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PHYSIOLOGICAL RESPONSES AND PRODUCTIVE PERFORMANCE OF BROILER CHICKS FED DIETS SUPPLEMENTED WITH DIFFERENT LEVELS OF CINNAMON POWDER

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ABSTRACT: This study was investigated to evaluate the influence of feeding a natural feed additive, cinnamon powder (CP), at different levels on physiological responses, carcass traits and productive performance of broiler chicks. Ninety six unsexed seven-day old; Hubbard broiler chicks were allocated into four treatment groups. Each treatment consisted of three replicates eight birds each. The first diet was the control without CP. The second, third and fourth diets were supplied with 1, 3 and 5% cinnamon powder, respectively. Results showed that the addition of CP at 1.0, 3.0 and 5.0 % has significant effect ($P<0.05$) on feed conversion ratio at 1-3 WK of age, total protein, globulin, glucose, cholesterol, triglyceride, high-density lipoprotein (HDL), low-density lipoprotein (LDL), very low-density lipoprotein (VLDL), heterophiles (H), lymphocytes (L), basophiles (B) and H/L ratios at 6th and 7th week of age, Aspartate aminotransferase (AST) and albumin at 6th week of age, but no significant effect was observed on BW, BW gain, feed intake at all periods and feed conversion ratio at four to six and one to six WK of age, albumin and Aspartate aminotransferase (AST) at 7th week of age, Alanine aminotransferase (ALT), monocytes (M) and eosinophils (E) at 6th and 7th week of age. Moreover, the addition of CP did not have any significant effect on carcass traits except spleen and heart weight percentage. It could be concluded that the addition of CP up to 5% seems to have no effect on growth and carcass traits; but, it can be used to improve cellular immune responses for broiler chicks.

Key words: cinnamon powder – Broiler–physiological – growth – carcass.

INTRODUCTION

The increasing cost of meat production is one of the most decremented factors affecting poultry industry. It is obvious that the increasing in productive cost of meat is mainly due to the increasing cost of broiler feedstuffs which constituted about 80% of the total productive cost. Therefore, current research trend is to look for natural by-products of feed resources used as feed additives (Ziad and Mohammad, 2008). Recently, the use of antibiotic as growth promoters in poultry diets has been banned by European union and seriously stricted by decision-makers and consumers because of the evolution of microbial resistance to these products and the potential harmful impacts on human health (Botsoglu and Fletouris, 2001;Williams and Losa, 2001; McCartney, 2002 and Nabil et al., 2010). There are rising public and government pressures in several countries of EU and some non-EU to explore for a natural alternative to antibiotics (Nabil et al., 2010). Phytogenic used as feed additives to promote the productive performance, preclude of infectious diseases and the immune system of birds (Khorasaninejad et al., 2010; Hakim et al., 2007; Nabil et al., 2010; Gomez et al., 2008; Galib and Huda. 2013). One of the oldest medicinal plants is Cinnamomum zeylanicum (cinnamon), belonging to the Lauracea family. Cinnamon has strong antibacterial properties, analgesic, antioxidant and hypocholesterolaemic activities (Mastura et al., 1999 and Shihabudeen et al., 2011). Cinnamomum zeylanicum bark essential oil is rich in active components such as trans-cinnamaldehyde with antimicrobial effects against animal and plant pathogens (Mastura et al., 1999). Charis (2000) showed that cinnamon was used as digestive stimulants, antiseptic, and appetite stimulants in human beings as well as animals. The present study was conducted to evaluate the influence of feeding a cinnamon powder (CP) at different levels on physiological responses, productive performance and carcass characteristics of broiler chicks.

MATERIALS AND METHODS

his study was carried out at the Poultry Farm, Department of Animal and Poultry Production, Faculty of Agriculture, South Valley University, Qena during the period from December 2016 and lasted up to January 2017.

Chicks and housing:

Ninety six unsexed seven-days old; Hubbard broiler chicks were randomly divided into 4 treatment groups. Each treatment had 3 replicates with eight birds each (4 treatments X 3 replicates X 8 chicks = 96 chicks). Chicks in each replicate within each treatment had nearly similar initial live BW. Chicks were reared in batteries in a windowless house. The battery was previously cleaned and disinfected. The chicks of each replicate were allocated in a cage with slatted floor of iron.

