

Field Evaluation of Toltrazuril and Garlic for Treatment of Coccidiosis in Broiler Chickens

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Abstract

This study was performed to investigate the effect of toltrazuril and fresh crushed garlic on the treatment of broiler chicks infected with coccidiosis. A hundred one-day old unsexed Cobb broiler chicks were used in this study. Chicks are classified into 5 equal groups (n=20 birds/group), Gp (1) contained 20 healthy broilers and acted as a negative control. Birds of groups 2, 3, 4, and 5 were inoculated orally with 1x10⁵ sporulated oocysts of *Eimeria tenella* (*E. tenella*) (field isolate) on the 14th day of age. Group 2 was experimentally infected, did not receive treatment and acted as a positive control. Group 3 was experimentally infected and treated with toltrazuril (1ml/liter drinking water) for two successive days. Group 4 was experimentally infected and treated with fresh crushed garlic (50 g/Kg ration) for 5 successive days. Group 5 was experimentally infected and treated with toltrazuril (1ml/liter drinking water) and fresh crushed garlic (25g/Kg ration) for 5 successive days. All birds were individually weighed at the beginning of the experiment, the 1st and 10th days post treatment. Five birds from each group were sacrificed and two blood samples from each chick were collected for determination of erythrocyte count, MDA and CAT. Specimens from intestine were collected for histopathological study. The obtained results showed that the broilers infected with *E. tenella* had loss of appetite, depression, ruffled feathers, debility, dropped head and bloody diarrhea. Infected chicks with coccidia induced a significant decrease in the body weight, weight gain, RBCs, Hb, PCV%, platelets, and MCHC. Beside, an increase in FCR, MCV, MCH, and MDA associated with non-significant decrease in CAT was recorded. Infected birds treated with toltrazuril and garlic either alone or in a combination could recover birds from the clinical signs. Moreover, we recorded a significant increase in body weight, weight gain coupled with non significant increase in RBCs, Hb and PCV%, Platelet, MCHC and non-significant decrease in MCV and MCH compared with experimentally infected and non treated group (+ve control). Infected broilers with coccidiosis induced pathological lesions in the small intestine represented as ruptured villi, and diffused haemorrhage. Treatment of the infected birds with toltrazuril and garlic showed apparently normal mucosa, submucosa and muscularis mucosa with serosa. It could be concluded that the infected broiler chickens with *E. tenella* induced adverse effects in body performance, erythrocyte count and pathological changes. Treatment of infected chicks with toltrazuril and garlic led to disappearance of the clinical signs, improved body performance and pathological effects.

KEYWORDS

Coccidiosis, Toltrazuril, Garlic, Chicks.

INTRODUCTION

Poultry industry is one of the most important food suppliers in the world (Bogosavljevic-Boskovic *et al.*, 2010). Coccidiosis is a major parasitic disease of poultry caused by *Eimeria* species leading to significant economic consequences to the broiler industry (Allen and Fetterer, 2002; El-Banna, *et al.*, 2004). Intensive rearing of chickens on floor pens creates favorable conditions to rapid spread of the disease resulting in severe economic losses. Coccidiosis is not clinically recognizable until the tissue damage associated with the second or third generation schizogony occur (Conway *et al.*, 2002). *Eimeria tenella* (*E. tenella*) infection in chickens induce many clinical signs as digestive disturbance, bloody diarrhea, immune suppression, susceptibility to other diseases and heavy mortality in the affected flocks (Morris *et al.*, 2007).

The ideal anticoccidial drugs should limit the number of coccidian that complete their life cycles and allow at the same time

the bird to develop natural immune response, thus encouraging a balance of nature between chicken and parasite without affecting bird performance (Abdien and Abdel-Fattah, 2003).

Toltrazuril is a broad-spectrum anticoccidial drug which is highly effective in eliminating various species of avian coccidia (Nasr *et al.*, 2021). It is a triazinetrione halofugionone and quinazolinone derivatives which prevent and treat coccidiosis in broilers and turkeys (Mulder *et al.* 2005). Toltrazuril has anticoccidial action against most stages of *Eimeria* spp. (Mundt *et al.*, 2003).

Herbal plants and their byproducts may serve as remedies for coccidiosis because of their low toxicity and reduced cost of production (Abbas *et al.*, 2012). Garlic contains many important constituents such as 33 sulfur compounds, several enzymes, 17 amino acids, and minerals (Kharde and Soujanya, 2014). The sulphur compounds are responsible for garlic pungent odor and its medicinal effects (Chowdhury *et al.* 2002). Garlic has important

role as immune stimulator (Pourali et al., 2010). Garlic contains Allicin that has antimicrobial effects against many viruses, bacteria, fungi, and parasites (Fayed et al., 2011).

The aim of the present study was to investigate the anticoccidial effect of toltrazuril and garlic against *E. tenella* and their effects on body performance erythrogram as well as pathological changes in broiler chicks.

