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EFFECT OF DIETARY MAGNESIUM SUPPLEMENTATION FORMS AND LEVELS ON BROILER CHICKS PERFORMANCE AND SOME CARCASS CHARACTERISTICS

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ABSTRACT

This study was carried out to evaluate the effect of magnesium supplementation forms and levels to the diet of broiler chicks on performance and some carcass traits. One day old of 180 broiler chicks (Arbor Acres plus) were allocated randomly into 6 treatment groups of 30 chicks each (2 sources x 3 doses factorial experiment). The distribution of birds was random. Each form of magnesium was added to the basal diet at doses 0, 60 and 120 mg Mg/kg diet. The study lasted for 35 days. Results showed that, birds fed the control diet that was supplemented with inorganic magnesium recorded an enhancement ($P<0.05$) in body weight gain, feed intake and feed /gain ratio (feed conversion). Adding the highest supplementation level of Mg (120 mg Mg/ kg diet) to broiler diet recorded significant improvement ($P\leq0.01$) in body weight gain, feed intake and feed conversion. No significant differences were observed in weights of live body, carcass, giblets and proportions of dressing and giblets due dietary treatments.

Keywords: broilers, nanoparticles, performance, carcass, dressing.

INTRODUCTION

The creation of balanced rations that provide appropriate amounts of protein, energy, and micronutrients (minerals and vitamins) is crucial for the health and well-being of poultry. Among all, minerals are not absolutely necessary, they are essential for sustaining the productivity of poultry. Because the minerals in diets are not as bioavailable, poultry need additional supplementation to meet their physiological needs.

Previously, minerals were presented as inorganic salts, which are less absorbed and, as a result, excrete a significant portion into the environment, posing problems for the environment. Additional, options for supplementing livestock and poultry feed contain organic mineral chelates and nano-minerals (**Swain et al., 2021**).

Ensuring that the broiler chicken's mineral nutrition is sufficient in all aspects is crucial to its overall well-being and health. The need for mineral nutrition will rise in parallel with higher rates of growth and more advanced techniques of production. The skeleton of the bird contains the plurality of its minerals, so maintaining skeletal integrity may be pivotal. However minerals are involved in every facet of metabolism, balancing the body's production of free radicals and acting as cofactors for enzymes (**Goff, 2018**). Additionally, the immune system, the gastrointestinal tract, and carcass quality are just a few of the variables that minerals affect.

The macrominerals calcium, phosphorus, sodium, potassium, magnesium, chlorine, and sulfurare the minerals that poultry need in their diet in significant amounts (mg or g per day). Much lower amounts of the trace or microminerals (micrograms per day or fewer) are required. The microminerals that need to be most concerned about in terms of practical diets are copper, iodine, iron, manganese, selenium, and zinc. Despite requests for them, minerals including boron, chromium, molybdenum, silicon, fluorine, and vanadium are unlikely to be lacking in chicken diets.

One of the most prevalent divalent cations in living cells, magnesium is critical for a variety of cellular functions. Magnesium has benefits in the metabolism of lipids, carbohydrates, and amino acids in addition the metabolism of calcium and vitamin D in bone. Magnesium is present in numerous essential enzyme handles that use ATP and power all main metabolic pathways, either as an activator or cofactor. For hens, magnesium is vital, and researches have shown that it can activate over 100 different enzymes (**NRC 1994**).

This study was designed to evaluate the effect of addition magnesium in the forms of inorganic or nano, at three levels for each form (0, 60 and 120 mg Mg/kg diet) to broilers diet on performance and carcass characteristics.

