Egypt. Poult. Sci. Vol (37)(II): (637-650)(2017) **(1734)**

Egyptian Poultry Science Journal

http://www.epsaegypt.com

ISSN: 1110-5623 (Print) – 2090-0570 (Online)

USE OF NANO-CALCIUMAND PHOSPHORS IN BROILER FEEDING

Sohair, A. A.; M. A. El-Manylawi[1] ; Bakr.M[2] and A.A.Ali[1]

[1] Depa.of anim. Prod. , Fac. of Agric., Cairo Uni. ,Egypt.

[2] Nat. Inst. of Laser Enhanced Sci. , Cairo Uni. ,Egypt.

Corresponding author: Amro Arfa Ali; E-mail: amro.arfa@agr.cu.edu.eg

Received:17/05/2017 Accepted:01/05/2017

ABSTRACT: An experiment was carried out to study the effect of using Nano-hydroxyapatite(NHA) nanoparticles as a source of calcium and phosphorous in broiler diets at graded levels from 2 to 10 %(2, 4, 6, 8 and 10 %) of the standard source (Di calcium phosphate ,DCP) which was used at 2 % of the diet. Hydroxyapatite Nanoparticles were synthesized in laboratory by wet chemical method and the particle size and morphology were determined using transmission electron microscope. Hydroxyapatite Nano particles purity 99% ranged between 20 and 90 nm. Feeding trail was conducted using mash feed .A total number of 360 one-day old Hubbard chicks will be randomly divided into 6 groups of 60 chicks each with 3 replicates each with20chicks. Results showed that reducing dietary CDCP had a negative effect on body weight gain (BWG) and fed intake(FI) of broiler chicks ,but when using Nano-hydroxyapatite led to improve both of BWG and FI and led to maintaining the stability of both. Also, there were no significant differences in digestibility coefficient of NFE, CF, EE, CP and OM for treatments fed Nano-hydroxyapatite (NHA), correspondingly compared to the control group. There were no significant differences in the average values of carcass characteristics and meat analysis among treatments. Data obtained that the average values of economical efficiency were improved with fed broiler chicks on diets containing Nano _hydroxyapatite compared with control diet. It could be concluded that supplementation of 6 % of calcium phosphate as nanoparticles can be practiced instead of the conventional practice of di calcium phosphate incorporation in broilers diet. Thus, it is postulated that the usefulness of Nano form in reducing the mineral quantity to the diet will reduce**.**

Key words: Nano-hydroxyapatite, broiler, nutrients digestibility, economical efficiency

INTRODUCTION

Calcium (Ca) and phosphorus (P) are required in huge quantities by poultry and included in numerous organic processes Hassan et al. (2016) .Calcium necessity is effectively happy with low value sources, for example, limestone or clam shell. however, diets in view of plant fixings contain a lot of unavailable phosphorus as phytates (60-80% of aggregate P) which can not be used by poultry. Thus, inorganic phosphorus, which is dependably cost, is added to meet dietary P prerequisites of chicken for ideal development and generation Williams et al. (2000). This practice brings about overabundance measures of P discharge that can have negative natural impacts when such litter is connected as a manure to soil (Sharpley,1999 and Rodehutscord, 2009).The discharge of P has coordinate ramifications for both water and air quality concerns (Powers and Angel, 2008).

With a view to increasing economic efficiency, attempts are being made to manipulate the poultry diets in order to decrease the concentration of P in excreta with no adverse effect on performance or feed utilization (Angel et al.,2005).Feeding broiler chicken with P source in accordance with nutrient recommendations can decrease P intake as well as the amount of P excreted (Angel et al.,2006).Earlier, addition of phytase to improve P availability and utilization by poultry has been reported to substantively decrease P excretion(Selle and Ravindran,2007; Shastak,2012,El-Sherbiny et al.,2010andAbd-Elsamee et al., 2012).

The recent trend has been focused on use of nanoparticles .Supplementation of minerals in nano form reportedly increases the absorption and consequent reduction in their excretion. Swain et al.(2015)reported that nano minerals are having a great potential even at very lower doses than the convention organic and inorganic sources.