MATERIALS AND METHODS

This study was approved and conducted according to Zagazig University guidelines.

Experimental birds

One hundred apparently healthy, one-day old, unsexed broiler chicks of a commercial breed (Cobb breed) were used. They were provided by El-wady Poultry Company. After thorough cleaning and disinfection, the chicks were housed in a constant environmental and hygienic condition, fed on an artificially prepared ration free from anti-coccidia drugs, antibiotics and chemical additives. Tap drinking water was offered ad-libitum throughout the experimental period (five successive weeks). The chicks were floor reared in separate units with 2 inches of top-dressed litter of fresh wood shavings was used as bedding. The temperature was adjusted at 32°C during the first week and was reduced 2°C per week. Optimum light was provided daily throughout the experimental period. Prophylactic routine medication and vaccination programs against bacterial and viral diseases were used.

Eimeria strain

The strain was kindly obtained from Parasitology Department, Faculty of Veterinary Medicine, Zagazig University.

Drugs

Toltrazuril (Baycox)[®] 2.5% was obtained from Bayer Company. Its recommended therapeutic dose is 25 mg/Kg bw for 2 successive days equal to 1 ml/liter drinking water according to the manufacturer guidelines (Mathis et al., 2003).

Fresh garlic (*Allium sativum*) was obtained from market, cleaned washed and crushed. Its therapeutic dose is 50 g/kg ration for 5 successive days (Ziarlarimi et al., 2011).

Experimental design

A hundred, one-day old unsexed Cobb broiler chicks, were used in this study. Chicks were classified into 5 groups; Gp 1 con-

tained 20 healthy broilers, non-medicated and acted as a negative control. Groups 2, 3, 4, and 5 were inoculated orally with 1x10⁵ sporulated oocysts of *Eimeria tenella* (field isolate) on the 14th day of age. Gp 2 was experimentally infected with *E. tenella*, non-treated and acted as a positive control. Gp 3 was experimentally infected with *E. tenella* and treated with toltrazuril (1ml/ liter drinking water) for two successive days. Gp 4 was experimentally infected with *E. tenella* and treated with fresh crushed garlic (50g/ Kg ration) for 5 successive days. Gp 5 was experimentally infected with *E. tenella* and treated with toltrazuril (1ml/ liter drinking water) and half dose of fresh crushed garlic (25g/Kg ration) for 5 successive days.

All birds were individually weighed at the beginning of the study and on the 1st and 10th days post treatment for estimation of body weight gain and FCR. On the 1st day post treatment, 2 blood samples were collected from control and infested chicks. The 1st sample was collected in a tube containing EDTA for erythrogram (Jain, 1986). The 2nd sample was collected in a centrifuge tube to obtain clear serum for estimation of MDA (Ohkawa et al., 1979), and CAT (Aebi, 1984).

Histopathological examination

Specimens from intestine were fixed in 10% neutral buffer formalin and then processed using the routine histopathological technique (Bancroft and Gamble, 2002).

Statistical analysis

The obtained data were analyzed using computerized SPSS program version 16 (Tamhane and Dunlop, 2000).

RESULTS

Our results revealed that the main clinical signs in the chicks infected with *E. tenella* were loss of appetite, depression, ruffled feathers, debility, dropped head and bloody diarrhea.

Broiler chickens suffering from coccidiosis revealed a significant decrease in body weight, weight gain, feed consumption and FCR on the 1st and the 10th days post infection compared with the healthy group. On the other hand, experimentally infected groups treated with toltrazuril or garlic either alone or together induced significant increase in body weight, weight gain and feed conversion rate on the 1st and 10th days post treatment compared with the experimentally infected non-treated group (+ve control) (Table 1).

Chicks experimentally infected with coccidiosis revealed a significant decrease in RBCs, Hb, PCV%, MCHC and CAT coupled with significant increases in MCV, MCH, and MDA beside

Table 1. Effect of toltrazuril (1ml of 2.5%/ liter of drinking water) and garlic (50 g of fresh crushed garlic/kg ration) on the Body weight gain, Feed consumption and feed conversion rate of healthy and experimentally infected broilers with coccidia (Mean ± S.E.)

