

PREVALENCE OF COCCIDIA INFECTION AMONG DOMESTIC PIGEON (*COLUMBA LIVIA DOMESTICA*) AND QUAILS (*COTURNIX YPSILOPHORA*) IN QENA PROVINCE, SOUTHERN EGYPT

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ABSTRACT

Coccidiosis, caused by species of the apicomplexan parasite Eimeria, is a major disease of pigeons and to quails. Therefore, the present study was conducted to detect the prevalence and identify the species of Eimeria causing coccidiosis in both pigeons and quails in Qena province, Southern Egypt. In the current study, three hundred and sixty fecal samples of each species were collected and screened for Eimeria infection by floatation technique from November 2017 to October 2018. The results of the current study revealed an overall prevalence of 56%, with a higher infection rate in pigeon (58.3%) in comparison to quails (53.9%). Additionally, squabs had the highest prevalence (72.8%) as compared to adults (37.3), whereas the higher prevalence of Eimeria was observed in male birds in both species. Peak prevalence was observed in Autumn and Winter for pigeon and quails respectively. The results also, showed that more than one Eimeria species existed in most fecal samples, and the infection rate of identified Eimeria spp. in these samples was Eimeria labbeana (37.2%), E. columbae (30.8%), E. columbarum (27.9%) and E. gourai (4%) respectively. On the other hand, common Eimeria spp. found in quails were E. tsunoda (51.3%), E. uzura (28%) and E. bateri

(20.5%). This indicates that *Eimeria* species are the predominant species in Qena Province. Histopathology also revealed a developmental stage of the parasite in the intestinal tract and desquamation of the epithelial lining with areas of necrosis. In conclusion, this study provides basic information on the first detection of coccidiosis of pigeons and quails in Qena Province, Egypt, which has an implication on the sustainable birds' production for human protein requirement.

Key words: Egypt; pigeons; quails; Coccidiosis, prevalence, significant

INTRODUCTION

Pigeons are ubiquitous birds and can be found in virtually every town and city around the Globe (*Marques et al., 2007*). They live side by side with human as a source of food, hobby and experimental purposes (*Sari et al., 2008*). While, the brown quail is a poultry species raised for eggs and meat in both home and commercial farms. It is characterized by fast body weight gains and a short rearing period until egg production (6-7 weeks).

In Upper Egypt, the domestic pigeon (*Columba livia domestica*) and Quails are reared for meat production by some households, thereby contributing significantly to the protein need of the local population.

Avian coccidiosis is a disease caused by *Eimeria* species and considered as one of the most extensive and common disease in spite of advances in chemotherapy, management, nutrition and genetics (*Mcdougald and Raid, 1991*). It causes not only economically important changes such as impaired growth, poor food utilization and depigmentation but can also produce change in the metabolism, tissue composition and dietary requirement, all of which impact adversely on poultry production (*Allen, 1986*).

Previous studies have detailed the existence of coccidiosis worldwide and in some parts of Egypt (*El-Madawy, 2001 and Al Nasr,2011*). However, there is paucity of information regarding coccidiosis in domestic pigeons and Quails in Upper Egypt particularly, Qena province. Therefore, the present study was conducted to declare the prevalence and the seasonal dynamic of coccidiosis in pigeons and quails in Qena Province. Also, to identify the risk factors associated with its occurrence.

MATERIALS AND METHODS

Study area:

The present study was carried out in and around the Qena region located between 26°10'12"N latitude and 32°43'38"E longitude, in the Southern Egypt. The climatic condition of the area has a hot desert climate, with very hot summers and very little precipitation year-round. Winters are warm at days, but become cool at nights.

Sampling and parasitological procedures:

The present investigation was carried out for a period of one year from September 2017 to October 2018, a total of 360 birds (180 from pigeons and 180 from quails) were considered for the present study to assess the prevalence of coccidia infection in examined birds.

About 5-10 g of each sample was collected in separate screw - capped vials with proper labeling (age, sex and weight) and brought to the Parasitology laboratory, Faculty of Veterinary Medicine, South Valley University. The faecal samples thus collected were examined either on the same day or stored in a refrigerator at 4°C for subsequent

screening. The faecal samples were first examined grossly to establish its consistency and presence of mucus, blood etc. Subsequently, standard procedures were followed to determine the presence or absence of coccidia oocysts. Flootation method was used to concentrate the coccidia oocysts using saturated salt solution (as per standard procedure (*Soulsby, 1982*). Furthermore, Faecal samples which were found positive for coccidian oocysts by floatation method were mixed with 2.5% potassium dichromate solution in medium sized petri dishes and left at room temperature (25-27°C) for sporulation of oocysts. Coccidia species were identified according to the size and morphological characteristics of the oocysts (the shape and colour of the oocysts; thickness of the oocyst walls; presence of micropyle, cap, polar granules, oocyst or sporocysts deposits; size and shape of the sporocysts; shape of the Stieda bodies and of sporozoites etc.) and sporulation time. The identification of each species was made with reference to the measurements of 25 oocysts from at least 5 samples. Micrometry of oocyst of different coccidia species was done as per the procedure described by *Sloss et al., (1994)*. Moreover, the identification was done based on available literature (*Levine, 1985 and Norton, 1986*).

RESULTS

Survey results:

In the present investigation, out of 360 samples screened for coccidia, 202 samples were positive with an overall prevalence of 56.1%, of which 58.3% of pigeon(105out of 180) were found to be infected, while 97 quails were found to harbour *Eimeria* oocysts with an overall prevalence of 53.9% as depicted in Table (1).

The same table displayed that the average total oocyst count among pigeon and quails in the present investigation was 15240 and 1760 OPG, respectively.

In pigeon, the present study demonstrated that, *Eimeria* infection was more prevalent in males (76.5%) as compared to females (56.4%). Similarly, young ages (73.3%) appeared to be more frequently infected than adults (44.7%) as shown in Table (2).

