THE SKELETON STRUCTURE OF EDIBLE-NEST SWIFTLET (*AERODRAMUS FUCIPHAGUS*) AND PIGEON (*COLUMBA LIVIA*): A COMPARATIVE STUDY

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Received on: 03.04.2020
Accepted on: 28.05.2020

ABSTRACT

Edible-nest swiftlet (*Aerodramus fuciphagus*) is known as the producer of edible bird nest, which is also sometimes called as the caviar of the East. The swiftlet has distinct behavior compared to other birds, such as flying behavior. This research was conducted to explore the skeleton difference of edible-nest swiftlet and pigeon (*Columba livia*). This study revealed that there were at least four structures from the skeleton of the swiftlet which can be distinguished from pigeon skeleton; they were the number of os costae, the number of uncinate processes in costae, the structure of os sternum, and the structure os ischium and os pubis. Edible-nest swiftlet has six costae, in which five of them connected to the sternum and one costae not connected to the sternum. Pigeon has seven costae, in which five of them connected to sternum and two costae not connected to sternum. Edible-nest swiftlet has four uncinate processes in its costae, and pigeon has five uncinate processes in its costae. Xiphisternum process in the sternum structure of edible-nest swiftlet was almost negligible, but in the pigeon it can be identified easily. Moreover, ischiopubic fenestra in swiftlet connects os ischium and os pubis, but in pigeon the ischiopubic fenestra separates os ischium and os pubis. Further information related to complete skeletal system of edible-nest swiftlet will be reported separately.

***Key words*:** Skeleton, pigeon, *Columba livia,* edible-nest swiftlet, *Aerodramus fuciphagus*

Introduction

Edible-nest swiftlet (*Aerodramus fuciphagus*) belongs to family Apodidae, genus *Aerodramus*. It has eight subspecies, which are *Aerodramus fuciphagus amechanus, A.f. dammermani, A.f. fuciphagus, A.f. germani, A.f. inexpectatus, A.f. micans, A.f. perplexus, A.f. vestitus* (Integrated taxonomic information system, 2020). The swiftlet is one of several birds that are farmed in South East Asia due to its unique ability to produce an edible nest from its saliva. The nest is called edible bird's nest (EBN) and it has a high price in the market as it is believed to have many nutritional and medicinal values. Several biological effects of EBN are pro-mitogenic effects, EGF-like activity, pro-proliferative and immune-enhancing effects, antioxidative effects, antiviral effects, anti-inflammatory effect, bone strengthening and skin-enhancing effect (Wong, 2013). Researches related to edible-nest swiftlet and its product have been widely conducted, such as nitrite content, swiftlet's ability, behaviour and quality of its products (Yusuf *et al*., 2019). The related research was also important to help veterinarians to diagnose the disease of animals, and it can be seen in the research conducted by Wirahadikesuma *et al*. (2020), which used an alternative method for diagnosing a disease. Another research related to edible-nest swiftlet (*Aerodramus fuciphagus*), especially the anatomical structures of the pelvic limb of white-nest swiftlet, was also conducted to find the reason why the birds are not able to walk, stand and perch while standing. The study revealed that the thigh muscles of edible-nest swiftlet were undeveloped, and thus the ability to perch while standing is diminished. The study also revealed that the metatarsus of the swiftlet was shorter than that of white-headed munia. The digits of edible-nest swiftlet were also short and curvy, which are suitable for clinging or hanging. The semitendinosus muscle area of the swiftlet was almost negligible, with very few muscle bundles present surrounded by connective tissues (Zuki *et al*., 2012). These findings invite us to explore the skeletal system of the edible-nest swiftlet and compare it to another bird.

Materials and Methods

Sample collection and preparation

In this study, 15 edible-nest swiftlets obtained from edible-nest swiftlet farmer in Wajo Regency, South Sulawesi Province were studied. The skin and feathers of the edible nest swiftlets were separated from the body by using tweezers and scissors. The muscles and skeleton were dried and then muscles were removed from the bones with the help of fire ants (*Solenopsis* sp.). The edible-nest swiftlets carcasses were put in a box that has a hollow wall of wire with a diameter of 1 mm, to avoid being carried away by the ants. The ants only destroy the muscles of the edible-nest swiftlets. Two boxes were used in this preparation stage and the edible-nest swiftlet carcass samples were inserted separately to facilitate the collection of separated bones from the preparation. The box containing the edible-nest swiftlet carcass was exposed to the sunlight but allowed many fire ants to live. Observations were made every three to four hours to see the conditions of drying and destruction of the muscles by the ants. The clean skeleton then collected and observed to identify its structure and compared to the pigeon skeleton. The structure of the pigeon skeleton was referred to Meghna (2020) and Zusi (2013).