	Initial BWt (g)	1 st Day				10 th Day			
		BW (g)	BWG (g)	FC (g)	FCR	BW (g)	BWG (g)	FC (g)	FCR
Gp (1)	774.5±3.65a	1310.32±3.56a	557.20±1.65a	670	1.10±0.09b	1980.00±1.67a	660.12±2.69b	1150	1.72±0.19b
Gp (2)	760.50±2.76a	957.30±3.69bc	200.10±1.34d	620	3.10±0.15a	1364.0±3.31e	454.0±2.98e	950	2.25±6.16a
Gp (3)	751.50±4.68a	1132.30±2.95b	370.40±1.56b	675	1.85±.26b	1924.0±2.68ab	831.10±4.55a	1050	1.26±0.11b
Gp (4)	755.37±3.63a	1060.30±2.75c	305.40±2.54c	650	1.54±0.21b	1830.05±3.62c	800.60±4.62a	1000	1.21±0.13b
Gp (5)	758.48±3.65a	1108.00±4.34b	349.80±2.58bc	655	1.80±0.67b	1776.10±4.53d	668.43±2.76b	1010	1.36±0.19b

Mean value with different superscripts (sup, sub) of the same row indicate significant difference at P < 0.05. BW: body weight; BWG: body weight gain; FC: food consumption; FCR: food conversion ratio; g: gram.

non-significant decrease in platelet, compared with the healthy group.

Experimentally infected broilers with coccidiosis, treated with toltrazuril or garlic either alone or with a half dose of garlic revealed increases in RBCs, Hb, PCV%, platelet, MCHC and CAT, but showed decreases in MCV, MCH and MDA compared with the experimentally infected non treated group (+ve control) (Table 2).

Opened caecum of chick experimentally infected with *E. tenella* on the 8th day of infection show caecal content tinged with blood (Fig. 1).



Fig. 1. An opened caecum of experimentally infected chick with *E. tenella* on the 8th day of infection showing caecal content tinged with blood.

Small intestine of control broilers on the 8th day of infection show apparently normal mucosal and sub mucosal tissues (Fig. 2).

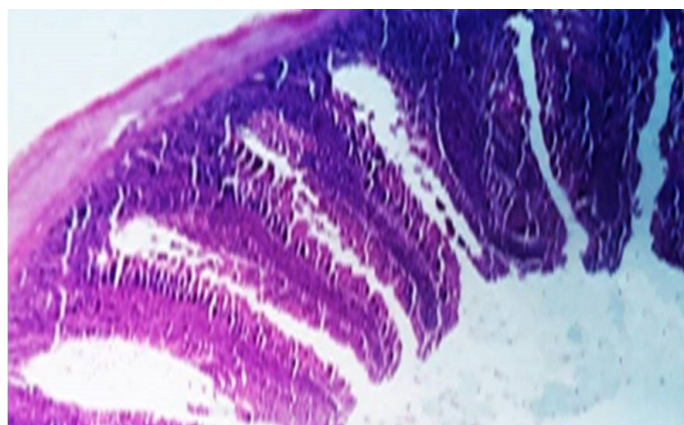


Fig. 2. Small intestine of healthy broilers on the 8th day of infection showing apparently normal mucosal and sub mucosal tissues. (H&E x 400).

Small intestine of control broilers on the 18th day of infection show apparently normal mucosa and sub mucosa tissues (Fig. 3). Small intestine of experimentally infected broilers on the 8th day

of infection show ruptured villi with developmental stages of *E. tenella* (Fig. 4). Small intestine of experimentally infected broilers on the 8th day of infection show diffuse hemorrhage (Fig. 5).

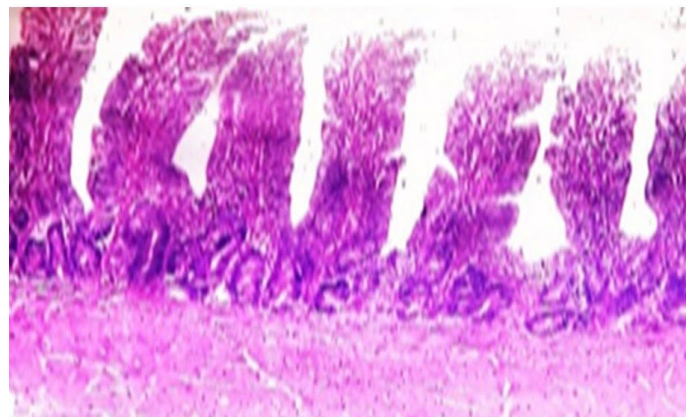


Fig. 3. Small intestine of healthy broilers at the 18th day of infection show apparently normal mucosa and sub mucosa tissues (H&E x 400).

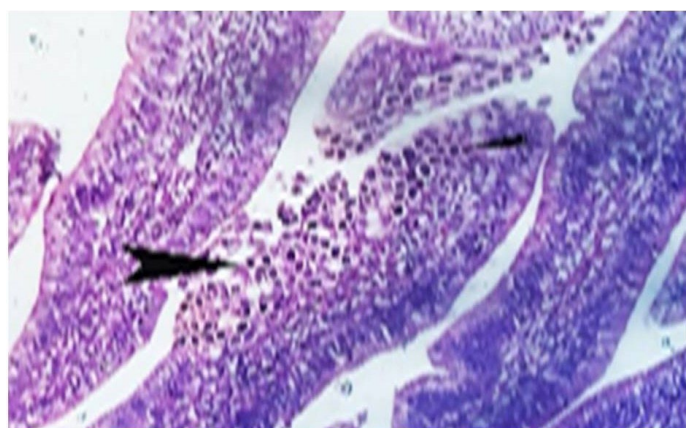


Fig. 4. Small intestine of experimentally infected broilers at the 8th day of infection shows ruptured villi with developmental stages of *E. tenella* (arrowhead) (H&Ex 800).

