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Determine the weight of thymus, bursa of Fabricius and spleen and its ratio to body weight in some diseases of broilers

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Abstract

Evaluation of lymphoid organs weight and determination of their weight: body weight ratio is the most used model to estimate protection rate given by vaccines against some diseases. This study designed to provide a generic look at the chicken lymphoid system through the use of thymus, bursa of Fabricius and spleen indices in an attempt to access further clarify or to give a tentative diagnosis for confirming final diagnosis of poultry diseases. Results indicated that recognizable difference ($p < 0.05$) in bursa of Fabricius and spleen indices in infectious bursal disease (IBD) and mycotoxicosis in compared to the control. The bursa of Fabricius / bodyweight ratio in IBD and mycotoxicosis -infected chickens were significantly lower compared to the uninfected control. There were no significant difference ($p > 0.05$) between the thymus, bursa of Fabricius and spleen indices of the infectious bronchitis (IB), chronic respiratory disease (CRD) and coccidiosis compared to the uninfected control. In conclusion the morphometric diagnosis of the thymus, bursa of Fabricius and spleen, gain good information on the process of disease diagnosis in case of IBD and mycotoxicosis.

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Introduction

The production of meat-type poultry has greatly expanded over the past several decades (Windhorst, 2006). The primary focus of the commercial broiler industry is to maximize profits by promoting maximal yield and maintaining the health of the bird (Reisinger *et al.*, 2011). One of the main expenses faced by the industry is loss

associated with poultry diseases, including costs of vaccination, prevention, treatment, reduction in weight gains, and mortality.

Temporary or permanent dysfunction of the immune response, resulting from insult to the immune system and leading to increased susceptibility to disease (Dohms and saif, 1984).

Understanding the physiology and immunology of the lymphoid system is handicapped without knowledge of its basic structure. Immunologically mature cells enter the circulation and colonize the peripheral lymphoid organs: spleen, lymph node and gut-, bronchus- and skin-associated lymphoid tissues. Secondary lymphoid organs, unlike the thymus and bursa, are not sites for antigen-independent differentiation and lymphocyte proliferation (Ciriaco *et al.,* 2003).

Over the years, many have investigated the function (s) of the bursa of Fabricius including antibody production (Glick *et al.,* 1956). The bursa of Fabricius is critical for normal development of the B lymphocytes responsible for antibody production. The bursa is unique to birds and was first implicated as having a role in the development, or generation, of antibody responses (Glick *et al.,* 1956; Ratcliffe, 2006). Seal *et al.,* (2000) reported regressive changes found in the lymphopoetic system as time advanced, also a focal vacuolation and destruction of lymphocytes in the cortical areas and germinal centers of the spleen and thymus following pathogen infection in chickens. Marked degeneration of the medullary region was reported in the bursa. The adult avian spleen has been characterized as predominantly a lymphocyte producing and an erythrocyte-destroying organ (Ahmad *et al.,* 2007).

The objective of this study to be determined, under this assumption, the relative difference of each disease for the chosen evaluation endpoints (a change in organ somatic index), to access the basic information helps the practitioner for better diseases diagnosis.

Material and Methods

Data were collected from 100 broilers cases their age around 4 weeks which were a worded to the faculty of veterinary medicine, university of Baghdad and Group Office – Al- Sink- Baghdad were considered for this study. Diseases were diagnosed based on flock history, clinical signs, post–mortem findings and microscopic appearance. However, some of the cases were confirmed by laboratory analysis of enzyme linkages immunosorbent assay (ELISA) and the data were subjected in tables. This study was approved by the ethical and research committee of Veterinary Medicine College/University of Baghdad.

Thymus, bursa, spleen weight and body weight indices

Before being sacrificed the body weight (g) were evaluated for each individual and 5 birds from each group were killed by cervical dislocation, following a thorough visual appraisal, the thymus, bursa and spleen were immediately removed, dry and individually weighed (g) for each individual and the ratio of thymus, bursa, spleen

weight: body weight (%) was calculated. The results were expressed for each experimental group as the arithmetic mean and standard deviation (Heckert *et al* 2002).

$$\text{Where, thymus: body weight ratio} = \frac{\text{Thymus weight in grams}}{\text{Body weight in grams}} \times 100$$

$$\text{Bursa: body weight ratio} = \frac{\text{Bursa weight in grams}}{\text{Body weight in grams}} \times 100$$

$$\text{Spleen: body weight ratio} = \frac{\text{Spleen weight in grams}}{\text{Body weight in grams}} \times 100$$

Results

The values of the body weight, thymus, bursa and spleen weight and indices of IBD, IB, CRD, Coccidiosis and mycotoxicosis were summarize as the mean ±SD for each organ within each disease illustrated in Table 1, 2 and 3 respectively. The Results of the present study revealed that there is no significant difference ($P > 0.05$) in the body weight of all diseases in compare with control Table 1. On the other hand, the thymus weight and index showed significant difference ($P < 0.05$) only in the mycotoxicosis compare with other cases and control. The thymus / bodyweight ratio in the mycotoxicosis -infected chickens was significantly lower.

