Digestive System

Dr. Bruce Hunter,[1] Ashley Whiteman,[1] Dr. Babak Sanei,[2] and Al Dam[2]

Birds have a digestive tract that is in many ways similar to yours, but is much shorter (to reduce weight for flight) and has a specially modified stomach for processing seeds and plant material. The anatomy and physiology of the digestive tract varies considerably among avian species that have adapted to eating different types of food. This fact sheet will concentrate on seed eating bird species and will not discuss the special adaptations of raptorial or fish eating birds.

The digestive tract will be discussed in 3 sections, (1) upper digestive tract (oral cavity, proximal esophagus and crop), (2) lower digestive tract (distal esophagus, stomach and intestinal tract), and (3) the liver and pancreas, that are attached to the intestines and produce key products that regulate and assist with its ability to process and digest food (figure 1). Each section of the digestive tract is specialized to perform specific functions such as producing gastric acids, grinding food material, absorption of nutrients, water absorption etc.

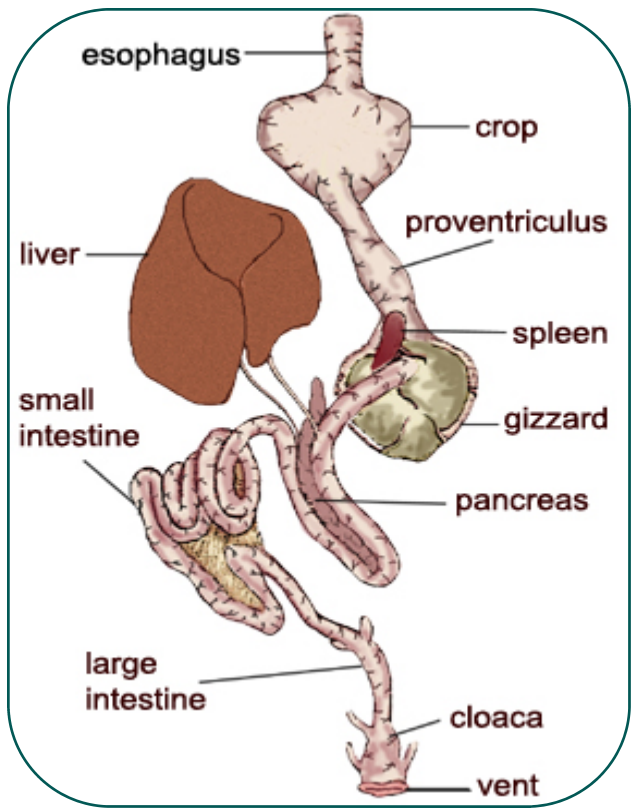


Figure 1. A schematic of the avian digestive tract.

Avian Digestive System

The upper digestive tract

The mouth or oral cavity have many special features. Birds have no teeth. All the food grinding is done in the stomach. The tongue is modified depending on the species and may range from thin and pointed, heavily cornified in the fowl, to muscular, flexible and extremely tactile in psittacines. Most birds have few taste buds and therefore a poor sense of taste. The oral cavity and esophagus contains many salivary glands that produce stringy mucus to lubricate the passage of dry food material like seeds, plant material and in commercial birds pellets (figure 2).

The crop is simply an out-pouching of the esophagus that stores food for later digestion. Some species like owls have no crop. In pigeons the crop lining changes dramatically when they are feeding young. These hormonally regulated (the hormone is prolactin) changes result in thickening and fat deposition in the cells that line the crop to produce the so called "crop milk" which is the main food for baby pigeons.

