Physiological and Histological Study of the Thyroid gland in Spilopelia senegalensis and Spilopelia decaocto in Iraq

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Abstract:

The current study aimed to know the anatomical description and histological structure of the thyroid gland in two species of wild doves in Iraq (the laughing dove *Streptopelia senegalensis* and the collared dove *Streptopelia decaocto*). The current study included (30) sexually adult birds (15) of laughing doves and (15) of collared dovecollected from different areas of Al-Diwaniyah city / southern Iraq.

The results of the anatomical study showed that the thyroid glands of birds are double, oval in shape, located in a ventrolateral position in the posterior part of the neck, in close proximity to the carotid arteries and jugular veins and surrounded by a capsule of connective tissue. The average weight, length and width of the right thyroid gland in the laughing dove were \((0.030 \pm 0.02) \text{ g}, (0.424 \pm 0.02) \text{ cm}, (0.283 \pm 0.02) \text{ cm}\), respectively. The average weight of the right thyroid gland was \((0.044 \pm 0.05) \text{ g}, \text{ length } (0.470 \pm 0.02) \text{ cm}, \text{ and width } (0.320 \pm 0.04) \text{ cm}\) in the collared doves. While, the weight, length and width of the left thyroid gland in the laughing dove were \((0.30 \pm 0.02 \text{ g}, 0.504 \pm 0.03 \text{ cm}, 0.305 \pm 0.01 \text{ cm})\) respectively. The average weight of the left thyroid gland was \((0.011 \pm 0.004 \text{ g}, \text{ length } (0.504 \pm 0.03) \text{ cm}, \text{ and width } (0.305 \pm 0.01) \text{ cm}\) in the collared dove.

The results of the study showed that there was a significant difference (P<0.05) in the mean diameter of large vesicles and thickness of the epithelial layer lining the large and small vesicles between the two species of laughing and collared dove. While there is no significant significance for the average diameter of the medium and small vesicles and the thickness of the medium vesicles between both species of doves.

In addition, the results showed that there was a significant difference (P<0.05) in the level of T3 hormone and the level of AST and ALT liver enzymes in the laughing dove compared with the collared dove. While the results did not show any significant difference in the level of T4 hormone between both species.

We conclude from the current study that the laughing dove is more adaptable than the collared dove in cold weather.

Keywords: Thyroid gland, Spilopelia senegalensis, Spilopelia decaocto, wild birds.
**Introduction:**

Birds exist in different environments on the surface of the globe, especially in the tropics, and their numbers and species decrease as we head to the poles. Birds are one of the forms of life and an excellent indicator of the health of many ecosystems (Gregory et al., 2001, Al-Hayali, 2005).

Birds are considered one of the largest species of the animal kingdom, as the bird category includes (9990) species distributed in (20) orders. Birds are characterized by the beauty of their shape and voice, and therefore many countries have put in place some laws to protect them from overhunting during breeding times to prevent their extinction (Abu al-Hob, 1994 Grimmett et al., 2011).

Birds are important to humans because they are an important source of animal protein and eggs, such as chicken, turkey, duck and quail, and some of them are used for ornamental purposes (Al-Hayali, 2005). In addition, it has an important role in ecological balance and biological control, as some birds such as hawk and owl feed on rats, mice and other rodents, while others feed on harmful insects (Abureesh et al., 2007).

The laughing dove (*Streptopelia senegalensis*) and the collared dove (*Streptopelia decaocto*) Fig. 1 are Iraqi birds of a kind domesticated nature belonging to the family Columbidae; They build their nests on top of buildings and window sills or on trees (Allouse, 1962; Moudhafer et al., 2006; Al-Obaidietal., 2011).

The laughing dove, also known as the palm dove, is endemic to all parts of Africa, the Middle East, and some parts of Asia such as India and Pakistan, and in Australia. In Iraq, it was considered a rare bird 50 years ago, but now it has become a common bird, especially near cities. The collared dove, also known as the Eurasian collared dove, is also native to warmer temperate regions from southeastern Europe to Japan (Anonymous, 2004).

The thyroid gland plays a key role in regulating the basic metabolic rate, stimulating physical growth, feather growth, fertility, reproduction and secondary sexual characteristics besides its vital role in calcium metabolism. This is accomplished through the hormone calcitonin as well as the secretion of the hormones Triiodothyronine (T3) and Thyroxine (T4) (Whittow, 2000).
It is classified as a vital endocrine gland located on the ventral surface of the base of the neck within the thoracic inlet. It is a paired paired organ. Each thyroid gland is closely connected to the common carotid artery on the medial side. It is a reddish-brown lenticular organ with an average length of 10 mm, width of 6 mm, and thickness of 2 mm, and it is covered by a thin capsule of connective tissue containing fat cells, and each thyroid follicle is surrounded by a network of capillaries (Breitet et al., 1998).