These results have been proven for nano_Se (selenium) (Mohapatra et al.,2014andHuang et al.,2015)nano_Zn (zinc) (Ahmadi et al.,2013; Mishra et al.,2014andMohammadi et al.,2015) and nano-Cr (chromium)(Sirirat et al.,2012).

In view of beneficial effects of nano minerals, the present study was taken up with the objectives to examine the effect of different levels of Nano-hydroxyapatite on broiler performance ,nutrients digestibility, carcass characteristics and economical efficiency comparing to the use of conventional di calcium phosphate (CDCP) in broiler diets.

MATERIALS AND METHODS

This study was directed in Poultry Station, Faculty of Agriculture, Cairo University,Gize, Eygpt, from May to June, 2014.The practical part of the study was performedat the Laboratories of both Faculty of Agriculture, Cairo University, Organization Nano Tech (Nano Tech Egypt is company fabricate different Nano materials) and the College of Dentistry, Cairo University, Egypt. Analyze intended to study the use of Nano-calcium and phosphorus in broiler nutrition .Nano-Hydroxyapatite material was prepared by (Nano Tech) as air-dried.

Preparation and composition of Nano-Hydroxyapatite (NHA)

Nano-Hydroxyapatite (NHA)was set up by wet substance method wherein a fluid arrangement of calcium nitrate (18 mM) was arranged and blended with a watery arrangement of diammonium hydrogen phosphate (10.8 mM). The pH of both the arrangements was acclimated to 9 utilizing 0.1M sodium hydroxide before blending. The blend of arrangements were centrifuged at 12000 rpm and the particles were permitted to settle at the base which was then spread out as a thin film in plate and dried in hot air stove at 90°C. In the wake of drying white delicate powder (calcium phosphate nanoparticles) was acquired utilizing an indigenously created unit. The size and morphology of the readied calcium phosphate nanoparticles was completed by utilizing Transmission Electron

Microscopy.Vijayakumar and Balakrishnan (2014)

Chemical synthesis of hydroxyapatite

Hydroxyapatite can be incorporated through a few strategies, for example, wet synthetic affidavit, biomimetic statement, sol-gel course (wet-substance precipitation) or electrodeposition. The hydroxyapatite nanocrystal suspension can be set up by a wet compound precipitation response taking after the response condition below

$$10\ Ca(OH)2 + 6\ H3PO4 \rightarrow Ca10(PO4)6(OH)2 + 18\ H2O$$

The determined chemical composition of Nano-hydroxyapatite (NHA) used in this study was 31% calcium and 18.5% available phosphorus. Furthermore, the price for Nano-hydroxyapatite (NHA) was 25 LE/ Kg.

Experimental design

Five levels of Nano-hydroxyapatite (2, 4, 6 , 8 and 10% of the standard source of DCP) were used in broiler chick diets as asource of calcium and phosphorus during both growing and finishing period . While, the control group was fed diet containing 2% DCP withoutNano-hydroxyapatite.Therefore, there were six experimental groups.

Experimental diets

The experimental diets were manufactured in agricultural experiments research station in Giza at the Faculty of Agriculture, Cairo University. Diets developed to be containing 24% protein and 3000 kcal ME / kg diet during the first four weeks. Then, diets contained 22% protein and 3050 kcal ME / kg diet during the rest period to meet the requirements of broileraccording to NRC (1994).The chemical composition and calculated analysis of theexperimentaldiets are shown in Tables (1 and 2).

Experimental birds

A total number of 360 one-day old Hubbard chicks will be randomly divided into 6 groups of 60 chicks each with 3 replicates of 20 chicks per each.

Measurements

Live body weights and feed intake wererecorded weekly to calculate both body weight gain and feed conversion ratio; besides, records of daily mortality were obtained.