Diets and management:

The experimental period was divided into two feeding phases, starter (from 1-3 WK of age) and grower (from 4-6 WK of age). The basal experimental diets had 21.75 and 18.25% crude protein and 3935 and 3990 Kcal ME/kg diet for the starter and the grower diet, respectively (Table 1). Experimental diets were formulated to meet the nutrient requirements of the broiler chicks (NRC, 1998).

Chicks were full access to feed and water during the experimental period. Artificial light was applied to maintain 23 hrs. light

per day during the experimental period. The environmental temperature was about 32º C during the first week old and it was gradually reduced by about 2º C weekly until about 24º C at the fourth week up to the end of the experiment (at 6 WK of age).

The experiment was included four treatments, treatment 1; chicks were received diet without any additives (control). Whereas, treatments 2, 3 and 4 chicks were received 1, 3 and 5% cinnamon powder (CP), respectively

Hygiene:

Chicks were vaccinated against Newcastle disease virus twice, first dose with Hitchner B1 on the 6th day of age and second dose with LaSota strain in drinking water at 19th day of age. At 11 days of age, chicks were vaccinated against infectious bursal disease virus (Gambaro).

Productive performance:

Live body weight (BW) and feed intake were recorded at 1, 3 and 6 WK of age for each replicate. Feed conversion ratio (gm feed: gm gain) was calculated for each replicate within each period. Dead chicks during the experiment were recorded daily and mortality rate was calculated for the entire experimental period. There were only two chicks died at 39 and 41 days of age from the group supplemented by 1 % cinnamon and the control group, respectively.

Serological analysis of the antibody titer for Newcastle disease virus (NDV).

Hemagglutination inhibition (HI) test was carried out according to OIE, (2012) using NDV antigen (Izovac LASOTA) on the serum samples collected from chicks groups at 49 days old (6 serum samples from each group) which were received Newcastle disease virus vaccine and were supplied with different levels of cinnamon powder as well as vaccinated cinnamon non treated control group.

Physiological parameters:

Fresh blood samples, 2 ml/sample, were collected from two chicks (chosen randomly) within each replicate at 6 WK of age. These chosen chicks were injected intravenously in the brachial vein with 0.2 ml of 10% suspension of packed sheep red blood cells (SRBC's). Fresh blood samples were collected from those chicks at 7 WK of age. However, blood samples were betided every time between 7:00 to 7:30 am. The blood samples were collected to determine total protein and albumin as described by Kaplan and Szalbo, (1983) and Doumas, (1971), respectively, while serum globulin was obtained by subtracting the values of the albumin from the corresponding values of the total protein (albumin: globulin ratio was then calculated); cholesterol (Wiebe and Bernert, 1984); glucose (Trinder, 1969); serum AST, ALT were determined according to (Reitman and Frankel, 1975), triglyceride (Schmit, 1964); very low density lipoprotein (Friedewald et al, 1972), HDL was determined according to (Warnick, 1983) and LDL (Assmann et al, 1984). Two drops of blood from each sample were smeared on two glass slides. The smears were stained within 2 to 3 hrs. of preparation using Leishman Stains. One hundred leukocytes, including heterophils (H), lymphocytes (L), basophils, eosinophils and monocytes were counted on each slide and H/L ratio was calculated by dividing the number of heterophils by that of lymphocytes as described by Sturkie (1986). Both slides were counted and the mean H/L ratio was calculated for each chick. At 7WK of age the two previous chicks from each replicate within each treatment group were slaughtered for estimation weights

and percentages of liver, pancreas, spleen, heart, abdominal fat and gizzard from live BW.