MATERIALS AND METHODS:

The present experiment was carried out at the Agricultural Farm of Animal and Poultry Production, Faculty of Agriculture, Minia University. One hundred eighty, unsexed, Arbor Acres plus broiler chicks, one-day old were appropriated into two groups, the 1st group was fed diets incorporated with inorganic magnesium, while the 2nd group was fed diets incorporated with nano magnesium. Each group was randomly divided into three subgroups the 1st subgroup was fed basal diets contained 600 mg magnesium, while the 2nd and 3rd subgroups were fed basal diets incorporated with 60 and 120 mg magnesium/Kg diet, respectively. The initial body weight on average was nearly the same. Chicks were investment and kept in ground floor (10 chicks/ m^2) in open housing system. Feeds and water available *ad-libitum* during the whole experiment period (0 to 35 days of age). All treatments maintained sanitary conditions and similar management practices for the chicks. Two feeding phases were used during the trial period: the starter period, which lasted from 1 to 21 days, and the finisher period, which lasted from 22 to 35 days. Chicks of all treatment groups were received a control diet as recommended by the National Research Council, **NRC, (1994)**,

The ingredients and the proximate chemical analysis of control diet of broiler chickens are shown in Table (1).

The preparations of Mg nanoparticles from its oxide (MgO) were prepared eco-friendly (green synthesis) using green tomato Aqueous extracts according to the method of **(Ogunyemi et al., 2023)**

During the 5-weeks feeding experiment the BW of the birds and their feed consumption were recorded weekly. The body gain and feed conversion (FCR) were calculated.

Three birds from each treatment were randomly nominated at the end of the experiment (5 weeks of age), weighed, and then slaughtered after a 12-hour fast. Birds were scalded after complete bleeding, feathers were removed. The edible organs "liver, gizzard, heart, and spleen" were taken out, weighed, and presented as a proportions of live body weight.

Statistical analysis:

The factorial experiments were designed as 2 supplementation froms x 3 supplementation levels. Data were statistically analyzed by using the general liner model (GLM) procedure of statistical analysis system (**SAS, 2003**). The statistical model used in each experiment as follows:

$$Y_{ijk} = \mu + A_i + + B_j + AB_{ij} + e_{ijk}$$

Where:

Y_{ijk} = The observation value on the concerned trait.

A_i : The fixed effect of supplementation form ($_1$ = 1,2).

B_j : The fixed effect of the supplementation levels ($_j$ = 1,2,3).

AB_{ij} : The fixed effect of interaction between supplementation from and levels.

e_{ijk} = A random error.

Significant differences among treatments were arranged by Duncans multiple range test at level 5% (**Duncan, 1955**).

Table (1): Ingredients and chemical analysis of control diet of broiler chickens

Ingredient, %	**Starter diet (0-21 days of age)**	**Finisher diet (22-35 days of age)**
Ground Yellow corn	55.23	54.30
Soybean meal, 44% crude protein	32.82	36.61
Corn gluten meal	5	0
Sun flower oil	3.05	6
Dicalcium phosphate	1.65	0
Monocalcium phosphate	0	1.05
Limestone	1.15	1.2
Sodium chloride	0.25	0.25
DL-methionine	0.15	0.14
Lysine	0.25	0.2
Cystine	0.2	0
Vitamin-mineral premix *	0.25	0.25
total	100	100
Calculated chemical analysis		
Crude protein,	22.98	20.96
Metabolizable energy(Kcal/ kg)	3050	3172.65
Crude fiber	3.78	3.76
Calcium	0.91	0.75
Available phosphorus	0.45	0.38
Methionine+ Cystine	1.0	0.8
Mg	0.18	0.19

* Vitamins and minerals mixture of each kilogram contains:; 800 mg Vitamin K3; 40 mg Vitamin B1; 1600 mg Vitamin B2; 600 mg Vitamin B6;4800.000 IU of Vitamin D3; 4.000 mg Vitamin E acetate ; 4.00 mg of Vitamin B12; 4.00 mg pantothenic acid; 8.00 mg Nicotinic acid; 400 mg Folic acid; 20 mg Biotin; 200 mg chorine; 4.000 Copper; 400 mg Iodine; 120.00 mg Iron; 22.000 mg Manganese; 22.000 mg Zinc, and 40 mg Selenium.