The thyroid gland has an important role in regulating body temperature by changing the basal metabolic rate, which affects body temperature (Rasool et al., 2004). Nazifi et al., (2003) indicated the effect of temperature changes during seasons on the secretion of thyroid hormones in many animals, such as cows, buffaloes, sheep and birds. That high temperatures lead to a decrease in the activity of the thyroid gland, and consequently a decrease in the level of its hormones, and this is done by influencing and reducing the secretion of the thyroid-stimulating hormone TSH (Al-Haidary, 2005). On the other side, high temperatures affect the function of the liver and the level of its enzymes, so the current study was designed on two species of Iraqi wild birds (the laughing dove and the collared dove) to compare the structure and histology of the thyroid gland between these two species in order to study the physiological changes of some hormones and enzymes during the seasons of the year to know the extent Its resistance (doves) to the Iraqi atmosphere and the heat stress affecting its numbers and spread.

Figure (1) shows (a) the collared dove (Campbell, 2000) (b) the laughing dove (Gill and Donsker, 2013).
**Materials and working methods:**

The current study was conducted in the animal house of the Department of Biology/College of Education/University of Al-Qadisiyah on two species of Iraqi wild birds, the laughing dove and the collared dove. Different areas in the city of Diwaniyah / southern Iraq. The birds were anesthetized before autopsy with chloroform.

**Anatomical study:**

The weight and length of the birds were taken before they were anesthetized. Then the birds were anesthetized and dissected by making an abdominal incision to extract the gland and clarify its relationship with near organs. The imaging was done using a digital camera. The lengths and widths of the gland were measured and the total weight of the gland was calculated using a sensitive electric balance (Kazim and his group.(1990). As for the histological study, after the birds were sacrificed, the thyroid glands were taken and placed in a dilute formalin solution at a concentration of (10%) until the histological study was conducted. Figure (2) shows the location of the thyroid gland in the collared dove and the location of the thyroid gland in the laughing dove.

(a)The location of the thyroid gland in the collared dove  
(b)The location of the thyroid gland in the laughing dove
Histological study:

Histological sections were prepared according to the method (Bancroft et al., 1996).

Histological examinations:

The diameter of the thyroid vesicles and the thickness of the lining epithelium were measured using an Ocularmicromete with a power of x40. 10 sections were examined, then the general average was calculated to extract the average diameter of the thyroid vesicles and the thickness of the lining layer for each species of bird in the study.

Statistical analysis:

Results were subjected to statistical analysis in order to find out the differences by using the T-test. The significant differences were determined at the 5% probability level (Al-Rawi and Khalaf Allah, 2000).

Results and discussion:

The laughing dove and the collared dove are among the local Iraqi wild birds that live near homes, farms and forests, and they tolerate the changing Iraqi climate, which is hot, dry in summer and cold and humid in winter. Therefore, the current study was conducted on the thyroid gland to find out part of the adaptation of these birds to the Iraqi climate. The results of the anatomical study of both species of laughing and collared doves showed that the thyroid glands of birds are double, oval in shape, located in a ventrolateral position in the back of the neck, and occur on both sides of the trachea in close proximity to the carotid arteries and jugular veins. At the level at which the common carotid arteries divide to extrude the anterior cervical and vertebral arteries and the thyroid gland is surrounded by a capsule of connective tissue (Whittow, 2000) Figure (1).

The results also showed that the average length of the laughing dove was (26.68 ± 1.39) cm and the body weight was (94.74 ± 5.54) g, while the average body length of the collared dove was (28.74 ± 1.28) cm, and the body weight was (148.3 ± 14.13) g in winter. The results of the statistical analysis showed that there was a significant difference between the length and weight of the collared dove compared with the laughing dove, according to the table (Table 4-1).
These results are in agreement with the findings of Abd Rabou et al., (2019), where he explained that the collared dove was larger than the laughing dove and the Turtle Dove dove. The diversity of traits is mostly due to the contribution of geographical location as well as the main migration routes (UNEP, 2003).

Where (Havlíček et al., 2021) found in a similar research that this discrepancy between bird species reflects the possible variation in their functional roles, feeding habits and the pattern of resource use in addition to the presence of insects and feeding birds on them (Mahabal, 2005; Thakur et al., 2010).

