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EFFECT OF SUPPLEMENTING DIET WITH SODIUM BENTONITE AND/OR ORGANIC CHROMIUM ON PRODUCTIVE, PHYSIOLOGICAL PERFORMANCE AND IMMUNE RESPONSE OF MATROUH CHICKENS STRAIN.

1- DURING GROWTH PERIOD.

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ABSTRACT: The main objective of this study was to investigate the effect of sodium bentonite (Na-B) (0, 5 and 10 g/kg diet) and chromium picolinate (CrPic) (0, 800 and 1200 µg Cr /kg diet) in the diet on growth performance, the mortality rate; some blood serum constituents, as well as the immune response and economic efficiency of male chicks of local strain Matrouh during the growing period. 540 one-day old male chicks were randomly chosen from a flock reared on the floor and distributed into 9 treatment groups (60 males / each treatment) in a factorial arrange. Feed with Na-B supplementation (5 and 10 g /kg diet) had a significant positive effect ($P \leq 0.05$) on body weight (BW), body weight gain (BWG), and feed intake (FI), as well as, serum globulin, triodothyronine hormone (T3), glutathione peroxidase (GPX) and decrease in mortality rate and malonidialdehyde (MDA) values. However, feed conversion ratio (FCR), total antibody responses against SRBCs, total protein, albumin, growth hormone (GH), cholesterol and calcium were insignificantly affected by these treatments, but they gave the highest net return and best economic efficiency ($P \leq 0.\ 01$) compared to their controls at 12 wks of age. Supplementation of 800 or 1200 µg CrPic /kg diet significantly increased BW, BWG and improved FCR, as well as, a titer of SRBCs, serum total protein, albumin, globulin, and GH concentrations. While, the mortality rate and serum cholesterol were significant ($P \leq 0.\ 05$) decreased. However, there were no significant differences among treatments in calcium, T3, MDA and GPX. Supplemented diets with CrPic gave the highest net return and best economic efficiency ($P \leq 0.\ 01$) compared to their controls. Moreover, BW, BWG, FI and FCR, mortality rate, serum globulin and calcium influenced by the interaction between dietary Na-B and CrPic. Whereas, SRBCs, total protein, albumin, GH, cholesterol, T3, MDA and GPX were not significantly influenced by their interaction. It is clear that, supplementing the chick's diet with both 10 g Na-B and 1200 µg CrPic /kg diet alone or together is recommended for improving most of the growth performance, serum biochemical traits as well as improved immune responses and gave the highest net return and best economic efficiency during the growing period of Matrouh male chicks

Keywords: Sodium Bentonite- Chromium Picolinate- Growth Performance- Blood.

INTRODUCTION

Bentonite is aluminosilicate (natural clay) conforming gut structure and has beneficial effects on feed conversion ratio and growth rate of broilers (Damiri et al., 2012). Bentonite as a feed added substance has been utilized effectively as a part of poultry feeds with no destructive impacts (Safaeikatouli et al., 2010). Salari et al., (2006) showed that 10 to 20 g Na-B per kg of the diet can be utilized as a pellet fastener with no adverse effect on broiler performance. Hepatic proteins alongside blood parts have been assessed as health indices in different studies (Akbarian et al., 2012). Bentonite has been utilized adequately as a feed additive in poultry feeds, with the swelling of bentonite, creating a lessening in the rate of feed travels through the digestive tract, allowing time for more successful use (Damiri et al., 2012). The gastrointestinal tract (GIT) expends around 20% of dietary energy and has 50 to 75% protein turnover rate for each day (Cant et al.1996). Almost 25% of daily protein synthesis is emitted into the GIT to support digestive and obstruction usefulness. In addition, GIT has been an essential center of activity of phytogenic feed additives. Bentonite at 5% was the ideal level for the most extreme percent weight gain, particular growth rate and feed efficiency (Eya et al., 2008).

Chromium (Cr) is an essential element required for carbohydrate, fat, and protein metabolism (Chen et al., 2006). Dietary chromium supplementation advances the growth rate and feed efficiency of growing poultry, and these beneficial effects appear to be more noteworthy under heat stress (Onderci et al., 2005). Chromium is included a protein, digestion system (NRC, 1994) and is thought to have a part of a nucleic acid digestion system on the grounds that an expansion in stimulation of amino acid fuses into liver protein in vitro was watched (Weser and Column 1969). The Cr affects the function of digestive enzyme (Pacheco et al., 2012). The Cr toxicity depends on the oxidation state and on blood, a large portion of Cr III binds with the protein molecules, and less quantity binds with oligopeptide. Sources of Cr are the drinking water, air and through ingestion (Assesm and Zhu 2007). Chromium propionate is an organic source of chromium absorbed more efficiently than few other organic chromium sources (Clodfelder et al., 2004). The essential part of Cr in a digestion system is to potentiate the activity of insulin through its nearness in an organometallic atom (the glucose resilience variable) (Anderson, 1999). Chromium is an insulin potentiator, subsequently, hypothesized to work as cell reinforcement (Preuss et al., 1997). Improvements in the immune response have been observed when organic forms of Cr were supplemented to broilers (Toghyani et al., 2007).

Therefore, the target of this study was to evaluate the effect of supplementing different levels of Na-B and CrPic in the diet on chick's performance, mortality rate, antibody response, some blood serum constituents and economic efficiency of local strain Matrouh male chicks during the growth period.

MATERIALS AND METHODS

The trial work of this study was carried out at the Inshas Poultry Research Station, Anim. Production Research Institute, Agriculture Research Center, Giza, Egypt, the experiment started from February until April 2016.