RESULTS AND DISCUSSION:

Impact of magnesium supplementation forms and levels on growth performance:

Body weight gain:

Data of body weight gain are presented in Table (2) showed that, the effect of magnesium forms either inorganic or nano on broiler chicks, was highly significant ($P \leq 0.01$) on body weight gain during the periods 3 to 5 and 0 to 5 weeks of age. A highly significant increase in body gain was recorded for birds fed diets incorporated with inorganic Mg form during the periods 3 to 5 and total 0 to 5 weeks of age , while the influence of Mg supplementation forms on body gain during the period 0 to 3 wks of age was not significant ($p>0.05$).

These results were not compatible with those obtained by **van der Hoeven-Hangoor et al., (2013)**, who investigated the effects on broiler chickens which fed on three different magnesium sources (magnesium oxide, magnesium sulphate and magnesium chloride). The authors found that, dietary $MgSO_4$ led to a linear decrease in body weight gain. **Göçmen et al., (2018)** reported that, feeding broiler chicks diets incorporated with organic or inorganic Mg did not have any effect on chicks' body weight gain.

The results of Mg levels indicated that, there was discernible effect ($P \leq 0.01$) of Mg supplementation levels on body weight gain during all experimental periods except the period from 3 to 5 weeks of age compared to the control group. Adding the highest supplementation level of Mg (120 mg/ kg diet) to broiler diet recorded higher body gain of broiler chicks.

The previous results are in compliance with **Estevez and Petracci, (2019)** reported that**,** broiler chicks' daily weight gain (DWG, g/d) increased ($P \leq 0.05$) when magnesium supplemented at a level of 0.3% in their diet (3000 ppm).

On the other hand, some authors presented insignificant effect of dietary Mg on body weight gain, **Göçmen et al., (2018)** reported that, feeding broiler chicks diets prepared into the basal diet with adding organic and inorganic Mg at 0, 0.2, and 0.4% levels did not significantly affect the chicks' body gain.

The data of interaction between Mg supplementation forms and levels indicated, there were highly significant ($P \leq 0.01$) differences in body gain among treatments during all periods of the experiment. Chicks fed diets incorporated with 60 mg inorganic Mg/kg diet recorded the greatest body gain during the periods (3 to 5) or (0 to 5) weeks of age. However, birds fed diet enriched with 120 mg nano Mg /kg diet recorded the greatest body gain compared with other treatments throughout the period from 0 to 3 weeks of age.

The improvement of body weight gain for birds received 60 mg inorganic Mg/kg diet may be due to that magnesium is an paramount cation in the diet of most animals (**Leeson and summers, 2001**), and it is necessary for normal bone mineralization, nerve conveyance and muscular function (**NRC, 2005**). The body's foremost metabolic pathways, including oxidative phosphorylation (**Vitale et al., 1957**) and P transfer between adenosine triphosphate, adenosine diphosphate, and adenosine monophosphate, which results in the formation of adenosine triphosphate (**Leeson and Summers, 2001**), also depend on magnesium as a cofactor (**NRC, 2005**).

Feed consumption:

The data presented in Table (3) revealed that, Mg supplementation forms (inorganic or nano), had a highly effect ($P \leq 0.01$) on feed consumption values of broiler chicks at all experimental periods except the period from 0 to 3 weeks of age. The greatest value of feed consumption was calculated for birds fed diets incorporated with inorganic Mg form during the periods (3 to 5) or (0 to 5) weeks of age. While, the effect of Mg supplementation forms on feed consumption during the period from 0 to 3 wks of age was not significant ($p>0.05$).

The previous results were not compatible with those obtained by **Göçmen et al., (2018)** who speculated that, addition of organic and inorganic Mg had no effect on feed intake of broiler chicks.

These results preserved that, there were significant ($P \leq 0.01$) differences among all supplementation levels of Mg in feed consumption during the periods (0 to 3) or (0 to 5) weeks of age. The greatest significant value of feed consumption was recorded for birds fed diets incorporated with 120 mg Mg/kg diet followed by birds fed the lower supplementation. Also, birds fed all supplementation levels of Mg recorded numerically ($P>0.05$) increased in feed consumption in comparison with basal diet during the period 3 to 5 wks of age.