Digestion trial

The digestibility trial was carried out at the end of 6thweek of age by using 18 birds, 3birds from each treatment to determine the nutrients digestibility and minerals retention of the tested diets. The collection period lasted for 3 days, the excreta was called daily after being sprayed with 2% boric acid solution to prevent any loss in ammonia, then dried in an oven at 60^{o}c, and weight after drying then ground well, mixed and stored for chemical analysis. The proximate analyses of feed and dried excreta were done according to the official methods (AOAC, 1990). Fecal nitrogen was determined according to Jakobson *et al*. (1960). Nitrogen – free extract was calculated according to Abou – Raya and Galal (1971). Atomic absorption was used to determine calcium content of feed and excreta , while total phosphorus was determined calorimetrically according to the method described by David (1966).

Carcass traits

At the end of the growth period (6 weeks of age) 3 chickens were randomly selected from each transaction for the study of the different qualities of sacrifice. Birds have fasted for 8 hours prior to slaughter. Individually birds were weighted to the nearest gram, and then slaughtered by cutting his throat with a sharp knife and according to the Islamic religion. Having achieved full bleeding slaughter weight was recorded, and was immediately separated the head. Altric by removing the feathers as has been conducted. Then, the bottom body opened and removed all the guts, and the weight of the empty carcass without a president, liver and heart. Every one of the components of the carcass commensurate with the living body weight, were awarded a total proportion of edible parts as follows:

Total edible parts (%) = empty carcass (without the head) weight. + Gizzard weight. / WT fasted. * 100.
Edible viscera weight. = Liver weight. , Heart weight.
Total edible parts% = Total edible parts weight. / Fasted weight. * 100

Economicalefficiency

The economical efficiency of experimental diets was calculated as the ratio between income (price of weight gain) and cost of feed consumed. All treatments were economically evaluated by using two methods; the first was the total cost needed to obtain one-kilogram body gain and the second was the net revenue per unit of total costs.

Statistical analysis

The data were analyzed using General Linear Models (GLM) procedure of SAS Institute (2001). The one-way statistical model was used as:

$Y_{ij} = \mu + T_i + e_{ij}$

Where:

μ= overall mean of Y_{ij} .

T_i = effect of treatment, I = (1,…, 6).

e_{ij} = Experimental error

Variables having a significant F-test were compared using Duncan's multiple rang test Duncan, (1955).

RESULTSAND DISCUSSION

Growth performance

Growing period (1-4 weeks of age)

Table 3 showed growth performance of birds fed the different dietary treatments from 1-4 weeks of age. The results showed significant (P<0.0.05) improvements in body weight gain (BWG) by 16%, 11.1% ,7.4 and 4.5% and feed intake (FI) by 11.7%, 10.15, 5.7% and 2.9 % for treatments fed 6%, 8% , 4% and 10% Nano-hydroxyapatite , respectively compared to the control group . The best values of BWG and FI were recorded for treatment fed 6% followed by that fed 8% Nano-hydroxyapatite. No significant differences in feed intake values due to fed broiler chicks on 2% Nano-hydroxyapatite which recorded significant (P<0.05) comparedwith the control group.Also, there were no significant(P<0.05) effect in FCR values due to different dietary levels of Nano-hydroxyapatite.

Finishing period (5-6 weeks of age)

Table 4 showed the effect of the different dietary treatments on growth performance from 5-6 weeks of age.The results showed significant (P<0.05) improvements in body weight gain (BWG) for treatments fed 4%, 6% and 8% Nano-hydroxyapatite , correspondingly compared to the control group fed.

The best values of BWG and FI were recorded for treatments fed 6% NDCP followed by that fed 8% Nano-hydroxyapatite. No significant differences in feed intake values of birds fed 2% or 10% Nano-hydroxyapatite compared with the control group. The FCR values did not affected by different levels of Nano-hydroxyapatite.

Over all period(1-6 weeks of age)

The effect of dietary treatments on broiler performance during the overall period is shown in Table 5.The results showed significant (P<0.05) improvements in body weight gain (BWG) by 15.1 %, 11 % ,7.6 and 3.5% and feed intake (FI) by 11.2%, 8.9, 5.8% and 3 % for treatments fed 6%, 8% , 4% and 10% Nano-hydroxyapatite , respectively compared with the control group .

