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Effect of *Yucca Schidigera* Extract on *Salmonella Enteritidis*-Infected Poultry Compared with Fosfomycin Drug

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Abstract

THE RESEARCH aimed to investigate the impact of *Yucca schidigera* extract on Salmonella enteritidis -infected poultry compared to the fosfomycin drug. 140 salmonella free chickens were classified into the first control-negative group and four Salmonella-infected groups at nine days old (1×10^8 CFU/ml) orally. The second group acts as a positive group, while the 3rd, 4th, and 5th groups were treated with fosfomycin, *Yucca schidigera* extract, and both of them, respectively. Fosfomycin was administered at 5 days post-infection at 14 days old for 5 days. Yucca extract was administered from day 1 until the end of the experimental period (42d). The re-isolation of salmonella from all treated groups after 35 days was negative. The fifth group showed normal liver function enzymes, urea, and creatinine; maintained albumin and globulin at normal levels from 14 to 35 days; and maintained normal total antioxidant levels. The fourth and fifth groups displayed highly significant levels of lysozyme at 21 days old, followed by a non-significant decrease at 28 and 35 days old and a decrease in relative fold changes of IL-6 compared with the second group. In the fifth group, the hemagglutination inhibition antibody titer was non-significantly higher at 21 and 28 days of age, and there was a significant increase at 35 and 42 days of age in comparison with the fourth group. Therefore, *Yucca schidigera* is a safe, effective, biocompatible, and cost-efficient alternative natural product that could be used for the treatment of salmonellosis by enhancing immune responses and activating antioxidative capacity.

Keywords: Chicken, zoonotic disease, Fosfomycin, *Yucca.*

Introduction

Salmonellosis is an important disease originating from Salmonella spp., gram-negative foodborne zoonosis bacteria. It enters the human food chain mainly from contaminated poultry carcasses, eggs, or faeces from seemingly healthy chickens, which are responsible for the pandemic *Salmonella enteritidis*. Salmonellosis is caused by non-typhoidal Salmonella enterica serotypes, which are typified by a self-limiting gastroenteritis syndrome that exhibits diarrhea, fever, and abdominal distress. Young chickens are more susceptible to Salmonella *enteritidis* than adult chickens [1,2].

The treatment of bacterial infections requires the use of potent antimicrobials. The European Medicines Agency has standardized and approved the use of fosfomycin. Fosfomycin (cis-1,2-epoxyphosphonic acid) is licensed for use in most domestic animals and is typically employed to treat infectious diseases in piglets and broiler chickens [3]. Fosfomycin has a distinctive chemical composition because it was isolated from the *Streptomyces fradiae* strain and is known as phosphonomycin. Recently, it was manufactured. Because it has a propyl group and an epoxide, it acts as a naturally occurring broad-spectrum bactericidal antibiotic [4].

Fosfomycin inhibits an enzyme-mediated process in the initial step of bacterial cell wall synthesis by inactivating the cytosolic N-acetylglucosamine enolpyruvyl transferase, preventing the formation of N-acetylmuramic acid (MurA) from N-acetylglucosamine and phosphoenolpyruvate, which facilitate formation of bacterial wall peptidoglycan

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chain. Fosfomycin inhibits MurA by attaching to the bacterial thiol group of a cysteine before β-lactams and glycopeptides act [5]. Fosfomycin could treat gram-negative bacteria, including Escherichia coli and Salmonella, as well as multidrug-resistant pathogens like vancomycin-resistant enterococci, methicillin-resistant Staphylococcus aureus, and penicillin-resistant Streptococcus pneumonia [6].

Antibiotic resistance is a global concern for poultry production. Recently, there has been a lot of focus on antibiotic alternatives in an attempt to provide safe and ecologically green additives to control pathogenic microorganisms [7,8]. *Yucca schidigera* (Agavaceae), an herbaceous plant, has been shown to improve feed efficiency, boost output, and lower ammonia emissions in chickens, all of which are health-promoting activities [9]. Furthermore, Yucca supplementation enhanced intestinal health, lowered pathogenic bacterial growth, and enhanced the absorption of vital minerals in broilers with antibacterial properties and immunomodulatory effects [10,11].

Our study attempted to develop a novel approach for treating salmonellosis by administering commercial *Yucca schidigera* powder extract and comparing its effect on *Salmonella enteritidis*-infected poultry to that of a fosfomycin drug.