The previous results are in compliance with **Estevez and Petracci, (2019)** reported that, adding Mg at a rate of 0.3% (3000 ppm) to the diet did not have an adverse effect on the daily average feed consumption (DAFC, g/d) of broiler chickens.

On the other hand, Guo et al., (2003) and **Liu et al., (2007)** speculated that, the all tested levels of magnesium (0.5, 1.0, and 2.0 g/kg, respectively) had no impact on feed intake, which was linearly lowered by increasing $MgSO4$. Also, **Göçmen et al., (2018)** speculated that, addition of different levels of inorganic and organic Mg did not significant effect on feed intake of broiler chicks.

Data of interaction between Mg supplementation forms and levels speculated that, no discernible effect ($P<0.05$) on feed consumption among all treatments during all periods. Chickens fed diet incorporated with 60 mg inorganic Mg/ kg diet recorded the greatest ($P<0.05$) value of feed consumption throughout (3 to 5) or (0 to 5) weeks of age. Also, birds fed diets supplemented with 120 mg nano Mg/kg diet achieved the highest ($P<0.05$) value of feed consumption during the period 0 to 3 weeks of age. While, chicks fed control diet had the lowest value.

Table (2): Impact of magnesium supplementation forms and levels on broiler chickens' body gain.

Items	Body weight gain (g/ bird/ period)		
Age, weeks	0-3	3-5	0-5
Mg supplementation forms (A):			
Inorganic Mg	778.51	1361.59[a]	2140.10[a]
Nano Mg	778.28	1178.31[b]	1956. 61[b]
±SEM	10.28	36.58	45.04
Significance	NS	**	**
Mg supplementation levels (B):			
Control (0.0)	677.33[b]	1205.48	1882.82[b]
60′ mg/kg diet	809.65[a]	1298.33	2107.98[a]
120" mg/kg diet	848.20[a]	1306.05	2154.26[a]
±SEM	12.59	44.80	55.17
Significance	*	NS	**
Interaction between Mg supplementation forms and levels (A*B):			
Inorganic Mg (0.0) (control)	656.92[c]	1255.50[bc]	1912.42[b]
Inorganic Mg (60 mg /kg diet)	836.47[a]	1456.85[a]	2293.32[a]
(Inorganic Mg (120 mg /kg diet	842.13[a]	1372.45[ab]	2214.58[a]
Nano Mg (0.0) (control)	697.74[c]	1155.49[bc]	1853.23[b]
Nano Mg (60 mg /kg diet)	782.83[b]	1139.80[c]	1922.63[b]
(Nano Mg (120 mg /kg diet	854.28[a]	1239.64[bc]	2093.92[ab]
±SEM	17.81	63.36	78.02
Significance	**	**	**

[a-c]Means within the columns with different superscript are significant difference (P<0.05). Values are expressed as means ± standard error. ′= 10 % (60 mg/kg diet) of Mg above NRC recommendation of Mg in broilers diet. "=20 % (120 mg/ kg diet) of Mg above NRC recommendation of Mg in broilers diet. SEM: standard error of the mean. N.S = not significantly different (P≥ 0.05). (*)= significant (P< 0.05). **) =highly significant (p≤0.01).

Table (3): Impact of magnesium supplementation forms and levels on broiler chickens' feed consumption.

