

Studies On Effect Of Salmonella Pullorum In Balady Chicks And Its Treatment With Doxycycline

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ABSTRACT

In this study the adverse effect of Salmonella pullorum on body performance, immuno-biochemical and pathological alterations in balady chickens with treatment. A total of 100 cloacal swabs (50 from freshly dead chicks - 50 from chicks suffering from diarrhea) were collected from chickens in private locality in Sharkia Provence for isolation and identification of Salmonella spp, from infected chickens. Nine positive swabs for sale (9) were 4 single isolates {(S. enteritidis (1), S. typhimurium (1), S. pullorum, (2)} and 5 mixed isolates {(S. enteritidis + S. typhimurium, (1), S. enteritidis + S. pullorum, (1), S. typhimurium+ S. pullorum, (2)}. isolated Sale were sensitive to doxycycline. A total of 120, one day old balady chickens (60 healthy and 60 experimantally infected with S. pullorum) were divided into 4 groups, 1st group healthy chicks non infected non treated, 2nd group treated with doxycycline, 3rd group infected non treated and 4th group chicks infected and treated with doxycycline. Specimens from internal organ were taken for pathological changes and estimation of doxycycline residues.

Healthy chickens received doxycycline treated and sal infected chicks non treated showed significant reduction in phagocytosis, killing %, total protein, albumin, A/G ratio and significant elevation in total, α , β globulins, AST, ALT, ALP, uric acid, creatinine beside non significant reduction in eosinophil, basophil, monocyte and non significant increase in γ globulin. Healthy chickens received doxycycline showed significant decrease in heterophilis and significant increase in weight gain, lymphocyte beside non significant leukocytosis. Sal infected chicks showed clinical signs as ruffled feathers, emaciation, droppy wings, anorexia, diarrhea and dehydration, mortality rate was 20%. Significant reduction in body weight, lymphocyte and significant increase in leukocytosis and heterophilis. Salmnnellosis infected and treated chicks showed reduction in clinical signs, mortality rate decreased to 3.33 % and reduction in Sal re-isolation post treatment was recorded beside improve in immunological and biochemical parameter at 7th day post treatment. Doxycycline residues were detected in high levels in kidney followed by liver then breast muscle at 1st and 4th days post administration and completely disappeared from all tested tissues at 7th days post administration. Doxycycline residue and histopathological changes were studies

It could be concluded that *Salmonellosis* induce changes in biochemical parameters and doxycycline reduce severity of Salmonellosis and improvement of hepatorenal functions.

INTRODUCTION

Infections with bacteria of the genus Sal are responsible for major problem of poultry farming in which is a major infectious disease of all ages of birds (1). Sal is enteric pathogen colonized the intestinal tract of poultry causes

heavy economic loss through mortality and induce several disease as pullorum disease, typhoid and paratyphoid (2). Salmonella spp. Is a Gram negative, short plump shaped rods, non sporeforming, non capsulated and aerobic organisms (3). The disease produced by Sal pullorum is called pullorum disease, also called

bacillary white diarrhea, acute and chronic septicemic in nature; mostly affect the growing stage (2-3 weeks of age) induces height mortality, reduced egg and meat production (4). Pullorum disease causes a high mortality rate among chicks, weakness and white diarrhea. Subacute, acute, or chronic clinical signs may be appeared (5). Salmonellosis induce catarrhal, hemorrhagic or necrotic enteritis, degeneration and necrosis of the hepatocytes and myocarditis (5).

Doxycycline is a semisynthetic tetracycline has broad spectrum activity against Gr+ve & Gr-ve bacteria (6), absorbed orally (7), inhibit protein synthesis in bacteria (8).

This study was planned to isolate and induce experimental Salmonellosis in chickens and study its effects on immuno-biochemical parameters and pathological effect beside its treatment.

MATERIAL AND METHODS

Bacteriological examination

A total of 100 cloacal swab (50 from freshly dead + 50 from diseased chickens) were collected under aseptic condition, inoculated into Selenite F broth and incubated at 37°C for 18 hr. Then, re-inoculated into MacConkey's agar media, incubated at 37°C for 24-48hr. Positive plates give pale colonies (9). Suspected colonies were selected for further morphological and biochemical identification (10).

Antibiotic sensitivity

Susceptibility isolated sal spp to antibiotics (Doxycycline, ceftiofur sodium, Florfenicol, Ciproflo-fxacin, Gentamycin, Amoxycycline and Neomycine) were tested by disc diffusion methods (11).

Experimental chickens

A total of 120, one day old balady chicks were obtained from local hatchery in Sharkia Provence were used in this trial. Chickens

proved free from sal pullorum by bacteriological examination used in this study. Chickens were fed balanced starter fresh ration from Kahar Company and clean drinking water ad-libitum.

Sal pullorum titration

Sal pullorum used in this study was isolated from freshly dead and diseased chickens, identified and used in this study (11). At 21th day of age 50 chickens were infected by Sal pullorum (1×10^4 CFU) via crop was titrated according (12).