Observation

Observation of prepared bones was conducted by looking at its whole structure then focused on a specific structure to identify and compare them. Further, the bone parts were photographed using a Canon D720 camera with the specification for capturing small objects and resulting in a

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clearer bone appearance. Bones further divided into several groups, including the skull bones of the head, neck bones, wrist shoulder with wings, spine in the chest, and pelvic bones with tail and leg bones. Photographs were taken from various sides, lateral, dorsal, ventral, cranial and caudal. The final step was to observe at photographs of the bones to determine the names of the bones, their parts and compare them to the skeleton models in pigeons based on literature.

Results and Discussion

Exploration of the skeletal system of edible-nest swiftlet in Fig. 1 showed that the edible-nest swiftlet had six costae with five costae connected to os sternum through costalis cartilage and one costa not connected to os sternum. Os costae or ribs that do not reach the sternum often referred as floating ribs. Other ribs associated with thoracic vertebrae are formed from a robust, dorsal element called as vertebral rib, and a more slender, ventral element called as sternal rib. The vertebral rib, as its name implies, extends from the vertebra and articulates with sternal rib, which in turn articulates with the sternum (De Iuliis and Pulera, 2011). On the other side, the pigeon has seven costae with five costae connected to os sternum through costalis cartilage and two costae not connected to os sternum. Moreover, in costae, the edible-nest swiftlet had four uncinate processes and all of them attached in connected costae in os costa II, os costa III, os costa IV, os costa V. The pigeon has five uncinate processes with one uncinate process in unconnected costa: os costa 2, and four uncinate processes in connected costae which are os costa III, os costa IV, os costa V, os costa VI. Uncinate processes, also called appendix epiplleuralis attached in the upper part os costae at vertebra rib and is used as an area in which muscles are attached and help brace the ribs. This structure is an essential factor to help the bird to fly. In another part of thorax, the skeleton of the edible-nest swiftlet was also different from pigeon skeleton for the os sternum. Xiphisternum processes divided the lower part of the sternum into three parts. On the side, the edible-nest swiftlet sternum showed a different structure, which is xiphisternum process, and is difficult to identify (Fig. 2). The sternum of edible-nest swiftlet was similar to the sternum of humming birds (*Archilochus colubris*) where the sternal body (corpus sterni) is long in relation to overall body size, and the carina is deep in relation to sternal length and the caudal border of the sternal corpus is entire and markedly broader between the lateral

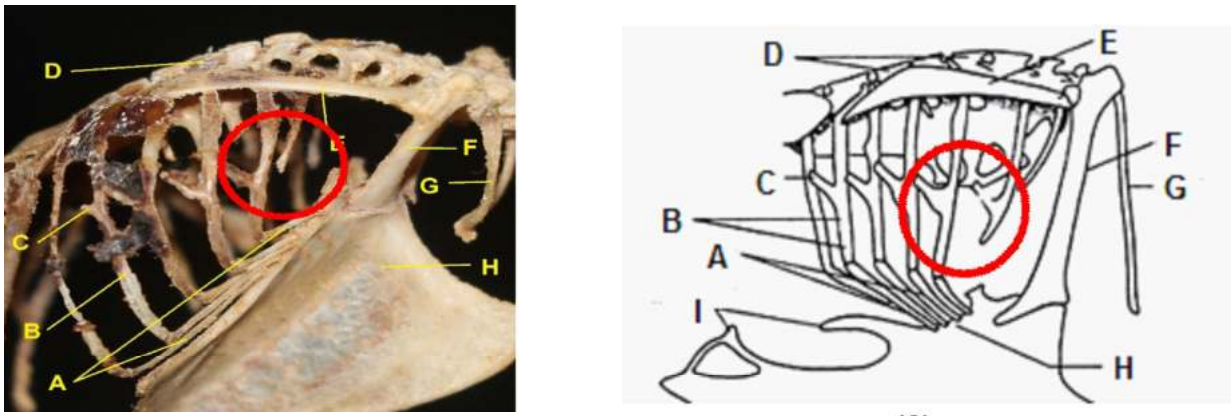


Fig. 1: Os costae of edible-nest swiftlet (1) and pigeon (Meghna, 2020) (2), red circle: area of uncinate processes, A: sternal ribs, B: ribs, C: uncinate process, D: vertebrae thoracic, E: scapula, F: coracoid, G: furcula, H: sternum, I: xiphisternum processes