The best BWG and FI values were recorded for treatments fed 6% NHA followed by that fed 8% Nano-hydroxyapatite. There were nosignificant (P<0.05) differences in feed conversion ratio due to using Nano-hydroxyapatite compared with the control group.Also**,** there was no significant (P<0.05) different for mortality rate values due to using Nano-hydroxyapatite in broiler chick diets.

The improvement of broiler performance due the use of Nano-hydroxyapatitein broiler diets could be attributed to the fact that the nanomaterals are very minute in size, leading to a great improvement in their properties because of higher surface area and increased absorption, so broiler chick performance was improved comparing to control diet .

The results of enhanced broiler performance in the present study are in agreement with those obtained by Vijayakumar and Balakrishnan (2014)who observed that using calcium phosphate nanoparticles (hydroxyapatitein) at levels of 50% instead of the conventional dicalcium phosphate in broiler chick diets increased body weight gain compared with control.

Also, Hassan et al. (2016) fed broiler chicks with seven treatment groups received three levels of eitherconventional dicalcium phosphate (CDCP) ornanodicalcium phosphate(NDCP) being 1.75%, 1.31 and 0.88% and less level of NDCP being 0.44 % of NDCP. These levels present 100, 75, 50 and 25% of the recommended P requirement. They stated that birds fed different levels of NDCP gained significant more body weight and utilized feed more efficient than the control group that fed 1.75% CDCP. Using NDCP instead of CDCP increased BWG and FI by about 25% and 10%, respectively.

Digestibility coefficient and minerals retention:

Data presented inTable 6 showed digestibility coefficient of birds as affected by fed the different dietary treatments .The results showedslightly improvement for nutrients digestibilitybut with no significant differences ($P<0.05$) in digestibility coefficient of NFE, CF, EE,CPand OM for treatments fed Nano-hydroxyapatite, correspondingly compared to the control group.

Results showed that the calcium and phosphorus retention significantly($P<0.05$) decreased with decreasing dietary level ofdicalcium phosphate. White, there were significant increase in calcium and phosphorus retention values due to increasing dietary level of nano-hydroxyapatite as shown in Table 6.

These results indicated that the addition of dicalcium phosphate in nano form improves the absorption and subsequent reduction in their excretion .

The present results are in harmony with those obtained by Weiss et al. (2006) who showed that nanoparticle-sized ingredients might increase the functionality or bioavailability of ingredients and nutrients, and there by minimize the concentrations needed in the food product.

On this regard, Chan et al. (2006) and Gross et al. (2014) reported that calcium phosphate materials in nano-size have higher specific surface area and surface roughness compared to conventional calcium phosphate materials. Therefore, nano-sized calcium phosphate materials have stronger interaction with organic materials.Also,Rajendran (2013) reported that calcium phosphate materials in nano-size are expected to have better bioactivity compared to conventional materials since supplementation of mineral in the form of nano increases bioavailability and efficiency of utilization by increasing the surface area.Hassan et al. (2016)found that feeding broiler chicks on diets containing 0.44 % NDCP decreased the excreted Ca and P by 51 and 46 % , respectively comparing to the control diet.

Carcass characteristics and meat analysis:

Carcass characteristics included carcass weight; weights of liver, heart and gizzard (% of LBW) at 6 weeks of age as affected by dietary treatments are shown in Table 7.The results of carcass weight followed the same trend as body weight gain. The highest carcass weight values were recorded for birds fed the different levels of Nano-hydroxyapatite, correspondingly compared to the control group. The best carcass weight were recorded for treatment fed 6% NDCP followed by that fed 8% Nano-hydroxyapatite.Results presented in table 7 showed no significant differences in the average values of meat analysis (moisture , CP and EE) due to feeding broiler chicks on diets containing nano-hedroxy apatite comparing to control group .No significant

(P >0.05) differences were detected on liver, heart and gizzard weights (% of LBW) among all treatments.Theseresults are consistent withVijayakumar and Balakrishnan (2014) and Hassan et al. (2016).