Experimental design

Chicks were divided into 4 groups (30 each). 1st group, healthy chicks non infected non-treated, 2nd group healthy chicks treated with 10 mg doxycycline/ kg B.wt. in drinking water for 5 consecutive days, 3rd group infected chicks and non treated and 4th group chicks infected and treated with 10mg doxycycline/kg B.wt. in drinking water for 5 consecutive days. Five chicks from each group were slaughtered at 1st, 7th and 15th day post treatment 2 blood samples. 1st samples were taken on anticoagulant for total and differential leukocytic count according (13), phagocytic % (14) and killing %. (15). the 2nd sample was used for obtain clear sera were separated for estimation AST and ALT (16) ALP (17), total proteins (18), protein fraction (19) uric acid (20) and creatinine (21).

Re-isolation of Sal pullorum

Sterilized cloacal swabs were taken from all chicks post treatment. For re-isolation of sal pullorum

Body weight

From each group 5 chicks were weighted individually at the start of the experiment (21th day of age) and at 1st day post treatment (28th day of age) and the consumed diets were recorded, also, weight gain and feed conversion rate were calculated.

Histopathological examination

Specimens from liver, spleen, kidneys, heart, lung and intestine were collected from each sacrificed chickens and fixed in 10% neutral formalin buffer solution, paraffin sections of 4-5 micron thickness were

performed and stained with hematoxylin and eosin (H &E) examined microscopically (22)

Drug residues

Three chicks from treated group as well as from infected treated group were slaughtered at 1st, 4rd and 7th day post treatment. Samples were collected from breast muscles, liver and kidneys for doxycycline residues detection by bacteriological assay (23).

Statistical analysis: Obtained data was analyzed (24)

RESULTS

Bacteria isolated from collected swabs revealed 9 (9%) *Sal* spp in single isolates 4 (*Sal. enteritidis* (1) - *Sal typhimurium* (1) and *Sal pullorum* (2) while mixed isolate (5) were (*Sal enteritidis* + *Sal typhimurium* (1) - *Sal enteritidis* + *Sal pullorum* (2) and *Sal typhimurium*+*Sal pullorum* (2). Isolate *sal* were

doxycycline sensitive. Results of biochemical were recorded in tables (3-7)

Gross pathological lesions in infected chicks with *sal* were bronze discoloration and necrotic foci on liver, In addition to splenomegaly. pathological changes that appeared in internal organ of infected chicks with salmonellosis were congestion of hepatportal blood vessels and mild vacuolation of the hepatocytes (Fig.1), Moreover degeneration and necrosis of renal tubular epithelium (Fig.2), Oedema of blood vessels of spleen with leukocytic infiltration (Fig.3), Oedema of the cardiac blood vessels and leukocytic infiltration (Fig. 4), Necrotic and desquamated epithelial cells with leucocytes occlude the lumen of the intestine (Fig.5), Lung showed severe bronchitis with leukocytic infiltration, congested capillaries and desquamated epithelium (Fig.6). Healthy chicks received doxycycline showed coagulative, necrosis and extensive hemorrhages among the hepatic cells. (Fig7), Focal interstitial aggregation of lymphocytes and cloudy swelling and vacuolation in the renal tubular epithelia (Fig.8).

Table 1. Result of isolation of *Sal* from cloacal swab samples

Total swab	isolates	No	%	Isolates	No	%	Total +ve	
							No	%
100	Single isolate	4	4	<i>Sal enteritidis</i>	1	11.11	9	9
				<i>Sal typhimurium</i>	1	11.11		
				<i>Sal pullorum</i>	2	22.22		
	Mixed isolate	5	5	<i>Sal. enteritidis</i> + <i>Sal. typhimurium</i>	1	11.11		
				<i>Sal. enteritidis</i> + <i>Sal. pullorum</i>	2	22.22		
				<i>Sal typhimurium</i> + <i>Sal pullorum</i>	2	22.22		

Table 2. Result of sensitivity test for *Salmonella* Spp. from chickens origin to antibiotics

Antibiotic disc	Mark of sensitivity disc	Disc-potency (ug)	Inhibitory Zone(mm)	Sensitive
Doxycycline	DX	30	19	+++
Ceftiofur sodium	CF	30	19	+++
Florfenicol	FF	30	19	+++
Ciprofloxacin	CF	5	16	++
Gentamycin	Gm	10	15	++
Amoxycylline	AM	30	15	++
Neomycine	NM	30	12	+

Table 3. Result of salmonellosis on mortality and reisolated sal of chicks

Groups	Parameters	Total No	Mortality rate		Reisolated Sal post treatment (day)		
			No	%	1	7	14
Healthy Chickens	Control	30	00	00	0.00	0.00	0.00
Diseased Chickens	treated	30	00	00	0.00	0.00	0.00
	Non treated	30	6	20	30/30	30/30	30/30
	treated	30	1	0.3	5/30	5/30	5/30

Table 4. Body performance of healthy and diseased balady chicks (Mean ± S.E.)