Four different *Eimeria* species were identified from pigeon, being *Eimeria labbeana* (37.2%), *E. columbae* (30.8%), *E. columbarum* (27.9%) and *E. gourai* (4%) as illustrated in Figures (1).

Table (4) summarizes the most common morphological features of identified *Eimeria* species infection pigeon.

On the other hand, the higher prevalence of *Eimeria* species infection in quails was recorded in male (57%) as compared to female (53.6%). Likewise, young ages (72.4%) appeared to be more susceptible to infection than adult (28%).

Three species were recorded; include *E. tsunoda* (51.3%), *E. uzura* (28%) and *E. bateri* (20.5%) as illustrated in Figures (2).

Table (5) summarizes the most common morphological features of identified *Eimeria* species infection quail.

The relationship between seasonal dynamics and prevalence of *Eimeria* is presented in Table (3) & Figure (3). From these table, It was found that the highest peak of *Eimeria* infection among pigeon was observed in Autumn (77.8%), whereas the least number of pigeons was found infected with *Eimeria* in Spring (35.6%). On the contrary, the Winter season showed the highest peak (73.3%) in quails, with the lowest prevalence in Summer (22.2%).

Histopathological results:

The pathological changes observed due to coccidian infection in pigeon included different developmental stages of coccidia in enterocytes (Fig.6&7 a, b and c). In addition to, the intestinal tract displayed severe necrosis with sloughing of the intestinal villi (Fig.6&7 d). Also, there are destruction of the intestinal glands (Fig. 6&7 e) with congestion and dilatation in the blood vessels (Fig.6&7 f). Hemorrhage with red blood cells infiltration was also detected.

Table (1): Prevalence and intensity of coccidia among examined birds:

Pigeon			Quail		
No. of examined	No. of infected	%	No. of examined	No. of infected	%
180	105	58.3	180	97	53.9
Intensity of infection (oocyst/gram)					
High rate	Low rate	Average	High rate	Low rate	Average
46000	3400	15240	3600	600	1760

Table (2): Prevalence of coccidia in relation to age and sex of examined birds:

Birds								
	Pigeons				Quails			
	Age		Sex		Age		Sex	
	Adult (<2month)	Young (>2month)	Male	Female	Adult (<2month)	Young (>2month)	Male	Female
No.ofexamined	94	86	17	163	75	105	14	166
No. of infected	42	63	13	92	21	76	8	89
Total %	44.7%	73.3%	76.5%	56.4%	28%	72.4%	57%	52.6%

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Table (3): Seasonal dynamics of coccidia in relation to age and sex of examined birds:

Season		Birds							
		Pigeons				Quails			
		Age		Sex		Age		Sex	
		Adult (<2month)	Young (>2month)	Male	Female	Adult (<2month)	Young (>2month)	Male	Female
autumn	No.of examined	19	26	11	34	15	30	2	43
	infected	13	22	7	28	3	26	2	27
	%	68.4%	84.6%	63%	82%	20%	86.7%	100%	62.7%
winter	No.ofexamined	22	23	-	45	-	45	-	45
	infected	16	18	-	34	-	33	-	33
	%	72.7%	78.2%	-	75.6%	-	75.3%	-	73.3%
spring	No.of examined	26	19	6	39	30	15	12	33
	infected	6	10	6	10	13	12	6	19
	%	23%	52.6%	100%	25.6%	43.3%	80%	50%	57.5%
summer	No.of examined	27	18	-	45	30	15	-	45
	infected	7	13	-	20	5	5	-	10
	%	25.9%	72.2%	-	44.4%	16.7%	33.3%	-	22.2%

Table (4): In pigeons: *Eimeria spp.* oocysts characterization:

Species	Oocyst					Sporocyst		
	Morphology			Measurements (µm)		Measurments(µm)		
	Shape	Wall	Micropyle	Length	Width	Length	Width	Figure
<i>E. labbeana</i>	spherical to subspherical	Double	-	21.5-22.6	16.9- 19.8	10.54-16.68	6.2- 10.6	Fig4, C
<i>E. columbarum</i>	spherical or subspherical	Double	-	19.5	17.2	11.3	5.7	Fig4, D
<i>E. columbae</i>	Subspherical	Double	-	16.35	12.95	9.5	4.9	Fig4, E
<i>E. gourai</i>	spherical to sub-spherical	Double	+	21.7-22.4	21.6 -21.8	12.4-13.5	8.06-8.89	Fig4, F

Table (5): In quails: *Eimeria* spp. oocysts characterization:

Species	Oocyst					Sporocyst			
	Morphology			Measurements (µm)		Shape	Measurements(µm)		
	Shape	Wall	Micropyle	Length	Width		Length	Width	Figure
<i>E.tsunodai</i>	Ovoid	Double	-	19.8	15.76	Ovoidal	9.8	4.58	Fig.5 C
<i>E. uzura</i>	Ovoid, elliptical	Double	+	22.42	20.75	elongated	13.33	5.32	Fig.5 D
<i>E. bateri</i>	Spherical to subspherical	Double	-	16.24	14.62	elongated	9.56	4.95	Fig.5 E