Small caecum of experimentally infected broilers on the 18th day of infection show complete destruction of intestinal mucosa in addition to cystic dilation of some sub mucosal glands and lymphoid depletion from submucosal lymphatic tissue (Fig. 6). Small intestine of experimentally infected broilers on the 18th day of infection show mucinous degeneration of enterocytes in addition to spreading of numerous developmental stages of *E. tenella* (Fig. 7). Small intestine of experimentally infected broilers toltrazuril treated on the 8th day of infection show congestion of submucosal blood vessels in addition to atrophy of submucosal glands (Fig. 8).

Table 2. Effect of toltrazuril (1ml of 2.5% liter of drinking water) and garlic (50 g of fresh crushed garlic/Kg ration) on erythrogram, MDA and CAT of healthy and experimentally infected broilers with coccidia (Mean ± S.E.)

	Erythrogram			Platelet (x10 ³ /cmm)	Blood indices			Antioxidants	
	RBCs (x10 ⁶ /cmm)	HB (g/dl)	PCV (%)		MCV (fl)	MCH (pg)	MCHC (g/dl)	MDA (nmol/μL)	CAT (nmol/μL)
Gp (1)	6.18±0.32a	16.15±0.92a	43.10±2.65a	95.02±1.89a	87.25±3.76b	28.45±2.43b	33.08±2.65a	10.66±1.32b	5.30±1.05a
Gp (2)	2.35±0.50c	7.58±0.81c	32.31±3.53c	91.20±1.75a	96.21±4.73a	36.08±1.55a	19.82±1.63b	17.49±1.43a	2.21±1.03b
Gp (3)	4.05±0.49b	12.90±0.78b	39.12±2.54a	94.10±3.98a	88.84±2.88b	30.50±3.55b	30.80±2.58a	16.94±1.56a	5.163±1.92a
Gp (4)	2.92±0.76c	9.65±0.83c	32.53±2.56c	93.21±5.65a	87.10±2.54b	29.46±1.65c	32.10±2.37a	10.81±0.89c	2.62±0.97b
Gp (5)	4.60±0.93b	13.46±0.55b	41.40±2.56a	95.34±3.61a	89.10±2.57b	30.26±1.64b	31.46±2.56a	10.98±1.15b	5.16±1.08ca

Mean value with different superscripts (a,b,c) of the same row indicate significant difference at P < 0.05.

RBCs: Red blood cells; HB: Haemoglobin; PCV: Packed-cell volume; MCV: Mean corpuscular volume; MCH: Mean corpuscular haemoglobin; MCHC: Mean corpuscular haemoglobin concentration; MDA: Malondialdehyde enzyme; CAT: Catalase enzyme.

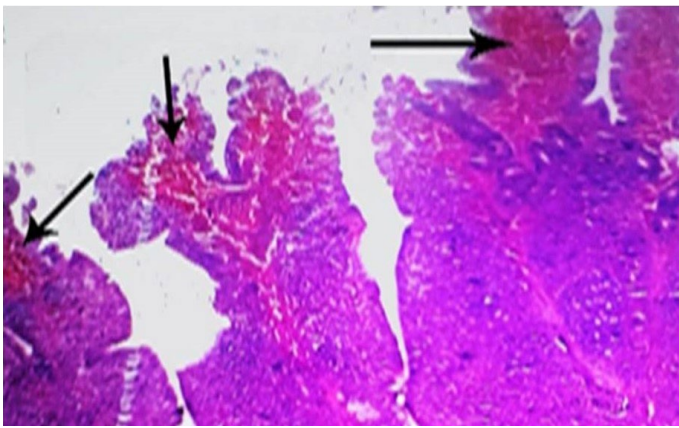


Fig. 5. Small intestine of experimentally infected broilers on the 8th day of infection shows diffuse hemorrhage (arrows) (H&E x800).