Parameter	Healthy chicken		Diseased chicken	
	Control	Treated	Non treated	Treated
B.W at start of exponent (gm) (21 th days of age)	209.08± 3.75	207.05± 2.43	205.44± 5.38	201.48± 2.17
Weight at 1 st day PT (28 th day of age) (gm)	427.42± 8.10	455.31± 8.21*	402.42± 7.12*	418.18± 6.73
Body weight gain (gm/ chick)	218.34± 8.07	248.26± 9.66*	196.98± 5.31*	216.70± 7.48
Feed consumption (gm/ chick)	415.4	429.43	394.53	420.42
Feed conversion rate	1.90	1.73	2.04	1.94

B.W = body weight PT= post treatment * Significant at P < 0.05

Table 5. Total and diferential leukocytic count in balady chicks (Mean ± S.E.)

Parameter	Healthy		Non treated	Diseased balady chicken			
	control	treated		Day post treatment			
			1 st day	7 th day	15 th day		
TWCs (10 ³ /cmm)	11.49±0.19	11.14± 0.24	12.15± 0.15*	11.67± 0.10	11.14± 0.30	11.44± 0.42	
Diferential leukocytic count 10 ³ /cmm)	Lymphocyte	3.72± 0.13	4.18± 0.15*	3.30± 0.10*	3.35± 0.08*	3.40± 0.19	3.70± 0.25
	Neutrophil	2.62± 0.24	1.93± 0.14*	3.80± 0.31*	3.30± 0.20*	2.64± 0.43	2.60± 0.17
	Eosinophils	1.84± 0.13	1.82± 0.18	1.80± 0.11	1.81± 0.16	1.82± 0.19	1.83± 0.28
	Basophils	1.72± 0.10	1.70± 0.16	1.70± 0.12	1.70± 0.25	1.71± 0.17	1.73± 0.21
	Monocyte	1.59± 0.12	1.51± 0.19	1.55± 0.27	1.56± 0.19	1.57± 0.14	1.58± 0.18
	Phagocytosis	6.49 ± 0.63	4.42± 0.38*	4.14± 0.52*	5.40± 0.22	5.85± 0.59	5.98± 0.28
	Killing %	30.05± 1.07	25.16± 1.45*	24.03± 1.97*	25.98± 1.29*	28.04± 1.43	29.16± 1.84

* Significant at P < 0.05

Table 6. Some biochemical parameters in healthy and diseased chicks (Mean \pm S.E.)

Parameter	Healthy chicken			Diseased chicken			
	control	treated	Non treated	Day post treatment			
				1 st day	7 th day	15 th day	
Protein Picture (mg/dl)	T.Protein	6.48 \pm	5.68 \pm	5.70 \pm	5.80 \pm	6.19 \pm	6.45 \pm
		0.25	0.27*	0.21*	0.16*	0.31	0.42
	Albumin	3.65 \pm	2.60 \pm	2.51 \pm	2.84 \pm	3.34 \pm	3.58 \pm
		0.31	0.17*	0.38*	0.17*	0.42	0.31
	α	0.59 \pm	0.71 \pm	0.69 \pm	0.63 \pm	0.60 \pm	0.61 \pm
		0.03	0.03*	0.02*	0.03	0.06	0.10
	β	0.68 \pm	0.79 \pm	0.85 \pm	0.74 \pm	0.69 \pm	0.69 \pm
		0.04	0.03*	0.06*	0.04	0.03	0.03
	γ	1.56 \pm	1.58 \pm	1.65 \pm	1.59 \pm	1.56 \pm	1.57 \pm
		0.10	0.13	0.18	0.16	0.16	0.16
total	2.83 \pm	3.08 \pm	3.19 \pm	2.96 \pm	2.85 \pm	2.87 \pm	
	0.10	0.19	*0.12	0.20	0.17	0.24	
A/G ratio	1.29 \pm	0.84 \pm	0.79 \pm	0.96 \pm	1.17 \pm	1.19 \pm	
	0.11	0.12*	0.13*	0.10*	0.26	0.31	
Liver enzymes (U/L)	AST	38.06 \pm	41.21 \pm	42.52 \pm	40.53 \pm	38.72 \pm	38.36 \pm
		0.95	0.74*	0.98**	0.43*	0.81	0.63
	ALT	58.30 \pm	61.26 \pm	61.78 \pm	59.84 \pm	58.84 \pm	58.74 \pm
		0.89	0.43*	0.60**	0.17*	0.54	0.43
	ALP	64.17 \pm	67.31 \pm	69.06 \pm	65.94 \pm	64.60 \pm	64.53 \pm
		0.95	0.63*	0.74**	0.23*	0.53	0.60
Kidney Function (mg/dl)	Uric acid	5.13 \pm	6.85 \pm	6.60 \pm	6.7 \pm	5.52 \pm	5.40 \pm
		0.64	0.32*	0.10*	0.14*	0.49	0.58
Creatinine	1.02 \pm	1.54 \pm	1.48 \pm	1.40 \pm	1.14 \pm	1.11 \pm	
	0.12	0.18*	0.11*	0.10*	0.14	0.19	

* Significant at P < 0.05

** Significant at P < 0.01

Table 7. Doxycycline residues (μ g/gm) in chicks tissues. (n=3)