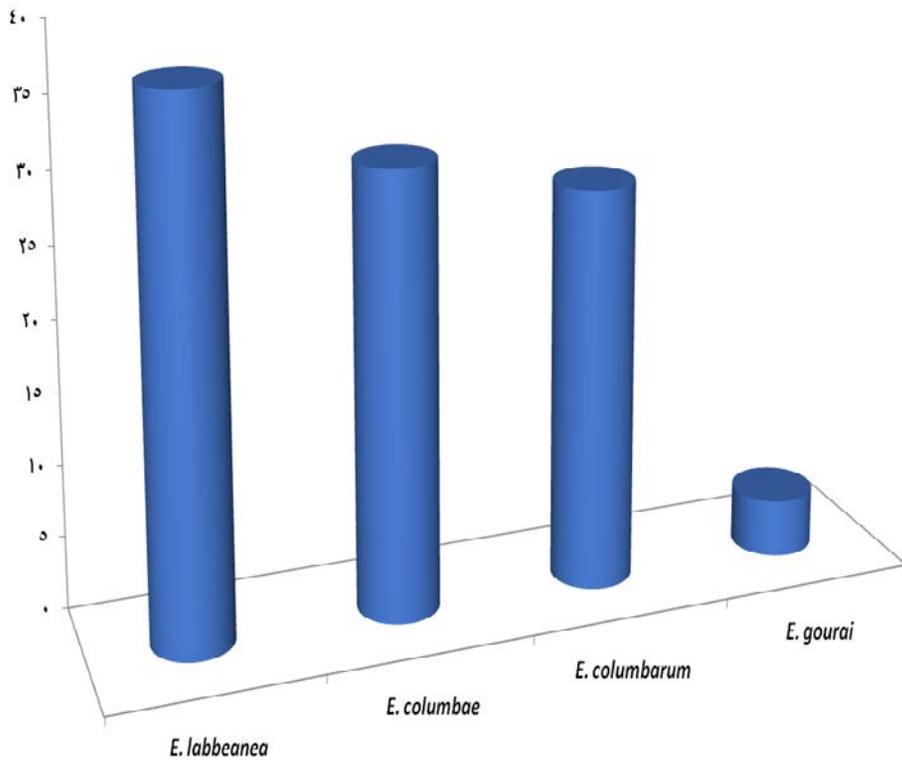


Fig. (1): Prevalence of *Eimeria* species infecting pigeons

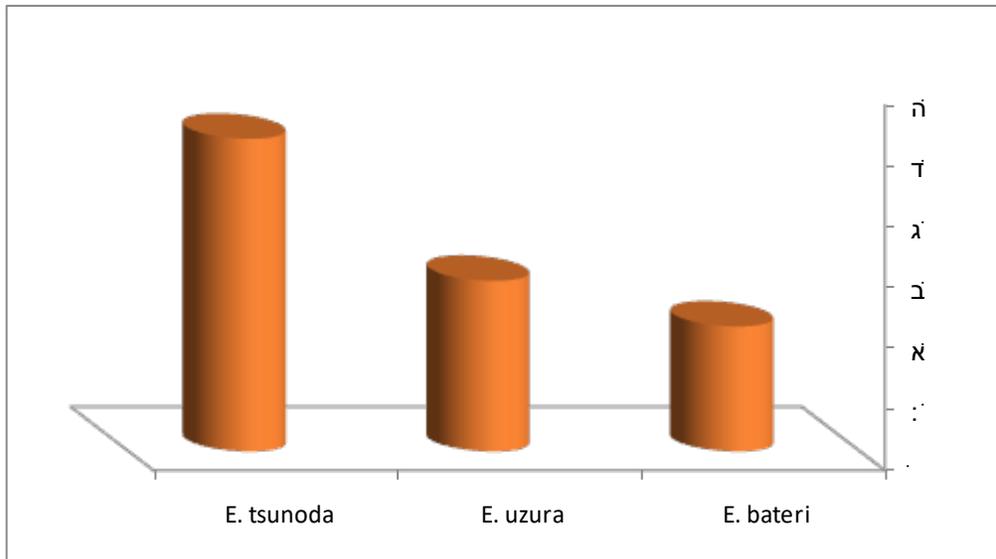


Fig. (2): Prevalence of *Eimeria* species infecting quails

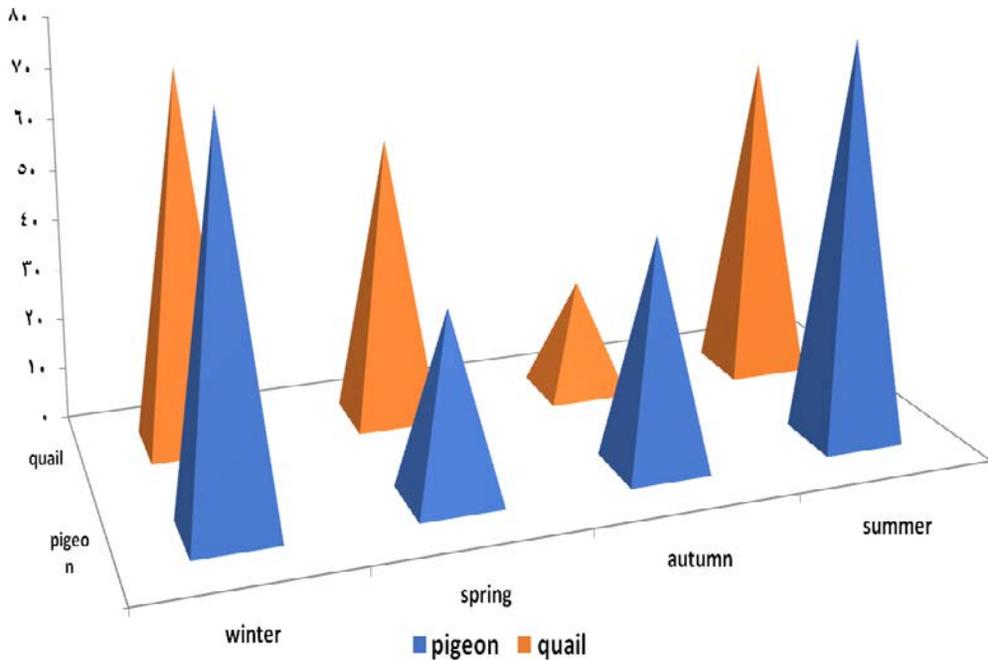


Fig. (3): Seasonal dynamic of *Eimeria* spp. in pigeon and quail