A 3x3 factorial arrangement experiment was performed at three levels of Na-B (0, 5 or 10 g/kg diet) and three levels of CrPic contained 12.27% Cr (0, 800, or 1200 µg Cr /kg diet). 540 male chicks of Matrouh local strains at the first day of age were randomly chosen from a flock reared on the floor and distributed into 9 treatment groups (60 males / treatment). All the treatment groups had a nearly similar average body weight. Each group was divided into three replicates (20 males /each). The composition and chemical analysis of the experimental diet is presented in Table 1. It was an aflatoxin concentration in the cock's diet and contaminated naturally (6.73 micrograms / kg dry matter) during the growing period. The ingredients of bentonite are SiO_2, 54.15%; AL_2O_3, 17.78%; Fe_2O_3, 4.31%; MgO, 2.82%; Na_2O, 2.12%; CaO, 2.87%; MnO, 0.02%; K_2O, 0.62%; TiO_2, 0.16%; P_2O_5,0.06%; Cr_2O_3, 0.003%; TOT/S, 0.09%; LOl, 14.9% (Abdel-Motelib et al. 2011). The mean value of the daily ambient temperature and relative humidity during that period in the house were 21.78± 0.58 °C and 47.28 ± 2.19 %, respectively. The trial time frame stretched out for 12 weeks, from 1day - 12 weeks of age.

All experimental birds were kept under similar environmental conditions and exposed to 24 hours' light during the initial two days of age, 16 hours' light during 3-6 days of age and steady 14-hour light from 2 to 12 weeks of age. The chicks were fed ad libitum and fed starter diets from 0 to 8 wks and after that changed to grower diets to 12 wks of age (Table 1). Fresh water was available all the experimental periods. The mortality rate was calculated during the experimental period. The chicks were resolved examination against diseases. Individual body weight was recorded at first day, 4, 8 and 12 wks of age. Body weight gain, feed intake and feed conversion ratio were calculated at the interims from 0 to 4, 4 to 8, 8 to 12 and 0 to 12 wks of age. Feed conversion was calculated as g feed / g gain. The antibody response against SRBC was measured from 6 chicks in every treatment at 11 wks of age. The chicks were injected with 0.2 ml of 9% SRBC in 0.9% saline. Serum tests were gathered on the 7th day of each implantation to choose threatening to SRBC essential immunizes titers, separately. Immune response creation was measured by an agglutination test using the Microtiter methodology (Trout et al., 1996).

At the end of the experimental period, 3 chicks were randomly chosen for each treatment, and blood tests were obtained from the brachial vein for serum total protein, albumin, GH, cholesterol, calcium, T3, MDA and GPX determination. Blood serum was separated by centrifugation of blood at 3000 rpm for 15 min and was then stored at -20°C for analysis. Serum total protein, albumin, cholesterol and calcium concentrations were measured by spectrophotometer utilizing available commercial kits produced by Bio- analytic, Egypt. Globulins were estimated by subtraction of albumin value from the total protein value of each sample Serum was so isolated to quantify triodothyronine (T3) hormone level Radioimmunoassay (RIA) kits (diagnostic product's corporation, Los Angeles, USA) were utilized for carrying out these tests. Malonidialdehyde (MDA) and glutathione peroxidase (GPX) concentration in serum determined by the method of Valenzuela (1991) and Weydert and Cullen (2010), respectively.

Data obtained were statistically analyzed using the General Linear Model of SAS (2004). A factorial arrangement 3x3 was used, considering the sodium bentonite and chromium picolinate supplementation level as the main effects, as follows:

$Y_{ijk} = \mu + T_i + R_j + (TR)_{ij} + e_{ijk}$ where:

Y_{ijk} = An observation;

μ = Overall mean;

T = Effect of sodium bentonite supplementation level; i= (1, 2 and 3);

R = Effect of chromium picolinate supplementation level; j = (1, 2 and 3);

TR= Interaction effect due to sodium bentonite and chromium picolinate levels; ij= (1,2,3…..9);

eijk = Random error.

Differences between treatments means were compared using Duncan's Multiple Range Test (Duncan, 1955).

RESULTS AND DISCUSSION

Body weight (BW) and body weight gain (BWG)

Results of BW and BWG of male chicks of Matrouh local as affected by Na-B and CrPic and their interactions are summarized in Table 2.

Feed with Na-B supplementation (5 and 10 g /kg diet) significantly increased ($P \leq 0.05$) BW at 12 wks of age and BWG from 8 to 12 and 0 to 12 wks of age. These might be a direct result of Na-B having the ability to upgrade, improve execution and supplement absorbability (Miazzo et al. 2005 and Salari et al. 2006). The improvement in final BW and BWG observed in the present study could have been due to the presence of Na-B in the diet, which might have increased feed retention time through the gut of the chicks. Thus subjecting the nutrients to enzymatic action for quite a long time, or could have been due to the action of bentonite in enhancing digestibility of certain nutrients. These results are in agreement with those of Tauqir and Nawaz (2001) demonstrated that 1, 2 and 3% Na-B enhanced ($P > 0.05$) weight gain and final weight. Moreover, Pasha et al. (2008) reported similar enhancements in broilers by 0.5 and 1% Na-B.

Supplemented diets with 800 or 1200 µg CrPic /kg diet had a significant effect on BW at 8 and 12 wks of age and BWG from 4-8 and 0-12 wks of age. These results are in agreement with those of Aslanian et al. (2011) who stated that male broiler feed Cr supplemented diet had higher BW and improved the BWG than the control diet ($P \leq 0.05$) from 21 to 42 days of age. Abdallah et al. (2013) indicated that CrPic supplementation, at 200, 400, 600 and 800 ppb levels, improved weight gain of Golden Montazah chickens. Samanta et al. (2008) found that live weight gains and protein and conversion efficiency of feed protein to muscle protein improved owing to Cr^{3+} supplementation (0.5mg Cr^{3+} kg^{-1} diet) ($P \leq 0.05$) Also, CrPic supplementation improved growth performance of broiler (Jackson et al. 2008). They proved to increase in BW by supplementing Cr may be a direct result of protein absorption framework (Anderson, 1999). Likewise, Cr is accepted as a basic part in crucial section of the glucose versatility segments (GTF).

The interactions between Na-B and CrPic had a significant effect on BW at 12 wks of age and BWG from 8-12 and 0-12 wks of age.

Feed intake (FI) and feed conversion ratio (FCR):

Results of FI and FCR of male Matrouh chicks as affected by Na-B and CrPic and their interactions are summarized in Table 3.