Days post treatment	Healthy chicks doxycycline treated			Diseased chicks doxycycline treated		
	Liver	Kidney	Breast muscle	Liver	Kidney	Breast muscle
1	1.80 \pm	2.56 \pm	1.48 \pm	1.63 \pm	2.78 \pm	1.59 \pm
	0.16	0.18	0.13	0.25	0.21	0.20
4	0.38 \pm	0.51 \pm	0.26 \pm	0.45 \pm	0.69 \pm	0.32 \pm
	0.09	0.06	0.07	0.17	0.14	0.15
7	00	00	00	00	00	00

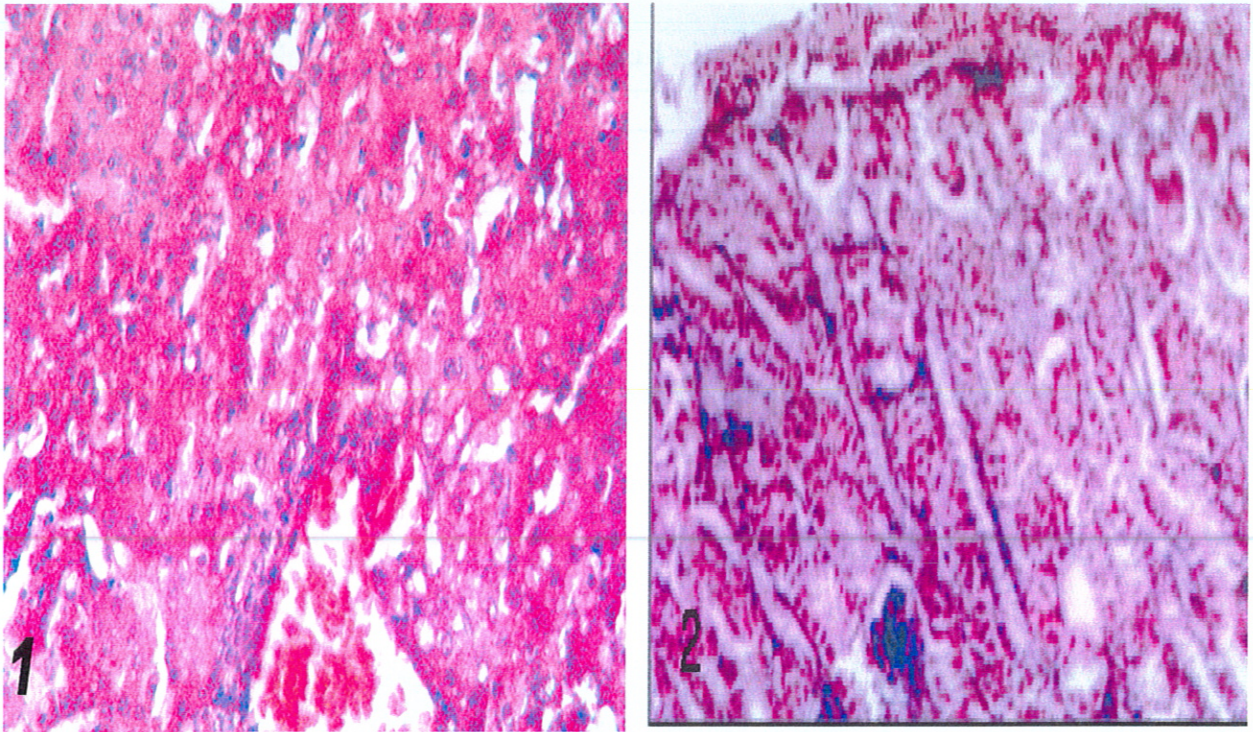


Fig. 1. Section in the liver of infected chicks with *Salmonella Pullorum* showing congestion in the hepatoportal blood vessels and mild vacuolation of the hepatocytes (H&E stain x 400).

Fig. 2. Section in the Kidney of infected chicks with *Salmonella Pullorum* showing degeneration and necrosis of tubular epithelial cells with granular eosinophilic cytoplasm. (H&E, stain x120).

