

Anatomical Comparison of the Nasal Cavity in Adult Male and Female Cockatiel (*Nymphicus Hollandicus*)

Nuha I. M. Al-Rubaie¹, Kadhim, K. K.²

¹Department of Anatomy and Histology. College of Veterinary medicine. Baghdad University, Iraq. ²Department of Anatomy and Histology. College of Veterinary medicine. Baghdad University, Iraq.

*Corresponding author: Nuha I. M. Al-Rubaie, E-mail: Noha.Ibrahim1108a@covm.uobaghdad.edu.iq

Abstract

This study document the detailed of morphological features of the nasal cavity in cockatiel (*Nymphicus hollandicus*) by the use of twelve adult birds. In the present study, the nasal cavity was a cone shaped extended from the external nares to choana that was slit-like openings communicate the nasal cavity with the oral cavity. The nasal septum divided the nasal cavity, longitudinally into equal right and left halves, the nasal cavity had rostral and middle that were projected from the lateral wall of the nasal cavity with nasal meatuses between these conchae, these were common meatus which was situated between the nasal conchae and nasal septum, the dorsal was passage between the dorsolateral wall of the nasal cavity and the rostral nasal concha and the intermediodorsal meatus located between the rostral nasal concha and middle nasal concha, the ventral meatus present between the rostral and middle nasal conchae ventrally and the floor of the nasal cavity. Nostrils were located behind the soft fold cere which was covers the area above the beak. In transverse section of the rostral concha appeared as a leaf-like and the middle nasal concha was scrolled ventrolaterally with two and one half turns of scrolls the length was measured (2.2±0.3) mm in male and (2.1±0.5) mm in female, The middle concha was the largest, it was measured (2.5±0.1) mm and (2.3±0.3) mm in male and female respectively, there was no significant difference ($p>0.05$) in musearements of the length of the nasal conchae between male and female birds.

Introduction

The respiratory organs of birds differ from those of mammals with respect to many specific features (Dar *et al.*, 2014). Birds are endothermic vertebrates that possess various adaptations at the structural, behavioural or physiological level for their survival in the environment. Comparative anatomy explain how organisms applied (AL-A'araji and AL-Kafagy, 2016). Unlike mammals, the direction of inspired air within the respiratory tract follows a unidirectional flow, it possesses certain anatomical structures nasal conchae which subdivides the cavity into nasal meatuses (Getty, 1975; Cevik-Demirkan *et al.*, 2007).

The nasal cavity possessing several anatomical features such as chonchas and meatuses (Cevik-Demirkan *et al.*, 2007). The nasal cavity is separated into two halves by medium septum, each one containing three common conchae are exhibit in most avian species a rostral, middle and caudal nasal conchae. The three common conchas are exhibit in domestic birds, In most avian species, there are three conchae with broad variations in forms; the rostral, middle, and caudal nasal conchae, homology to those of the mammals and other vertebrates (Banks, 1993; Baumel *et al.*, 1993). The rostral concha is located in the vestibular region in some cases one of them might be missed, for example the

rostral nasal concha sometimes absent in Sulidae (Bang, 1971) and quail (King and McLelland, 1984). And the middle concha, which is typically the largest (Cevik-Demirkan *et al.*, 2007; Dar *et al.*, 2014).

Materials and Methods

The present study was conducted at the Department of Veterinary Anatomy and histology, College of Baghdad Veterinary. Baghdad University. Sixteen adult males and females cockatiel from Australia were obtained. Birds approved by ethical committee of Baghdad Veterinary College, Baghdad University were considered. After euthanized by the intramuscular injection of combination of diazepam (Diazem-Deva 2-4 mg/kg) and ketamine HCl (20-60 mg/kg) (AL-Bayati *et al.*, 2016; Reshag and Hamza, 2017; AL-Taai, 2021). General gross description of nasal cavity was done (Mohammed and AL-Kenani, 2006), the heads were sectioned sagittal and transversally in rostro-caudal section. The nasal cavity were observed and photographed using stereomicroscope (Al-aameli and Kadhim, 2017). Then, were examined by Olympus (CX21, Tokyo, Japan) light and photographed with digital camera. Statistical analysis and The mean difference between groups was performed through SPSS version 20 (Ali *et al.*, 2018).