Feed with Na-B supplementation (5 and 10 g /kg diet) had a significantly increased ($P \leq 0.05$) value of FI from 4-8, 8-12 and 0-12 wks of age. Moreover, FCR was insignificantly affected by these treatments. These results are in agreement with those of Damiri et al. (2012), who stated that chickens fed diets contained SB consumed more feed; and showed greatest feed utilization when broilers were fed ration containing 0.75% and 2.25% Na-B, while minimum FI was noted in 3.75% ($P \leq 0.05$) treatment. Pasha et al. (2008), used two bentonite levels (0.5% and 1.0%) in broiler diets and reported more FI in chicks fed higher levels of Na-B (1% Na-B) than their control. While, Tauqir and Nawaz, (2001) found decreased in FI and had no significant effect on FCR of broiler chicks fed diet including 2, 3 and 4% Na-B. These may be a direct result of increased time of digestion in linen and more use of supplements (Damiri et al., 2012).

Supplemented diets with 800 or 1200 µg CrPic /kg diet had no significant effect on

FI during all the experimental periods (except at 8 to 12 weeks of age) and improved FCR from 4-8, 8-12 and 0-12 wks of age. Anandhi et al. (2006) found that FI of broilers was not improved by supplementation of up to 750 µg/kg of chromium as chromium picolinate. Other reports demonstrated that Cr supplementation of broiler diets (1.5 and 2.5 mg Cr /kg) significantly improved FCR from 1-6 weeks of age (El-Kaiaty et al. 2005). Abdallah et al. (2013) indicated that CrPic supplementation, at 200, 400, 600 and 800 ppb levels, did not affect feed consumption of both sexes but, improved FCR of Golden Montazah chickens.

The interactions between Na-B and CrPic had significant effect on FI from 4-8, 8-12 and 0-12 wks of age and FCR from 8-12 and 0-12 wks of age.

Mortality rate:

The mortality rate was 13.9, 10.0 and 7.2 % for the control and the treated groups received Na-B, respectively (Figure 1). The results were in accordance with the findings of Aghashahi et al. (2015), who found that the mortality rate of broiler chickens tended to decrease in Na-B supplemented group ($P \leq 0.01$). Barmase et al. (1990) reported a significant reduction in mortality of broilers upon addition of 0.5 per cent bentonite to 0.5-ppm aflatoxin containing diets. The decrease in mortality rate by Na-B may be due to decreased aflatoxin uptake, which may diminish its impact on body organs (Zaki et al. 2008).

The mortality rate was 13.3, 10.0 and 7.8 % for the control and treated groups received CrPic, respectively (Figure 2). The results were in accordance with the findings of Lien et al. (1999) who stated that supplemental dietary chromium as CrPic decreased mortality and alters glucose metabolism in chickens. Ibraham (2005) reported that mortality rates of broilers were 10.0, 4.0, 2.0, 7.5, 4.0, and 7.5 % for the control and treated groups received Cr (10, 20, 30, 40 or 50 mg Cr/kg diet), respectively. It was proved that mortality rates decreased in groups received Cr supplemented with the diets up to 50 mg Cr/kg compared to control group. Jackson et al. (2008) reported that dietary supplementation of Cr as CrPic (200 and 400 ppb) decreased mortality in broiler chicks in the finishing period.

The mortality rate was decreased in the groups received Na-B, CrPic in combination or alone as compared with their control (Figure 3). Mortality rate was 18.3, 6.7 and 5.0 % for the control and treated groups received Na-B (10g/kg) +800 µg CrPic/kg or Na-B (10g/kg) +1200 µg CrPic/kg, respectively.

Antibody response and blood constituents:

Results of antibody response and blood constituents of male Matrouh chicks as affected by Na-B and CrPic and their interactions at the end of the experimental period are summarized in Table 4.

Feed with Na-B supplementation (5 and 10 g /kg diet) significantly increased ($P \leq 0.05$) values of serum globulin, T3 hormone, glutathione peroxidase (GPx) enzyme activity and decreased MDA values. However, there is no significant difference among treatments in total antibody response against SRBCs, total protein, albumin, growth hormone (GH), cholesterol and calcium (Table 4). These results are in agreement with those of Aghashahi et al. (2015) reported that the Na-B increased T3 concentration at day 35 of the experiment ($P \leq 0.05$) and no significant difference was found between the groups concerning GH concentrations ($P \leq 0.05$) compared to control in broiler chicks. Khanedar et al. (2012) found that the addition of bentonite (1 or 1.5 % from Na-B or Ca-B) to the diet had no significant effect on the protein and albumin. El-Abd (2014) indicated that, there is no significant difference among treatments (0, 4 % and 6 % bentonite) in total protein, globulin, creatinine, cholesterol, LDL, HDL and triglyceride of Japanese quail chicks.