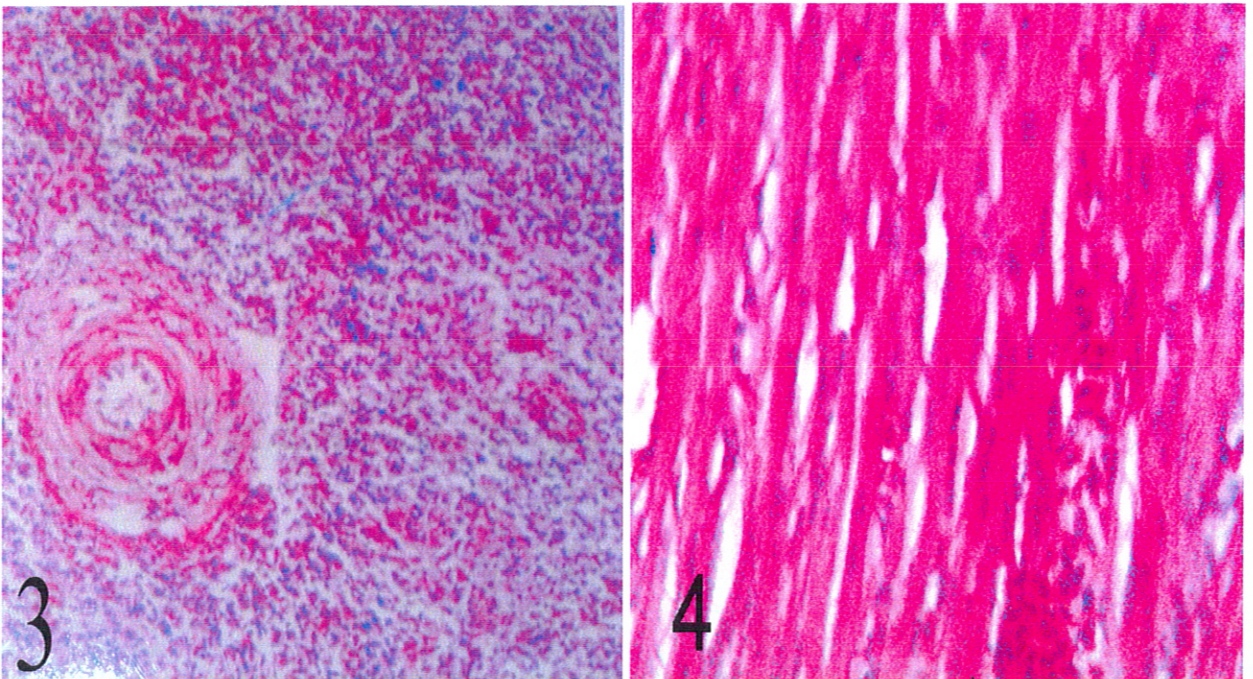


Fig. 3. Section in the spleen of infected chicks with *Salmonella Pullorum* showing oedema in blood vessels with leukocytic infiltration. (H&E stain X 1200)

Fig. 4. Section in the heart of infected chicks with *Salmonella Pullorum* showing perivascular edema and few round cells infiltrations. Congestion of the cardiac blood vessels and extravasated erythrocytes among the cardiac muscles were seen (H&E stain x 400).

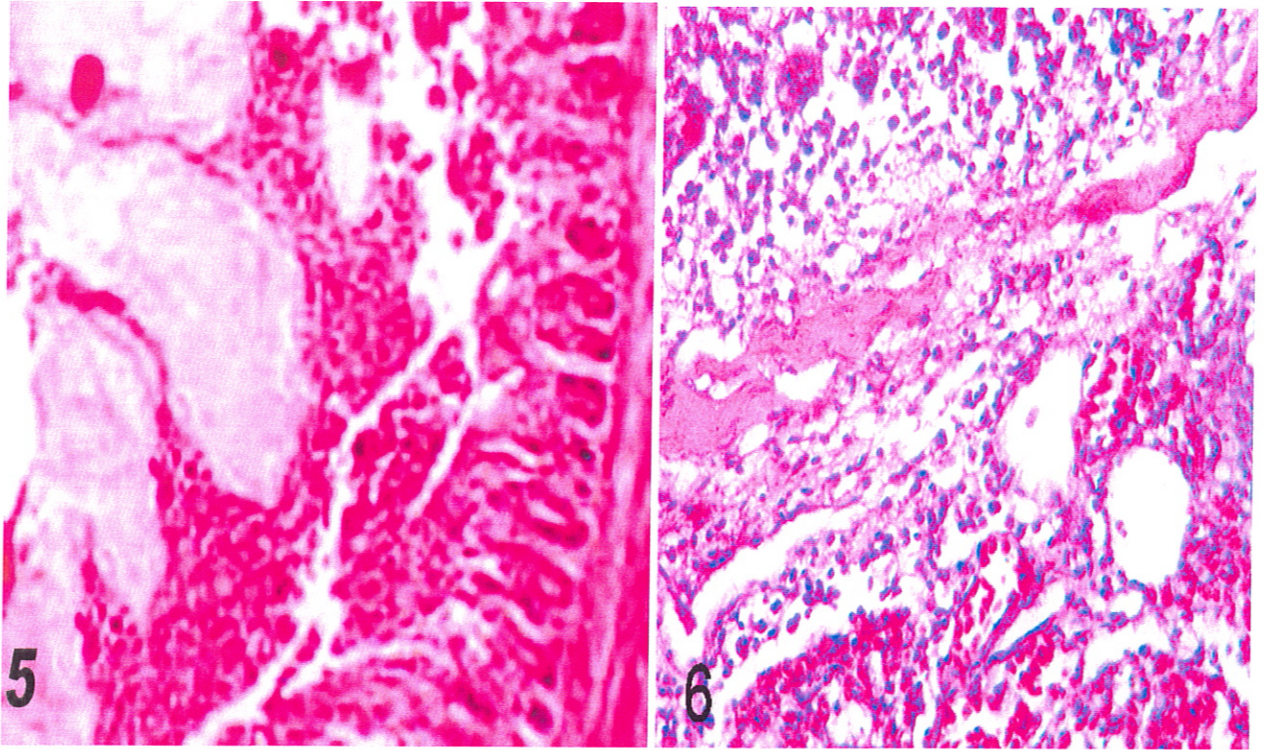


Fig. 5. Section in the intestine of infected chicks with *Salmonella Pullorum* showing necrotic mass and desquamated epithelial cells and leucocytes in the lumen (H&E stain x 400).