Items	Feed consumption (g/ bird/ period)		
Age, weeks	0-3	3-5	0-5
Mg supplementation forms (A):			
Inorganic Mg	1073.87	3044.39^{a}	3515.28^{a}
Nano Mg	1125.36	2761.42^{b}	3250.09^{b}
±SEM	17.28	60.11	60.64
Significance	NS	**	**
Mg supplementation levels (B):			
Control (0.0)	997.25^{b}	2769.05	3204.37^{b}
60′ mg/kg diet	1119.57^{a}	2929.46	3424.99^{ab}
120″ mg/kg diet	1182.53^{a}	3010.20	3518.70^{a}
±SEM	21.17	73.62	74.26
Significance	**	NS	**
Interaction between Mg supplementation forms and levels (A*B):			
Inorganic Mg (0.0) (control)	937.15^{b}	2838.15^{b}	3284.47 ^{b}
Inorganic Mg (60 mg /kg diet)	1123.29^{a}	3166.91^{a}	3645.59^{a}
(Inorganic Mg (120 mg /kg diet	1161.18^{a}	3128.10^{a}	3615.77^{a}
Nano Mg (0.0) (control)	1057.35^{b}	2699.95^{b}	3124.27 ^{b}
Nano Mg (60 mg /kg diet)	1114.84^{a}	2692.01^{b}	3204.37 ^{b}
(Nano Mg (120 mg /kg diet	1203.88^{a}	2892.30^{ab}	3421.63^{ab}
±SEM	29.93	104.12	105.03
Significance	*	*	*

$^{a-b}$Means within the columns with different superscript are significant difference ($P<0.05$). Values are presented as means ± standard error. ′= 10 % (60 mg/kg diet) of Mg above NRC recommendation of Mg in broilers diet. "=20 % (120 mg/ kg diet) of Mg above NRC recommendation of Mg in broilers diet. SEM: standard error of the mean N.S = not significantly different ($P\geq 0.05$). (*)= significant ($P< 0.05$). **) =highly significant ($p\leq0.01$).

Feed conversion ratio:

The results presented in Table (4) revealed noticeable effects of Mg supplementation forms (P≤0.01) on feed conversion values during all periods of the experiment except the period from 0 to 5 weeks of age. Significant improvement in feed conversion was found for birds fed inorganic form during the periods (0 to 3) or (3 to 5) weeks of age. Also, birds fed inorganic Mg recorded insignificant (P>0.05) improvement in FCR during 0 to 5 weeks of age.

These data presented that, there were effects (P≤0.01) observed on feed conversion due to adding Mg supplementation levels during the different experimental periods. Significant improvement in feed conversion was reported for chicks received diets supplemented with 60 mg Mg /kg diet at all experimental periods except the period from 3 to 5 weeks of age. Also, birds fed the lower supplementation level of Mg (60 mg /kg diet) recorded insignificant (P>0.05) improvement in feed conversion during 3 to 5 weeks of age.

These results are equidistant to the finding of **Sedgh-Gooya and Torki, (2018)** showed that, feed conversation ratio of laying hens was improved when fed either 300 or 600 mg/ kg of Mg oxide compared to others fed the control diet (P< 0.05). Likewise, **Estevez and Petracci., (2019)** speculated that, adding Mg to the diet at a rate of 0.3% (3000 ppm) had no negative impact on feed conversion.

On the other hand, Göçmen et al., (2018) speculated that, addition 0.2 and 0.4 organic or inorganic Mg did not significant effect on feed conversion ratio.

The present data of interaction between Mg supplementation forms and levels revealed that, there was an effect (P≤0.01) on feed conversion of broiler chicks. Birds fed diets supplemented with 60 mg inorganic Mg /kg diet had the best value of feed conversion ratio during the periods (0 to 3 or 0 to 5) weeks of age. While, this effect on feed conversion during 3 to 5 weeks of age was not significant (p>0.05).

Impact of magnesium supplementation forms and levels on some carcass traits:

Data presented in Table (5) indicated that, there were no significant effects of Mg supplementation forms (P>0.05) on live body weight, carcass, giblets and proportions of dressing and giblets. Birds fed diets supplemented with inorganic magnesium recorded numerically enhancement (P>0.05) in values of the previous parameters.

These results are not consistent with **Göçmen et al., (2018)** fed broiler chicks on diet had 0.2 and 0.4 organic or inorganic Mg. They determined that, there were significant effects (P<0.05) in carcass, liver, wing weight and carcass yield between treatments.