Statistical Analysis:

Data collected were statistically analyzed by the analysis of variance with the General Linear Model (GLM) procedure of the SAS Institute (SAS, 1996). All statements of significance are based on the 0.05 level of probability. Significant differences among treatments were performed using Duncan's multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

1. BW and BW gain:

Data of BW at 21 and 42 days of age are presented in Table (2). Data showed that all treated groups were not significant on BW and BW gain. These results indicated that cinnamon powder doesn't have any role to improve BW may be due to the lack of cinnamon powder effects on digestive enzymes as digestion stimulating factors and enhanced productive performance. These results are in agreement with Koochaksaraie et al. (2011) who revealed that, different level of cinnamon powder (control, 250, 500, 1000 and 2000 mg/kg) resulted in no significant effect on BW and BW gain of broiler chicks except at 42-49 days which BW gain was significantly higher in the treated group with 500 mg/kg of cinnamon powder. On the contrary Safa Eltazi (2014) and park sang oh et.al (2011) stated that, cinnamon incBWreased significantly ($P<0.05$) BW at 5 WK of age when fed broiler chicks on diets containing cinnamon at (0, 3, 5 and 7%). This difference in the results can be due to the different levels used in the different experiments.

2. Feed intake and feed conversion ratio:

Data of feed intake and feed conversion ratio at 1-3, 4-6 and 1-6 WK of age are presented in Table (4). Data explained that supplementing the broiler diet with cinnamon powder resulted in no significant effect on feed intake and feed conversion ratio except at 1-3 WK of age that supplementing groups were significantly ($P<0.05$) lower in values of feed conversion ratio than the control group. These results indicate that cinnamon powder doesn't have any role to improve feed intake and feed conversion ratio may be due to the lack of cinnamon powder effects on digestive enzymes causing lower efficiency in the utilization of feed and no role in appetite. These results are in agreement with Koochaksaraie et al. (2011) who revealed that, different level of cinnamon powder (control, 250, 500, 1000 and 2000 mg/kg) resulted in no significant effect on feed intake and feed conversion ratio except at 42-49 days of age which control group were significantly lower values of feed conversion ratio as compared with other treated groups. On the contrary park sang oh et.al (2011) and Safa Eltazi (2014) stated that, cinnamon affected significantly ($P<0.05$) on feed intake and feed conversion ratio at 6 WK of age when fed broiler chicks on diets containing cinnamon at (0, 3, 5 and 7%).

3. Physiological parameters:

3.1. Blood serum total protein, albumin and globulin:

Data of serum total protein, albumin and globulin at 6 and 7 WK of age are presented in Table (4). Data showed that, supplementing the broiler diet with 0, 1, 3 and 5% cinnamon level resulted in significant effect ($P<0.05$) on total protein at the 6^{th} and 7^{th} WK of age being

higher in the control group than the other treated groups. Moreover, supplementing the broiler diets with cinnamon had a significant effect (P<0.05) on globulin at the 6th and 7th WK of age being higher in the supplemented group with 1 and 5% cinnamon than the control and the other treated group at the 6th WK of age and it was being higher in the control group than the other treated groups at the 7th WK of age. In addition, cinnamon resulted in significant effect (p<0.05) on albumin being lower in the supplemented group with 1% cinnamon than the control and the other treated groups at the 6th week of age, whereas total serum albumin was not significant affected by cinnamon at the 7th week of age. These results are in a partial agreement with Sura Safi (2018) who stated that there was a significant increase (P<0.05) in the total protein and globulin in the two treated groups compared with the control group, while non-significant differences were obtained in albumin concentration when broiler chicks fed on diets containing 500 and1000 mg/kg of cinnamon powder. On the contrary Abd El-Hakim et al., (2009) and Al-Shuwaili et al. (2015) showed that no significant difference was observed in the total protein of turkeys fed on diets containing 0, Garlic (5%), Ginger (5%) and Cinnamon (5%). The Previous results indicate that decline in total protein, globulin and albumin at the 6th week of age than at the 7th week of age could be due to the use of cinnamon powder which led to the effectiveness of immune stimulation and liver function occurred at the end of 6th week by injection with SRBC's suspension.