Supplemented diets with 800 or 1200 µg CrPic /kg diet had a significant ($P \leq 0.05$ or $P \leq 0.01$) a linear increase in the titer of SRBCs, serum total protein, albumin, globulin and GH concentrations. While, serum cholesterol significantly ($P \leq 0.05$) decreased. However, there is no significant difference among treatments in calcium, T3, MDA and GPX (Table 4). These results were in agreement with those obtained by Bahrami et al. (2012) who demonstrated that both 800 and 1,200 ppb of Cr as Cr-l-Met significantly increased antibody titers of broiler chicks compared to the control group ($P \leq 0.01$) at 30 days of age. Abdallah et al. (2013) found that antibody response against SRBC (IgG) of Golden Montazah laying hens was significantly ($P \leq 0.05$) higher in 48-week old laying hens fed 800 ppb Cr differentiated and control or 200,400 and 600 ppb treatment groups. El-Hommosany (2008) showed that total antibody and IgG titers against SRBCs were significantly higher in quail chicks received Cr differentiated and those of controls at secondary immune responses. The upgrade of immune response via Cr supplementation may be because of their antioxidant property. It reasons to protect immature lymphocytes from harm from free radical because of oxidation chromium supplementation is seen to improve the immune response, either through an immediate impact on the cytokines (Borgs and Mallard, 1998) or through the roundabout impact of decreasing the glucocorticosteroid levels (Samanta et al. 2008). Uyanik et al. (2002) who showed that broiler chicks fed 20, 40, or 80 µg Cr/kg diet for 44 days, increased lymphocyte counts, total antibody, IgG, and IgM titers. All levels of Cr increased the cell-mediated response to phytohemagglutinin. In the same respect, Rosebrough and Steele (1981) found that supplemented Cr in turkey poultry diets increased rate of glucose utilization and immune response, which explains the decreased mortality rate observed. On the other hand, Eshra (2005) found a direct increase in blood total protein levels with increasing dietary supplementation of Cr yeast in chicken. The increase in plasma protein and Globulin in the chickens that were supplemented with 800 or 1200 µg CrPic /kg diet increased protein synthesis in the supplemented group over the control group, which resulted in highly live body weight and weight gain, the group as compared with the control group. The increase in serum albumin might be because of increased amino acid synthesis within the liver, suggesting that Cr may improve amino acid synthesis (Moonsie-Shageer and Mowat. 1993). Additionally, Uyanik et al. (2002) watched a diminishment in plasma total lipid, cholesterol by adding Cr and represented that, the decrease in lipid parameters could result from the increasing activity of insulin that discouraged the unsaturated fat amalgamation by increasing glycogen build up. Independently or as a blend supplemental Vit. C and Cr brought about abatement in MDA focus (Tawfeek et al. 2014). Attia et al. (2015) stated that serum MDA and cholesterol focus diminished with dietary Cr. However, Ibrahim et al. (2010) reported that blood calcium and T3 concentration was not influenced significantly ($p \leq 0.05$) by adding different levels of chromium yeast (0.5, 1, 1.5 and 2 mg Cr-yeast/kg) into broiler diets. The same result was recorded by Mostafa (2007). Al-Bandr et al. (2010) found that blood calcium was not influenced by including Cr into the diets. Sahin et al. (2002) showed that adding Cr to broiler diet expanded serum Ca. A possible illumination for the effect of Cr supplementation on Ca absorption framework may be a direct result of that, this mineral (Cr) strives for the same limiting areas.

Results showed that calcium of the chicks was significantly ($P\leq0.05$) influenced by interactions between dietary sodium bentonite and organic chromium, whereas, SRBCs, total protein, albumin, globulin, GH, cholesterol, T3, MDA and GPX were not significantly affected by the interaction at the end of the experimental period.

Economic efficiency:

Results of economic efficiency of male Matrouh chicks as affected by Na-B and CrPic and their interactions at the end of the experimental period are summarized in Table 5.

Data in Table 5 indicate that feeding chick diets supplemented with Na-B at levels of 5 and 10 g /kg diet gave the highest net return and best economic efficiency ($P\leq0.01$) compared to those feds the control diet. These results are in agreement with those obtained by Fatouh et al. (2012) who found improved in EEF values of kampell ducks at 24.98 and 31.66 % of the groups fed 0.50 and 1.0 % Na-B, respectively, as compared to the control group during the studied laying period from 25 to 48 weeks of age. El-Abd (2014) reported that according to sodium bentonite levels, the Japanese quail chicks fed diet containing 6% recorded the highest values of economic efficiency, followed by chicks, which fed a diet containing 4% sodium bentonite. Supplemented diets with 800 or 1200 µg CrPic /kg diet had a significant ($P\leq0.01$) a linear increase in the net return and economic efficiency compared to those fed the control diet. These results are in agreement with those obtained by Mohammed et al. (2014) who found that organic chromium (0.5 ppm Cr/kg) supplemented group showed the highest return and also the highest total costs while, the control group showed the lowest return and the lowest total costs.

Regarding the interaction effect, results in Table 5 demonstrated that the best economic efficiency value was obtained with chicks fed diets containing Na-B (10g/kg) +1200 µg CrPic/kg followed by Na-B (10g/kg) +800 µg CrPic/kg as compared to the control group.

CONCLUSION

Based on these results, it can be concluded that the present study indicated that Supplemented chick's diets with either 10 g Na-B or 1200 µg CrPic /kg diet alone or together may improve the growth performance, serum biochemical traits as well as improved immune responses and give the highest net return and best economic efficiency during the growing period of male Matrouh chicks.

Table (1): The composition of the experimental basal diets.

Ingredients	Starter diet (%)	Grower diet (%)
Yellow corn	59.84	65.40
Soya bean 44%	24.20	22.00
Wheat bran	8.20	3.00
Corn gluten 60%	4.00	------
Di Ca P export	1.53	1.39
Limestone	1.52	7.44
Salt (NaCl)	0.37	0.30
*Premix	0.30	0.30
L Methionine	0.04	0.17
Total	100.00	100.00
Protein	19.0	16.05
Metabolizable energy (M.E.)	2800	2726.76
Crude fiber (C. F.)	4.124	3.375
Calcium	0.995	3.804
Total Phosphorous	0.692	0.619
Lysine	0.949	0.820
Methionine	0.403	0.490

*Premix added to the 1 kg of diet including vit.A 10000 I.U; vit. D3 2000 I.U; vit. E 15 mg; vit. K3 1 mg; vit B1 1mg; vit. B2 5 mg; vit. B12 10 µg; vit B6 1.5mg; Niacin 30mg; Pantothenic acid 10mg; folic acid 1mg; Biotin 50 µg; choline 300 mg; zinc 50mg; copper 4mg; iodine 0.3 mg; iron 30mg; selenium 0.1mg; manganese 60mg; cobalt 0.1mg and carrier CaCo3 up to 1kg.
**According to Feed composition tables for Animal & Poultry feedstuffs used in Egypt (2001).

Table (2): Body weight and body weight gain $(\bar{X} \pm SE)$ of male Matrouh chicks as affected by different levels of dietary sodium bentonite and organic chromium and their interactions during the different experimental periods.