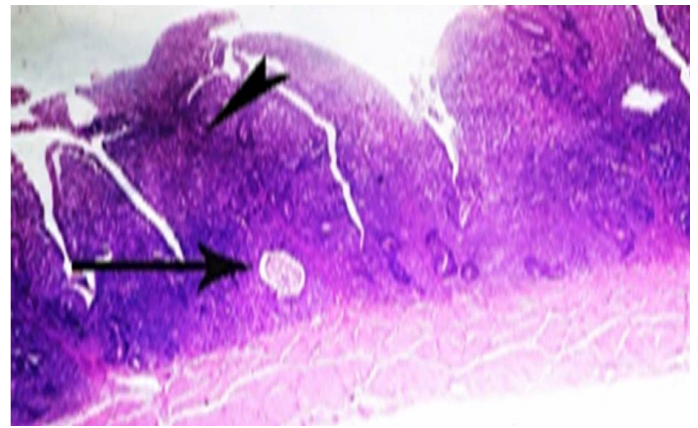


Fig. 8. Small intestine of experimentally infected broilers toltrazuril treated on the 8th day of infection show congestion of submucosal blood vessels (arrow) in addition to atrophy of submucosal glands(a-arrowhead) (H&E x 400).

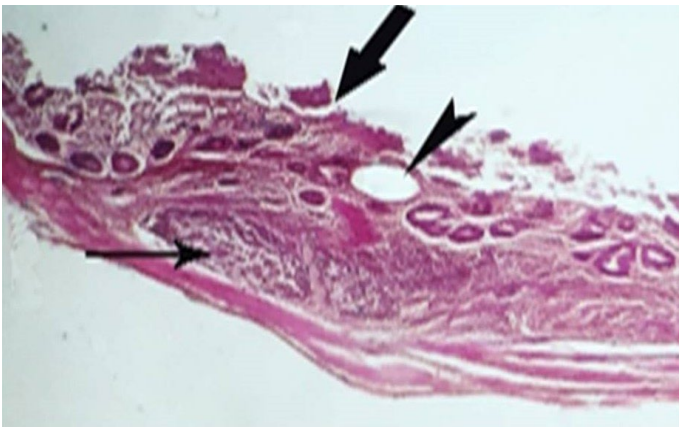


Fig. 6. Caecum of experimentally infected broilers on the 18th day of infection showing complete destruction of intestinal mucosa (thick arrow) in addition to cystic dilation of some sub mucosal glands (arrowhead) and lymphoid depletion from submucosal lymphatic tissue (thin arrow) (H&E x400).

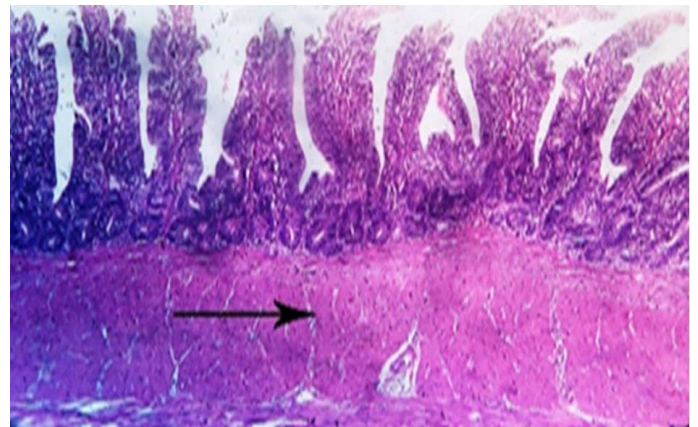


Fig. 9. Caecum of experimentally infected broilers toltrazuril was treated on the 18th day of infection showing thickness of muscularis mucosa (arrow) with mild congestion of submucosal blood vessels (H&E x 400).

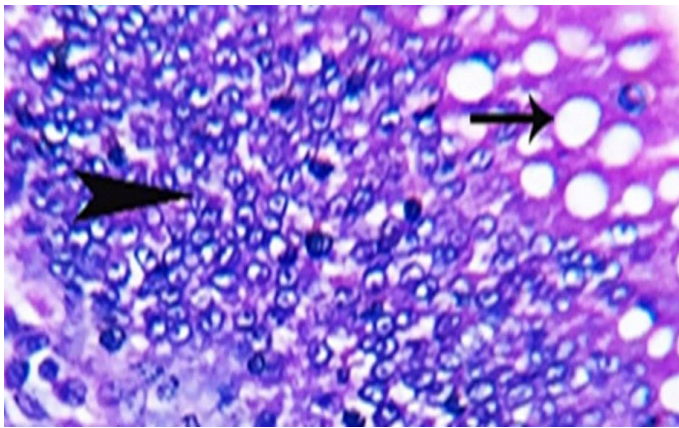


Fig. 7. Small intestine of experimentally infected broilers on the 18th day of infection show mucinous degeneration of enterocytes in addition to spreading of numerous developmental stages of *E. tenella*(a-arrowhead) (H &E x 1200).