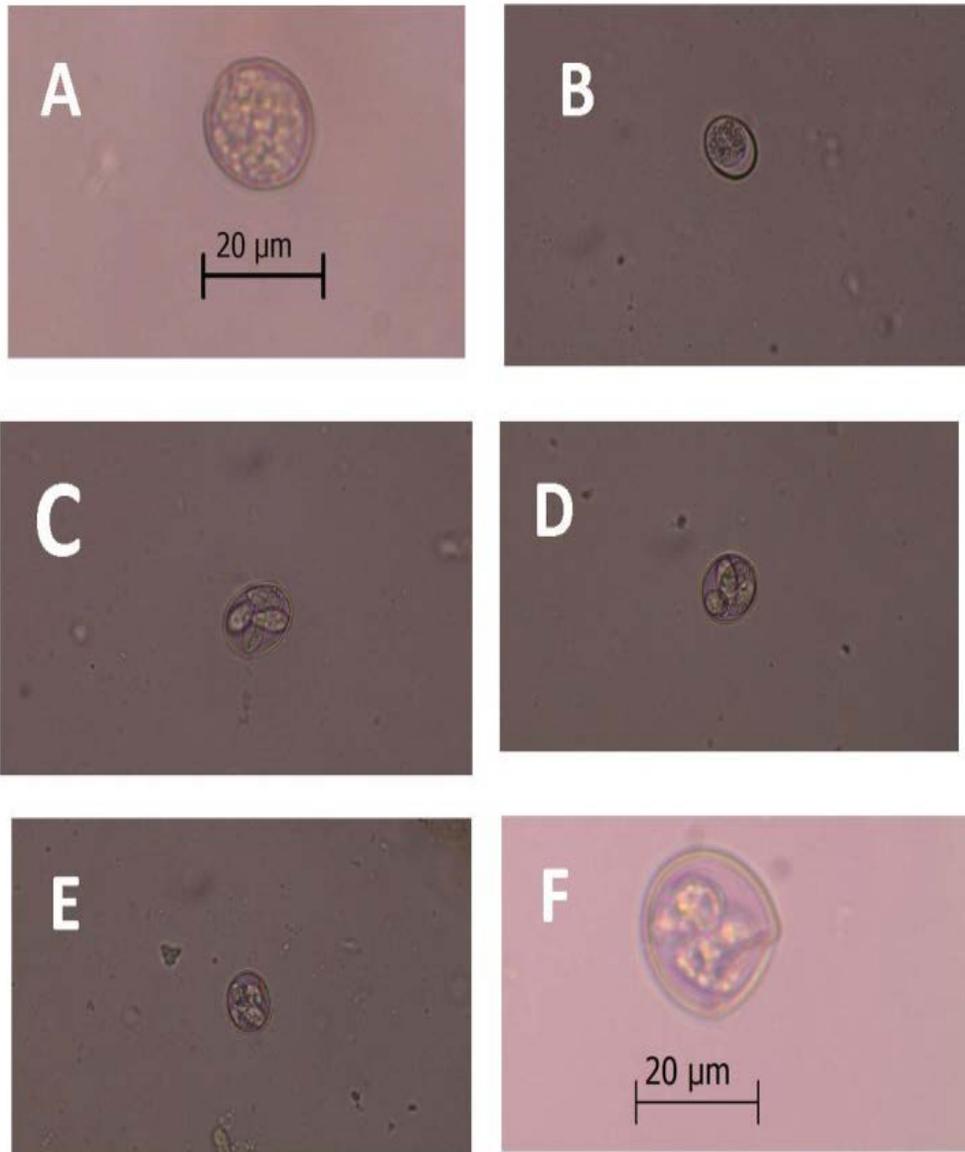


Fig. (4): *Eimeria spp.* oocysts in pigeon, A&B)unsporulated oocyst,C) sporulated oocyst of *Eimeria labbeana*, D) sporulated oocyst of *Eimeria columbarum*, E) sporulated oocyst of *Eimeria columbae*, F) sporulated oocyst of *Eimeria gourai*.