Table (1). The body weight, thymic weight and index (mean ± SD) of broiler groups

Body weight	Thymic weight	Thymic index	Disease
712±49[a]	2.560±0.148[a]	0.390±0.040[a]	IBD
700±59[a]	2.644±0.210[a]	0.385±0.037[a]	IB
670±51[a]	2.588±0.153[a]	0.412±0.039[a]	CRD
688±35[a]	2.538±0.153[a]	0.392±0.042[a]	Coccidiosis
730±69[a]	2.004±0.139[b]	0.276±0.051[b]	Mycotoxicosis
741±58[a]	2.725±0.165[a]	0.401±0.028[a]	Control

[a, b] Values bearing similar superscript between column do not differ at ($P < 0.05$)

No significant difference was observed in bursa weight of any cases **(**Table 2). At this instance a significant difference in the bursa index of mycotoxicosis in compared to the others group. The bursa of Fabricius / bodyweight ratio in the mycotoxicosis -infected chickens was significantly lower ($P < 0.05$).

Table (2). The body weight, bursa weight and index (mean ± SD) of broiler groups

Body weight	Bursa weight	Bursa index	Disease
712±49[a]	1.666±0.082[a]	0.218±0.038[ab]	IBD
700±59[a]	1.766±0.048[a]	0.255±0.019[a]	IB
670±51[a]	1.404±0.053[a]	0.210±0.029[ab]	CRD
688±35[a]	1.626±0.077[a]	0.259±0.017[a]	Coccidiosis
730±69[a]	1.216±0.204[a]	0.166±0.023[b]	Mycotoxicosis
741±58[a]	1.719±0.087[a]	0.203±0.034[ab]	Control

[a, b] Values bearing similar superscript between column do not differ at ($P < 0.05$)

Similarly, a significant difference ($P < 0.05$) in the weight and indices of spleen of IBD and mycotoxicosis in compared to the IB, CRD, coccidiosis and uninfected control group. The spleen / bodyweight ratio in IBD and mycotoxicosis -infected chickens were significantly lower compared to the other groups. There were no significant difference ($P > 0.05$) between the bursa of Fabricius and spleen indices of the IB, CRD and Enteritis compared to the control (Table 3).

Table (3). The body weight, spleen weight and index (mean ± SD) of broiler groups

Body weight	Spleen weight	Spleen index	Disease
712±49[a]	0.836±0.037[b]	0.115±0.007[bc]	IBD
700±59[a]	0.940±0.055[a]	0.142±0.010[a]	IB
670±51[a]	0.872±0.056[ab]	0.133±0.010[ab]	CRD
688±35[a]	0.964±0.064[a]	0.140±0.015[a]	Coccidiosis
730±69[a]	0.750±0.030[c]	0.104±0.011[c]	Mycotoxicosis
741±58[a]	0.958±0.050[a]	0.129±0.012[ab]	Control

[a, b, c] Values bearing similar superscript between column do not differ at ($P < 0.05$)

Discussion

The lymphoid organ data indicate that the growth of both primary and secondary lymphoid organs was depressed significantly ($P < 0.05$). The thymus and bursa of Fabricius are unique primary lymphoid organs, which plays an important role in T and B cell development and generation of the cellular and immunoglobulin repertoire (Cooper *et al.*, 1966; Boehm and Bleul, 2007). So, any alterations in the development of these organs in response to possible lymphotrophic agents will result in altered immunological functions associated with both B and T lymphocytes.

Evaluation of bursa weight and determination of bursa weight: body weight ratio is the most used model to estimate protection rate given by vaccines against IBD. Also, the contribution of the avian spleen to the immune system as a whole may be more important than in mammals because of the poorly developed avian lymphatic vessels and nodes. The structure of bursa of Fabricius is related to normal humoral immune function in chick. However, the somatic indices of bursa and spleen are not difficult to assess and are indicative of potential gross or biochemical abnormalities that can affect the health and long-term viability of the individuals within the affected population.

In the present study, the thymus, bursa and spleen weight: body weight ratio were used in an attempt to further clarify the diseases diagnosis. The result showed that, the relative weight of bursa and spleen in IBD and Mycotoxicosis groups respectively were significantly decrease in size, it was indicative of bursal and spleen atrophy (FAO 1997). According to Mc Ferran, (1997), this score would be related to chronic or sub-acute bursal infection because not all lymphoid follicles were injured. The presence of some bursa alteration with such characteristics suggests that there was influence of the residual passive immunity in the propagation. Likewise, the significantly decreased of spleen index, which is the secondary immune lymphoid organ. Findings in this study reinforced the importance of avian spleen in antibody production (John, 1994) has affected antibody production.
It was found that the lymphoid organ indices are useful indicators of toxicant effect (Sellers *et al.,* 2007) and on the ability of the animals to tolerate the toxicant stressors (Eerola *et al.,* 1987) or provide lymphoid cells during an immune response (Heckert *et al.,* 2002). Such discrepancy has led to a lower lymphoid index and it's associated with lesions indicative of IBD and mycotoxicosis diseases. Alternatively, such decrement of organ indices was attributed to atrophy of organs leading to a much smaller size and thus their ratios as seen in the IBD and mycotoxicosis group (Sur and Celik, 2003; Lavoie and Grasman, 2007).

The findings of this study were consistent with previous studies, which reported that the bursa of IBD and mycotoxicosis in chicken was characterized by lymphocyte depletion and reticuloendothelial cell proliferation. Also, the high degree of spleen atrophy is a common finding, a sign of the immunosuppressive effect of mycotoxins.
In conclusion, this study approved that the reduction in the weight and indices of the lymphoid organs, achieve good information on the process of disease diagnosis mainly in case of IBD and mycotoxicosis.

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