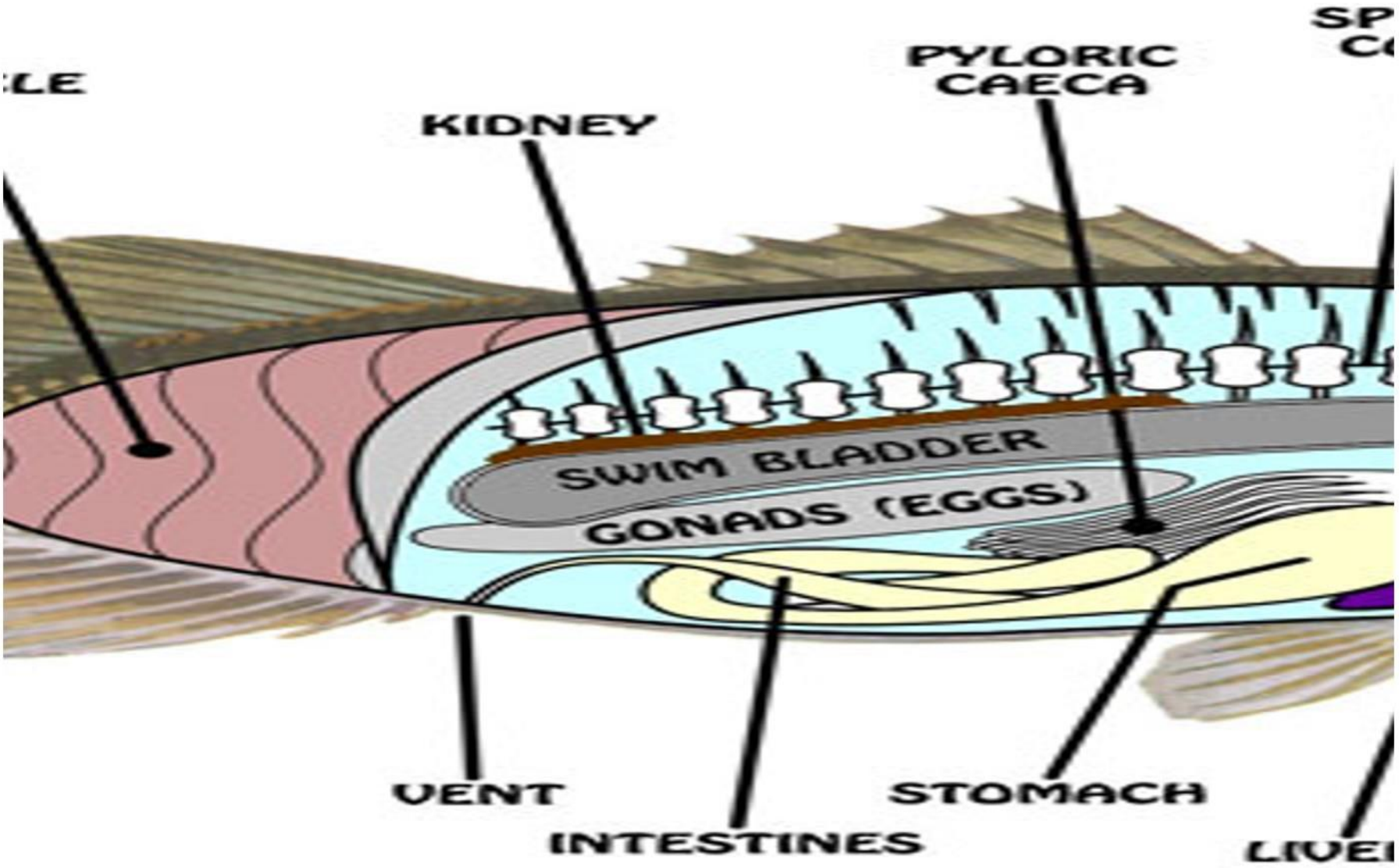
the esophagus also plays an important role in maintaining water balance, serving as a site for the absorption of water imbibed by the fish in order to offset osmotic loses to a hypertonic environment

STOMACH

A stomach may be present or absent. In its simplest form, the stomach is an elastic sac that receives and stores food, and begins chemical digestion; how-ever, in mullet, Corregonus, Sardinella, or Mormyrus most of which aremicro phagous detritivores or herbivores – part of the stomach may be modi-fied into a gizzard-like structure.

Fishes which lack stomachs include Holocephalans, which typically feed on mollusks as well as some fish; lungfish, which are predatory on fish, mollusks,and arthropods, barnacle eating blennies, and a variety of herbivorous fishes.

The stomach is a site of protein digestion initiated by the enzyme pepsin. Hydrochloric acid (HCl) secreted by gastric glands provides proper pH for pepsin, and also serves as a chemical barrier to bacteria and parasites. It may also assist with the breakdown of hard, shelly materials. The stomachs of many fishes also exhibit chitinase activity, although whether this enzyme is secreted in the stomach or esophagus or both is not clear.


PYLORIC
CAECA
KIDNEY
SWIM BLADDER
GONADS (EGGS)
VENT
INTESTINES
STOMACH

DIGESTIVE ENZYMES

- Like other animals, fish possess an array of digestive enymes by which large macromolecular nutrients are broken down into smaller molecules that can be assimilated. Most fish possess seven main digestive enzymes – trypsin, mal-tase, amylase, two +aminopepsidases (carboxypepsidase), lipase, and alkaline phosphatase. Almost all the major enzymes are present in all fish regardless of their food habits, however, the relative concentration and activity varies according to food preference.

Pepsin is localized in the stomach where it functions at optimum pHs between 1 and 4, while the others are found in the intestine at more alkaline pHs. The optimum pH for each enzyme varies with different regions and between different species.

In genera the optimum pH for trypsin lies between 6.8–7.8, for carbohy drases 5–7, and for lipases the two sources of most alkaline > 7-8. There are enzymes for the mid-gut – the pancreas and the secretory cells in the gut wall.

OTHER ORGANS

The pancreas is an important source of digestive enzymes. It may be a discrete organ or a diffuse mass of tissue (Hilliard and Potter, 1988), often interwoven among pyloric caeca. Islet cells, the sources of insulin and glucagons, may be found within the pancreatic mass as is typical of higher vertebrates, or separately, often in association with liver tissues. Endocrine pancreas islet cells are often consolidated into large tissue masses, known as Brockmann bodies.

Newly absorbed nutrients are transported to the liver by the hepatic portal vein..

The liver, which may be the largest organ besides swimming muscles in a fish's body, is not directly involved with digestion, but assimilates nutrients, produces bile, and detoxifies toxins from both endogenous (metabolic) and exogenous sources. A final organ associated with digestion is the gall bladder which secretes bile, produced by liver, that aids in emulsification and increases intestinal pH. The gall bladder also excretes absorbed toxins and metabolic wastes back into the gut for elimination

Thank You