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MORFOLOGIA MACROSCOPICĂ A APARATULUI RESPIRATOR LA STRUȚUL AFRICAN (*Struthio camelus*)

Rezumatul tezei

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SUMMARY

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Human as well as animal anatomy represents a branch of science that arose in the distant past and not only remained a fundamental discipline until today, but also contributed to the evolution of some modern day disciplines such as anatomopathology, semiology, surgery, obstetrics, etc. In time, veterinary anatomy focused on species of animals that were domesticated early in history.

Lately the activity of breeding and raising animals started including other species, either in order to complete the increasing necessity of food, or to serve for ornamental and sportive purposes. One of these species is the African ostrich, a species that was domesticated rather recently and whose morphologic areal is yet not completely known. This is one of the reasons for which, in the present thesis, I have tackled a detailed study of the respiratory system in this species with plenty of anatomical differences to other species belonging to the same family.

Part I of the thesis, the **"Bibliographical study"** includes three chapters.

The first chapter is titled **"General aspects regarding the biology of the *Struthio camelus* species".** This chapter includes, first and foremost, a general description of this bird, primitive in phylogeny, with characteristics that differentiate it from the other representatives of the class it belongs to. Its weight (of up to 160 kg), its size and rhythm of growth are neatly superior to those of any other order. Exterior characteristics are presented, emphasising those which differ between the two sexes as well as the most important morphological and physiological adaptations to the environment. One of the characteristic which make the species easily identifiable, even when the plumage is not yet fully formed, is the existence of just two fingers in the pelvic limb at *Struthio camelus* (any other species of the order having three fingers).

Following this, a presentation will be made of the morphological characteristics and the spread of all the subspecies belonging to the order *Struthioniformes: S. c. australis, S. c. camelus, S.c. massaicus, S.c. syriacus* şi *S.c. molybdophanes.* The chapter also includes a map of the species' current geographical distribution.

Finally, the phylogenetic evolution of this order is shortly described.

The second chapter entitled **"Raising ostriches, influences in the economic areal"**, treats certain economical aspects, among which is the dynamic of this activity from its beginnings to the directions it is currently taking in the present day. A very important aspect, noticed by many scientists who tackled this domain from a biological and economical point of view is the fact that "the pre-existent published scientific research is limited and it is difficult to establish techniques and optimal practices to allow producers to obtain maximum productivity with a minimal investment. Due to the fact that in the recent years, an interest was manifested in raising ostriches, a lot of information has appeared, but it is usually lacklustre for this domain of activity." This has represented a motivation towards the completion of the current study.

This chapter also synthetically describes the steps of promoting the ostrich as a production animal, starting with the second half of the nineteenth century, thing which was determined by the quality of the feathers, the skins and especially the quality of the meat.

The third chapter is titled **"General aspects regarding the morphology of the respiratory system in birds".** This chapter includes known data referring to the aspect and the structure of different components of the respiratory tract in the individuals of this class, including in those of the Struthiniformes order.

Certain interesting aspects are presented and explained, especially particularities which appeared as an adaptation of the species to the environment they live in. A series of such adaptations are reminded, in the order of the segments of the respiratory tract.

Most often the nostrils are located at the base of the beak, placed dorsally, ventrally or laterally on it. The Kiwi is the only bird where the nostrils are placed at the apex of the beak. In certain species, the nostrils are entirely covered by cornified cells, as is the case of the Morus genus (marine birds), where the respiration is performed through the buccal cavity (they present permanent openings at the commissures of the beak), the birds having adapted to entering an aquatic environment at very high speeds, from a considerable height. In some cormorants, the infraorbital sinus is absent. At

marine birds, the nasal gland secrets a hypertonic solution of 5% sodium chloride, which allows these birds to safely consume sea water (3% saline solution).

The unilateral specialisation of the anterior limbs (in flight) imposes on birds the usage of the beak for a number of actions, not only for the prehension of food but also for body hygiene, building nests, etc. These activities require a long neck (approximately 2,7 times longer than in a mammal of the same weight). The increase in length determines an increase in the resistance of air passing through the trachea. This is compensated, however, by an increase in the diameter of the organ in comparison to mammals. Consequently, the resistance of the tracheal air flux is the same at a bird and a mammal with the same body weight.

In song birds there are five pairs of muscles for the syrinx (dorsal tracheobronchial, rostral tracheobronchial and ventral tracheobronchial as well as dorsal and ventral syrinx muscles). In the vast majority of species that do not belong in this category there is usually a single syrinx muscle, the lateral tracheal.