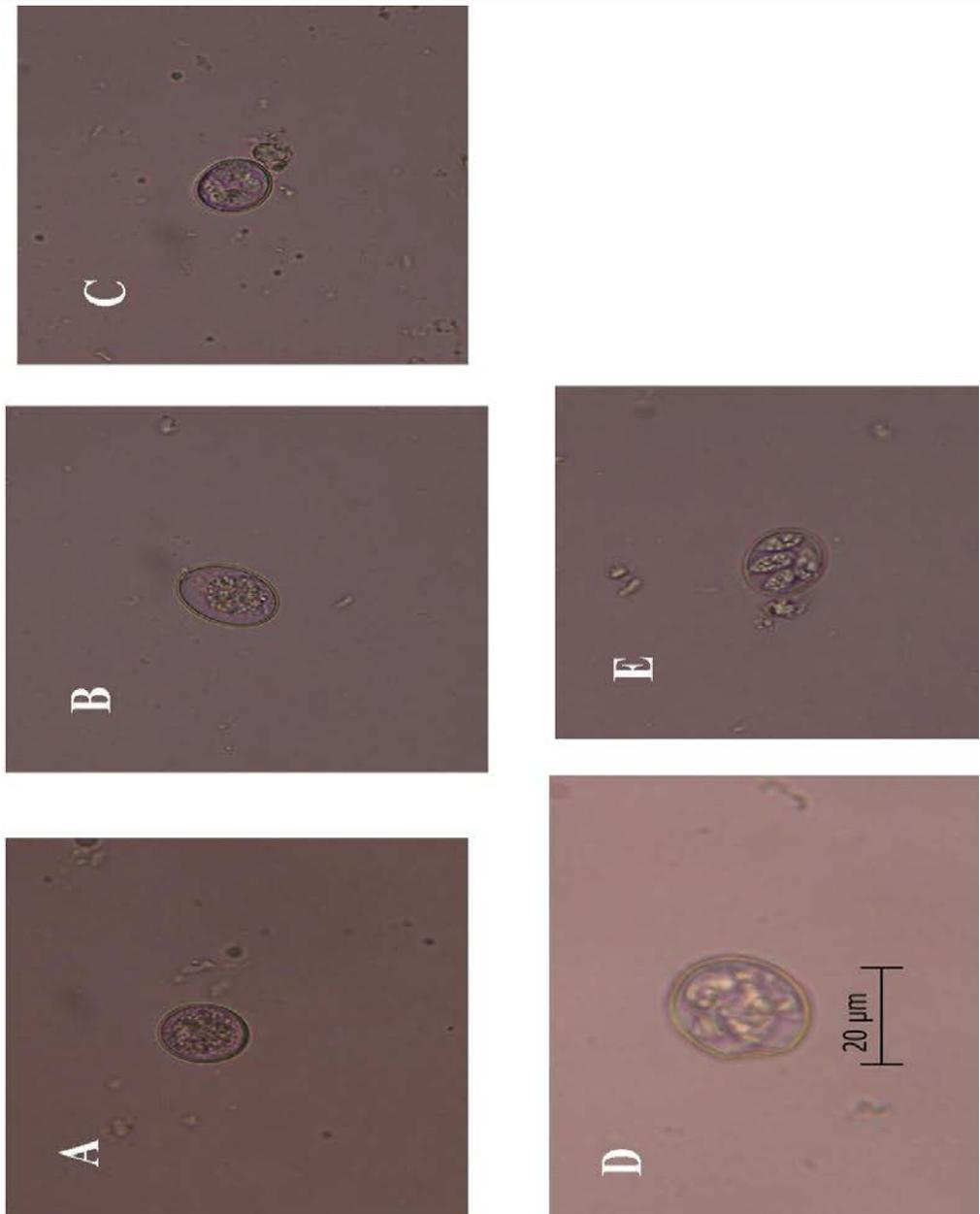


Fig. (5): *Eimeria spp.* oocysts in quail, A&B) unsporulated oocyst, C) sporulated oocyst of *Eimeria tsunoda*, D) sporulated oocyst of *Eimeria uzura*, E) sporulated oocyst of *Eimeria bateri*.

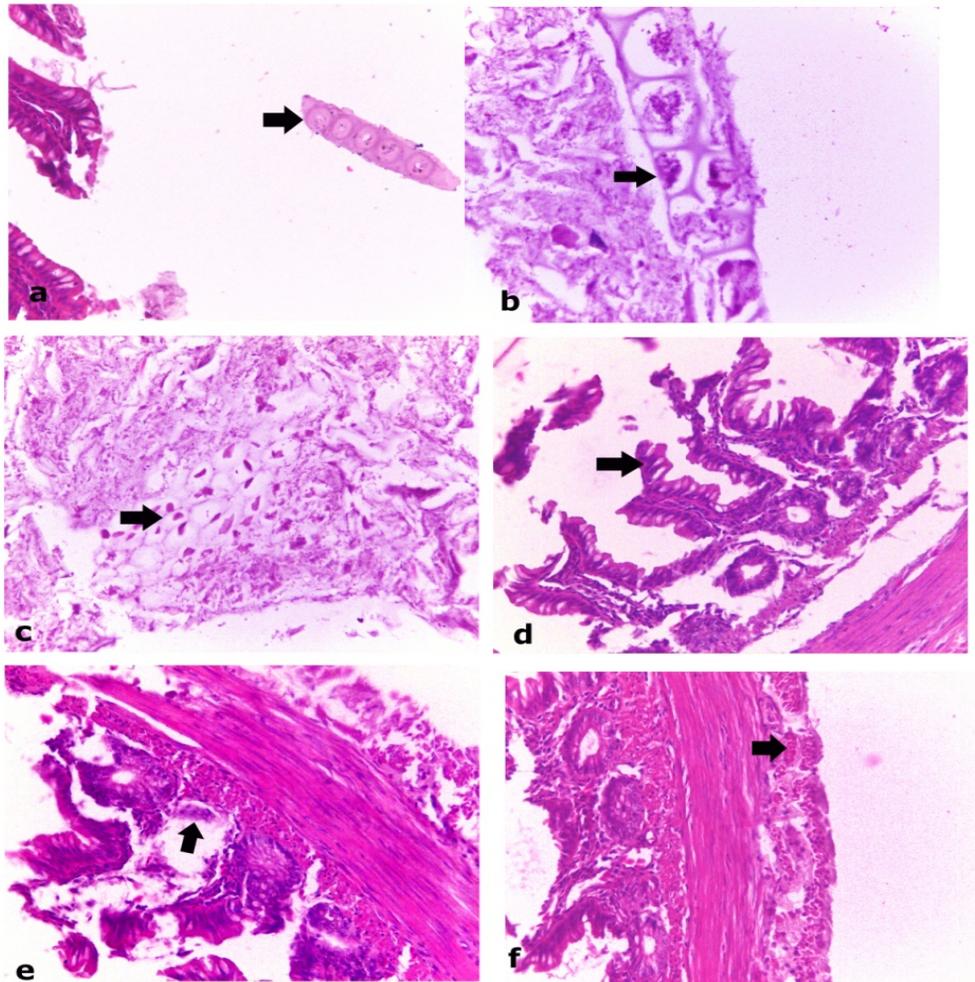


Fig. (6) Pathological effect of *Eimeria* spp., (a-f): Photomicrograph of intestine of pigeon infected with parasitic coccidia showing different developmental stages of *Eimeria* infection(a, b & c), intestine showing severe necrosis with sloughing of the intestinal villi (d), intestine showing destruction of the intestinal glands (e), intestine showing congestion and dilatation in the blood vessels (f). (H&E., X 400).