Economical efficiency

Results presented in Table 8 showed the average values for economical efficiency of birds fed the different dietary treatments from 1- 6 weeks days of age. The results showed improvements in net revenue valuesby36.5, 27.3, 22.1,12.2 and 5.7 % for treatments fed 6, 8 , 4. 10 and 2% Nano-hydroxyapatite respectivelycompared to the control group. In this regard, Vijayakumar and Balakrishnan (2014) concluded that using 50 % of calcium phosphate nanoparticles (Hydroxyapatite) can be practiced instead of the conventional practice of dicalcium phosphate incorporation in broilers diet and led to increase in body weight gain over the control. Thus, it is postulated that the usefulness of nano form in reducing the mineral quantity to half in the diet will reduce the cost of feeding when the actual production of calcium phosphate nanoparticles is up scaled to an industrial level.

IN CONCLUSION,

for practical application it is possible to fed broiler chicks diets containing 6 % of conventional dicalcium phosphate in nano form to improve broiler performance and economic efficiency.

Table (1): Composition and calculated analysis of experimental diets during the grower period (1-4 weeks of age)

	control	2%NHA	4% NHA	6% NHA	8% NHA	10% NHA
Yallow corn	52.06	54.77	54.73	54.69	54.65	54.61
Soybean meal	34.2	34.2	34.2	34.2	34.2	34.2
Gluten	7.0	7.0	7.0	7.0	7.0	7.0
Soybean oil	2.59	1.84	1.84	1.84	1.84	1.84
Dicalcium phosphate	2.0	0.0	0.0	0.0	0.0	0.0
Nano-hydroxyapatite[1]	0.0	0.04	0.08	0.12	0.16	0.2
Limestone	1.0	1.0	1.0	1.0	1.0	1.0
Premix[2]	0.3	0.3	0.3	0.3	0.3	0.3
NaCL	0.3	0.3	0.3	0.3	0.3	0.3
L-LYSINE	0.3	0.3	0.3	0.3	0.3	0.3
DL-methionine	0.25	0.25	0.25	0.25	0.25	0.25
Total	100	100	100	100	100	100
Calculated analysis[3]						
CP%	24	24	24	24	24	24
ME(Kcal/kg)	3000	3004	3003	3002	3001	3000
EE	5.25	4.5	4.5	4.5	4.5	4.5
CF	3.61	3.61	3.61	3.61	3.61	3.61
Lys.%	1.4	1.4	1.4	1.4	1.4	1.4
Meth.%	0.6	0.6	0.6	0.6	0.6	0.6
Meth.+Cys.%	0.99	0.99	0.99	0.99	0.99	0.99
Calcium%	0.90	0.48	0.49	0.49	0.50	0.50
AV. p%	0.51	0.14	0. 15	0.16	0.17	0.18
Price /ton (LE)	7100	7019	7028	2037	7046	7055

(1) Price Kg: 25 (LE)

(2) Vitamin - mineral mixture supplied per Kg of diet: Vit A, 12000 IU; Vit D_3, 2200 IU; Vit E, 10 mg; Vit K_3, 2 mg; Vit B_1, 1mg; Vit B_2, 4mg; Vit B_6, 1.5mg; Vit B_{12}, 10µg; Niacin, 20 mg; Pantothenic acid, 10 mg; Folic acid, 1 mg; Biotin, 50 µg; Copper, 10 mg; Iodine, 1mg; Iron, 30 mg; Manganese, 55 mg; Zinc, 50 mg and Selenium, 0.1 mg.

(3) According to NRC (1994).

Table (2): Composition and calculated analysis of experimental diets during the finisher period (4-6 weeks of age)