Items		Body weight (gm)				Body weight gain (gm)			
		Initial	4 weeks	8 weeks	12 weeks	0-4 week	4-8 week	8-12 week	0-12 week
SB (g/kg):		NS	NS	NS	**	NS	NS	*	**
0		31.93±0.25	192.60±5.22	488.36±5.99	763.78±11.55^{b}	160.68±5.17	295.76±7.48	275.42±12.99^{b}	731.86±11.51^{b}
5		31.80±0.30	204.33±6.60	499.25±8.05	824.76±10.43^{a}	172.53±6.48	294.92±10.24	325.51±10.77^{a}	792.97±10.38^{a}
10		31.46±0.30	209.53±6.83	507.64±7.53	817.49±20.00^{a}	178.08±6.74	298.11±8.09	309.85±16.92^{ab}	786.03±19.95^{a}
Cr / Kg diet (µg).		NS	NS	**	**	NS	*	NS	**
0		31.80±0.30	196.95±5.74	472.36±3.81^{b}	757.58±12.97^{b}	165.15±5.64	275.42±6.23^{b}	285.22±13.89	725.78±12.89^{b}
800		31.72±0.26	199.47±6.78	506.37±5.73^{a}	819.65±11.76^{a}	167.76±6.65	306.89±7.69^{a}	313.29±12.30	787.94±11.75^{a}
1200		31.67±0.31	210.04±6.46	516.53±7.61^{a}	828.80±17.02^{a}	178.38±6.45	306.49±9.50^{a}	312.27±16.56	797.14±16.99^{a}
Interaction effects:		NS	NS	NS	**				
SB (g/kg)	Cr/Kg (µg)								
0	0	32.09±0.41	186.87±10.04	473.33±9.01	750.71±11.11^{ed}	154.78±9.87	286.47±15.15	277.38±15.01^{ab}	718.62±10.81^{de}
	800	31.83±0.36	196.05±9.45	497.08±12.76	771.05±11.38^{cde}	164.22±9.49	301.04±15.53	273.96±14.99^{ab}	739.21±11.21^{cde}
	1200	31.85±0.56	194.88±8.83	494.67±7.33	769.58±32.49^{cde}	163.03±8.60	299.79±8.61	274.92±35.63^{ab}	737.74±32.49^{cde}
5	0	31.79±0.60	203.85±8.31	467.92±5.42	804.42±18.50^{bcd}	172.07±8.23	264.07±6.56	336.50±17.59^{a}	772.63±18.37^{bcd}
	800	32.05±0.50	205.00±15.52	504.50±6.56	827.83±13.94^{abc}	172.95±15.28	299.51±12.27	323.33±16.43^{a}	795.78±13.74^{abc}
	1200	31.56±0.54	204.14±11.60	525.33±15.8	842.04±20.70^{ab}	172.58±11.26	321.20±23.30	316.71±23.70^{a}	810.48±20.66^{ab}
10	0	31.53±0.57	200.12±11.58	475.84±5.55	717.63±21.97^{e}	168.60±11.19	275.72±8.54	241.79±22.75^{b}	686.10±21.80^{e}
	800	31.27±0.50	197.37±11.37	517.50±9.29	860.08±16.52^{ab}	166.10±10.92	320.13±12.55	342.58±23.37^{a}	828.81±16.51^{ab}
	1200	31.59±0.57	231.11±8.44	529.58±11.91	874.77±17.65^{a}	199.53±8.90	298.47±15.45	345.18±21.57^{a}	843.19±17.13^{a}

Means having different letters in the same column are significantly different * = (P<0.05), ** = (P<0.01); NS= Not significant

Table (3): Feed intake and feed conversion ratio $(\bar{X} \pm SE)$ of male Matrouh chicks as affected by different levels of dietary sodium bentonite and organic chromium and their interactions during the different experimental periods.

Items		Feed intake (gm)				Feed conversion ratio			
		0-4 week	4-8 week	8-12 week	0-12 week	0-4 week	4-8 week	8-12 week	0-12 week
SB (g/kg):		NS	**	*	*	NS	NS	NS	NS
0		428.02±11.15	964.02±6.52^{b}	1528.77±11.78^{b}	2920.81±25.45^{b}	2.69±0.12	3.56±0.1	5.62±0.23	4.11±0.06
5		434.74±12.71	985.02±13.25^{b}	1573.48±27.62^{a}	2993.23±35.63^{a}	2.54±0.10	3.4±0.17	4.87±0.15	3.79±0.08
10		440.62±11.54	1044.79±13.16^{a}	1536.94±13.12^{ab}	3022.34±20.23^{a}	2.51±0.13	3.26±0.09	5.19±0.46	3.79±0.16
Cr / Kg diet (µg).		NS	NS	**	NS	NS	*	*	**
0		431.73±11.89	995.82±14.28	1587.53±24.02^{a}	3015.07±37.01	2.65±0.15	3.64±0.11^{a}	5.77±0.41^{a}	4.17±0.1^{a}
800		424.71±11.22	1002.25±19.75	1532.11±11.81^{b}	2959.06±30.41	2.56±0.12	3.29±0.13^{b}	4.96±0.22^{b}	3.77±0.09^{b}
1200		446.94±11.37	995.76±15.26	1519.55±13.11^{b}	2962.24±21.64	2.52±0.1	3.28±0.12^{b}	4.95±0.23^{b}	3.74±0.1^{b}
Interaction effects:		NS	*	**	*	NS	NS	*	*
SB (g/kg)	Cr/Kg (µg)								
0	0	421.52±22.57	956.92±12.18^{d}	1528.34±21.17^{b}	2906.78±55.91^{c}	2.78±0.39	3.57±0.17	5.60±0.55^{ab}	4.14±0.18^{a}
	800	421.38±18.47	964.30±13.53^{cd}	1524.64±23.72^{b}	2910.32±54.57^{c}	2.57±0.17	3.61±0.26	5.64±0.45^{ab}	4.09±0.04^{a}
	1200	441.14±22.60	970.85±11.43^{cd}	1533.33±25.17^{b}	2945.32±34.81^{bc}	2.71±0.06	3.5±0.13	5.62±0.33^{ab}	4.10±0.04^{a}
5	0	431.33±25.91	1017.18±22.24^{bc}	1672.69±21.77^{a}	3121.2±26.39^{a}	2.51±0.04	3.87±0.23	5.02±0.36^{b}	4.05±0.09^{a}
	800	421.06±20.40	966.19±13.94^{cd}	1518.22±22.07^{b}	2905.47±15.56^{c}	2.49±0.27	3.24±0.14	4.70±0.11^{b}	3.66±0.05^{b}
	1200	451.82±24.57	971.67±25.19^{cd}	1529.52±27.84^{b}	2953.01±38.01^{bc}	2.63±0.19	3.07±0.28	4.88±0.29^{b}	3.65±0.08^{b}
10	0	442.33±20.19	1013.34±25.80^{bcd}	1561.56±16.83^{b}	3017.22±33.39^{abc}	2.67±0.29	3.49±0.14	6.69±0.91^{a}	4.33±0.23^{a}
	800	431.67±26.76	1076.26±13.93^{a}	1553.46±16.44^{b}	3061.39±3.61^{ab}	2.62±0.26	3.02±0.05	4.54±0.01^{b}	3.56±0.06^{b}
	1200	447.85±20.17	1044.76±15.07^{ab}	1495.79±15.03^{b}	2988.4±49.32^{bc}	2.25±0.10	3.27±0.11	4.35±0.12^{b}	3.46±0.04^{b}