Material and Methods

Ethical approval

The protocol and conduct of this experiment were reviewed and approved by the Animal Health Research Institute (AHRI), Agriculture Research Centre (ARC), Egypt. Moreover, approval number 72/24 was performed according to the guidance of the Egyptian Ethics Committee and in compliance with the NIH Guidelines for the Care and Use of Laboratory Animals.

Fosfomycin drug and Yucca schidigera

Fosfomycin (Adwiafos) was obtained from the ADWIA Company; 100 g of Adwiafos contained 25 g of Ca fosfomycin. It was administered orally in accordance with the company's instructions as 40 mg/kg body weight orally for five successive days. Commercial feed additive *Yucca schidigera* extract powder, obtained from IDPCO -Egypt, was mixed into feed using a mixer machine at a dose of 250 mg/kg ration [12].

Experimental chicks:

In this study, 150 one-day-old broiler chicks were employed from a Giza farm. Throughout the trial, the birds were given unlimited access to ration and water, and housed in separate sanitized cages. All birds received vaccination against Newcastle disease (ND) using Hitchner B1 vaccines on the 7th day, H5N2 influenza vaccine on the 10th day, infectious Bursal Disease Virus vaccine on the 14th day, and Lasota vaccine for ND on the 18th day of age.

Salmonella enteritidis

The *Salmonella enteritidis* strain was isolated from previously infected broilers [13]. Each chicken in the infected group was given 0.5 ml of saline containing 1×10^8 colony-forming units (CFU) of *Salmonella enteritidis* per ml orally at 9 days old.

Methods

In vitro antimicrobial sensitivity test

A disc diffusion test to assess antibiotic sensitivity was conducted. To compare the inhibition zones of the antibiotics fosfomycin, levofloxacin, oxytetracycline, thiamphenicol, ciprofloxacin, and spectinomycin (Oxoid, UK), Muller-Hinton broth, and agar were used. The National Committee for Clinical Laboratory Standards was followed to interpret the inhibition zone sizes [14].

Confirmation of salmonella-free chickens

Ten chicks were slaughtered on the day of arrival and the gut, yolk sac, spleen, liver, lung, and heart were cultured to confirm that the chickens were not infected with Salmonella.

Grouping design

A total of 140 chickens were classified into five groups: first control-negative group and four groups infected with *Salmonella enteritidis* at 9 days of age. The second group was considered the positive group, whereas the third, fourth, and fifth groups were treated with fosfomycin, *Yucca schidigera* extract, and both of them, respectively. The third and fifth groups were treated with fosfomycin at 14 days old (5^{th} day post infection) for 5 days. However, the fourth and fifth groups administered *Yucca schidigera* extract from day one old until the end of the experimental period (Table 1).

Clinical signs and mortality

Following the experimental infection, all birds were monitored daily for clinical symptoms and mortality.

Sampling, PM, and Re-isolation

Postmortem was examined on dead birds. Five birds were slaughtered in order to obtain their organs and blood after the clinical indications (5th day post infection, 14 days of age), throughout treatment (21, 28, and 35 days old), and at study end (42 days old) for biochemical and immunological investigation. The internal organs were inspected macroscopically for any lesions. Aseptic procedures were used to remove the liver, lung, heart, and intestine tissues to

re-isolate and identify Salmonella via bacteriological examination [15].

Laboratory analyses

Liver and renal function were investigated by measuring serum alanine amino transferase(ALT) and aspartate amino transferase (AST) enzyme levels and urea and creatinine levels on 21 and 35 days, whereas albumin, globulin, and total protein levels were estimated on 14, 21, 28, and 35 days [16]. Immunity evaluation by determining lysozyme activity was performed by dissolving 1% agarose in 0.06 M PBS (pH 6.3) with 500 mg/L Micrococcus lysodeikticus. The lysozyme concentrations were obtained from the logarithmic curve of the standard lysozyme [17]. A hemagglutination inhibition (HI) test of the Newcastle Disease Virus Vaccine (NDVV) was conducted in serum, and results were expressed as positive when hemagglutination was inhibited [18]. Total antioxidant activity was estimated using the colorimetric method with biodiagnostic kits (CAT. No. TA 2513). Molecular detection of liver interleukin-6 (IL-6) mRNA expression was performed by quantitative real-time PCR (RT-PCR) using a Ql Aamp RNae syMini kit (Qiagen, Germany, GmbH) for RNA extraction and oligonucleotide primers from Metabion (Germany), as listed in Table 2. Taqman (RT-PCR) analysis was performed using a Stratagene MX3005p real-time PCR machine. The CT of each sample was compared with that of the positive control group according to the (ΔΔ Ct) method using the following ratio: 2-ΔΔ Ct [19].