The data showed that, there was discernible effect (P≤ 0.01) of Mg supplementation levels on giblets weight, dressing% and giblets%. Birds fed diets enriched with 60 mg Mg/kg diet presented the best value of the previous parameters. Also, birds fed the lower supplementation level of Mg (60 mg Mg/kg diet) recorded numerically enhancement (P>0.05) in live body and carcass weight.

The present data of interaction between Mg supplementation forms and levels revealed that, there was significant (P<0.05) effect was detected between treatments in values of giblets weight and dressing %. Birds fed diets supplemented with 60 mg nano Mg/kg diet achieved the best value of giblets weight and dressing percentage. However there were not substantial (P>0.05) effects are revealed in values of live body, carcass weights or giblets percentage among all treatments.

The enhancements in growth performance may be primarily accountable for the increase in carcass yield (Table 2). Also, Magnesium (Mg) is vibrant and essential for growth of animal and survival. It is the fourth most prevailing cation in organisms (**Wolf and Cittadini, 2003**).

CONCLUSIONS

From this experiment it might be concluded that adding inorganic magnesium supplementation to broilers diet led to enhance in some productive performance of broiler chickens. Likewise, adding magnesium in lower level ameliorate some carcass traits.

Table (4): Impact of magnesium supplementation forms and levels on broiler chickens' feed conversion ratio.

Items	Feed conversion ratio (gm feed/gm gain)		
Age, weeks	0-3	3-5	0-5
Mg supplementation forms (A):			
Inorganic Mg	1.38[b]	2.23[b]	1.64
Nano Mg	1.44[a]	2.34[a]	1.66
±SEM	0.009	0.02	0.01
Significance	**	**	NS
Mg supplementation levels (B):			
Control (0.0)	1.47[a]	2.30	1.70[a]
60′mg/kg diet	1.38[b]	2.27	1.62[b]
120″ mg/kg diet	1.39[b]	2.31	1.64[b]
±SEM	0.01	0.02	0.01
Significance	**	NS	**
Interaction between Mg supplementation forms and levels (A*B):			
Inorganic Mg (0.0) (control)	1.42[a]	2.26	1.71[a]
Inorganic Mg (60 mg /kg diet)	1.34[c]	2.17	1.59[c]
(Inorganic Mg (120 mg /kg diet	1.38[bc]	2.28	1.63[bc]
Nano Mg (0.0) (control)	1.49[a]	2.33	1.69[a]
Nano Mg (60 mg /kg diet)	1.42[a]	2.36	1.65[ab]
(Nano Mg (120 mg /kg diet	1.41[b]	2.34	1.63[bc]
±SEM	0.01	0.04	0.01
Significance	**	NS	**

[a-c]Means within the columns with different superscript are significant difference ($P<0.05$). Values are presented as means ± standard error. ′= 10 % (60 mg/kg diet) of Mg above NRC recommendation of Mg in broilers diet. ″=20 % (120 mg/kg diet) of Mg above NRC recommendation of Mg in broilers diet. SEM: standard error of the mean. N.S = not significantly different ($P\geq 0.05$). (*)= significant ($P< 0.05$). (**) =highly significant ($p\leq0.01$).

Table (5): Impact of magnesium supplementation forms and levels on some carcass traits.