3.2. Blood serum glucose, cholesterol and triglyceride:

Data of serum glucose, cholesterol and triglyceride at 6 and 7 WK of age are presented in Table (5). Data showed that, supplementing the broiler diet with 0, 1, 3 and 5% cinnamon level resulted in significant effect (p<0.05) on glucose at the 6th and 7th WK of age being higher in the control and the supplemented group with 5% cinnamon than the other treated groups at the 6th WK of age and it was being lower in the supplemented group with 5 % cinnamon than the control and other treated groups at the 7th WK of age. Moreover, supplementing the broiler diet with cinnamon powder level was significantly effect (p<0.05) on cholesterol at the 6th and 7th WK of age being lower in the supplemented group with 5% cinnamon than the control and the other treated groups at the 6th and 7th WK of age. in addition, supplementing the broiler diet with cinnamon powder level was significantly effected (p<0.05) on triglyceride at the 6th and 7th WK of age being lower in the supplemented group with 5% cinnamon than the control and other treated groups at the 6th WK of age and it was being higher in the supplemented group with 3% cinnamon than the control and other treated groups at the 7th WK of age. This is in a partial agreement with Al-Shuwaili et al. (2015) and koochaksaraie et.al (2011) who showed that, 250 mg/kg cinnamon powder resulted in a significant increase in glucose level in starter, finisher and overall rearing period as well as an increase in triglyceride level at the finisher phase as compared to 1000 and 2000 mg/kg of broiler chicks fed on diets containing 0, 250, 500, 1000 and 2000 mg/kg of cinnamon powder. Generally, decreased in glucose, cholesterol and triglyceride at the 6th and 7th week of age with some cinnamon level than the control could be due to the use of cinnamon powder which led to improve

physiological parameters. It is obvious that lipid lowering protect the tissues from lipid peroxidation and stimulate activity of liver function and immunity against strange objects.

3.3. HDL, LDL, VLDL, AST and ALT:

Data of HDL, LDL, VLDL, AST and ALT at 6 and 7 WK of age are presented in Table (6). Data revealed that supplementation of broiler chick diets with 0, 1, 3 and 5% cinnamon level resulted in significant effect ($P<0.05$) on HDL at 6 and 7 WK of age being higher in the supplemented group with 3 and 0% cinnamon powder than the other treated groups. Moreover, supplementing the broiler diet with 0, 1, 3 and 5% cinnamon level had a significant effect ($p<0.05$) on LDL at 6 and 7 week of age being higher in the supplemented group with 0 and 1% cinnamon powder than the other treated groups. In addition, supplementing the broiler diet with 0, 1, 3 and 5% cinnamon level resulted in significant effect ($p<0.05$) on VLDL at 6 and 7 WK of age being higher in the supplemented group with 0 and 1% cinnamon powder than the other treated groups respectively. These results are in agreement with Ciftci et al., (2010) and Najafi and Taherpour (2014), who showed that there was no significant difference between treatments in term of (HDL-C) level of broiler chicks. In contrast, the lowest and highest serum LDL levels ($P<0.05$) were observed in broilers treated with 0.8% cinnamon and the control group, respectively. Antioxidant properties of cinnamon prevent peroxidation of fatty tissues lipid, especially unsaturated fatty acids. Hypertriglyceridemia effects in chickens fed with cinnamon may be due to active ingredients leading to decreased activity of lipogenic enzymes and thus contribute to reducing re-synthesis (de novo) of fatty acids in the liver and subsequently reducing blood LDL-C level.

On the other hand, supplementing the broiler diet with 0, 1, 3 and 5% cinnamon level had a significant effect ($P<0.05$) on AST being higher in the supplemented group with 5% cinnamon powder than the control and other treated groups at 6 WK of age. In addition, supplementing the broiler diet with 0, 1, 3 and 5% cinnamon level did not significant effect on ALT at 6 and 7 WK of age. These results are in a partial agreement with koochaksaraie et.al (2011), Soltan et al. (2008) and Al-Shuwaili et al. (2015) who showed that supplemented groups with garlic 5%, Ginger 5% and cinnamon 5% reduced significantly ($p<0.05$) AST and ALT. Generally (Langhout, 2000; Williams and Losa, 2001; Hernandez et al., 2004) and Al-Shuwaili et al. (2015) showed that AST and ALT considered as liver enzymes which increased with liver damage (hepatocellular degeneration), so the decrease in AST and ALT may provide evidence for the occurrence of hepatoprotective effect. It is obvious that cinnamon powder does not have any role on (ALT) at 6 and 7 WK of age and AST at 7 WK of age but cinnamon powder don't decreased (AST) level at 6 week of age may be due to the lack of cinnamon powder effects on liver functions.