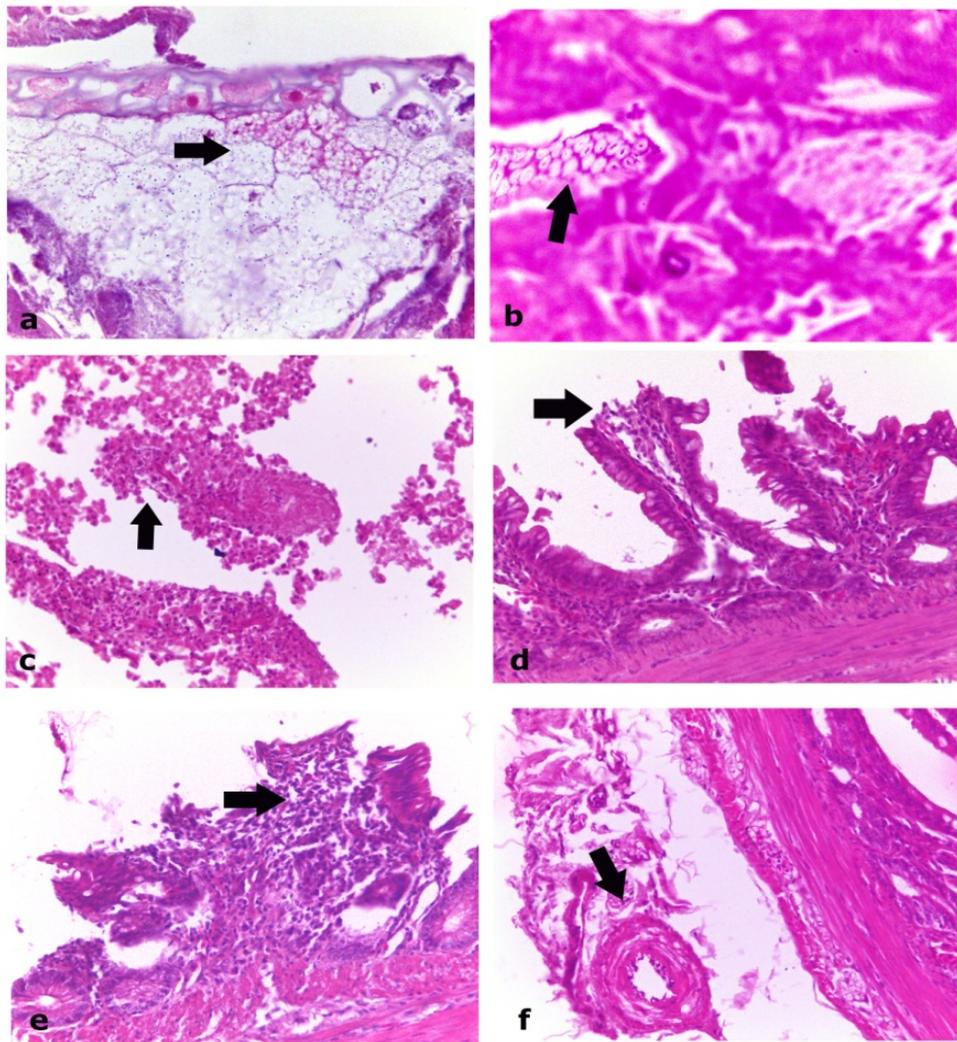


Fig. (7): (a-f)Pathological effect of quail *Eimeria* spp:Photomicrograph of intestine of quail intestinal tract showing different developmental stages of *Eimeria* infection(a, b & c), intestine showing necrosis and desquamation of the intestinal villi (d), intestine showing focal inflammatory cells infiltration (e), intestine showing congestion and thickening in the blood vessel wall (f). (H&E., X 400)

DISCUSSION

Coccidiosis is an economically important disease which is caused by unicellular protozoa, *Eimeria*. It continues to be a serious threat to animal health and results in lowered productivity due to the associated morbidity, mortality, and cost of treatment and control measures.

Through the present study four *Eimeria* species were detected infecting pigeon (*E. labbeana*, *E. columbarum*, *E. columbae*, and *E. gourai*) in and around Qena Province, Egypt. These findings are related to previous studies (*Varghese, 1980*) in *Eimeria gourai*), but the present study was not in accordance with the finding detected by *Joseph et al., (2017)*, who found the prevalence of *E. labbeana*, *E. columbarum* and *E. columbae* was 6%, 6% and 37% respectively. This variation might be due to the difference in number of samples and site of taking them.

The prevalence of *Eimeria* spp. infecting pigeons was 58.3%. The obtained results were nearly similar to that reported by *Baris et al., (2008)* who found that the overall prevalence of *Eimeria* infection among domestic pigeons was 59.6% in Turkey. On the contrary, the present finding was much higher than that reported previously in Assam, India 38.81% (*Saikia et al., 2017*); 28.96% in West Bengal (*Bandyopadhyay et al., 2006*); 35% in Turkey (*Sari et al., 2008*) and 35% in Baghdad (*Mahdii and Al-Rubaie, 2013*). On the other hand, the current prevalence was lower than that recorded in West Pomerania province, Poland which reached 100% (*Aleksandra and Pilarczyk, 2014*). These variations might be attributed to the rearing method of pigeons as birds are mainly kept as free range, which favors the spread of parasites (*Natalaet al., 2009*); as the possibility of contamination of pigeon shipping crates and the bodies of water from which the birds drank on the route of flights with coccidia oocysts (*Michalczyk et al., 2011*).