Results

In the present study, the nasal cavity in a cockatiel was a cone shaped passage extended from the external nares to choana that formed rostrally by nostrils. The nasal cavity had nasal conchae exhibited rostral and middle that were projected from the lateral wall of the nasal cavity (Fig.1). The nasal septum divided the nasal cavity, longitudinally into equal right and left halves, the nasal cavity had nasal meatuses between these conchae, these were common meatus which was situated between the nasal conchae and nasal septum, while the dorsal was passage between the dorsolateral wall of the nasal cavity and the rostral nasal concha, the intermediodorsal meatus located between the rostral nasal concha and middle nasal concha, the ventral meatus present between the rostral and middle nasal conchae ventrally and the floor of the

nasal cavity (Fig.2). Nostrils were located behind soft fold cere which covers the area above the beak. (Fig.3, 4). In the transverse section, the rostral concha appeared as a leaf-like and the middle nasal concha was scrolled ventrolaterally with two and one half turns of scrolls (Fig.4). The length of the rostral nasal concha was measured (2.2 ± 0.3) mm in male and (2.1 ± 0.5) mm in female. While the middle concha was the largest, it was measured (2.5 ± 0.1) mm and (2.3 ± 0.3) mm in male and female respectively as shown in table, analysis appeared there was no significant difference ($p>0.05$) in the measurements of the length of the nasal conchae between male and female birds (Table). In this study found that in a cockatiel the choana had the slit-like choanal cleft that communicating the nasal cavity with the oral cavity (Fig.5).

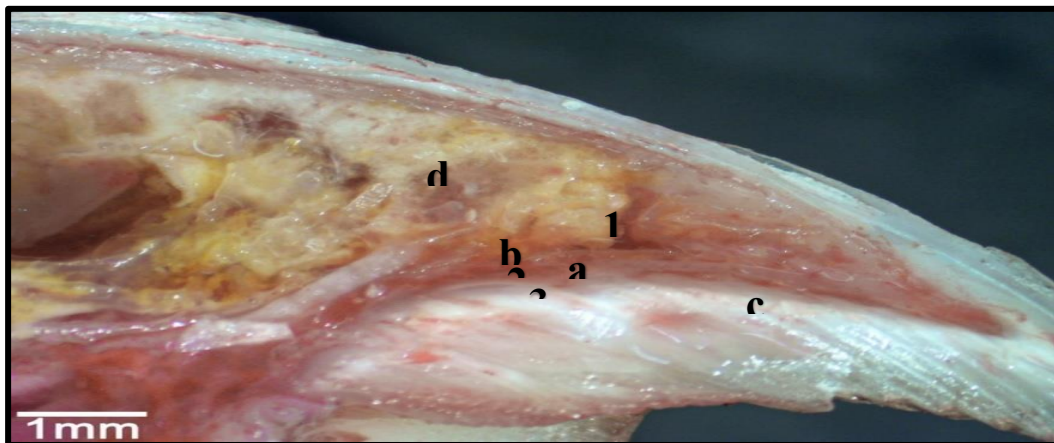


Figure 1. Macrograph: Sagittal section through the nasal cavity in a cockatiel showing: rostral nasal concha (a); respiratory nasal concha (b); nasal vestibule (c); respiratory region (d); dorsal meatus (1); intermediodorsal meatus (2); ventral meatus (3).

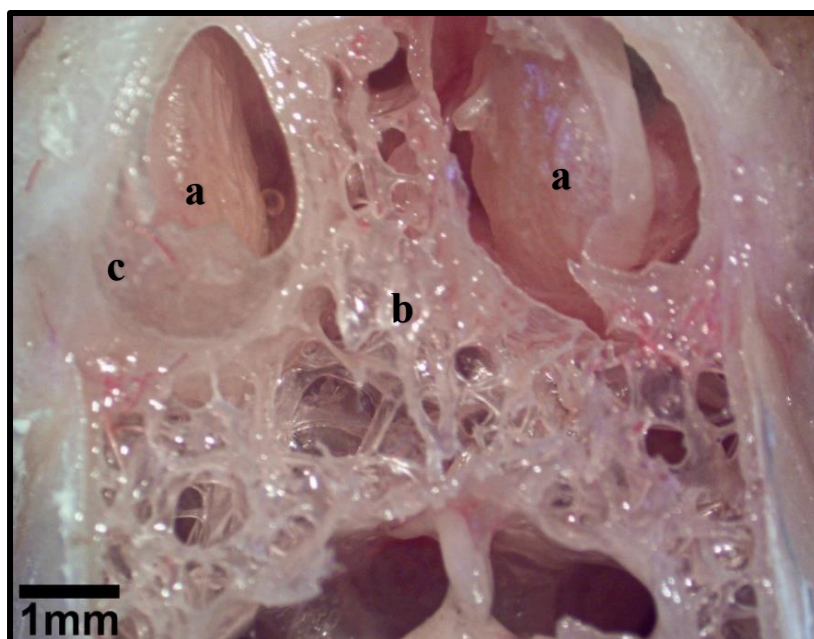


Figure 2. Macrograph: Transverse section through the nasal cavity in a cockatiel showing: respiratory nasal concha (a); nasal septum (b); nasal opening (c).