3.4. Percentages of white blood cells differentiation: heterophiles (H), lymphocytes (L) monocytes (M), basophiles (B), eosinophils (E) and H/L ratio.

Data of percentages of white blood cells differentiation H, L, M, B, E and H/L ratio at 6 and 7 WK of age are presented in Table (7). Data revealed that supplementation of broiler chick diets with 0, 1, 3 and 5% cinnamon level was significantly effected ($P<0.05$) on H at 6

and 7 WK of age being higher in the supplemented group with 3% and 0% cinnamon powder than the other treated groups. Moreover, supplementing the broiler diet with 0, 1, 3 and 5% cinnamon level had a significant effect ($p<0.05$) on L at 6 and 7 WK of age being higher in the supplemented group with 5 and 1% cinnamon powder than the control and the other treated group. In addition, supplementing the broiler diet with 0, 1, 3 and 5% cinnamon level had a significant effect ($p<0.05$) on H/L ratio at 6 and 7 WK of age being higher in the supplemented group with 3 and 0% cinnamon powder than the other treated groups. Also, supplementing the broiler diet with 0, 1, 3 and 5% cinnamon level had a significant effect ($p<0.05$) on B at 6^{th} and 7^{th} week of age being higher in the supplemented group with 1% cinnamon and control group at 6^{th} and 7^{th} week of age respectively. Whereas, supplementing the broiler diet with 0, 1, 3 and 5% cinnamon level resulted in no significant effect ($p<0.05$) on M and E at 6 and 7 WK of age. These results are in a partial agreement with (Al-Kassi, 2009) and Najafi and Taherpour (2014), who showed that there was no significant difference between treatments in terms of H count of broiler chicks fed on diets containing 0, synbiotic (Biomin IMBO), antibiotic (virginiamycin), ginger, cinnamon. However, the highest L count was observed in broilers treated with 0.8 cinnamon which was significantly different only with the control group ($P<0.05$). The previous results accordance Al-Kassi, (2009) and Najafi and Taherpour (2014) indicate that increasing L count in the blood following increase in white blood cells count can play an important role in stimulating the immune system of broiler and the increase in white blood cells count represents stimulation of the host's immune system; in other words, anti-viral, anti-bacterial and antifungal properties of medicinal plants can be effective in improving immune function.

4. Carcass traits: Live BW, carcass weight and carcass weight net, relative weight (%) of liver, pancreas, abdominal fat, spleen, heart and gizzard:

Data of Live BW, carcass weight and carcass weight net, relative weight (%) of liver, pancreas, abdominal fat, spleen, heart and gizzard at 7 WK of age are presented in Table (8). Data revealed that supplementation of broiler chick diets with 0, 1, 3 and 5% cinnamon level had a significant effect ($P<0.05$) on heart and spleen weight being higher in the supplemented group with 3% cinnamon powder than the control and the other treated groups. Whereas, supplementation of broiler chick diets with 0, 1, 3 and 5% cinnamon level resulted in no significant effect on Live BW, carcass weight and carcass weight net, relative weight (%) of liver, pancreas, abdominal fat and gizzard. These results are in a partial agreement with koochaksaraie et.al (2011) and park sang oh et.al (2011), who stated that, cinnamon did not significant effect on gizzard weight whereas the weight of immune organs (spleen) was significantly. The previous results indicate that cinnamon powder do not have any role on carcass traits except heart and spleen may be due to the lack of cinnamon powder effects on growth performance. Whereas, cinnamon powder was improved some internal organs as heart and immune organs as spleen may be due to stimulate immune system.

5. The immunological effect of cinnamon powder supplementation on NDV antibody titer:-

The geometric mean of antibody titers against NDV were 7.4, 3.72 and 6.17 log2 in 1, 3 and 5 cinnamon powder treated groups (fig. 1), respectively, in compare to the geometric mean of HI titer of control group was 9.4log2. Although control group titer was higher than those of treated groups, the treated group levels remained at the protective level (4 log2) against NDV (Reynolds and Maraqa 2000). The lymphocytes proliferation in cinnamon treated groups (table 7) than control group is accountd for enhancing the cellular immunity (T cells) but not humoral immunity (B cells).