Means having different letters in the same column are significantly different * = ($P<0.05$), ** = ($P<0.01$); NS= Not significant

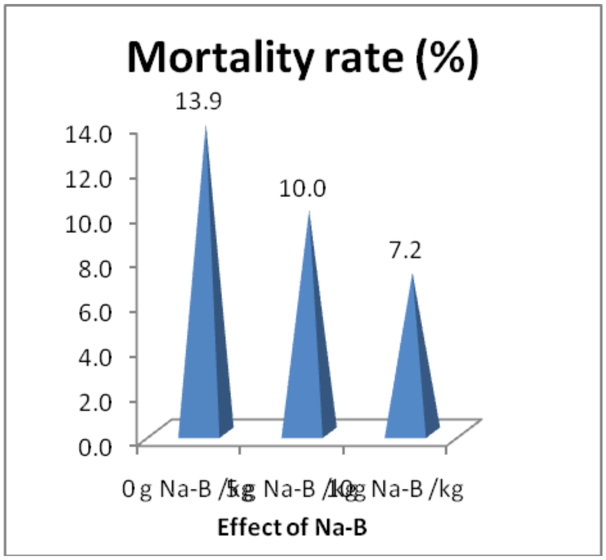

Figure1. Effect of Na-B on mortality rate

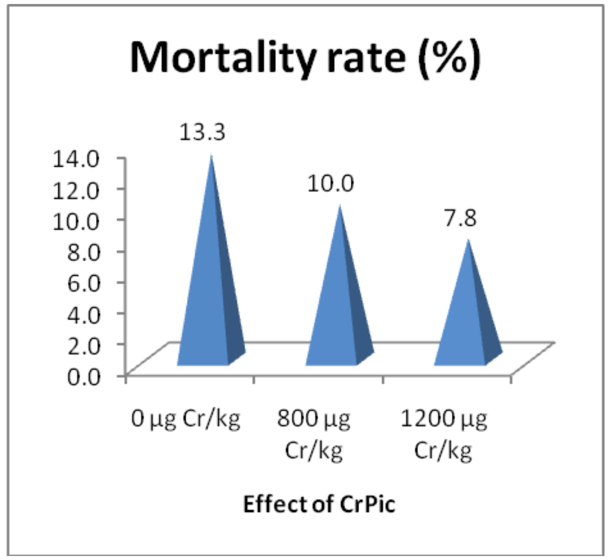

Figure 2. Effect of CrPic on mortality rate

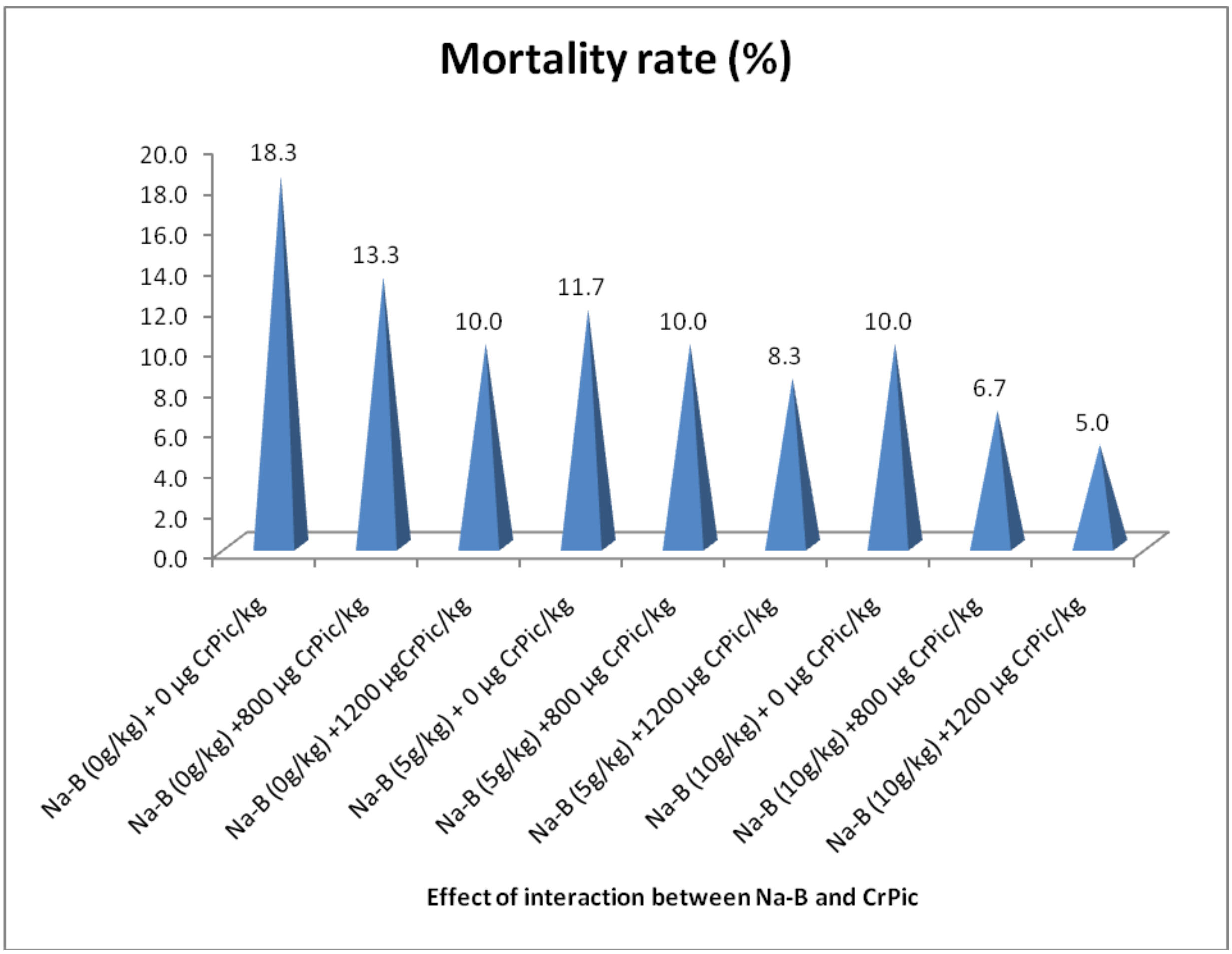

Figure 3. Effect of interaction between Na-B and CrPic on mortality rate

Table (4): Antibody response and blood constituents $(\overline{X} \pm SE)$ of male Matrouh chicks as affected by different levels of dietary sodium bentonite and organic chromium and their interactions at the end of the experimental periods.

Items		SRBCs	Total protein (g/dl)	Albumin (g/dl)	Globulin (g/dl)	GH	Cholesterol (mg/dl)	Calcium (mg/dl)	T3 (ng/dl)	MDA (µmol/ml)	GPX (U/ml)
SB (g/kg):		NS	NS	NS	*	NS	NS	NS	*	**	*
0		4.73±0.19	4.71±0.11	2.26±0.10	2.51±0.04^{b}	1.76±0.10	128.07±5.86	14.05±0.24	4.47±0.35^{b}	2.86±0.12^{a}	46.94±2.24^{b}
5		4.80±0.21	4.87±0.11	2.35±0.08	2.56±0.06^{ab}	1.82±0.08	125.47±5.22	14.3±0.42	4.92±0.29^{ab}	2.73±0.15^{a}	55.48±1.77^{a}
10		5.10±0.22	5.12±0.20	2.39±0.09	2.73±0.15^{a}	1.91±0.12	125.77±3.45	14.75±0.26	5.82±0.33^{a}	2.23±0.12^{b}	52.98±1.78^{a}
Cr / Kg diet (µg).		**	*	*	*	*	**	NS	NS	NS	NS
0		4.35±0.06^{b}	4.59±0.12^{b}	2.13±0.08^{b}	2.48±0.09^{b}	1.62±0.09^{b}	138.09±3.84^{a}	13.9±0.39	4.77±0.35	2.75±0.16	53.75±1.76
800		4.98±0.07^{a}	5.01±0.14^{a}	2.43±0.07^{a}	2.60±0.09^{ab}	1.89±0.1^{ab}	125.97±3.65^{b}	14.59±0.29	5.11±0.40	2.61±0.16	51.8±2.36