	control	**2%NHA**	**4%NHA**	**6%NHA**	**8%NHA**	**10%NHA**
Yallow corn	56.5	59.56	59.52	59.48	59.44	59.40
Soybean meal	31.5	31.5	31.5	31.5	31.5	31.5
Gluten	5.0	5.0	5.0	5.0	5.0	5.0
Soybean oil	2.75	2.0	2.0	2.0	2.0	2.0
Dicalcium phosphate	2.0	0.0	0.0	0.0	0.0	0.0
Nano hydroxyapatite	0.0	0.04	0.08	0.12	0.16	0.2
Limestone	1.0	1.0	1.0	1.0	1.0	1.0
Premix[1]	0.3	0.3	0.3	0.3	0.3	0.3
NaCL	0.3	0.3	0.3	0.3	0.3	0.3
L-Lysine	0.15	0.15	0.15	0.15	0.15	0.15
DL-methionine	0.15	0.15	0.15	0.15	0.15	0.15
Total	100	100	100	100	100	100
Calculated analysis[2]						
CP%	22	22	22	22	22	22
ME(Kcal/kg)	3050	3054	3053	3052	3051	3050
EE	5.41	4.66	4.66	4.66	4.66	4.66
CF	3.6	3.6	3.6	3.6	3.6	3.6
Lys.%	1.25	1.25	1.25	1.25	1.25	1.25
Meth.%	0.5	0.5	0.5	0.5	0.5	0.5
Meth.+Cys.%	0.99	0.99	0.99	0.99	0.99	0.99
Calcium%	0.90	0.47	0.48	0.49	0.49	0.50
AV. p%	0.51	0.14	0. 15	0.16	0.17	0.18
Price /ton (LE)	6900	6819	6828	6837	6846	6855

(1) Price Kg: 25 (LE)
(2) Vitamin - mineral mixture supplied per Kg of diet: Vit A, 12000 IU; Vit D_3, 2200 IU; Vit E, 10 mg; Vit K_3, 2 mg; Vit B_1, 1mg; Vit B_2, 4mg; Vit B_6, 1.5mg; Vit B_{12}, 10µg; Niacin, 20 mg; Pantothenic acid, 10 mg; Folic acid, 1 mg; Biotin, 50 µg; Copper, 10 mg; Iodine, 1mg; Iron, 30 mg; Manganese, 55 mg; Zinc, 50 mg and Selenium, 0.1 mg.
(3) According to NRC (1994).

Table (3): Effect of dietarytreatments on broiler performanceduring thegrowing period (1-4 weeks of age)

Treatments	L.B.W (g)	B.W.G (g)	F.I (g)	F.C.R
Control	1350^{d}	1310^{d}	2266^{bc}	1.73^{a}
2%	1333^{d}	1293^{d}	2249^{c}	1.74^{a}
4%	1450^{bc}	1410^{bc}	2397^{b}	1.7^{a}
6%	1566^{a}	1526^{a}	2533^{a}	1.66^{a}
8%	1500^{b}	1460^{b}	2496^{a}	1.71^{a}
10%	1412^{c}	1372^{c}	2333^{b}	1.7^{a}
LSD	30	30	40	0.05

Means designated with the same letter within the same column are not significantly different at 0.05 level of probability.

Table (4): Effect of dietarytreatments on broiler performance during the finishing period(5-6 weeks of age)

Treatments	L.B.W (g)	B.W.G (g)	F.I (g)	F.C.R
Control	2125^{e}	775^{b}	1487^{bc}	1.9^{a}
2%	2100^{e}	767^{b}	1459^{c}	1.9^{a}
4%	2285^{c}	835^{a}	1577^{b}	$1.8\ 8^{a}$
6%	2440^{a}	874^{a}	1634^{a}	1.86^{a}
8%	2355^{b}	865^{a}	1594^{a}	1.84^{a}
10%	2200^{d}	788^{b}	1533^{b}	1.94^{a}
LSD	30	20	30	0.05

Means designated with the same letter within the same column are not significantly different at 0.05 level of probability.

Table (5): Effect of dietarytreatments on broiler performanceand mortality rate during the overall period (1-6 weeks of age)

Treatments	L.B.W (g)	B.W.G (g)	F.I (g)	F.C.R	Mortality rate	
					NO.	%
Control	2125[e]	2085[e]	3753[d]	1.8[a]	2[a]	6.6[a]
2%	2100[e]	2060[e]	3708[d]	1.8[a]	1[a]	3.3[a]
4%	2285[c]	2245[c]	3974[b]	1.77[a]	1[a]	3.3[b]
6%	2440[a]	2400[a]	4176[a]	1.74[a]	1[a]	3.3[a]
8%	2355[b]	2315[b]	4090[b]	1.76[a]	1[a]	3.3[a]
10%	2200[d]	2160[d]	3866[c]	1.79[a]	1[a]	3.3[a]
LSD	30	30	40	0.05	1.0	2.5

Means designated with the same letter within the same column are not significantly different at 0.05 level of probability.