Fig. 6. Section in the lung of infected chicks with *Salmonella Pullorum* showing severe bronchitis with leukocytic infiltration, congested capillaries and desquamated epithelium (H&E stain x 400).

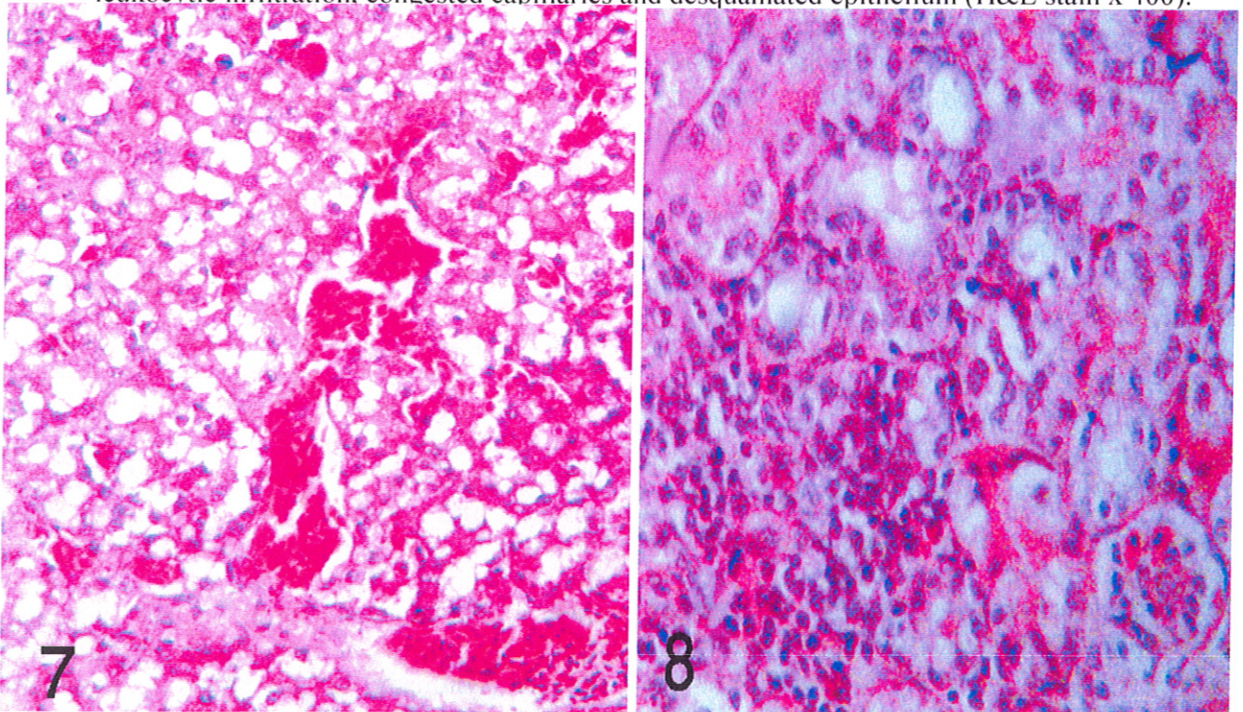


Fig. 7. Section in the liver of healthy chicks treated with doxycycline showing coagulative, necrosis and extensive hemorrhages among the hepatic cells (H&E stain x 400).

Fig. 8. Section in the Kidney of healthy chicks treated with doxycycline showing focal interstitial aggregation of lymphocytes and cloudy swelling and vacuolation in the renal tubular epithelia (H&E stain x 400).

DISCUSSION

Bacteriological examination of collected cloacal swaps revealed isolated *Sal spp.* 9(9%) distributed as 4 single isolates { *Sal. enteritidis* (1) - *Sal typhimurium* (1) and *Sal pullorum* (2)} while 5 mixed isolates were {*Sal enteritidis* + *Sal typhimurium* (1) - *Sal enteritidis* + *Sal pullorum* (2) - *Sal typhimurium* and *Sal pullorum* (2)}. Same prevalence was reported (25). Prevalence of isolated sal from chick was varying 1.7-28.6% (26) and 16.10%. (27)

Disc diffusion test revealed that isolated *Sal spp* was sensitive to doxycycline This finding was supported by (28) stated doxycycline is active against *Salmonella spp.*

The result obtained in this study revealed that most common clinical signs appeared in the infected chicks with *sal pullorum* were ruffled feather, emaciation, droopy wings, anorexia, close eyes, watery diarrhea, dehydration, decreased body weight and mortality rate was 20%. Similar clinical signs were recorded (29) in chickens infected with *sal pullorum*. *Salmonellosis* induce mortality vary from 10-80% (30) and reduction in body weight in duckling (31). Reduction in body weight may be due to deleterious effect of *sal pullorum* (32).

Oral administration of doxycycline to healthy chicks resulted in significant increase in body weight, weight gain and improvement in feed conversion rate. This results may be due to antimicrobials induce increase in growth rate in growing chicks, increase body weight gain and improved feed conversion rate through inhibiting pathogenic organisms which damage gut epithelium impairing food absorption (33).