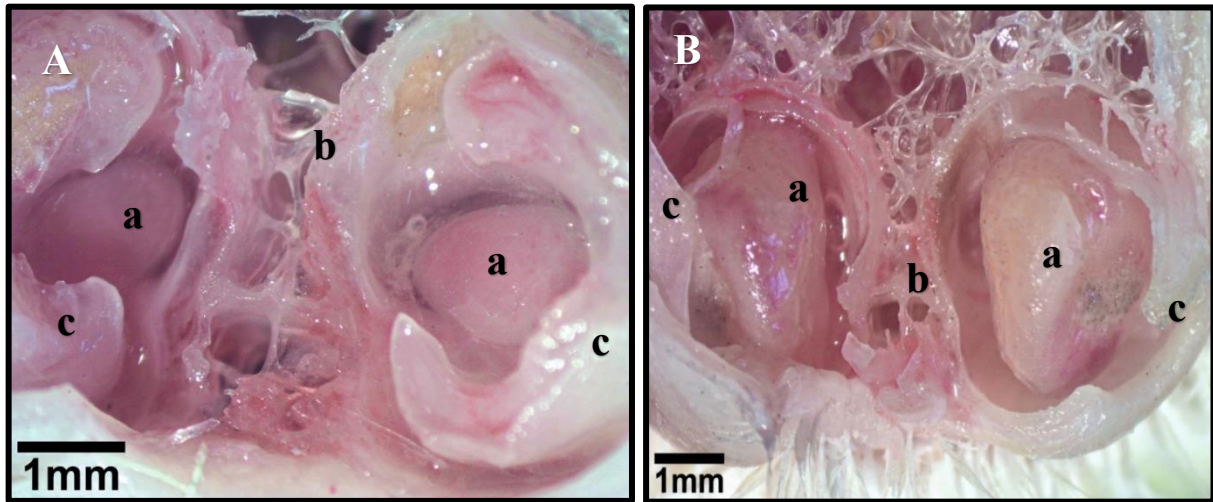


Figure 3. Macrograph: Transverse section of the nasal cavity in male (A) and female (B) cockatiel showing: middle nasal concha (a); nasal septum (b); nasal cere (c).

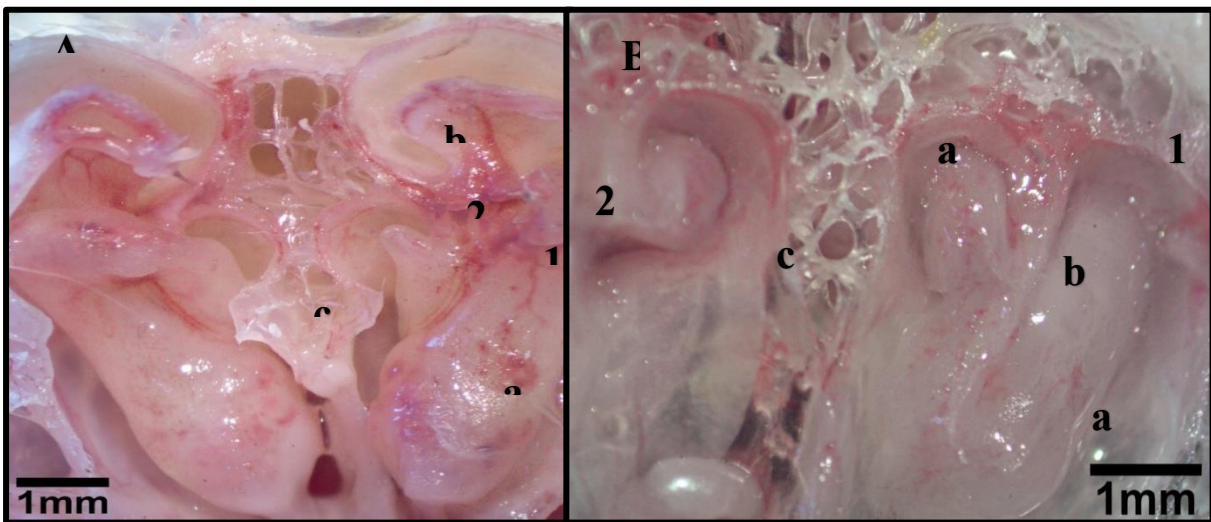


Figure 4. Macrograph: Transverse section of the nasal cavity in male (A) and female (B) cockatiel showing: rostral nasal concha (a); middle nasal concha (b); nasal septum (c); dorsal meatus (1); intermediodorsal meatus (2).