Table (6): Effect of dietary treatments onthe digestibility coefficient and minerals retention ofbroiler chicks at 6 weeks of age**.**

treatments	digestibility coefficient (%)					Minerals retention	
	OM	CP	EE	CF	NFE	Ca	P
control	77.2 [a]	88.5 [a]	78.1 [a]	23.2 [a]	75.5 [a]	0.75[a]	0.36[a]
2%	77.1[a]	88.9 [a]	78.7 [a]	23.3 [a]	75.6 [a]	0.24[d]	0.12[c]
4%	77.7 [a]	89.1 [a]	78.9 [a]	23.1 [a]	76.1 [a]	0.26[c]	0.13[bc]
6%	78.3 [a]	89.5 [a]	78.1 [a]	22.9 [a]	75.9 [a]	0.27[c]	0.13[bc]
8%	77. 5 [a]	88.5 [a]	78.9 [a]	23.1 [a]	75.5 [a]	0.32[b]	0.15[b]
10%	77.7[a]	89.2 [a]	79.1 [a]	23.2 [a]	76.1 [a]	0.33[b]	0.15[b]
LSD	0.5	0.5	0.5	0.2	0.5	0.01	0.01

Means designated with the same letter within the same column are not significantly different at 0.05 level of probability.

Table (7): Effect of dietary treatments oncarcass characteristicsand meat analysis of broiler chicks at 6 weeks of age .

Treatments	Carcass weight (g)	Liver (%)	Heart (%)	Gizzard (%)	Carcass characteristics		Meat analysis (%)		
					Dressing	Giblets	Moisture	CP	EE
Control	1615[c]	2.54[a]	0.61[a]	1.93[a]	61.93[a]	5.89 [a]	71.11[a]	18.62[a]	4.74[a]
2%	1608[c]	2.53[a]	0.60[a]	1.94[a]	61.93[a]	5.89 [a]	71.10[a]	18.71[a]	4.73[a]
4%	1733[b]	2.53[a]	0.60[a]	1.95[a]	61.95[a]	5.86 [a]	71.13[a]	18.83[a]	4.66[a]
6%	1858[a]	2.51[a]	0.59[a]	1.93[a]	62.10[a]	5.88 [a]	70.73[a]	18.7[a]	4.65[a]
8%	1792[b]	2.53[a]	0.60[a]	1.94[a]	62.00[a]	5.90 [a]	71.30[a]	18.50[a]	4.73[a]
10%	1667[c]	2.53[a]	0.60[a]	1.95[a]	61.98[a]	5.89 [a]	70.90[a]	18.59[a]	4.71[a]
LSD	30	0.01	0.01	0.01	0.5	0.01	1.5	0.5	0.3

Means designated with the same letter within the same column are not significantly different at 0.05 level of probability

Table (8): Effect of dietary treatments oneconomical efficiency of the experimental diets of broiler chicks at 6 weeks of age .

treatments	Fixed cost (LE) [(a)]	Feed cost (LE)	Total cost (LE)	Body wt Kg	Cost/ kg Body wt (LE)	Total revenue (LE) [(b)]	Net revenue (LE)	EE[(c)]	REF[(d)]
control	9	26.26	35.26	2.125	16.59	51	15.74	0.44	100%
2%	9	24.76	33.76	2.100	16.07	50.4	16.64	0.49	105.7
4%	9	26.62	35.62	2.285	15.59	54.84	19.22	0.53	122.1
6%	9	28.06	37.06	2.440	15.18	58.56	21.5	0.58	136.5
8%	9	27.56	36.56	2.355	15.52	56.52	20.04	0.54	127.3
10%	9	26.13	35.13	2.200	15.97	52.8	17.67	0.5	112.2

(a): Bird price and raring cost.
(b): Assuming that the selling price of one kg, live body weight is 24 LE.
(c) : Net revenue per unit total cost.
(d): Assuming that the group number 1 represent the control

REFERENCES

Abd-Elsamee, M.O.; El-Sherbiny, A.E.; Hassan, H.M.A.; Samy, A.and Mohamed, M.A. 2012. Adding phytase enzyme to low phosphorus broiler diets and its effect upon performance, bone parameters and phosphorus excretion.Asian J. of Poult. Sci., 6: 129-137.

