1. Introduction

Coccidiosis is an intestinal sporozoic parasitic protozoan infection of birds and mammals. Nine species of the genus Eimeria, have been studied throughout the world, but only three are of economic importance: Eimeria columbae, E. columbarum and E. labbeana, which are characterized by varying degrees of virulence. The occurrence of these species was found in domestic pigeons (Columba livia domestica) and rock pigeons (Columba livia livia).
(Krautwald-Junghanns et al., 2009). *E. labbeana*, which lives in the small intestine of pigeons, causes, diarrhea, enteritis and even mortality of the infected birds. These coccidial organisms survive in the environment of the walls of oocysts. The infected birds excrete oocysts in their feces to provide a source of infection for other birds. The impacts of disease on animal agriculture include, lost revenues, costs of vaccination, prevention, eradication, decontamination and restocking. The life cycle of *Eimeria* is completed within seven days and multiplication begins when active oocysts are picked up by the birds and swallowed. After being swallowed coccidia inter into the intestinal lining and multiply several times and damage tissues. The incidence of coccidiosis in commercial poultry has increased due to higher stocking densities and intensive husbandry practices (Williams, 1999). It has been documented that it is the most consistently reported health problem in Poultry (Khan et al., 2006). Over three billion dollars are spent worldwide for the prevention of coccidiosis in poultry (Williams, 1999).

Epidemiological studies showed the economic importance of coccidiosis as a major parasitic disease of poultry in Nigeria (Chapman, 2008). Coccidiosis is a common and fatal disease in poultry including pigeons and estimated to be 2 billion dollars a year (Zhang and Zeng, 2005). Coccidiosis is a self-limiting disease, and its manifestation depends on the number of oocysts ingested and the immune status of the host. About one fourth of world’s meat supply is derived from poultry including pigeons and the proportion is increasing gradually in South Asian countries such as Sri Lanka, India, Bangladesh and Pakistan that represent about 22% of world population (Prabakaran, 2003). Pakistan is deficient in the production of animal protein foods for its increasing human population, as demand of poultry products is so much higher as compared to their production (Abedullah et al., 2007). The limitations to increased poultry products are parasitic diseases of birds. Helminths and protozoan infections can frequently be a major problem causing morbidity and even mortality in the birds (Khan et al., 2018; Kamal et al., 2020). Keeping in view coccidiosis as the major health problem in wild birds, present study was conducted to detect the prevalence and control of coccidiosis in wild pigeons through different chemotherapeutic agents.

### 2. Materials and Methods

#### 2.1. Study area

Present study was carried out in Lower Dir district, Khyber Pakhtunkhwa, Pakistan. Its geographical coordinates are 34° 33’ 56” North, 71° 55’ 52” East. This area is characterized by heavy rain fall in winter and hot weather in summer. Temperature range from 12°C up to 40°C.

#### 2.2. Ethical approval

This study was approved by the ethical review committee of Department of Zoology, University of Malakand, Lower Dir, Pakistan.

#### 2.3. Data collection

The pigeons about one year of age were collected from April 2016 to September 2016. Fresh faecal samples were collected in mini-plastic container and preserved in 10% formalin for coccidial infection screening.

#### 2.4. Diagnostic techniques

##### 2.4.1. Direct smear examination

About 1 g of feces was mixed with 20-25 ml of normal saline solution. The suspension was passed through a mesh and 1-3 drops of strained material were placed on clean glass slide and a thin layer of smear was made which was examined under the microscope detection of *Eimeria* sp. oocysts. Five slides from different parts of the same stool sample were examined. Samples found negative for *Eimeria* sp. oocysts were exposed to Sedimentation and Flotation techniques (Permine and Hansen, 1998).

For floatation about 1 g of fecal sample was suspended in 15ml water and strained through a cheese cloth. The suspension was allowed to settle for 10-15 min in the container. The sediment was mixed with saturated salt solution of NaCl in a centrifuge tube and shaken for 5 min. The oocysts floated to the top surface which were picked by the cover slip.

For sedimentation technique one gram of feces was mixed with 10-15ml of tap water in a bottle and shaken thoroughly. The suspension was passed through a filter. The strained fluid was poured into a tube and again shaken for 5 min. The supernatant was discarded and a drop of sediment was placed on glass slide and examined under low and high power of microscope for the presence of coccidian oocysts.