Statistical analysis

The obtained data were statistically analyzed using one-way ANOVA using SPSS 14 software [20].

Results

In vitro antibiotic sensitivity test

Salmonella enteritidis strain used was highly sensitive to fosfomycin, thiamphenicol, ciprofloxacin, and levofloxacin, but was resistant to oxytetracycline and spectinomycin. Therefore, fosfomycin was the drug of choice in this study (Table 3).

Clinical signs

From the fifth day after infection, infected birds began to exhibit clinical signs, which became more evident in the second group. These signs included listlessness, a tendency to huddle together, low feed intake, appetite loss, depression, wings dropping, ruffled feathers, and severe watery diarrhoea in affected birds. The chickens in the fosfomycin-treated group (third group) appeared normal following therapy, showing a steady recovery and a reduction in clinical symptoms. The fourth group showed a decrease in clinical symptoms; however, the fifth group appeared normal.

PM and mortality

Three chickens died in the second and third groups (3 out of 28 chicks) on the fifth day after infection, accounting for 10.71% of the mortality rate in these groups. The diseased and dead chickens exhibited congestion in the liver, heart, lungs, and spleens, as well as an enlarged caecum. The yucca-treated groups did not experience any mortality. Postmortem examination showed swollen and congested, with haemorrhagic streaks or necrotic foci in the liver and kidneys (Table 4).

Bacterial re-isolation

As expected, the first group showed no re-isolation of Salmonella during the experimental period in contrast to the second group. Positive re-isolation of Salmonella from all bird organs (5 days post infection) prior to fosfomycin treatment. Meanwhile, chickens showed negative re-isolation of Salmonella from all organs from the fifth group on day 21 and negative re-isolation from all treated groups on day 35 (Table 4).

Biochemical results

ALT and AST levels

The untreated second group showed noticeably higher levels of ALT and AST on days 21 and 42 than the treated group. Treatment with fosfomycin alone (third group) reduced liver enzyme levels on days 21 and 42 compared with the second group; however, the ALT enzyme level on day 42 showed no statistically significant difference compared with the first group. Administration of Yucca only throughout the period of the experiment (fourth group) resulted in significant improvement in these enzyme activities but did not reach normality. On the other hand, administration of both yucca and fosfomycin (fifth group) preserved normal liver function (Table 5).

Urea and creatinine levels

The second group showed noticeably higher levels of urea (on days 21 and 42) and creatinine on days 21 than the first group. The third group was able to reduce urea and creatinine levels on days 21 compared with the second group, and by day 42, urea had reached a non-significant level compared with the first group. However, the fourth group showed significantly lower values of urea and creatinine than the second group, whereas the fifth group had normal values of these parameters on 21 and 42 days (Table 6).

Albumin, globulin, and total protein levels

The second group showed noticeably declining levels of albumin and total protein from 14 days to 35 days but increased levels of globulin at 21 days compared with the first group. The third group had higher albumin and total protein levels at 21 days compared with the second group. The fourth and fifth groups could maintain albumin, globulin, and total protein at normal levels from 14 days to 35 days compared with the first group (Table 7).

Serum lysozyme activity

There was a significant increase in the lysozyme concentration in the second positive group compared with the first group from day 21 to day 35. The third group showed a significant decrease in the lysozyme concentration that approached normal values at 35 days of age compared with the second group. Birds that were treated with yucca either alone (fourth group) or with fosfomycin (fifth group) displayed highly significant levels of lysozyme at 21 days old when compared with the second group, then decreased at 28 and 35 days old but were still within the values of the second infected group (Fig. 1).