Table 4-1 shows the demographic indicators (body weight and length) of the laughing and collared dove

<table>
<thead>
<tr>
<th>Species of dove</th>
<th>Sample weight</th>
<th>length of dove</th>
</tr>
</thead>
<tbody>
<tr>
<td>laughing dove</td>
<td>94.74±5.54A</td>
<td>26.68±1.39A</td>
</tr>
<tr>
<td>collared dove</td>
<td>148.3±14.13B</td>
<td>28.74±1.28B</td>
</tr>
<tr>
<td>T test</td>
<td>10.648</td>
<td>3.314</td>
</tr>
<tr>
<td>P value</td>
<td>0</td>
<td>0.004</td>
</tr>
</tbody>
</table>

On the other side Thyroid indicators showed that the average weight, length and width of the right thyroid gland in the laughing dove were (0.030 ± 0.02) g, (0.424 ± 0.02) cm, (0.283 ± 0.02) cm, respectively. The average weight of the right thyroid gland was (0.044 ± 0.05) gm, its length was (0.470 ± 0.02) cm, and its width was (0.320 ± 0.04) cm in the collared dove, as shown in the data (Table 4-2). The average weight, length and width of the left thyroid gland in the laughing dove were (0.30 ± 0.02 g, 0.504 ± 0.03 cm, 0.305 ± 0.01 cm) respectively. The average weight of the left thyroid gland was (0.011 ± 0.004 g, length (0.504 ± 0.03) cm, and width (0.305 ± 0.01) cm in the collared dove.

There was a significant difference (P<0.05) between the weight ratio of the left thyroid between both species of doves. It increased in the laughing dove to (0.032 ± 0.007), while it decreased in the surrounded dove to (0.007 ± 0.003) as shown in the data (Table 4-3).
This is an indication of adaptation and adaptation. This is consistent with (McNabb and Darras, 2015), who proved in his study that the thyroid gland is affected by environmental factors, including the effect of temperature change on the function of the thyroid gland, including the secretion of hormones. Big and small also during the winter. (Beyzai and Adibmoradi, 2011).

Table 4-2 shows the average weight, length and width of the right thyroid in the laughing and collared dove

<table>
<thead>
<tr>
<th>Species of dove</th>
<th>weight right thyroid</th>
<th>length right thyroid</th>
<th>width right thyroid</th>
<th>average weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>laughing dove</td>
<td>0.030±0.02A</td>
<td>0.424±0.02A</td>
<td>0.283±0.02A</td>
<td>0.042±0.03A</td>
</tr>
<tr>
<td>collared dove</td>
<td>0.044±0.05A</td>
<td>0.470±0.02B</td>
<td>0.320±0.04B</td>
<td>0.029±0.03A</td>
</tr>
<tr>
<td>T test</td>
<td>0.742</td>
<td>3.582</td>
<td>2.271</td>
<td>0.782</td>
</tr>
<tr>
<td>P value</td>
<td>0.468</td>
<td>0.002</td>
<td>0.036</td>
<td>0.445</td>
</tr>
</tbody>
</table>

Table 4-3 shows the average weight, length and width of the left thyroid in the laughing and collared dove

<table>
<thead>
<tr>
<th>Species of dove</th>
<th>weight left thyroid</th>
<th>length left thyroid</th>
<th>width left thyroid</th>
<th>average weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>laughing dove</td>
<td>0.30±0.02A</td>
<td>0.477±0.04A</td>
<td>0.28±0.03A</td>
<td>0.032±0.007A</td>
</tr>
<tr>
<td>collared dove</td>
<td>0.011±0.004A</td>
<td>0.504±0.03A</td>
<td>0.305±0.01A</td>
<td>0.007±0.003B</td>
</tr>
<tr>
<td>T test</td>
<td>2.072</td>
<td>1.805</td>
<td>2.044</td>
<td>2.677</td>
</tr>
<tr>
<td>P value</td>
<td>0.070</td>
<td>0.089</td>
<td>0.057</td>
<td>0.016</td>
</tr>
</tbody>
</table>
Histological study:

The results of the study showed that there was a significant difference (P<0.05) in the mean diameter of large vesicles between the two species of laughing and collared doves, where the average diameter of large vesicles in the laughing dove was (6.70 ± 1.31), while its diameter in the surrounded dove was (5.47 ± 1.16). As shown in Table (4-7).