1200		5.30±0.08^{a}	5.10±0.16^{a}	2.44±0.09^{a}	2.72±0.1^{a}	1.98±0.08^{a}	115.25±3.63^{b}	14.61±0.23	5.33±0.36	2.46±0.15	49.86±2.55
Interaction effects:		NS	NS	NS	**	NS	NS	*	NS	NS	NS
SB (g/kg)	Cr/Kg (µg)										
0	0	4.46±0.38	4.59±0.23	2.02±0.19	2.61±0.02^{bc}	1.55±0.19	146.54±5.85	13.73±0.51^{bc}	4.3±0.63	3.07±0.22	52.11±3.51
	800	4.81±0.39	4.73±0.19	2.34±0.14	2.42±0.06^{cd}	1.83±0.14	125.29±6.07	14.06±0.39^{abc}	4.49±0.75	2.85±0.16	46.01±3.77
	1200	4.91±0.30	4.81±0.22	2.41±0.11	2.49±0.07^{cd}	1.89±0.18	112.39±6.51	14.34±0.42^{ab}	4.62±0.66	2.65±0.18	42.70±3.26
5	0	4.12±0.19	4.69±0.16	2.15±0.11	2.59±0.02^{bc}	1.67±0.08	136.99±6.01	12.90±0.42^{c}	4.69±0.57	2.81±0.23	55.48±3.29
	800	5.04±0.25	4.94±0.24	2.45±0.14	2.48±0.16^{cd}	1.84±0.16	128.19±8.82	15.39±0.38^{a}	4.92±0.64	2.76±0.35	56.76±3.27
	1200	5.23±0.20	4.98±0.21	2.43±0.13	2.60±0.06^{bc}	1.95±0.16	111.24±6.39	14.59±0.36^{ab}	5.15±0.48	2.63±0.25	54.19±3.77
10	0	4.48±0.28	4.49±0.27	2.21±0.12	2.23±0.20^{d}	1.64±0.21	130.74±6.59	15.05±0.42^{ab}	5.31±0.68	2.37±0.24	53.65±3.31
	800	5.07±0.26	5.35±0.17	2.48±0.16	2.89±0.01^{ab}	2.00±0.23	124.44±6.42	14.31±0.43^{ab}	5.91±0.62	2.2±0.18	52.61±3.54
	1200	5.75±0.18	5.51±0.26	2.47±0.19	3.06±0.14^{a}	2.09±0.12	122.14±6.19	14.88±0.51^{ab}	6.22±0.46	2.11±0.24	52.67±3.74

Means having different letters in the same column are significantly different * = ($P<0.05$), ** = ($P<0.01$); NS= Not significant

Table (5): Economic efficiency of male Matrouh chicks as affected by different levels of dietary sodium bentonite and organic chromium and their interactions at the end of the experimental periods.