CONCLUSION

From the results of the current study it could be concluded that the addition of CP up to 5% seems to have no effect on growth and carcass characteristics; but, it can be used to improve some physiological parameters and immune responses for broiler chicks.

Table(1): Composition of the starter and grower basal diets.

INGREDIENTS	Chemical analysis (determined) Starter (0-3 WK)	Grower (4-6 WK)
Crude protein	21.75±0.36%	18.25±0.3%
Gross energy	3935±61%	3990±61%
Crude fiber	3.89±0.24 %	3.14±0.19%
Crude fat	3.5%	4.98%
Moisture	9.3%	7.7%
Ash	6.9%	5.8%

Table(2): Averages ± (SE) of BW (gm) and BW gain (gm) as affected by the addition of cinnamon powder into broiler chick diets.

Days of Age	Control	Cinnamon powder, kg diet 1	3	5	SEM	P value
BW, g/period						
21	902. 08	962.50	908.33	856.25	17.2839.7	**0**.1884
42	2258.33	2200.00	2175.00	2129.16	8	0.7700
BW gain, g/period						
7 – 21	687.50	754.16	695.83	641.66	17.43	0.1387
21 – 42	1356.25	1237.50	1266.66	1272.91	29.7139.1	0.5939
7 – 42	2043.75	1991.66	1962.50	1914.58	2	0.7574

SEM = standard error of mean.

Table(3): Averages ± (SE) of feed intake (gm) and feed conversion ratio as affected by the addition of cinnamon powder into broiler chick diets.

Period	Control	Cinnamon powder, kg diet			SEM	P value
		1	3	5		
Feed intake, g/ period						
7 – 21	1025.00	995.83	964.50	922.83	20.7835.	0.3841
21 – 42	2439.58	2385.41	2349.91	2318.75	4553.42	0.7211
7 – 42	3464.58	3381.25	3314.41	3241.58		0.5601
Feed conversion ratio, g feed/g BWG						
7 – 21	1.49^{a}	1.32^{c}	1.38^{bc}	1.43^{ab}	0.02	0.0110
21 – 42	1.79	1.92	1.85	1.83	0.02	0.1919
7 – 42	1.69	1.69	1.69	1.69	0.01	0.9938

$^{a, b}$ Means in the same row followed by different letters are significantly different at ($p \leq 0.05$).

Table (4): Averages ± (SE) of serum total protein (TP), albumin (Alb.) and globulin (Glo.) as affected by the addition of cinnamon into broiler chick diets.

Days of Age	Control	Cinnamon powder, kg diet			SEM	P value
		1	3	5		
Total protein (g/ dl)						
42	2.83^{a}	2.63^{b}	1.49^{c}	2.80^{ab}	0.16	0.0001
49	5.12^{a}	3.28^{c}	3.69^{bc}	3.90^{b}	0.21	0.0001
Albumin (g/ dl)						
42	1.34^{a}	0.49^{c}	0.83^{b}	0.79^{b}	0.09	0.0001
49	2.81	2.20	2.61	2.76	0.13	0.4097
Globulin (g/ dl)						
42	1.49^{b}	2.14^{a}	0.66^{c}	2.00^{a}	0.17	0.0001
49	2.31^{a}	1.08^{b}	1.07^{b}	1.14^{b}	0.20	0.0405

Table (5): Averages ± (SE) of serum glucose, cholesterol and triglyceride as affected by the addition of cinnamon into broiler chick diets.

Days of Age	Control	Cinnamon powder, kg diet			SEM	P value
		1	3	5		
Glucose (mg/dl)						
42	292.66^{a}	163.66^{c}	214.66^{b}	315.66^{a}	18.63	0.0001
49	482.00^{a}	424.00^{a}	433.00^{a}	117.33^{b}	44.49	0.0001
Cholesterol (mg/dl)						
42	214.33^{a}	202.33^{a}	209.33^{a}	141.00^{b}	8.67	0.0004
49	234.60^{a}	226.26^{a}	148.03^{b}	135.23^{b}	18.43	0.0001
Triglyceride (g/l)						
42	156.43^{a}	132.43^{a}	148.73^{a}	41.98^{b}	14.46	0.0001
49	65.21^{b}	74.08^{ab}	110.38^{a}	18.27^{c}	11.17	0.0049

Table (6): Averages ± (SE) of serum HDL, LDL , VLDL, AST and ALT as affected by the addition of cinnamon into broiler chick diets.