While there is no significant significance for the average diameter of the medium and small vesicles between both species of doves, where the average values were (3.54 ± 0.69 and 1.50 ± 0.45), respectively, for the laughing dove, while the diameter of the medium vesicles was (3.36 ± 0.79) and the diameter of the small vesicles (1.31 ± 0.37). For the collared dove as shown in the table (Table 4-4)

Table 4-4 shows the average diameter of thyroid gland vesicles in the laughing and collared dove

<table>
<thead>
<tr>
<th>Species of dove</th>
<th>diameter of large vesicles</th>
<th>diameter of medium vesicles</th>
<th>diameter of small vesicles</th>
</tr>
</thead>
<tbody>
<tr>
<td>laughing doves</td>
<td>6.70±1.31A</td>
<td>3.54±0.69A</td>
<td>1.50±0.45A</td>
</tr>
<tr>
<td>collared dove</td>
<td>5.47±1.16B</td>
<td>3.36±0.79A</td>
<td>1.31±0.37A</td>
</tr>
<tr>
<td>T test</td>
<td>3.381</td>
<td>0.863</td>
<td>1.533</td>
</tr>
<tr>
<td>P value</td>
<td>0.001</td>
<td>0.392</td>
<td>0.132</td>
</tr>
</tbody>
</table>

Where the researchers (beyzai and abidmoradi,2011) confirmed, in their study of the changes in the thyroid gland of ostriches during the summer and winter seasons, that the average diameter of large vesicles in ostriches in winter was 122.98 ± 0.35, while the average diameter of small vesicles was 0.22 ± 56.37. Large and small was higher in the thyroid gland of ostriches in winter.

In the winter, when the thyroid is active, the colloidal substance is abundant and the interstitial spaces are few due to the large size of the vesicles . The species of cells lining the vesicles are mostly columnar, and the surrounding capsule is thin and contains a few bubbles.
On the other side, the statistical results showed that the average thickness of the mean vesicles did not show significant differences between the two species of doves in the winter season, as it amounted to (0.25 ± 0) for the laughing dove and (0.16 ± 0.24) for the collared dove, as shown by the data of Table (4-8).

While there was significant significance (P < 0.05) for the mean thickness of large and small vesicles, where the mean thickness of the laughing dove was (0.48 ± 0.09 and 0.07 ± 0.02), respectively, while the mean thickness of the dove surrounded by large vesicles was (0.34 ± 0.13) and the thickness of small vesicles(0.03±0.01).

As (Vishen et al., 2021) indicated in his study of the thyroid gland in chickens during the winter and summer seasons, it was found that the average thickness of the vesicles rises significantly in the winter season, due to the thickness of the epithelium lining the active vesicles is higher in the winter, and this increase in the lining epithelium indicates In the winter, the thyroid gland was more active during the winter.

Table 4-5 shows the average thickness of thyroid gland vesicles in the laughing and collared dove

<table>
<thead>
<tr>
<th>Species of dove</th>
<th>thickness of large vesicles</th>
<th>thickness of medium vesicles</th>
<th>thickness of small vesicles</th>
</tr>
</thead>
<tbody>
<tr>
<td>laughing dove</td>
<td>0.48±0.09A</td>
<td>0.25±0A</td>
<td>0.07±0.02A</td>
</tr>
<tr>
<td>collared dove</td>
<td>0.34±0.13B</td>
<td>0.16±0.24A</td>
<td>0.03±0.01B</td>
</tr>
<tr>
<td>T test</td>
<td>4.066</td>
<td>1.514</td>
<td>6.170</td>
</tr>
<tr>
<td>P value</td>
<td>0</td>
<td>0.146</td>
<td>0</td>
</tr>
</tbody>
</table>

Similar letters indicate that there are no significant differences at the 5% level of significance.

The different letters indicate a significant difference at the 5% significance level.
Figure (3) shows a section of thyroid tissue in a laughing dove. (A) Connective tissue surrounding the thyroid gland (B) Epithelial tissue surrounding the thyroid gland (C) Some smooth muscle fibers (D) Colloidal substance inside the alveoli (E) Represents the capsule that Surrounding the thyroid gland (F) cells lining the thyroid follicles (40 x Masson's trichrom)

Figure (4) section of thyroid tissue in the collared dove. (A) Connective tissue surrounding the thyroid gland (B) Epithelial tissue surrounding the thyroid gland (C) Some smooth muscle cells (D) Colloid inside the alveoli (E) Represents the enclosing capsule Thyroid gland (F) cells lining the thyroid follicles (40 x Masson's trichrom)
Figure (5) Section of thyroid tissue in laughing dove (A) Large follicles (B) Medium follicles (C) Small follicles (D) Colloid (E) represents the columnar cells lining the follicles (H & E X 40)

Figure (6) section of thyroid tissue in a laughing dove (A) blood vessel (B) large follicles (C) medium follicles (D) small follicles enlargement (10 X Masson’s trichrom)
Figure 7 shows a section of thyroid tissue in a laughing dove using Mason's stain (A) Large follicles (B) Medium follicle (C) Small follicle (D) Colloid (40 X Masson’s trichrom).