Three groups of pigeons were treated with sulfadimidine (0.2mg/L) amprolium (25mg/L) and triquen (2.5gm). Faecal samples collected were analyzed in the Laboratory. OPG count were performed by using McMaster Techniques described by Jarvie et al. (2005). The % efficacies of the drugs (Trustfield, 2005) were measured by faecal oocysts per gram counts reduction test calculated from the arithmetic mean of the group OPG as per the formula given below: Efficacy of drug treatment (%) = Mean pre-treatment OPG-Mean-Post treatment OPG x 100/ Mean pre-treatment OPG.

##### 2.4.2. Statistical analysis

The overall parasites found in pigeons were statistically analyzed by using a following Formula 1:

\[
\text{Prevalence Rate} = \frac{\text{Total No. of pigeons infected} \times 100}{\text{Total No. of pigeons examined}}
\] (1)

### 3. Results

A total of 18 pigeons were examined for the determination of parasitic infections. Out of the total pigeons examined 16 pigeons were found to be infected with coccidiosis caused by *Eimeria* sp. with overall prevalence of 88.8% (n=16/18). The OPG values in faecal samples in different treatment groups are given in Table 1.
Table 1. Comparative efficacy of three drugs against *Eimeria* sp. in 18 pigeons in Malakand region Groups.

| Group | NOPG Before treatment | NOPG After treatment | Drugs     |
|-------|------------------------|----------------------|-----------|
| Group A | 8±2.74                 | 2.2±1.74             | Sulphadimidin |
| Group B | 8.6±3.07               | 2.2±1.614            | Amprolium  |
| Group C | 7.9±2.64               | 2.76±2.22            | Triquen    |

NOPG: number of Oocysts per gram.

Table 2. Oocyst reduction rate (ORR) against efficacy of drugs administered.

| No. of pigeons positive for coccidiosis in each group | Oocysts before Treatment | Oocysts after Treatment | Oocyst reduction rate | Drugs |
|-----------------------------------------------------|--------------------------|-------------------------|-----------------------|-------|
| 5                                                   | 79                       | 60                      | 24.05%                | Triquen|
| 6                                                   | 81                       | 44                      | 44.68%                | Amprolium|
| 5                                                   | 80                       | 44                      | 45%                   | Sulphadimidin|

For all the groups, the chi square statistic is not significant at P <0.05). The percent efficacies of different drugs against coccidiosis are shown in Table 2. The efficacies of sulphadimidine, amprolium and triquen were 45%, 44.6%, and 24.0% respectively.

4. Discussion

Present research focused on the prevalence of coccidiosis and efficacy of sulfadimidine, amprolium and triquen against coccidiosis in pigeon of the Lower Dir district, Pakistan. Current investigation reveals 88.8% (n=16/18) prevalence rate. Our findings were comparable with the study conducted by others (Sari et al., 2008; Bobrek et al., 2012). According to Latif et al. (2016) the prevalence of coccidiosis infection was less in pigeons as compared to the present findings. The main factor behind this less prevalence of infection might be that the pigeons that are used by them are bred in poultry farms under proper hygienic conditions and appropriate vaccination after stipulated intervals against various infections administered while the pigeons used in present experiment were taken from the open environment in which therefore, the chances of parasitic infection are comparatively higher because they are inhabitant of open environment with microbial contamination which is manifested in the unhygienic feeding habits, because they are not subjected to vaccination and vice versa. Wild birds are reservoir of many parasitic diseases and play important role in contaminating the environmental agencies like water, soil, crops, fruits, vegetables etc and thus transfer the parasitic infections to the healthy birds through their plumage and fecal matter which are serious hazards for healthy birds.

Our study showed that sulphadimidine, amprolium and triquen could not inhibit the coccidiosis in pigeons. Our study is in conflict with the similar studies conducted by Avais et al. (2016) from Pakistan on the evolution of anticoccidial drugs and have reported 95.4% and 98.1% efficacy of sulphadimidine and amprolium respectively, while in present experiment sulphadimidine was noted with highest percentage of oocyst reduction rate which is 45% followed by amprolium 44.68% while the least oocyst reduction rate was observed in triquen 24.05% respectively. Another study conducted by Abakar et al. (2005) from Sudan on the efficacy of sulphadimidine and amprolium against coccidiosis and reported 93.89% and 98.44% efficacy respectively. A study conducted by (Adewole, 2012) showing high efficacy of sulphadimidine and amprolium against coccidiosis.

In conclusions, Pakistan is deficient in the production of animal protein food, therefore, there was a need to determine the prevalence of coccidian infection in pigeons and its control through different anticoccidial drugs are needed.

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Erratum

ERRATUM

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Where it reads:
Notes and Comments

It should be read:
Original Article