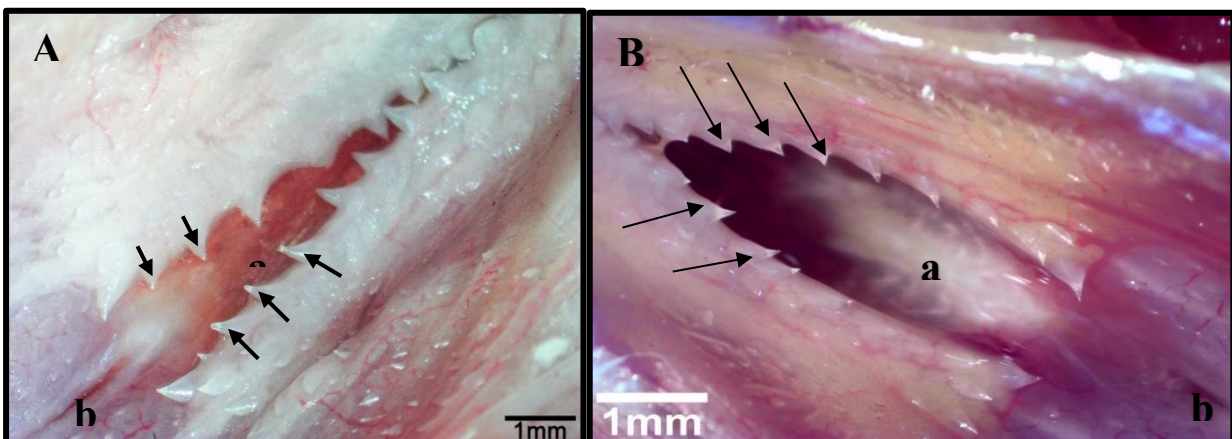


Figure 5. Macrograph: The oropharynx roof in male (A) and female (B) cockatiel showing: choanal cleft (a); infundibular cleft (b); palatine papillae at the edges of the choanal cleft (arrows).

Table: measurements of the nasal cavity in male and female cockatiel.			
Organ	Parameters (mm)	Male	Female
	Rostral nasal concha length	2.2±0.3 a	2.1±0.5 a
	Middle nasal concha length	2.5±0.1 a	2.3±0.3 a

The similar small letters represent no significant different at level $p < 0.05$.

Discussion

In this study, the nasal cavity was a cone shaped formed rostrally by nostrils. The nasal cavity had rostral and middle nasal conchae, this agreement with Kang *et al.* (2014) and Casteleyn *et al.* (2018). The nasal cavity included three conchae and the variation exist with regard to the number of conchae among the avian species (Bang and Wenzel, 1985; Jin *et al.*, 2008; Harem, 2018). Casteleyn *et al.* (2018) in chicken and pigeon mentioned that the rostral nasal concha is absent. Whereas, the caudal concha was absence in some Falconiformes and swifts (King and McLelland, 1984), in African grey parrots (Schmidt *et al.*, 2015) and in Song Sparrow (Danner *et al.*, 2017) and indistinct in Japanese jungle crow (Yokosuka *et al.*, 2009). The nasal septum divided the nasal cavity, into two halves, the complete division of nasal cavity into two equal halves, it was regulates the amount of air entering into nasopharynx through the choana (Yokosuka *et al.* 2009; Casteleyn *et al.*, 2018). The nasal cavity had nasal meatuses between these conchae, were common, dorsal, intermediodorsal and ventral meatuses, this is similar to Çevik-Demirkan. (2007) and Dar *et al.* (2014) in Japanese quail and Kuttanad ducks (*Anas platyrhynchos domesticus*). The present study showed nostrils were located above the beak covered by cere that was soft fold and the choana had the slit-like choanal cleft that communicating the nasal cavity with the oral cavity, this is accordance with Kadhim *et al.* (2013) and Casteleyn *et al.* (2018). The transverse section of the nasal cavity in rostral concha appeared as a leaf-like and in the middle nasal concha was scrolled. The rostral concha was C-shaped and middle part formed one and a half scrolls that mentioned by Çevik-Demirkan *et al.* (2007) in Japanese quail. Kang *et al.* (2014) indicated that the middle concha as whelk shell in duck, the middle concha was the largest greater of the middle nasal as observed in the domestic chicken and the middle nasal concha

occupies a large part of the nasal cavity of all birds (Bang, 1971; Bang and Wenzel, 1985),

Conclusions

This work clarified that the nostrils were with cere, there was two nasal conchae were rostral and middle nasal conchae and the middle nasal concha was the largest nasal conchae with the scrolling of this concha.

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Novelty Statement

The novelty of the study is focus on the nasal cavity in cockatiel bird that can be determine of the morphological features of the nasal cavity in male and female through the study of the morphological structures in this bird.

Authors Contribution

These authors each contributed equally.

Conflict of interest

The authors have declared no conflict of interest.

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