The present investigation declared that doxycycline induce significant decrease in heterophil, phagocytosis, killing % coupled with insignificant reduction in leukocytic count, eosinophil, basophil and monocyte in healthy chickens but *Sal pullorum* induce significant leukocytosis, neutrophils, lymphopenia and insignificant decrease in eosinophil, basophile, monocyte coupled with significant decrease in phagocytosis and

killing %. Elevation in leukocytic count may be due to the response of the chicks to infectious agent. Same data are recorded (34) in healthy chicks received doxycycline. doxycycline induce insignificant reduction in leukocytic count, monocyte, eosinophil, basophil beside significant lymphocytosis and heteropenia (35). Same change in leukogram was recorded (36) in chick salmonellosis. Leukocytosis in diseased chicks may be due to neutrophils, (37). Another authors stated leukocytosis may due to inflammatory response in gastrointestinal tract caused by bacterial infection (38). Inflammation stimulates migration of lymphocytes from blood and lymphoid tissues to inflammatory site led to reduction in lymphocytes ((39). *Sal pullorum* induce decreased phagocytosis and killing % (40).

The result obtained in this study revealed chickens either healthy doxycycline treated or suffering from *sal. pullorum* show a significant reduction in total protein, albumin and A/G ratio beside significant increase in total, α , β globulins and insignificant increase in γ globulins. Same results were reported (41) who stated that doxycycline induce significant reduction in total protein and albumin. Also (42) found that doxycycline was associated with significant increase in serum total, α and β globulins. This obtained result was similar to those recorded (43) who found that serum total protein was significantly decreased in chicks infected with *Sal pullorum*. A chicken infected with *sal pullorum* induces increase in α , β globulins (40). Reduction in total protein and albumin in chicken *sal pullorum* may be due to hepatic damage because liver is a main site for albumin production (44) and/ or due to anorexia and malabsorption of nutrients from inflamed intestine (45). Hypoalbuminemia in diseased chick due to destructive effect of bacteria and bacterial toxin on the liver cells which is the main sources of albumin and protein synthesis in the body (46). Same change in protein picture was recorded (29) in chicks infected with *sal pullorum*

The present investigation declared healthy chickens received doxycycline or

diseased one showed significant elevation in AST, ALT, ALP, uric acid and creatinine. Same changes were observed (47) in healthy mice received doxycycline. *Sal pulorum* induces elevation in liver enzymes uric acid and creatinine (29). These results were confirmed by pathological lesions where oedema, lymphocytic proliferation in portal area, degeneration and necrosis of renal tubular epithelial cells. Same changes in liver and kidney were recorded (48) in chicks infected with *Sal. Gallinarum*. Elevation in ALT may be due to liver dysfunction due to liver damage by the effect of the infectious agent toxins (49). Same finding was obtained (29) in chickens infected with *sal pulorum*. Same observation was recorded (50) found that infection by bacteria as *Sal spp* induce elevations in AST, ALT and ALP.

It is clear from the present study that doxycycline residues were found in liver, kidney and breast muscle at 1st and 4th days post treatment and completely disappeared from all examined tissues at 7th days post dosing and the residue was high in kidney followed by liver then breast muscle. Our finding agreed with that reported in chickens (51) who stated that the highest doxycycline residue was found in kidney followed by liver and lowest residues in breast muscle. Doxycycline residue was detected in the broiler muscle up to 5 days of administration (52). Doxycycline residue was present in liver, kidney and muscle up to 5 day post dosing (53). Similar results were recorded (54) who stated doxycycline was eliminated from kidney and liver after 4 days and present in muscle up to 5 days post dosing

Gross lesions in diseased chickens were friable and bronze discoloration with white necrotic foci in liver. Spleen was enlarged. Intestine showed various grades of enteritis with mucous in the lumen. These findings were supported by (55). The microscopic lesions recorded in the present investigation were almost similar to the lesions recorded by (56, 57 and 58).

It could be concluded that chickens infected with *sal pullorum* induced some

immunobiochemical changes and pathological adverse effect; the adverse effects were returned to normal levels at 7th days post doxycycline treatment.

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الملخص العربي

دراسات على تأثير السالمونيلا بلورم في الكتاكيت البلدى وعلاجها بالدوكسى سيكلين

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تم استخدام عدد ٦٠ كتكوت بلدى لدراسة تأثير الاصابه بالسالمونيلا على معدل النمو بعض التغيرات المناعيه والبيوكيميائيه وتأثيرها على الاعضاء الداخليه باثولوجيا. تم تجميع عدد ١٠٠ مسحه من فتحة المجمع (٥٠ كتكوت - ٥٠ كتكوت تعاني من وجود اسهال) من اماكن مختلفه بمحافظه الشرقيه لعزل السالمونيلا. بالفحص البكتريولوجي وجد ٩ مسحه من ١٠٠ تم عزل ميكروب السالمونيلا . وبالتعرف على السالمونيلا المعزوله بالشكل الظاهري للمزارع البكتريه والاختبارات البيوكيميائيه وجد عدوى منفردة ٤ (سالمونيلا انتريديس (١) ، سالمونيلا تيفموريم (١) وسالمونيلا بلورم (٢) وعدوى مشتركة ٥ (سالمونيلا انتريديس مع سالمونيلا تيفموريم (١) - سالمونيلا انتريديس مع سالمونيلا بلورم (٢) - سالمونيلا تيفموريم مع سالمونيلا بلورم (٢) وبعمل اختبار الحساسيه لهذه المعزولات وجد أن السالمونيلا حساسه للدوكسى سيكلين.