In regard to the age of examined pigeon, the present investigation revealed that young pigeons were more commonly susceptible to *Eimeria* infection (73.3%) as compared to adults (44.7%); this result was in line with the reports by *Radfar et al., (2011)*, *Aleksandra and Pilarczyk (2014)* and *Joseph et al., (2017)* whose found that the prevalence of *Eimeria* infection in young pigeon was 27.08 in Kano State; 89-93% in West Pomerania province, Poland and 53.1% in Nigeria respectively,. These results might be due to lack acquired immunity to coccidian infections and outbreaks can occur under conditions of poor hygiene (*Dalloul and Lillehoj, 2005*). Additionally, the Egyptian farmers are not well acquainted with modern livestock management practices.

In respect to the sex of examined birds, the current study concluded that the occurrence of *Eimeria* species was more prevalent in male pigeons (76.5%) as compared to their females (65.5%). The present data was not in consistent with that recorded by *Mohammed et al., (2017)* in Kano State, Nigeria, who found that the prevalence was higher in females (20.83%) as compared to males (18.06%). In contrast, *Ali et al., (2015)* recorded that no significances were found between male (85.7%) and female (81.8%) of infected pigeons in Babylon province. This variation might be due to the number of examined birds. Furthermore, male pigeons usually spend long periods outside their lofts, while females spend a much time in lofts for squab rearing.

Concerning the seasonal dynamics, the present study found that the highest peak of infection was in autumn (77.8%) and the lowest rate was recorded in spring season (35.6%). In contrast, *Saikiaet al., (2017)* found that the highest infection rate was observed in spring season (61.22%) and the lowest rate was recorded in winter with overall prevalence of 28.46%, in Assam, India. These variations might be due to the climatic changes, rainfall and resultant humidity, habitat and stress condition of the bird.

In the present study, the overall prevalence of *Eimeria* infection in quails was 53.9%. This is consistent with the findings of **Musaev et al., (1998)** in Azerbaijan (52%). But disagrees with the findings of **Liburd, (1969)** who reported higher prevalence rate of quail *Eimeria* species in British Columbia (73 %) and **Bashtar et al., (2010)** who found the prevalence rate was 80% in Saudi Arabian quails. The difference in the percentage of infection in many studies may be related to different factors such as, environmental conditions, seasonal fluctuations, type of anticoccidial drugs may have contributed to this difference (**Nematollahi et al., 2008**).

Age is an important risk factor associated with the prevalence of avian coccidiosis as all ages of birds are susceptible to the disease (**Lawal, 2016**). In line with this, this study reports that both young and adult birds were infected with coccidiosis with a higher prevalence recorded in young birds (72.4%). This finding supports earlier reports by **Mohammad, (2012)** who documented a higher prevalence rate of coccidiosis in younger birds (not sexually mature) compared to older birds. The higher prevalence recorded in the young birds could be attributed to the immature immune system in young birds leaving them susceptible to infection even with the lower or less pathogenic strain of *Eimeria* species.

In regard to the sex of examined quails, the obtained results demonstrated that male birds were reported to be more infected with coccidiosis compared to female birds. This finding may be attributed to the aggressive feeding nature of male birds making them pick up more sporulated oocyst from contaminated feed, water. In support of this report, **Mohammad, (2012)** recorded higher prevalence of coccidiosis among male quails compared to female counterparts in their studies conducted in Iraq.

Concerning the seasonal dynamic of *Eimeria* infection in quail, the current investigation found that highest prevalence was observed in winter (73.3%), while the lowest infection rate was documented in summer (22.2%). This result agrees with the findings of *Islam et al., (2016)*, who found that the highest peak of *Eimeria* infection among Japanese quail in some selected areas of Bangladesh was in winter (2.10%) and the lowest rate was in summer (1.26%).

The histopathological changes observed in duodenum, small intestine, caecum were more or less similar to those reported in quails by *Mohammad, (2012)*. The histopathological changes in intestinal tract pointed to the serious effect of *Eimeria* species in quails.

The three species of *Eimeria* identified in the present study have been reported by *Mohammad (2012)*, suggesting that these species of *Eimeria* cause coccidiosis in local quails and are worldwide in distribution.

CONCLUSION

The current study investigated that both pigeon and quail are highly susceptible to coccidia infection especially young and male in both species in and around Qena province, Egypt. Further studies are highly recommended to evaluate the impact of coccidian infections on the health and production of pigeon and quail and the options for successful control. It should be considered that health improvement and hygienic maintenance are very important in obtaining more economic outcome from pigeon and quail.

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REFERENCE

- **Al Nasr IS, 2011. Reclassification of *Eimeria schmidtii* Al-Yousif et al. (1997).** (Apicomplexa: Eimeriidae) with Description of its Endogenous Stages; Pakistan J. Zool., vol. 43(6), pp. 1127-1133.
- **Aleksandra B and B Pilarczyk, (2014).** Occurrence of coccidia infection in pigeons in amateur husbandry, Diagnosis and prevention. Annals of Parasitology 60: 93-97.
- **Ali JK, HH Alewi and HA Sawdi (2015).** Treatment of natural infection in pigeons birds with coccidiosis by using ginger extract in Babylon province; Kufa Journal For Veterinary Medical Sciences Vol. (6) No. (1).
- **Allen PC, (1986).** Biochemical changes in the intestinal mucosa associated with coccidiosis; Research in Avian coccidiosis. Proceeding Georgia coccidiosis conference; university of Georgia, Athens.194-202.
- **Bandyopadhyay PK, JN Bhatka and RA Shukla, (2006).** New *Eimeria* species (Protozoa: Apicomplexa: Sporozoea) from the Blue Rock Pigeon *Columba livia* (Aves: Columbidae). Zoos' Print J.; 21:2386-2387.