Figure (8) A section of thyroid tissue in the collared dove (A) Large follicles (B) Medium follicles (C) Small follicles (D) Colloid (E) represents the cubic cells lining the follicles (40H & E X).
Figure (9) shows a section of thyroid tissue in the collared dove (A) blood vessel (B) filled follicles (C) empty follicles (4 X Masson’s trichrom)

Figure 10 shows a section of thyroid tissue in the **collared** dove using Mason’s stain (A) Large follicles (B) Medium follicle (C) Small follicle (40 X Masson’s trichrom)
Physiological study:

Thyroid hormones are the main regulator of endocrine glands to generate heat and can increase energy consumption and stimulate basic thermogenesis by reducing the efficiency of metabolic activity (Yen, 2001).

In a close study on seasonal differences and their effect on metabolism in birds, it was found that the concentration of T3 in the plasma of birds increased during the winter season (Zheng et al., 2014).

The results of the current study showed a significant difference in the level of T3 hormone, as it reached (1.50 ± 0.28) nmol/L in the laughing dove compared with (1.16 ± 0.23) nmol/L in the laughing dove, with a significant significance (P < 0.05) during the winter season. While the results did not show significant differences in the level of thyroid hormone T4, which amounted to (6.42 ± 1.69) nmol / l in the laughing dove and it was (7.87 ± 2.02) nmol / liter in the surrounded dove, as shown in Table (4-11). This result agreed with (Li et al., 2010; Zheng et al., 2010), where it was found that the levels of thyroid hormones differ according to latitude and season, and the Eurasian tree sparrows dealt mainly with the cold by enhancing thermal capabilities by increasing activity of respiratory enzymes and an increase in the level of thyroid hormones in plasma, The winter birds also have a higher level of 3T than the summer birds (Jenni-Eiermann et al., 2002).

Perhaps this indicates that the laughing dove is more adapted to cold weather than the collared dove.

Table 4-6 shows the level of thyroid hormones for the laughing and collared dove.

<table>
<thead>
<tr>
<th>Species of dove</th>
<th>T3</th>
<th>T4</th>
</tr>
</thead>
<tbody>
<tr>
<td>laughing doves</td>
<td>1.50±0.28A</td>
<td>6.42±1.69A</td>
</tr>
<tr>
<td>Collared doves</td>
<td>1.16±0.23B</td>
<td>7.87±2.02A</td>
</tr>
<tr>
<td>T test</td>
<td>2.990</td>
<td>1.861</td>
</tr>
<tr>
<td>P value</td>
<td>0.008</td>
<td>0.078</td>
</tr>
</tbody>
</table>
On the other side, the results showed that there were significant (P<0.05) differences in the level of liver enzymes AST (266.2±22.65) IU/L and ALT (27.64±4.21) IU/L in the collared dove compared with the AST laughing dove (241.27±14.04) IU/L and ALT (20.45±3.29) IU/L as shown in Table (12-4).

These results are in agreement with what was stated in a previous study on the level of liver enzymes in laughing doves and collared doves during winter and summer (Al-Obaidi and Al-Shadeedi, 2011), where it was found that there are significant differences in the level of enzyme values between the two species of doves included in the study. The activity of these enzymes also depends on the species, age, sex and function of the animal, in addition to the stage of reproduction and nutrition (Bouda et al., 1980), and it is a species of enzyme that helps activate chemical reactions in the body and is found mainly in the blood and is also found in some tissues of the body, especially the heart. The liver is affected by the temperature surrounding the animal’s body (Al-Obaidi and Al-Shadeedi, 2011).

Table 4-7 shows the level of liver enzymes for the laughing and collared dove.

<table>
<thead>
<tr>
<th>Species of dove</th>
<th>AST</th>
<th>ALT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laughing doves</td>
<td>241.27±14.04A</td>
<td>20.45±3.29A</td>
</tr>
<tr>
<td>Collared doves</td>
<td>266.2±22.65B</td>
<td>27.64±4.21B</td>
</tr>
<tr>
<td>T test</td>
<td>3.063</td>
<td>4.376</td>
</tr>
<tr>
<td>P value</td>
<td>0.006</td>
<td>0</td>
</tr>
</tbody>
</table>
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