تم إجراء هذا البحث على عدد ١٢٠ كتكوت بلدى عمر يوم واحد خاليه من اى اصابات بكتريه، تم عمل عدوى اصطناعيه بالسالمونيلا بلورم لعدد ٦٠ كتكوت. تم تقسيم الكتاكيت الى اربع مجموعات متساويه. الأولى كتاكيت سليمه ظاهريا واكلينيكا ولم تعالج باي أدوية(ضابطه). الثانية كتاكيت سليمه وتم اعطائها ١٠ مجم دوكسى سيكلين/كجم من وزن الجسم فى مياه الشرب لمدة خمس أيام متتاليه. الثالثه كتاكيت مصابه ولم تعالج. الرابعه كتاكيت مصابه وتم علاجها باستخدام ١٠ مجم دوكسى سيكلين/كجم من وزن الجسم فى مياه الشرب لمدة خمس أيام متتاليه. تم دراسة كفاءه الدوكسى سيكلين وذلك بالاعتماد على اختفاء الأعراض المرضية، عدد الوفيات، التأثير على معدل النمو ومعدل استهلاك العلف ومعدل التحويل الغذائي. تم ذبح عدد ٥ كتكوت من كل مجموعه عند ٧، ١٥ و ٢١ يوم بعد نهايه العلاج وتم تجميع عينتين دم من كل كتكوت لقياس بعض الوظائف المناعيه ووظائف الكبد والكلى. وتم اخذ عينات من الكبد، الكلى وعضلات الصدر لتعيين بقايا الدوكسى سيكلين. تم اخذ عينات من الاعضاء الداخليه للكتاكيت المذبوحه والناطقه لدراسة تأثير السالمونيلا على تلك الاعضاء باثولوجيا.

أظهرت النتائج ان الكتاكيت السليمه ومعالجه بالدوكسى سيكلين والمصابه ولم تعالج وجود نقص معنوي في قوه الالتهام والقتل، البروتين الكلى ، الزلال، A/G وزيادة معنوية في الجلوبيولين الكلى والفا، بيتا، ALT, AST, ALP، حمص اليوريك، والكرياتينين . كما أدى إلي نقص غير معنوي في الخلايا الحامضيه، الخلايا القاعديه والملتهمه الكبيره وزيادة غير معنوية في جاما جلوبيولين، كذلك الكتاكيت السليمه المعطاه الدوكسى سيكلين وجد نقص معنوى فى خلايا الهيتيروفيل، وزيادة معنويه فى وزن الجسم المكتسب ، الخلايا الليمفاويه وزيادة غير معنويه فى كرات الدم البيضاء. الاصابه بالسالمونيلا فى الكتاكيت ادت إلى ظهور أعراض مرضية وأدت إلى زيادة نسبة الوفيات الى (٢٠%) فى المجموعه المصابه والتي لم يتم علاجها) ونقص معنوى فى وزن الجسم المكتسب، الخلايا الليمفاويه وزيادة معنويه فى العدد كرات الدم البيضاء وخلايا الهيتيروفيل.

علاج الكتاكيت المصابه بالسالمونيلا بالدوكسى سيكلين ادى الى اختفاء الاعراض وقلل الوفيات الى ٣،٣٣ وقلل اعاده عزل السالمونيلا بجانب تحسن فى وزن الجسم واستهلاك العلف والوظائف المناعيه والكيميائيه عند اليوم ٧ من نهايه العلاج.

وقد دلت نتائج الدراسة على أن الدوكسى سيكلين له بقايا فى الأنسجة عند اليوم الاول والرابع واختفى عند اليوم ٧ بعد نهايه العلاج وكان أعلى تركيز للبقايا فى الكبد يليها الكلى ، واقلها كان فى عضلات الصدر

وبالدراسة الباثولوجية للاعضاء الداخليه للكتاكيت المصابه بالسالمونيلا وغير المعالج وجد احتقان بالاويعه الدمويه وانتشار للخلايا اللانهايبه بالخلايا الكبدية بالإضافة إلى التهابات مع تتركز فى الكبد والرئة والكلى والقلب والطحال والأمعاء. الكتاكيت المصابه وتم علاجها بالدوكسى سيكلين سجلت تغيرات باثولوجية طفيفة مما انعكس على الحالة الصحية للكتاكيت المعالجه ونسبة النفوق

من كل ما سبق نلاحظ أن استخدام الدوكسى سيكلين بالجرعة العلاجية له تأثير فعال فى علاج الإصابه بالسالمونيلا وأدى إلى اختفاء الأعراض الظاهرية وعودة الوظائف الحيويه إلى المستوى الطبيعى بعد العلاج ب ٧ يوم.