Serum hemagglutination inhibition

A significant decrease in HI antibody titer against NDVV was estimated in the serum of the second group from 21 to 35 days in comparison with the first group. It is clear that the third and fourth groups had no positive effect on improving the HI titer throughout the study period. The fifth group exhibited a prominent and significant increase in HI antibody titers from 21 to 35 days of age compared with the second group. It also returns the HI level to the values of the first group at 28 and 42 days of age. The numerical values of HI antibody titers in the fifth group were not significantly raised at 21 and 28 days old but were significantly higher at 35 and 42 days old compared with the fourth group (Fig. 2).

Total antioxidant capacity

The second group exhibited a prominent and significant decrease antioxidant levels from 14 to 28 days of age compared with the first group. The total antioxidant levels in the third group returned to normal at 28 and 35 days of age. The protective effect of yucca was clear in the fourth and fifth groups, where it maintained the values of total antioxidants against salmonella infection compared with the second group throughout the period of the experiment (Fig. 3).

Interlukin 6 (IL-6)

The relative fold change of IL-6 mRNA gene expression was a significantly higher in the second group which reached 10.19. The fourth and fifth groups showed a noticeable decrease in the relative fold changes of IL-6 compared with the second group. It was also observed that fold changes in the fifth group were downregulated much better than those in the fourth group, where they reached 1.55 (Fig. 4).

Discussion

The antibiotic sensitivity test showed that fosfomycin had the highest efficacy against isolated *Salmonella enteritidis* in vitro, whereas oxytetracycline and spectinomycin had total resistance, as reported in previous studies [21, 22]. Depending on bird immunity, experimentally infected groups with Salmonella displayed varying degrees of clinical symptoms, ranging from moderate to severe. Conversely, the fosfomycin-treated groups exhibited a decrease in clinical symptoms from the third day of administration and appeared healthier throughout the experiment, indicating the significant effect of fosfomycin on controlling Salmonella infection in broiler chickens [23]. The second and the third groups showed 10.71% mortality, whereas fourth and fifth groups recorded no mortality, supporting the use of antibiotics to prevent Salmonella infections. However, substantial lesions lingered in some organs (21 and 35 days) because of the inability to produce the enzymes needed to liquefy the fibrinous lesion once treatment began, preventing the lesions from being completely resolute. Inflammation and the generation of exudate and other debris may prevent antibiotics from penetrating or destroying Salmonella. The intestine had the most Salmonella isolates, followed by the liver. Salmonella colonisation in the liver can result in hepatocyte necrosis, immunological cell infiltration, congestion, and haemorrhage in Salmonella-challenged birds [24, 25]. The fourth and fifth groups showed overall recovery without any organ damage, demonstrating an antibacterial action that prevented chicks from Salmonella infection because of the presence of yucca phenolic compounds [26, 27].

Elevated serum alanine aminotransferase and aspartate aminotransferase levels indicated liver impairment caused by Salmonella-challenged birds, as the polysaccharide endotoxin of Salmonella may promote inflammation and enhanced lipid peroxidation in hepatocytes. The challenged chickens had hypoalbuminemia, which suggested decreased liver function. Elevated serum globulin levels in challenged hens are associated with infection-induced antigen synthesis or liver disease progression and protein leakage [28]. Yucca treatment may boost liver antioxidant activity and modify renal function owing to its antioxidant-active components, which include phytochemicals such as steroidal saponins, flavonoids, and polyphenols. Yucca can lower blood urea levels by inhibiting its formation in the liver and increasing urea elimination. Yucca possesses antibacterial, anti-inflammatory, and immunostimulatory properties,

and metabolic benefits [28, 29, 30]. Fosfomycin has extremely low protein binding with good diffusion in corporal tissues, interstitial fluids, and intracellular fluids, flowing across the blood-brain barrier into amniotic fluid, lymph tissue, purulent bronchial secretions, and fluids [6].

