

UROPYGIAL GLAND IN BIRDS

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Occurrence and Location:

- The uropygial gland, often referred to as the oil or preen gland, is a bilobed gland and is found at the dorsal base of the tail of most psittacine birds.
- The uropygial gland is a median dorsal gland, one per bird, in the synsacro-caudal region. A half moon-shaped row of feather follicles of the upper median and major tail coverts externally outline its position.
- The uropygial area is located dorsally over the pygostyle on the midline at the base of the tail.
- This gland is most developed in waterfowl but very reduced or even absent in many parrots (*e.g.* Amazon parrots), ostriches and many pigeons and doves.

Anatomy:

- The uropygial gland is an epidermal bilobed holocrine gland localized on the uropygium of most birds.
- It is composed of two lobes separated by an interlobular septum and covered by an external capsule.
- Uropygial secretory tissue is housed within the lobes of the gland (Lobus glandulae uropygialis), which are nearly always two in number. Exceptions occur in Hoopoe (*Upupa epops*) with three lobes, and owls with one. Duct and cavity systems are also contained within the lobes.
- The architectural patterns formed by the secretory tubules, the cavities and ducts, differ markedly among species. The primary cavity can comprise over 90% of lobe volume in the Oilbird (*Steatornis caripensis*) and some woodpeckers and pigeons.
- The gland is covered by a circlet or tuft of down feathers called the uropygial wick in many birds. This feather tuft may aid in transmitting oil from the gland to the beak while preening.
- Sometimes there is a ring of feathers around the opening of the gland.
- It drains into a single papilla at the base of the tail. The dorso-caudally oriented papilla contains one, two, or multiple ducts and a tuft of down feathers at the openings. The uropygial gland papilla is like a nipple, and is often demarcated by a constriction, the isthmus, from the lobes. It has at least two ducts; these open upon the papilla's surface by means of orifices. In more than 90% of all birds these are two in number. The greatest, but somewhat variable, numbers are found in some species of cormorants.
- The nerve supply of the gland has both a medullar and a sympathetic origin.
- The gland is vascularized by branches of the caudal artery.

Function:

- The gland secretes a clear, oily fluid. Composition of avian uropygial gland secretions is very complex and may vary with species, gender, season, diet, and hormonal regulation. The secretion is a complex mixture of ester waxes, fatty acids, lipids, and wax alcohols.

- Secretions of this gland are an important component in maintaining feathers' condition. Material produced by the uropygial gland is very important for waterproofing feathers. Lipid secreted by this gland and the epidermal cells are spread over the feathers by the bill during preening. Birds can preen as often as once an hour at rest. Secretions are spread among the plumage by preening. Contact of the beak with the papilla induces a flow of secretion.
- Antiabrasive effects to prevent feather barbules from breaking and to maintain plumage in good condition when the feathers are drawn through the bill during preening.
- The secretion also acts as protection against feather-degrading ectoparasites such as feather lice.
- The sebaceous material secreted by uropygial gland contains vitamin D precursors, which are converted to the active form of vitamin D₃ when exposed to ultraviolet light. During preening, the active form of vitamin D₃ is ingested. Exposure to ultraviolet light is necessary for this metabolic process to take place.
- The oily material produced by the gland also produces antibacterial and antifungal components, which help maintain the integrity of the skin. This lipid layer of the secretion forms a protective bacteriostatic layer over the skin and may explain why birds are less prone to skin infections.
- Some other roles suggested are involvement in production of pheromones and excretory functions of several pesticides and pollutants.

Fig. 1. Anatomy of the uropygial gland as seen in frontal longitudinal section. (After Jacob and Ziswiler 1982)

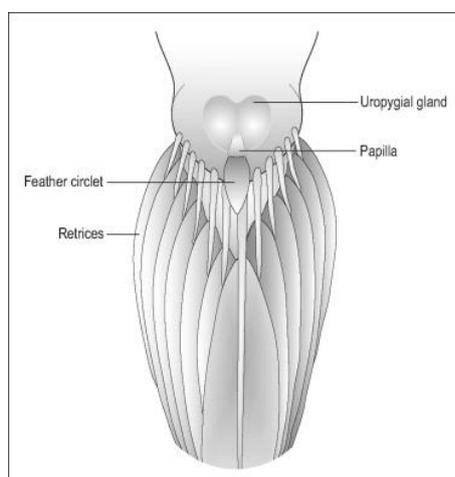
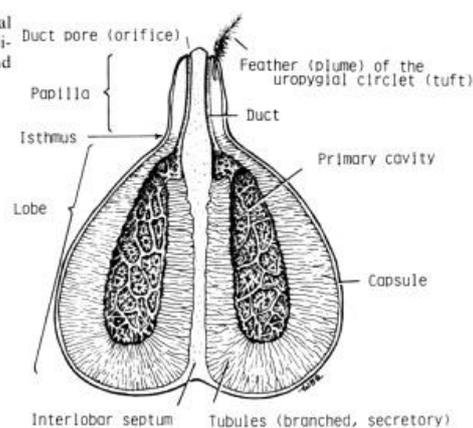


Fig 2, Dorsal view of uropygial gland.