Items	*Live body weight (g/ bird)*	*Carcass weight (g)*	*Giblets weight (g)*	*Dressing%*	*Giblets %*
Mg supplementation forms (A):					
Inorganic Mg	2193.89	1612.22	103.78	78.21	4.75
Nano Mg	2126.38	1551.43	99.02	77.61	4.66
±SEM	73.71	57.59	2.49	0.26	0.17
Significance	NS	NS	NS	NS	NS
Mg supplementation levels (B):					
Control (0.0)	2030.40	1455.48	100.39^{a}	76.62^{b}	4.94^{a}
$60^{\#}$ mg/kg diet	2105.55	1552.06	107.57^{a}	78.82^{a}	5.11^{a}
$120^{\#\#}$ mg/kg diet	2344.46	1737.94	96.21^{b}	78.23^{a}	4.10^{b}
±SEM	90.27	70.53	3.06	0.31	0.21
Significance	NS	NS	**	**	**
Interaction between Mg supplementation forms and levels (A*B):					
Inorganic Mg (0.0) (control)	2060.40	1515.58	102.12^{ab}	78.51^{a}	4.96
Inorganic Mg (60 mg /kg diet)	2070.58	1520.72	106.09^{a}	78.56^{a}	5.12
Inorganic Mg (120 mg /kg diet	2450.71	1800.37	103.15^{a}	77.67^{ab}	4.21
Nano Mg (0.0) (control)	2000.42	1395.38	98.69^{ab}	74.68^{b}	4.93
Nano Mg (60 mg /kg diet)	2140.52	1583.40	109.09^{a}	79.19^{a}	5.09
Nano Mg (120 mg /kg diet)	2238.21	1675.51	89.29^{b}	78.81^{a}	3.98
±SEM	127.67	99.75	4.32	0.45	0.13
Significance	NS	NS	*	*	NS

$^{a-b}$Means within the columns with different superscript are significant difference ($P<0.05$). Values are presented as means ± standard error. ′= 10 % (60 mg/kg diet) of Mg above NRC recommendation of Mg in broilers diet. ″=20 % (120 mg/ kg diet) of Mg above NRC recommendation of Mg in broilers diet. SEM: standard error of the mean. Giblets= liver+heart+gizzard. N.S = not significantly different ($P\geq 0.05$). (*)= significant ($P< 0.05$). (**) =highly significant ($p\leq 0.01$).

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الملخص العربي

تأثير إضافة علائق المغنسيوم بصوره ومستوياته المختلفة علي الأداء الإنتاجي وبعض صفات الذبيحة لكتاكيت التسمين

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اجريت هذه التجربة بهدف دراسة تأثيرات استخدام علائق الماغنسيوم بصورة ومستوياته المختلفة علي الأداء الإنتاجي وبعض صفات الذبيحة لكتاكيت التسمين. وفي هذه التجربة تم استخدام 180 كتكوت تسمين غير مجنس عمر يوم من سلالة اربرايكرز بلس وصممت التجربة كتجربة عاملية (2×3) حيث تم استخدام الماغنسيوم في صورتين هما الماغنسوم غير عضوي و الماغنسيوم في الصورة النانو وكل صورة اضيفت النانو تحت ثلاث مستويات هي صفر و 60و 120 ملجم ماغنسيوم لكل كيلو جرام عليقة لكلا الصورتين وتم تقسيم الطيور مجموعتين المجموعة الأولى غذيت على عليقة مضاف اليها ماغنسيوم غير عضوى بينما المجموعة الثانية غذيت على عليقة مضاف اليها نانو ماغنسيوم. قسمت كل مجموعة الى ثلاث تحت مجموعات التحت مجموعة الأولي غذيت علي عليقة كنترول تحتوى 600 مجم ماغنسيوم/كجم علف بينما التحت مجموعات الثانية والثالثة غذيت على عليقة الكنترول مضاف اليها 60 و 120 مجم ماغنسيوم/ كجم علف على التوالى. واستمرت التجربة من عمر يوم وحتي عمر خمسة أسابيع.أظهرت النتائج التي تم الحصول عليها أن إضافة الماغنسيوم في الصورة الغير عضوية وفي المستوي العالي (120 ملجم ماغنسيوم لكل كجم عليقة) أدت الي زيادة معنوية في مقدار الزيادة في وزن الجسم وكمية العلف المستهلك كما لوحظ تحسن معنوي في معدل التحويل الغذائي ولكن لم يلاحظ اي اختلافات معنوية في صفات الذبيحة نتيجة لإضافة الماغنسيوم في الصورة الغير عضوية أو الصورة النانو.