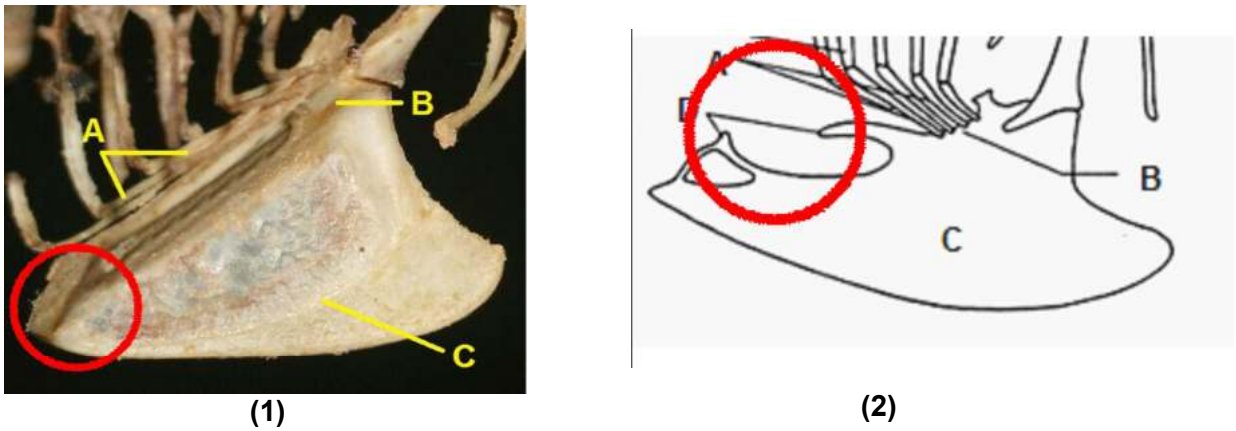
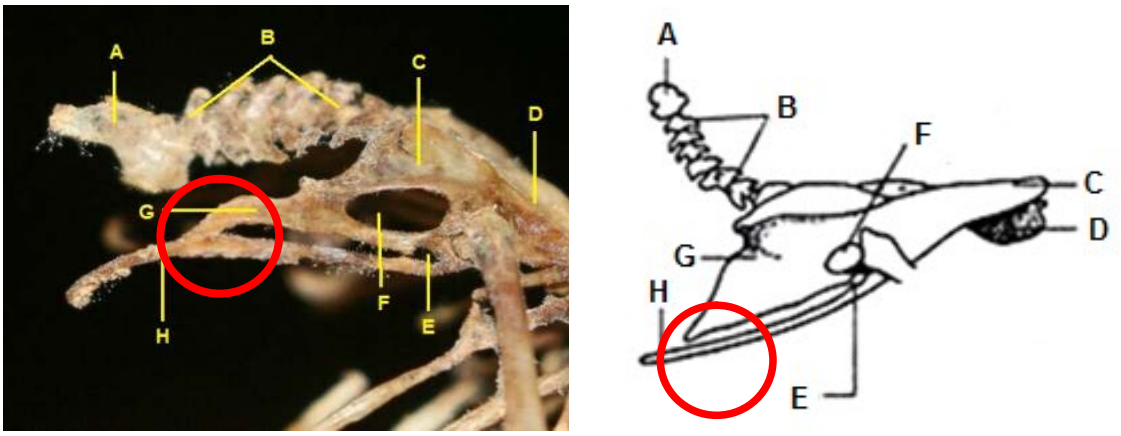


Fig. 2: Os sternum of edible-nest swiftlet (1) and pigeon (2) (Meghna, 2020), red circle: area of xiphisternum processes, A: sternal ribs, B: sternum, C: keel, D: xiphisternum processes



(1) **(2)**

Fig. 3**:** Ossa lumbalis and ossa caudalis of edible-nest swiftlet (1) and pigeon (2) (Meghna, 2020), red circle: area of ischiopubic fenestra, A: pygostyle, B: caudal posterior, C: ilium, D: synsacrum, E: obturator foramen, F: ilioishiadic foramen, G: pubis, H: ischium

angles (angulus lateralis) than at the rostral border (Zusi, 2013).

Further difference of edible-nest swiftlet skeleton was found in ischiopubic. The ischiopubic fenestra in swiftlet connects os pubis and os ischium, but in pigeon, the ischiopubic fenestra separates os pubis and os ischium (Fig. 3). In pigeon, the ischium lay ventral to the posterior part of the ileum. The separation between these bones is marked roughly by the ilioischiadic foramen. The curved pubis was very slender and elongated bone extending posteroventrally from the acetabulum, along the ventral margin of the ischium. Two other openings may be noted. The obturator foramen lies anteriorly between the pubis and ischium; the long and narrow ischiopubic fenestra lies more posteriorly (De Iuliis and Pulera, 2011).

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