Salmonella is an intracellular pathogen whose outer membrane vesicles contain immunogenic components such as lipopolysaccharides and outer membrane proteins. Lysozyme-lysed pathogenic bacteria trigger both specific and nonspecific immune responses. This was made possible by boosting lysozyme levels in the second group [2]. As a result, salmonella outer membrane vesicles can boost the phagocytic activity of chicken macrophages by activating and maturing macrophages and mononuclear phagocytes. Hence, the phagocytosis process serves as a cemetery for the engulfment and disintegration of intracellular Salmonella, as well as for stimulating lysozyme secretion, which is part of the innate immune response [2]. The high levels of lysozyme at 21 days of age in the fourth and fifth groups are consistent with prior studies that demonstrated that yucca treatment could boost the immunity of mirror carp by elevating lysozyme activity [31]. By time, the lysozyme concentration decreased in the fourth and fifth groups but was still equivalent to that of the Salmonella-infected group (second group). This may explain the role of avian heterophils in attacking Salmonella via the production of microbicidal peptides [32].Salmonella has a detrimental effect on HI antibody titers for NDVV. A substantial decrease protein and globulin levels was also reported in Salmonella-infected quail [33]. Repair in the HI antibody titer was seen in the fifth group. This healing effect of yucca may be linked to its concentration of steroidal saponin, which has immune-enhancing effects by emphasising the humoral immune response by increasing antibody formation [34].

The remarkable total antioxidant capacity values in the fourth and fifth groups were related to the high saponin and polyphenol content of yucca. Saponin can increase antioxidant levels by regulating the Nrf2 signalling pathway [35]. Polyphenols can decrease reactive oxygen species and interrupt the inflammatory response by scavenging free radicals in the cells [36]. The increased relative fold changes of IL6 in the second group reflect the role of the Salmonella outer membrane vesicles in boosting monocyte maturation and macrophage activation [2]. To eradicate the infection, activated macrophages generate IL6, a pro-inflammatory cytokine that initiates and worsens the course of inflammation [37]. The IL6 mRNA gene expression in the fourth and fifth groups was related to high resveratrol (polyphenol) levels in yucca. Resveratrol may block the nuclear factor kappa B pathway, resulting in a decrease in IL6 transcription [35, 38].

Conclusions

Yucca schidigera has a synergistic effect with fosfomycin in treating salmonellosis in poultry. Therefore, it could be used as a safe, effective, and cost-efficient natural product along with fosfomycin to enhance immune response and antioxidant capacity.

Acknowledgment

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Conflicts of interest

The authors declare that they have no conflicts of interest.

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TABLE 1. Experimental design and treatments of the experimental groups

Groups	First	Second	Third	Fourth	Fifth
1d old	-	-	-	*Yucca schidigera* (all over experiment period)	*Yucca schidigera* (all over experiment period)
9d old	-	*Salmonella enteritidis*	*Salmonella enteritidis*	*Salmonella enteritidis*	*Salmonella enteritidis*
14d old (5 d post infection)	-	-	Fosfomycin for 5 days	-	Fosfomycin for 5 days

TABLE 2. Primers sequences, target genes, and cycling conditions for TaqManRT-PCR

Target gene	Primers and probe sequences (5'-3')	Reverse transcription	Primary denaturation	Amplification (40 cycles)		Reference
				Secondary denaturation	Annealing and extension (Optics on)	
28S rRNA	GGCGAAGCCAGAGGAAACT GACGACCGATTTGCACGTC (FAM) AGGACCGCTACGGACCTCCACCA (TAMRA)	50°C 30 min.	94°C 15 min.	94°C 15 sec.	60°C 1 min.	Suzuki et al., [19]
IL6	GCTCGCCGGCTTCGA GGTAGGTCTGAAAGGCGAACAG (FAM) AGGAGAAATGCCTGACGAAGCTCTCCA (TAMRA)					

TABLE 3. *Salmonella. enteritidis* sensitivity test

Antibiotic	Resistant (mm)	Intermediant (mm)	Sensitive(mm)	Result (mm)
Ciprofloxacin (5 µg)	20	21-30	31	32
Thiamphenicol (10µg)	12	13-17	18	21
Fosfomycin (200 µg)	12	13-15	16	33
Levofloxacin(5 µg)	13	14-16	17	16
Spectinomycin (100 ug)	14	15-17	18	6
Oxytetracycline (30µg)	10	11-13	14	6

TABLE 4. Number of birds with PM lesions and *Salmonella. enteritidis* re-isolation at 14, 21, and 35 days of age in the experimental groups