These are only a few examples of adaptive “structure-function” correlations of the segments of the respiratory tract. In the chapter some other details are included, also in regards to the lungs and the air sacs.

The second part **“Personal Research”** begins with chapter 4, where the **aim and objectives of the research are presented**.

The fifth chapter is titled **“Materials and Methods”** and the materials and methods of study used are described, according to the intended purpose.

The sixth chapter **“Results and discussions”** is also divided in four subchapters, each of these finalising with a series of partial conclusions.

The first subchapter treats the anatomy of the nasal cavities. The bone base of these cavities is described, pointing out the differences between Paleognathae, a group to which the ostrich belongs, and Neognathae, the more phylogenetically evolved species. An ample description is made on the nasal choanae , their morphology being proven through four images of longitudinal or transversal sections, on more levels, through the cavities. Due to the fact that the Struthio camelus species has a paranasal sinus system which is relatively well represented, these were also described in detail. Moreover, in the case of the sinuses, radiological imagery has been provided, analysing and delimiting as correctly as possible each sinusal compartment.

The second subchapter describes the superior respiratory airways, from the pharynx to the syrinx. Particular attention has been paid to some muscles of the

pharynx, which were found to be less analysed in specialty literature. Some muscles of the hyo-branchial apparatus have rapports to the lateral walls of the pharynx. On each side of the pharynx, superficially, two muscles can be found: cranially, the ventral intermandibular muscle, which continues caudally with the constrictor coli muscle. Rostral to the ceratobranchial, the pharyngeal wall has rapports with two muscles located profoundly which seem to be in continuation with the anterior part of the constrictor coli muscle. These are the serpihyoid and the stylohyoid muscle. Most of the lateral side of the pharynx has rapports with the branchio-mandibular muscle.

Though not mentioned in specialty literature, it could be appreciated that through these muscles' topography, besides mobilising the components they are inserted on, they also act as a constrictor of the pharynx, mobilising the bolus to the origin of the oesophagus.

Although specialty literature only mentions the presence of an interbrachial septum in the cassowary, it has been noticed that, on the interior of the trachea, on the dorsal side, the tracheal rings form a faint longitudinal relief in the case of the Struthio species too.

The syrinx is simpler than in the rest of the birds, and it is located ventrally to the glandular stomach, on the second and third thoracic vertebra level and between the terminal part of the trachea and the primary bronchi. Its skeleton is made of three different groups of cartilages. These are the tympanum, the trachea-syringeal cartilages and the broncho-syringeal cartilages.

Although some authors mention the existence of a lateral tympaniforme membrane, we believe that the short ligament between the last ring of the tympanum and the first trachea-syringeal cartilage cannot be considered as such a structure.

The third subchapter describes the anatomic base of the thoracic cavity, the lungs and the air sacs in ostriches. Each thoracic vertebra is described in detail, as well as each rib and the sternum. An unique aspect was noted in the exceptional presence on the third pair of ribs of a secondary uncinated process. To ease the identification of these structures, images were taken of the thoracic cage, which was prepared through maceration.

Following this, the morphology of the horizontal septum is described in detail, as well as costo-septal muscles and the topography of the ostia through which the lung connects to the air sacs.

Like in other birds, at the ostrich, the lung occupies the most dorsal compartment of the thoracic cavity, located above the horizontal septum. It has three main faces, which generate more edges and angles. The rib face is convex both dorso-ventrally and cranio-caudally. On all its length the vertebral face has five wide notches, diagonal latero-caudally, which correspond to the rib notches. The septal face is connected to the horizontal septum. It is generally flat. The hilum is marked by three important orifices. The orifice for the main bronchia is located centrally. It is flanked cranially by the orifice for the pulmonary artery and caudally by the one for the corresponding vein. There are three medio-ventral secondary bronchi and five medio-dorsal secondary bronchi, but also a latero-ventral secondary bronchia, unmentioned in specialty literature.

In the ostrich, the air sacs are represented, as in other species of birds, by the cervical sacs, lateral and medial clavicular sacs, cranial and caudal thoracic sacs and abdominal sacs. The abdominal air sacs are relatively reduced in size, the left one being slightly better developed than the right one. Each abdominal sac presents a peri-renal diverticulum and a femoral diverticulum. The number and the topography of the ostia which connect the air sacs to the bronchial tree are generally similar to the ones reported in other species.

The seventh chapter includes the 12 final conclusions of the work.