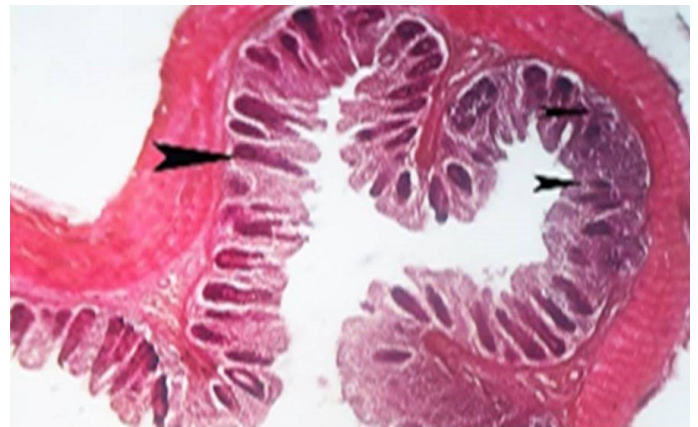


Fig. 10. Caecum of experimentally infected broilers garlic treated on the 8th day of infection showing atrophy of some submucosal intestinal glands (arrowhead) (H&E x 200).

Caecum of experimentally infected broilers toltrazuril treated on the 18th day of infection show thickness of muscularis mucosa with mild congestion of submucosal blood vessels (Fig. 9). Caecum of experimentally infected broilers treated with garlic on the 8th day of infection showing atrophy of some submucosal intestinal glands (Fig. 11). Caecum of experimentally infected broilers garlic treated on the 18th day of infection show leukocytic cells infiltrate submucosa in addition to partial inter glandular hyalinization (Fig. 11). Small intestine of experimentally infected group treated with toltrazuril and half dose of garlic on the 8th day of infection show mucinous degeneration of villus enterocytes within intestinal mucosa (Fig. 12).

Caecum of experimentally infected group treated with toltrazuril and a half dose of garlic on the 18th day of infection show apparently normal mucosa, submucosa and muscularis mucosa with serosa (Fig. 13).

DISCUSSION

Chicken infected with *E. tenella* revealed several clinical signs such as loss of appetite, depression, ruffled feathers, dropped wings and bloody diarrhea. Similar results were previously reported (Ahmed, 2004) in broilers suffering from coccidiosis. Our results were in complete harmony with those reported by Walk *et al.* (2011) who observed that, coccidiosis in chicken induced

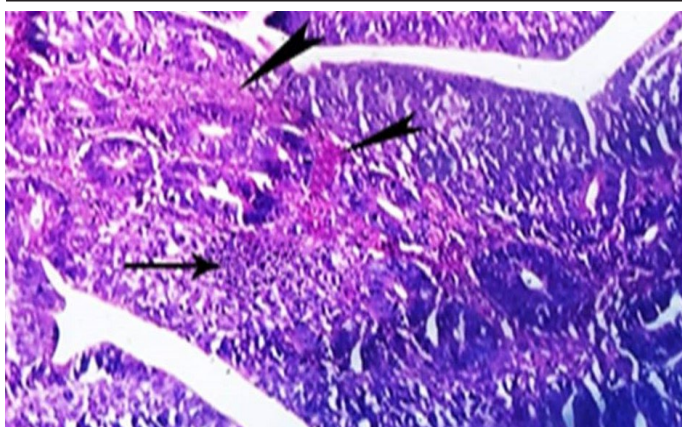


Fig. 11. Caecum of experimentally infected broilers garlic treated on the 18th day of infection show leukocytic cells infiltrate submucosa (arrow) in addition to partial inter glandular hyalinization (arrowhead) (H&E x 800).

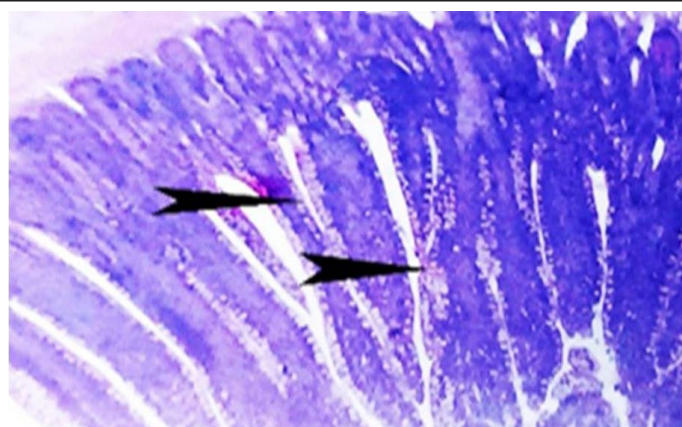


Fig. 12. Small intestine of group (5) on the 8th day of infection shows mucinous degeneration of villus enterocytes within intestinal mucosa (head arrow) (H&E x 400).