Groups	First	Second	Third	Fourth	Fifth
5 d post infection at 14 days old					
Clinical signs of Pm	-	5	4	2	3
Salmonella re-isolation					
Liver	-	4	2	2	3
Heart and lung	-	2	2	-	-
intestine	-	5	2	1	3
3 days post-drug treatment at 21 days old					
Clinical signs of Pm	-	3	-	3	-
Salmonella re-isolation					
Liver	-	5	-	1	-
heart&lung	-	1	-	-	-
intestine	-	5	1	2	-
35 days post yucca administration at 35 days old					
Pm clinical signs (35)	-	1	-	-	-
Salmonella re-isolation (35 d)					
Liver	-	2	-	-	-
heart&lung	-	-	-	-	-
intestine	-	2	-	-	-

TABLE 5. Serum ALT and AST levels in the experimental groups at 21 and 42 days of age

Groups	First	Second	Third	Fourth	Fifth
ALT(U/L)					
21 days	49.33±1.71d	68.11±1.10a	58.33±0.55b	53.33±0.55c	48.66±1.38cd
42 days	48.66±0.21c	70.66±0.54a	51.03±0.73bc	50.66±0.84b	48.66±0.91c
AST(U/L)					
21 days	20.33±0.55c	34.33±0.57a	28.33±1.17b	25.66±0.49b	23.07±0.36c
42 days	19.04±0.36c	27.66±1.11a	22.13±0.63b	21.33±0.55c	19.66±0.76bc

Data are presented as mean value ± Standard deviation.
Values in the same raw with the different letter are significantly different ($P \leq 0.05$).

TABLE 6. Serum urea and creatinine levels in the experimental groups at 21 and 42 days of age

Groups	First	Second	Third	Fourth	Fifth
Urea (mg/dl)					
21 days	24.66±0.21d	32.04±0.37a	29.21±0.29b	27.07±0.37c	26.33±0.56cd
42 days	25.11±0.36c	28.33±0.21a	25.33±0.55c	26.66±0.49b	26.35±0.73bc
Creatinine (mg/dl)					
21 days	0.45±0.009d	0.53±0.002a	0.49±0.008b	0.48±0.003bc	0.46±0.001d
42 days	0.45±0.007d	0.47±0.001b	0.46±0.006c	0.46±0.008c	0.45±0.005d

Data are presented as mean value ± Standard deviation.
Values in the same raw sample with different letters are significantly different ($P \leq 0.05$).

TABLE 7. Serum albumin, globulin, and total protein levels in the experimental groups

Groups	14 days old	21 days old	28days old	35days old
Albumin (g/dl)				
First	1.52 ± 0.12 a	1.72± 0.11 a	1.83 ± 0.16 ab	1.90 ± 0.26 a
Second	1.08 ± 0.11 b	1.05 ± 0.16 c	0.93 ± 0.06 c	0.91 ± 0. 41 c
Third	1.07 ± 0.05 b	1.53 ±0.13 b	1.71 ± 0.06 b	1.77 ± 0.22 ab
Fourth	1.55 ± 0.03 a	1.69 ± 0.02 ab	1.88 ± 0.15 a	1.90 ± 0.15 a
Fifth	1.57 ± 0.02 a	1.82± 0.23 a	1.82 ± 0.04 a	1.92 ± 0.04 a
Globulin (g/dl)				
First	1.85 ± 0.11ab	1.83 ± 0.14b	2.01 ± 0.32ab	2.70 ± 0.35 ab
Second	2.01 ± 0.13 a	2.04 ± 0.22a	2.33 ± 0.55a	2.90 ± 0.24 a
Third	1.95 ± 0.11ab	1.91 ± 0.08ab	1.92 ± 0.06 ab	1.96 ± 0.06 ab
Fourth	1.94 ± 0.14 ab	1.98 ± 0.38ab	1.99± 0.22 ab	1.89 ± 0.21 bc
Fifth	1.83 ± 0.06 ab	1.99 ± 0.11ab	2.01 ± 0.65 ab	2.49 ± 0.05 ab
Total protein (g/dl)				
First	3.37 ± 0.22 a	3.55 ± 0.26 ab	3.84 ± 0.38 a	4.60 ± 0.38 a
Second	3.09 ± 0.13b	2.09 ± 0.18 c	3.26 ± 0.27 b	3.81 ±0.24 bc
Third	3.02 ± 0.12bc	3.44± 0.1 6 ab	3.63 ± 0.02 ab	3.73 ± 0.04 ab
Fourth	3.49 ± 0.12 a	3.67 ± 0.37 a	3.87 ± 0.21 a	3.79 ±0.21 ab
Fifth	3.40 ± 0.08 a	3.81 ± 0.16 a	3.83 ± 0.59 a	4.41 ± 0.09 a

Data are presented as mean value ± Standard deviation.
Values in the same column with different superscript letters are significantly different ($P \leq 0.05$).