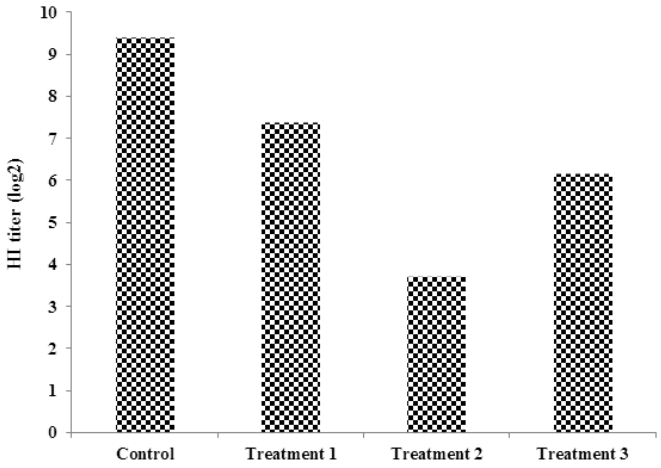
Days of Age	Control	Cinnamon powder, kg diet			SEM	P value
		1	3	5		
HDL						
42	112.70^{b}	115.16^{b}	135.01^{a}	104.60^{b}	4.03	0.0182
49	126.66^{a}	74.00^{c}	47.66^{c}	103.66^{ab}	10.32	0.0073
LDL						
42	70.34^{a}	60.68^{ab}	44.57^{bc}	28.33^{c}	5.29	0.0019
49	128.22^{a}	160.78^{a}	78.29^{b}	27.91^{c}	16.46	0.0011
VLDL						
42	31.28^{a}	26.48^{a}	29.74^{a}	8.39^{b}	2.89	0.0001
49	13.04^{b}	14.81^{ab}	22.07^{a}	3.65^{c}	2.23	0.0049
AST						
42	164.33^{b}	200.33^{b}	269.66^{a}	278.33^{a}	15.16	0.0002
49	253.00	259.00	257.33	250.00	8.06	0.9852
ALT						
42	18.00	17.33	14.33	18.33	1.20	0.6965
49	16.66	20.00	24.66	18.00	2.03	0.5908

Table: (7): Averages ± (SE) of Percentages of white blood cells differentiation: H, L, M, B, E and H/L ratio as affected by addition of cinnamon into broiler chick diets.

Days of Age	Control	Cinnamon powder, kg diet			SEM	P value
		1	3	5		
H						
42	43.00^{b}	37.00^{c}	50.66^{a}	38.66^{bc}	1.75	0.0022
49	45.33^{a}	17.66^{c}	22.33^{b}	25.00^{b}	3.22	0.0001
L						
42	43.00^{c}	51.33^{ab}	47.00^{bc}	54.33^{a}	1.49	0.0084
49	42.66^{d}	78.33^{a}	70.00^{b}	65.00^{c}	4.01	0.0001
M						
42	1.00	0.66	0.66	0.00	0.19	0.3493
49	0.33	0.00	1.00	0.66	0.19	0.3300
B						
42	4.00^{ab}	7.00^{a}	1.00^{b}	2.00^{b}	0.81	0.0126
49	7.66^{a}	0.66^{b}	1.00^{b}	5.00^{ab}	1.09	0.0351
E						
42	9.00	4.00	0.66	5.00	1.16	0.0587
49	4.00	3.33	5.66	4.33	0.91	0.8753
H/L ratio						
42	1.01^{a}	0.72^{b}	1.07^{a}	0.71^{b}	0.05	0.0062
49	1.06^{a}	0.22^{b}	0.31^{b}	0.38^{b}	0.10	0.0001

Table (8): Averages ± (SE) of Live BW, Carcass weight and Carcass weight net, relative weight (%) of liver, pancreas, abdominal fat Spleen, Heart and Gizzard.