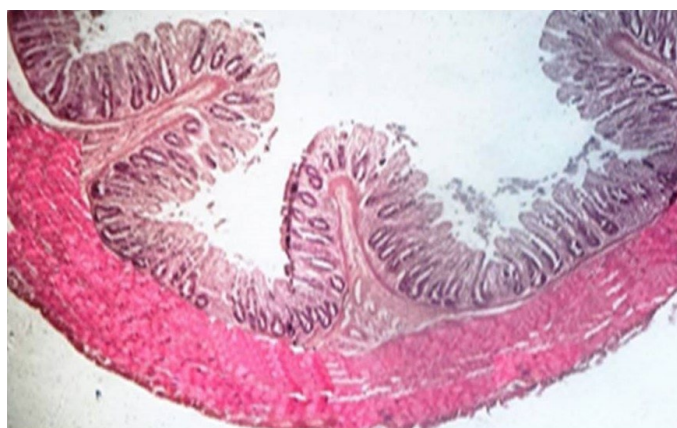


Fig. 13. Photomicrograph of caecum of group (5) on the 18th day of infection show apparently normal mucosa, submucosa and muscularis mucosa with serosa (H&E x 400).

clinical sign as depression inappetence, ruffled feather and retarded growth. Our results were also supported by previous researches of Eid *et al.* (2004) who stated that coccidiosis in broilers induced general weakness, ruffled feather, and retarded growth. Treatment of experimentally infected broilers with toltrazuril or garlic alone and together lead to disappearance of the clinical signs. Same observation was reported previously by El-Banna *et al.* (2005) in broilers suffering from coccidiosis and treated with toltrazuril. In addition, Nasr *et al.* (2021) mentioned that quails infected with *E. tenella* treated with toltrazuril for controlling coccidiosis showed disappearance of clinical signs. Our observations were also in agreement with that reported by Hussein *et al.* (2021) who stated that toltrazuril has effective action against coccidiosis in broilers and led to disappearance of the clinical signs. The anticoccidial effect of garlic might be due to its immunostimulatory activity leading to disappearance of the clinical signs (Adjei and Atuahene, 2023).

The results of the present study revealed a significant reduction in the body weight, weight gain, feed consumption and elevation in the feed conversion rate in broiler chicks infected with coccidiosis. Such effects might be due to the disruption of the intestinal integrity, which affected the absorption of nutrients and the efficiency of feed utilization, these being common effects of coccidiosis (Walk *et al.*, 2011). Coccidiosis in broiler chickens induced similar adverse effect and reduction in the body weight gain and increase in feed conversion rate (El-Banna *et al.*, 2005). Same findings were also recorded by Soutter *et al.* (2021), who recorded a reduction in the body weight gain and increase in the feed conversion rate. Similarly, Eckert *et al.* (2021) concluded that coccidiosis in broilers induced reduction in body weight gain and feed efficiency. Same reduction in body weight, weight gain and increase in FCR were reported previously by Taylor *et al.* (2022) in

broilers suffering from coccidiosis.

Treatment of infected broilers with toltrazuril or garlic either alone or together showed improvements in body weight gain and FCR compared with the experimentally infected and non treated group. These improvements in body weight might be due to the anticoccidial effect of toltrazuril. Our results were supported by the previous studies of Rashid *et al.* (2009) who mentioned that toltrazuril has anticoccidial effect and improved the body weight gain and feed conversion rate. Similarly, El-Banna *et al.* (2005) mentioned that toltrazuril has a good effect in the treatment of coccidia in broiler chickens and could improve the body performance. In addition, Fayed *et al.* (2011) mentioned that dietary garlic supplementation improved body performance, feed intake and body weight in broilers suffering from coccidiosis. This might be due to the presence of allicin which helps in the improvement and regeneration of the physiological structure of the intestinal epithelial layers, and improve feed absorption (Adibmoradi *et al.*, 2006). Broilers infected with coccidiosis and treated with garlic showed improvement in feed intake, body weight and feed conversion ratio (Majid *et al.*, 2019). Same improvement in the body performance was observed previously by Adjei and Atuahene (2023) who stated that supplementation of garlic in coccidiosis-infected broilers improved weight gain and feed efficiency.

Concerning to the effect of *E. tenella* on blood picture in broiler chickens, our results revealed a significant decrease in RBCs, Hb, PCV%, Platelet, MCHC beside a significant increase in MCV, and MCH. Such results agreed with Fukata *et al.* (1997) who reported that *E. tenella* infection induced significant decreases in the total RBCs, Hb, and PCV%. Reduction in erythrogram in chickens suffering from coccidiosis might be due to hemorrhage caused by the disease or severe bleeding and tissue damage in mucosal surface of the intestine occurred at the acute stage of in-