- **Baris S, B Karatepe, M Karatepe and K Murat, (2008).** Parasites of domestic (*Columba livia domestica*) and wild (*Columba livialivia*) pigeons in Niğde, Turkey; Bulletin of the Veterinary Institute in Pulawy 52: 551- 554.
- **Bashtar AR, F Abdel-Ghaffar, KAS Al-Rasheid, H Mehlhorn and I AL Nasr, (2010).** Light microscopic study on *Eimeria* species infecting Japanese quails reared in Saudi Arabian farms. Para Res;107:409-416.
- **Dalloul RA and HS Lillehoj, (2005).** Recent advances in immunomodulation and vaccination strategies against coccidiosis. Avian Diseases, 49(1):1-8.
- **EI-Madawy RS, (2001).** Studies on some protozoan parasites in birds; Thesis of master of veterinary science, Faculty of Veterinary Medicine.Zagazig University; DDC No 11010620.
- **Islam T, AK Talukder, ARahman, G Haider and AA Rahman, (2016).** Incidence of diseases in Japanese quail (*Coturnix coturnix japonica*) with special reference to bacterial and viral diseases in some selected areas of Bangladesh; Asian Australas. J. Biosci. Biotechnol; 1 (3), 410-418.
- **Joseph J, WB Emmanuel, VA Yafeh and ION Aguzie, (2017).** *Eimeria* species oocyst morphometry and prevalence of Infection in domesticated pigeon (*Columba livia domestica*) in Maiduguri Metropolis Borno State, Nigeria; African Journal of Parasitology Reaserch; Vol. 4 (8), PP. 244-248.
- **Lawal JR, SM Jajere, UI Ibrahim, YA Geidam, IA Gulani, G Musa and BU Ibekwe, (2016).** Prevalence of coccidiosis among village and exotic breed of chickens in Maiduguri, Nigeria. Veterinary World, 9(6):653-659.

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- ***Levine ND, (1985).*** Veterinary Protozoology. Iowa State University, Press Ames; 200-201.
 - ***Liburd EM, (1969).*** Incidence of coccidia in California quail (*lophortyxcalifornicus*) from the Okanagan valley, British Columbia. *Can J Zool*;47(4):645-648.
 - ***Mahdii EF and HMA Al-Rubaie, (2013).*** Study the prevalence of pigeon coccidiosis in Baghdad city. *The Iraq. J. Vet. Med*; 37(1): 106-108.
 - ***Marques SM, RM Quadros, CJ Da-Silva and M Baldo, (2007).*** Parasites of pigeons (*Columba livia*) in urban areas of langes, Southern Brazil. *Parasitol Latinoam*, 62: 183-187.
 - ***Mcdougald LR and WM Raid, (1991).*** Coccidiosis of poultry 9th (ed): Ames. Iowa.Lawa.State university press pp.780-719.
 - ***Michalczyk M, M Raś-Noryńska and R Sokół, (2011).*** Ocenazwalczaniatoltrazurilem(Baycox)inwazji *Eimeria* spp. u gołębipocztowych. *MedycynaWeterynaryjna* 67: 406-408.
 - ***Mohammad NH, (2012).*** A Study on the Pathological and Diagnosis of *Eimeria* Species Infection in Japanese Quail; *Bas. J. Vet. Res. Vol.* 11, No.1.
 - ***Mohammed BR, MK Simon, RIS Agbede and AH Arzai, (2017).*** Coccidiosis of domestic pigeons (*Columba livia domestica* Gmelin, 1789) in Kano State, Nigeria; *Annals of Parasitology* 2017, 63 (3), 199–203.
 - ***Musaev M, G Gaibova, G Ismailova, F Alieva and N Iskenderova N, (1998).*** The coccidia of the gallinaceous birds in Azerbaijan.*Tr J Vet Anim Sci*;22:409-413.

- **Natala AJ, ND Asemadahun, OO Okubanjo, BM Ulayi, YH Owolabi, ID Jato and KH Yusuf, (2009).** A survey of parasites of domesticated pigeon (*Columba livia domestica*) in Zaria, Nigeria. In International Journal of Soft Computing 4:148-150.
- **Nematollahi A, GH Moghaddam, F Niyazpour, (2008).** Prevalence of *Eimeria* sp. among broiler chicks in Tabriz (northwest of Iran). Res JPoultSci; 2(3):72-74.
- **Norton CC, (1986).** Coccidia of domestic goats, *Capra hircus*, with notes on *Eimeria ovinoidalis* and *E. bakuensis* (*E. ovina*) from sheep *Ovisaries*. Parasitology; 92: 279-289.
- **Radfar MH, S Faithi, EN Asl, MM Dehaghi, and HR Seghinsara, (2011).** A survey of parasites of domestic pigeons (*Columba livia domestica*) in South Khorasan. Iran Vet. Res., 4(1): 18-23.
- **Saikia M, K Bhattacharjee, PC Sarmah, DK Deka, P Kakati and P Konch, (2017).** Prevalence of coccidia in domestic pigeon (*Columba livia domestica*) of Assam, India, International Journal of Chemical Studies; 5(3): 453-457.
- **Sari B, B Karatepe, M Karatepe and M Kara, (2008).** Parasites of domestic pigeon (*Columba livia domestica*) and wild (*Columba livialivia*) pigeons in Nigde, Turkey, Vet.Inst.Pulawy; 52:551-554.
- **Sloss MW, RL Kemp and AM Zsac, (1994).** Veterinary Clinical Parasitology, 6th Edn, Iowa State University Press, Ames, Iowa.
- **Soulsby EL, (1982).** Helminths, Arthropods and Protozoa of Domesticated Animals. 7th Edition. Bailliere Tindall: London; p. 56-80.
- **Varghese T, (1980).** Coccidian parasites of birds of the avian order Columbiformes with a description of two new species of *Eimeria*. Parasitol, 1980; 80 (01):183-187.