Criteria	Cinnamon powder, kg diet				SEM	P value
	0	1	3	5		
Live BW	2550.00	2600.00	2691.66	2558.33	27.74	0.2587
Carcass weight	2500.00	2516.66	2641.66	2508.33	27.52	0.2216
Carcass weight net	2016.66	2025.00	2066.66	2025.00	20.77	0.8486
Liver weight%	1.80	1.85	1.88	1.86	0.04	0.9480
Pancreas weight %	0.20	0.19	0.22	0.25	0.01	0.0976
Abdominal fat %	0.08	0.13	0.13	0.13	0.01	0.1728
Spleen weight%	0.10^{b}	0.10^{b}	0.14^{a}	0.11^{b}	0.01	0.0424
Heart weight %	0.38^{b}	0.39^{b}	0.47^{a}	0.45^{a}	0.01	0.0009
Gizzard weight %	1.32	1.38	1.52	1.49	0.04	0.2621



Fig(1): The geometric mean of HI titers against NDVof broiler chicks received different levels of cinnamon powder.

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الملخص العربى
الاستجابات الفسيولوجية والاداء الانتاجى لبدارى التسمين المغذاة على علائق مضاف اليها مستويات مختلفة من القرفة

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أجريت هذه التجربة لدراسة تأثيرالمغذيات الطبيعية كإضافات غذائية ومستويات مختلفة من مسحوق القرفة على الاستجابات الفسيولوجية وخصائص الذبيحة والأداء الإنتاجي والكفاءة الاقتصادية لكتاكيت التسمين.تم تربية ستة وتسعون كتكوت غير مجنس عمر سبعة أيام من سلالة الهبر في بطارية ذات طابقين من الأسلاك في منزل بلا نوافذ. تم وضع الكتاكيت في أربع مجموعات معاملة. تتألف كل معاملة من ثلاث مكررات ، كل مكررة تحتوي على ثمانية طيور. المعاملة الأولى تم فيها تغذية الكتاكيت على العليقة الاساسية دون اى اضافات)المقارنة(..بينما اضيف للعليقة الاساسية للكتاكيت فى المعاملات الثاني والثالث والرابع بمسحوق القرفة (cinnamon powder) 1.0 و 3.0 و 5.0٪ على التوالي. أوضحت النتائج أن إضافة مسحوق القرفة عند 1.0 و 3.0 و 5.0٪ لم يكن لها تأثير معنوي على وزن الجسم والزيادة فى وزن الجسم والغذاء المستهلك فى كل فترات التجربة ومعدل التحويل الغذائي في الأسبوع من 4-6 و 1-6 من العمر و الالبيومين ناقلة امين الاسباراتات ((AST فى الاسبوع السابع من العمر و ناقلة أمين الألانين (ALT) والخلايا الاحادية والخلايا الحامضية فى الاسبوع السادس والسابع من العمر. ولكن ، كان لإضافة مسحوق القرفة تأثيرًا كبيرًا (P <0.05) على معدل التحويل الغذائي في الأسبوع 1-3 من العمر و البروتين الكلى والجلوبيولين و الجلوكوز و الكوليسترول والدهون الثلاثية و البروتين الدهني منخفض الكثافة (LDL) و البروتين الدهني عالي الكثافة (HDL) و البروتين الدهني منخفض الكثافة جدا (VLDL) و الخلايا المتعادلة و الخلايا الليمفاوية و الخلايا القاعدية في الأسبوع السادس والسابع من العمر و الالبيومين و ناقلة امين الاسباراتات ((AST في الأسبوع السادس من العمر. بالإضافة إلى ذلك ، لم يكن لمسحوق القرفة عند 1.0 و 3.0 و 5.0٪ أي تأثير معنوي على خصائص الذبيحة باستثناء وزن القلب والطحال. يمكن الاستنتاج أن إضافة مسحوق القرفة CP حتى 5٪ ليس له أي تأثير على النمو وخصائص الذبيحة والأداء الاقتصادي. ولكن ، يمكن استخدامه لتحسين الاستجابات المناعية الخلوية لدجاج التسمين.