Items		Weight gain (kg)	Price/kg (LE)	Total revenue chick (LE)	Total feed intake/ chick (kg)	Price/Kg feed (LE)	Total feed cost/ chick (LE)	Fixed chicks (LE)	Total cost chick (LE)	Net revenue/ chick (LE)	Economic efficiency (EEF)
SB (g/kg):										**	**
0		0.732	20.0	14.637	3.002	4.10010	12.307	2.000	14.307	0.330 ^{b}	2.192 ^{b}
5		0.793	20.0	15.859	2.993	4.10610	12.290	2.000	14.290	1.569 ^{a}	9.754 ^{a}
10		0.786	20.0	15.721	2.942	4.11210	12.096	2.000	14.096	1.625 ^{a}	9.349 ^{a}
Cr / Kg diet (µg).										**	**
0		0.726	20.0	14.516	3.015	4.10600	12.380	2.000	14.380	0.136 ^{b}	0.556 ^{b}
800		0.788	20.0	15.759	2.959	4.10612	12.150	2.000	14.150	1.609 ^{a}	9.946 ^{a}
1200		0.797	20.0	15.943	2.962	4.10618	12.163	2.000	14.163	1.779 ^{a}	10.793 ^{a}
Interaction effects:											
SB (g/kg)	Cr/Kg (µg)									**	**
	0	0.719	20.0	14.372	2.963	4.10000	12.149	2.000	14.149	0.223 ^{b}	1.402 ^{b}
0	800	0.739	20.0	14.784	3.022	4.10012	12.392	2.000	14.392	0.393 ^{b}	2.635 ^{b}
	1200	0.738	20.0	14.755	3.019	4.10018	12.379	2.000	14.379	0.375 ^{b}	2.538 ^{b}
	0	0.773	20.0	15.453	3.121	4.10600	12.816	2.000	14.816	0.637 ^{b}	4.025 ^{b}
5	800	0.796	20.0	15.916	2.905	4.10612	11.930	2.000	13.930	1.985 ^{a}	12.460 ^{a}
	1200	0.810	20.0	16.210	2.953	4.10618	12.126	2.000	14.126	2.084 ^{a}	12.777 ^{a}
	0	0.686	20.0	13.722	2.961	4.11200	12.175	2.000	14.175	-0.453 ^{b}	-3.760
10	800	0.829	20.0	16.576	2.949	4.11212	12.128	2.000	14.128	2.448 ^{a}	14.745 ^{a}
	1200	0.843	20.0	16.864	2.914	4.11218	11.985	2.000	13.985	2.879 ^{a}	17.063 ^{a}

Total revenue = Weight gain (kg) / chick X Price/kg (LE). Total cost chick (LE)= Total feed cost/ chick (LE)+ Fixed chicks (LE)
Net revenue/ chick (LE)= Total revenue chick (LE)- Total cost chick (LE) EEF= Net revenue/ chick (LE)/ Total cost chick (LE) X 100
Means having different letters in the same column are significantly different * = ($P<0.05$), ** = ($P<0.01$); NS= Not significant

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الملخص العربي

تأثير إضافة بنتونيت الصوديوم والكروميوم العضوي في العليقة على الأداء الإنتاجي والفسيولوجي والاستجابة المناعية في سلاله كتاكيت مطروح.

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الهدف الرئيسي من هذه الدراسة تقييم تأثير إضافة مستويات مختلفة من بنتونيت الصوديوم (٠، ٥، ١٠ جم / كجم عليقه) وبيكولينات الكروم (٠، ٨٠٠، ١٢٠٠ ميكروجرام / كجم عليقه) لعليقه الكتاكيت على أداء النمو ومعدل النفوق، وبعض مكونات الدم وكذلك الاستجابة المناعية والكفاءة الاقتصادية لكتاكيت ذكور سلالة مطروح أثناء فترة النمو. وأجريت هذه الدراسة على عدد ٥٤٠ ذكر من سلالة دجاج مطروح المحلي عند عمر يوم، قسمت عشوائيا إلى ٩ مجموعة (٦٠ ذكر لكل مجموعه) في تجربة عامليه ٣ X ٣.

إضافة البنتونيت للعليقة أدي إلى زيادة معنوية في وزن الجسم، والزيادة اليومية للجسم، والغذاء المأكول، وكذلك سيرم الجلوبيولين، وهرمون الثيروكسين، والبيروكسيديز الجلوتاثيون، انخفض معدل النفوق وقيم المالونالدهيد بينما لم يتأثر معنويا معدل التحويل الغذائي، والاستجابة المناعية، والبروتين الكلي، والألبيومين، وهرمون النمو، والكولسترول، والكالسيوم وأعطت الإضافة اعلي عائد صافي وأفضل عائد اقتصادي من تلك التي غذيت على عليقه الكونترول عند ١٢ أسبوع من العمر.

الإضافة الغذائية للكروم زاد معنويا وزن الجسم، والزيادة اليومية للجسم، والغذاء المأكول وحسنت معدل التحويل الغذائي، وكذلك الاستجابة المناعية، وتركيز سيرم البروتين الكلي، والألبيومين، والجلوبيولين، وهرمون النمو بينما انخفضت معنويا معدل النفوق، وسيرم الكولسترول ومع ذلك لا توجد اختلافات معنوية بين المعاملات للكالسيوم، وهرمون الثيروكسين، والمالونالدهيد، والبيروكسيديز الجلوتاثيون والإضافة الغذائية للكروم أعطت اعلي عائد صافي، وأفضل عائد اقتصادي من تلك التي غذيت على عليقه الكونترول.

علاوة على ذلك، تأثر معنويا تداخل التغذية بين بنتونيت الصوديوم وبيكولينات الكروم على وزن الجسم، والزيادة اليومية للجسم، والغذاء المأكول، معدل التحويل الغذائي، معدل النفوق وسيرم الجلوبيولين، والكالسيوم، في حين لم يؤثر ذلك التداخل على الاستجابة المناعية، البروتين الكلي، والألبيومين، وهرمون النمو، والكولسترول، وهرمون الثيروكسين، والمالونالدهيد، والبيروكسيديز الجلوتاثيون.

ومن الواضح أن ينصح بإضافة ١٠ جرام بنتونيت الصوديوم، و١٢٠٠ ميكروجرام / كجم للعليقة كلا على حدة أو معا الي عليقة الطيور لتحسين اداء النمو وبعض مكونات الدم وكذلك تحسين الاستجابات المناعية لتعطي اعلي عائد صافي وأفضل كفاءة اقتصادية خلال فترة نمو كتاكيت ذكور مطروح .