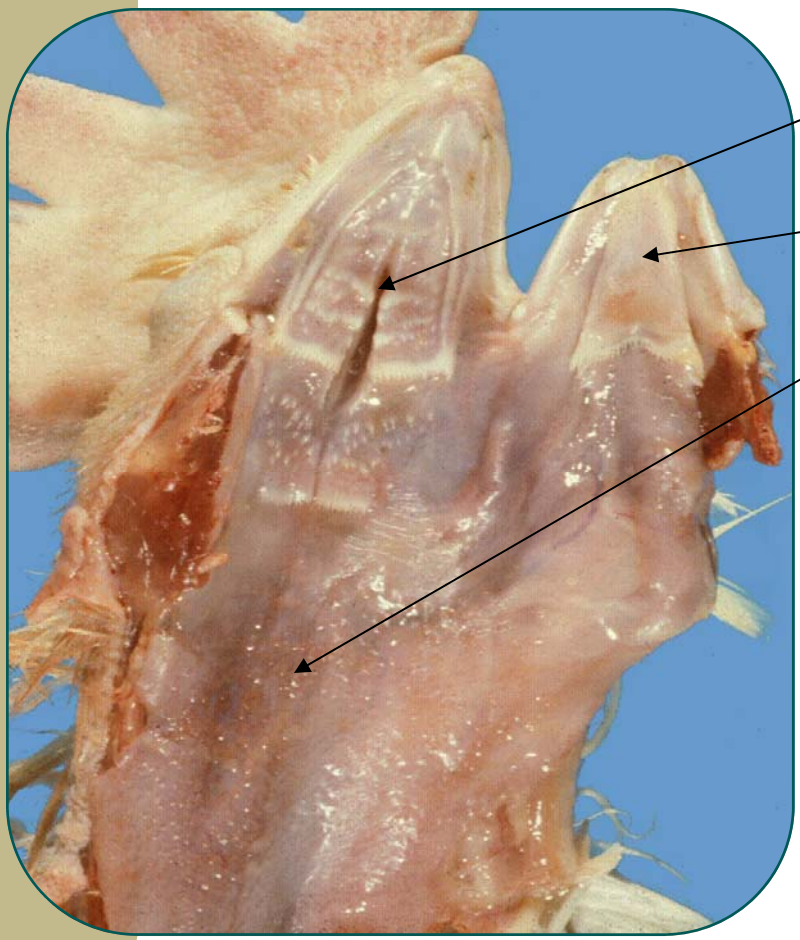


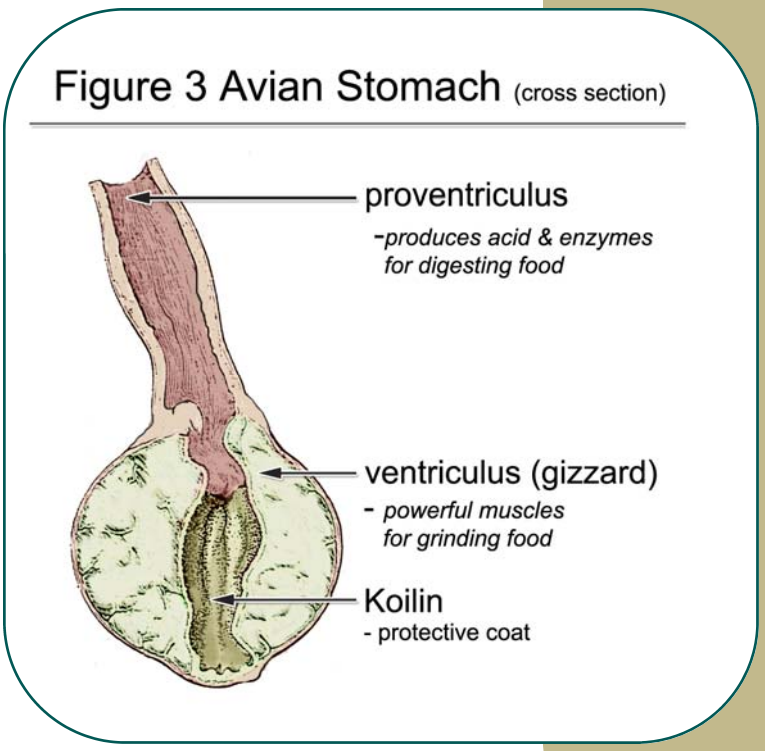
Figure 2.
Oral cavity and beginning of the esophagus of a chicken.

The lower digestive tract

The stomach of the bird has two parts (the proventriculus and the ventriculus) (figure 3). The proventriculus is the glandular portion of the stomach. The glands in this location produce digestive enzymes such as pepsinogen and HCl essential for breaking down food. The ventriculus or gizzard is the powerful muscular part of the stomach designed for grinding the food. The gizzard is lined by a specialized, very hard protein called koilin, that protects it from the grinding action as it breaks down food. Unless highly refined pelleted feeds are supplied, all species require supplemental gravel (grit) to assist in grinding the feed. This is necessary because birds don't have teeth. The stomach functions with a very complex sequence of contractions that allows for alternate mixing of digestive juices from the proventriculus followed by the powerful grinding of the gizzard. This coordinated proventricular-ventricular motility is innervated through nerves of the myenteric plexus.

The intestinal tract of the bird is very short; another specialized adaptation for flight by keeping the body as light as possible. The ventriculus opens to the small bowel through a muscular valve or sphincter called the pylorus. The first section of the small bowel is the duodenum. Bile ducts carrying digestive bile acids from the liver and pancreatic ducts bringing digestive enzymes from the pancreas dump into the duodenum and mix with the feed. There is extensive backwards and forwards mixing (peristaltic and retroperistaltic contractions) of the feed in the small bowel to compensate for its short length by increasing the time that food is available for digestion and absorption. The remainder of the small bowel is divided into the jejunum and the ileum. A small nodular appendage called Meckel's diverticulum marks the start of the jejunum. This is the site where the yolk sac was attached to the intestine in the embryo to provide nutrients during the incubation period. Paired cecae are located at the junction of the small and large bowel. The cecae are blind-ended out-pouchings of the intestinal tract that are important in maintaining water balance, advanced fermentation of food fiber and the absorption of B vitamins and various fatty acids. Most species of birds have cecae but a few species, notably pigeons and some of the

Figure 3. Avian stomach complex. Proventriculus produces acid and enyzymes; ventriculus is the powerful, muscular food grinder.



Biosecurity Education Initiative

FACTSHEET 5.5
March 2008

small passerine species (song birds) have only vestigial cecae. Gallinaceous species (chickens, turkeys, games birds etc.) have large, well-developed cecae.

The digestive tract terminates in the cloaca. The cloaca has 3 divisions or compartments separated by rings of smooth muscle. The colon empties into the coproduem. The ureters from the kidney and the vas deferens and oviduct from the male and female reproductive systems respectively, open to the urodeum. The cloaca empties from the proctodeum through the vent.

Since the digestive tract and the urinary tract share a common opening bird feces is a mixture of both feces (from the intestine) and urine (urates) from the kidneys. The white portion of bird feces is the urates from the kidneys (figure 4). When a bird has loose or runny droppings it is important to determine if this is truly diarrhea or excess urine from the kidneys.

Figure 4. Feces from a bird (parrot). The solid green material is the feces coming from the intestinal tract; the white material is solid urates originating from the kidneys and the liquid staining the paper is the urine.

University of Guelph [1]

Ontario [2]

CONTACT

OMAFRA's Agricultural Information Contact Centre:

1-877-424-1300