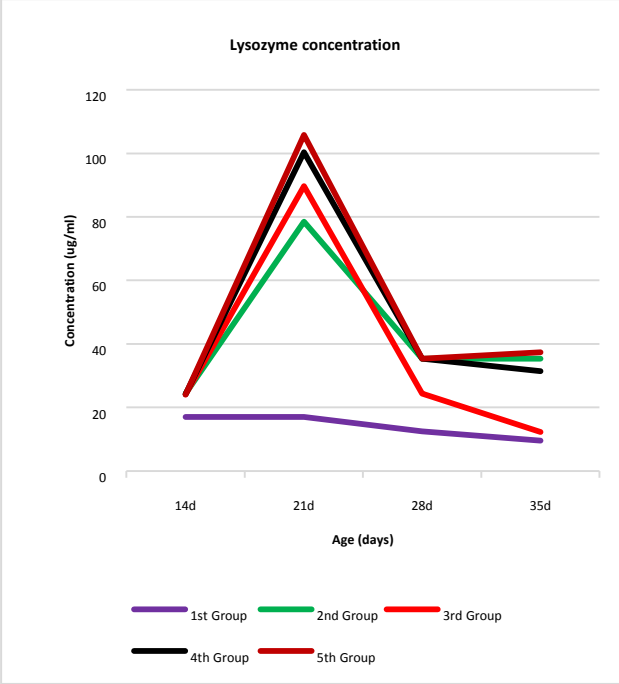

Fig. 1. Lysozyme concentrations in experimental groups according to age.

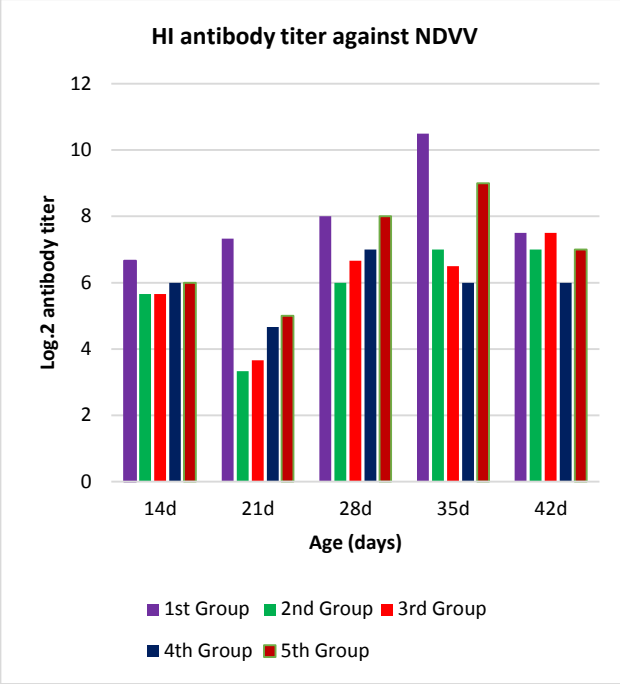

Fig. 2. HI antibody titers against NDVV in experimental groups at different ages.

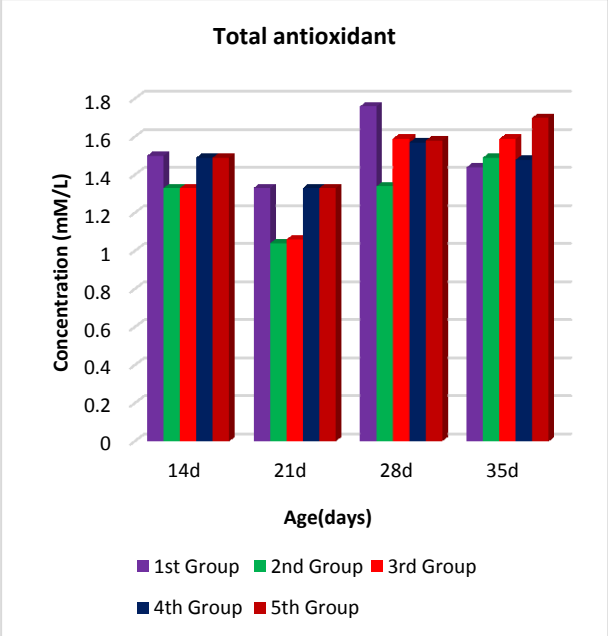

Fig. 3. Total antioxidant content in experimental groups according to age.