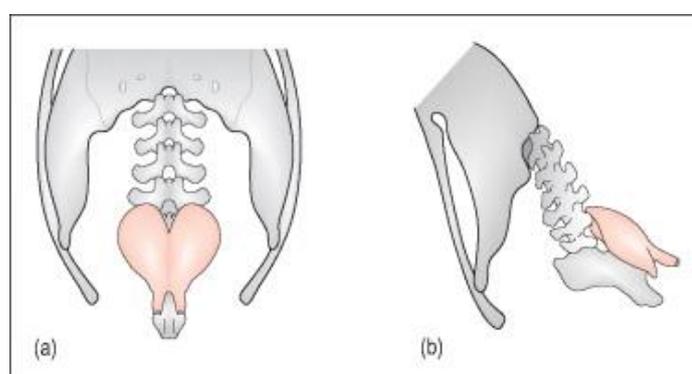


Fig 3. Location of uropygial gland in relation to pygostyle.

(a) Dorsal view (b) Lateral view

Uropygial gland histology:

- Because uropygial gland has many proposed functions it is surprising to find a lack of information with regards to its histological organisation. In fact, only 0.2% of bird species the gland has been studied histologically.
- The histological structure of this gland is similar to that of Sebaceous glands of mammals.
- Studies to date have shown that the UG has a holocrine arrangement similar to the sebaceous gland, thus secretion can be stored in ducts and expelled through the papilla when required.
- The gland is bounded by dense connective tissue known as the capsule. The main components of the capsule are elastic, collagenous fibres, which are arranged in a dense network around the gland. The capsule of some species (e.g members of Coraciiformes and Psittaciformes) may contain melanine granula on the dorsal side of the gland, which produces pigmentation and causes the appearance to become spotty or very dark.
- Blood vessels, lymph vessels, and nerve fibres are intertwined within the capsule walls, which again is similar to the structure of mammalian sebaceous glands.
- The capsule extends ventrally down between the lobes to form the interlobular septum. Like the capsule, it contains collagenous, elastic fibres and reticular fibres with a large number of blood vessels, lymph vessels, and nerve fibres.
- Bands of these connective tissues penetrate into the gland forming interfollicular septae, providing support for the secretory epithelium from outside the lobe.
- Each lobe of the gland is comprised of many follicles which are lined with secretory epithelial parenchyma.
- Follicles are present throughout the gland and are considered central, intermediate, or peripheral, depending on their location. T
- The epithelial parenchyma produces secretory products which are deposited into the lumen of each follicle. Secretory products are then relayed through a minute duct in the follicle into a secondary sinus to be stored. From the secondary sinuses the secretion is relayed to a primary sinus, and when stimulated by the bill of the bird, the secretion is expelled.
- The most common description of follicular structure involves four, well defined epithelial cellular regions. The basal epithelial layer in a follicle is the germinative layer, followed by the intermediate layer, secretory layer and finally the degenerative layer.
- The germinative layer is composed of one to two strata of flattened basal cells. It is the chief area of cellular division. The germinative cells are immature in function and become differentiated for secretory functions as they are driven towards the lumen
- The next defining layer is the intermediate layer, which is characterized by one to five strata of polygonal cells. These cells contain spherical nuclei and a basophilic cytoplasm, rendering them easily stainable. In most cases the peripheral follicles have a low number of these layers, whereas central follicles possess more.
- Following on from this layer of cells is the secretory layer. Cells in this layer have differentiated into voluminous polygonal units, one to ten strata thick. Within the cytoplasm of these cells, the Golgi apparatus is extensive and displays numerous granules. These granules are stored within the cytoplasm of the secretory cells where they are released on degeneration.
- The degenerative layer is the final, innermost layer where the secretion is liberated into the lumen of the follicle. Here the cells are characterised by pycnotic nuclei (a sign of cellular death) and become irregular in shape. The cells encroach the lumen of the follicle hypertrophy occurs, secretion granules coalesce, and finally the cells breakdown, releasing their contents.