festation (Eid *et al.*, 2004). Broiler chickens infected with *E. tenella* revealed similar decreases in RBCs, Hb and PCV%, beside significant increases in MCV, and MCH (Patra *et al.*, 2010). Coccidiosis induced a significant decrease in RBCs count, Hb content, PCV and MCHC with a significant increase in the MCV. These changes in erythrogram might be due to severe bleeding (Mohammed, 2012). Same changes in hemogram were recorded previously by Adamu *et al.* (2013) in chickens infected with *E. tenella*. Our results approved with Rehab (2017). Melkamu *et al.* (2018) also stated that coccidiosis in chickens induced significant decreases in the total RBCs, Hb, and PCV%, but infected broilers treated with toltrazuril or garlic either alone or with a half dose of garlic revealed non-significant decreases in RBCs, Hb, and PCV%, Platelet, MCHC beside non-significant increases in MCV, and MCH. Sokoł *et al.* (2014) reported that toltrazuril was effective in treatment of coccidiosis in Japanese quails. Garlic has anticoccidial effect due to its immunostimulatory activity and leading to an improvement blood picture (Adjei and Atuahene, 2023).

Our results showed that infected broilers with *E. tenella* revealed significant decrease in serum catalase and increase in MDA thought out the experimental period post infection compared with the healthy broilers. These results were agreed with Nasr *et al.* (2021) mentioned that quails infected with *E. tenella* showed a significant decrease in CAT and significant increase in MDA compared with the healthy group. Similar results were also reported by Pajic *et al.* (2019) who found that broiler chickens suffering from coccidiosis showed reduced CAT and elevation in MDA activity due to the excess of peroxides. The higher blood MDA in the infested birds is probably due to the oxidative stress occurring after infestation (Georgieva, 2005).

The recorded results in the current investigation revealed that infected broilers treated with toltrazuril showed a significant decrease in serum catalase and increase in MDA thought out the experimental period compared with the control broilers. Similar results were previously reported by Ramadan *et al.* (1997) who noticed that toltrazuril protected chickens from clinical coccidiosis and improved antioxidant enzymes. These results coincide with that previously cited by Grief (2000) who stated that toltrazuril is effective against all stages of the *Eimeria* species such as schizogony and gametogony stages and could improve CAT and MDA. Likely, Nasr *et al.* (2021) mentioned that Japanese quails infested with *E. tenella* and treated with toltrazuril induced improvement in CAT and MDA activity compared with the healthy group. Improved levels of MDA and CAT in broilers infected with *E. tenella* and supplemented with garlic might be due to the antioxidant properties of garlic, which causes oxidative stress against parasites and neutralize oxygen reactive species (Allen *et al.* 1998). Supplementation of garlic to broilers suffering from coccidiosis could induce in improved MDA and antioxidant enzymes due to presence of bioactive compounds that have anti-inflammatory and antioxidant properties (Adjei and Atuahene, 2023).

Infected broilers with coccidiosis induced several pathological lesions in the small intestine represented by ruptured villi, diffuse haemorrhage, caecum showed thickness of muscularis mucosa, mild congestion in submucosal. Similar microscopical lesions were observed by Teixeira *et al.* (2004) who found that coccidiosis induced villus erosion, hyperplasia of the crypts of Lieberkuhn. Same pathological lesions were observed previously by Assis *et al.* (2010) who stated that coccidiosis induced many gross and microscopical lesion in the intestine. Also, Mohammad (2012) stated that *Eimeria* species infection in Japanese quails induced villus erosion and necrosis in intestine. In addition, Davou *et al.* (2018) showed hyperplasia of epithelial cells, constriction of intestinal gland cavities in the small intestine and caecum in broilers infected with *E. tenella*. Similar lesions were observed by Ujvala *et al.* (2019) in turkey coccidiosis.

Treatment of coccidiosis in broilers by toltrazuril or garlic either alone or together show less lesions as mild congestion of the intestinal submucosa. Small intestine showed mild degeneration of villus within intestinal mucosa of the infected broilers. Birds treated with toltrazuril and a half dose of garlic showed appar-

ently normal mucosa, submucosa and muscularis mucosa with serosa. Caecum of infected broilers treated with garlic showed atrophy of submucosal intestinal glands. Improvement in the intestinal lesion was observed post treatment in turkeys suffering from coccidiosis and treated with Toltrazuril (Greuel *et al.* 1991). Similar results were previously recorded by Hussein *et al.* (2021) who stated that toltrazuril has effective action against coccidiosis in broilers and revealed less pathological lesions. Same pathological lesions were recorded by Nasr *et al.* (2021) in broiler chickens infected with *E. tenella* treated with toltrazuril. Broilers suffering from coccidiosis treated with garlic showed marked improvement and regeneration of the intestinal epithelial layer structure (Adibmoradi *et al.*, 2006). The obtained results agreed with Majid *et al.* (2019) who mentioned that broilers suffering from coccidiosis and treated with garlic revealed reduction in the lesion score and histopathology of the small intestines.

CONCLUSION

E. tenella infection in broiler chicks induce adverse effects on the body performance, erythrogram, and pathological changes. However, toltrazuril and garlic could help in the recovery of the clinical signs, and improve body performance, and the pathological effects.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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