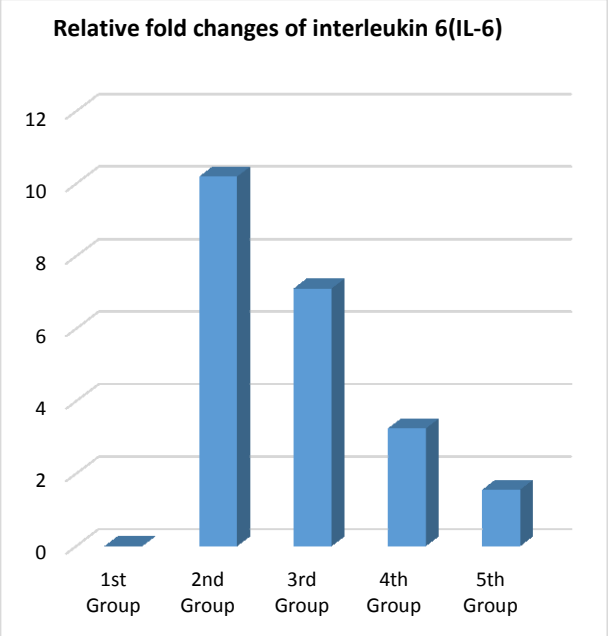

Fig. 4. Quantitative real-time PCR analysis of mRNA expression of IL-6 in experimental groups.

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تأثير مستخلص اليوكا شيديجيرا على الدواجن المعديه بالسالمونيلا إنتريتيديس مقارنة بعقار الفوسفوميسين

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الملخص

يهدف البحث إلى تقييم تأثير مستخلص نبات اليوكا شيديجيرا على الدواجن المصابة بالسالمونيلا المعوية مقارنة بعقار الفوسفوميسين. تم تقسيم 140 دجاج خالي من السالمونيلا إلى المجموعة الاولي الضابطه السلبية وأربع مجموعات مصابة بالسالمونيلا بعمر تسعة أيام. وكانت المجموعة الثانية بمثابة مجموعة إيجابية، بينما عولجت المجموعة الثالثة والرابعة والخامسة بالفوسفومايسين ومستخلص اليوكا شيديجيرا وكلاهما معا علي التوالي.ولقد تم إعطاء الفوسفومايسين عند عمر 14 يوم لمدة خمسة أيام و إعطاء مستخلص اليوكا شيديجيرا من عمر يوم حتى نهاية التجربه (42 يوم).

وكانت نتيجه عزل السالمونيلا سلبية من جميع المجموعات المعالجة بعد 35 يوما بينما اظهرت المجموعة الخامسة مستويات طبيعية لأنزيمات الكبد واليوريا والكرياتينين و الألبومين والجلوبيولين ومستوي مضادات الأكسدة الكليه عند عمر 14 يومًا إلى 35 يومًا. كما أظهرت المجموعتان الرابعة والخامسة ارتفاع معنوي من الليزوزيم عند عمر 21 يومًا، يليها انخفاض غير معنوي عند عمر 28 و35 يومًا، وانخفاض في التغيرات النسبية في الانترولكين 6 مقارنة بالمجموعة الثانية. واظهرت المجموعة الخامسة أرتفاع غير معنوي فى مستوى الأجسام المناعيه لإختبار مانع التلذن عند عمر 21 و 28 يومًا وزيادة معنوية عند عمر 35 و 42 يومًا مقارنة بالمجموعة الرابعة.

لذلك، يعتبر نبات اليوكا شيديجيرا منتجًا طبيعيًا بديلاً آمنًا وفعالًا ويمكن استخدامه لعلاج داء السالمونيلا عن طريق تحفيز الاستجابة المناعية ومضادات الأكسدة.

الكلمات الدالة: دواجن- امراض مشتركه- فوسفومايسين - اليوكا.