Abou-Raya, A.K. and Galal, A.G.H. 1971. Evaluation of poultry feeds in digestion trial with reference to factors involved. Egypt. J. Prod., 11:207-221.

Ahmadi, F.; Ebrahimnezhad, Y.; Maheri, N. and Ghalehkand, J. G. 2013. The effects of zinc oxide nanoparticles on performance, digestive organs and serum lipid concentrations in broiler chickens during starter period. International J. of Biosci., 3 (7): 23-29.

Angel, R.; Saylor, W.; Dhandu, S.; Powers, W. and Applegate, T. 2005. Effect of dietary phosphorus, phytase and 25 hydroxycholecalciferol on performance of broiler chickens grown in floor pens.Poult. Sci., 84:1031–1044.

Angel, R.; Saylor, W.; Mitchell, A.D.; Powers, W. and Applegate, T. 2006. Effect of dietary phosphorus, phytase, and 25-hydroxycholecalciferol on broiler chicken bone mineralization, litter phosphorus, and processing yields.Poult. Sci., 85:1200–1211.

AOAC. 1990. Official methods of analysis(15th ed.). Washington,DC, USA: Association Official Analytical Chemists.

Chan, C.K.; Kumar, T.S.S.; Liao, S.; Murugan, R.; Ngiam, M. and Ramakrishman, S. 2006. Biomimetic nanocomposites for bone graft applications. Nanomedicine-Uk,1: 177-88.

David, G. 1966. Determination of organic phosphorus compounds by phosphate analysis. Methods of Biochemical Analysis. Vol. III. Inter science publishers Ltd. London.

Duncan, D.B. 1955. Multiple Range and Multiple F Tests.Biometric, 11:1- 42.

El-Sherbiny, A.E.; Hassan, H.M.A.; Abd-Elsamee, M.O.; Samy, A. and Mohamed, M.A. 2010. Performance, Bone Parameters and Phosphorus Excretion of Broilers Fed Low Phosphorus Diets Supplemented with Phytase from 23 to 40 Days of Age. Inter. J. of Poult. Sci., 9 (10): 972-977.

Gross, K.A.; Andersons, J.; Misevicius, M. and Svirksts, J. 2014. Traversing phase fields towards nanosized beta tricalcium phosphate. Key Engineering Materials, 587:97-100.

Hassan, H. M. A., Samy, A., El-Sherbiny, A. E., Mohamed, M. A., andAbd-Elsamee, M. O. 2016. Application of Nano-dicalcium Phosphate in Broiler Nutrition: Performance and Excreted Calcium and Phosphorus. Asian Journal of Animal and Veterinary Advances, 11, 477-483.

Huang, S.; Wang, L.; Liu, L.; Hou, Y. and Li, L. 2015. Nanotechnology in agriculture, livestock, and aquaculture in China.Areview.Agron. Sustain. Dev., 35:369–400.

Jakobson, P.E.; Kirston, S.G. and Nelson, H. 1960. Digestibility trials with poultry. 322 bertning fraforsgs laboratoriet, udgivet of stants. Husdyrbugsud valy-Kabenhaven.

Mishra, A.; Swain, R.K.; Mishra, S.K.; Panda, N. and Sethy, K. 2014. Growth performance and serum biochemical parameters as affected by nano zinc supplementation in layer chicks. Indian J. Anim. Nutr., 31(4): 384-388.

Mohammadi, F.; Ahmadi, F. and Amiri, A.M. 2015. Effect of zinc oxide nanoparticles on carcass parameters, relative weight of digestive and lymphoid organs of broiler fed wet diet during the starter period. International J. of Biosciences, 6 (2): 389-394.

Mohapatra, P.; Swain, R.K.; Mishra, S.K.; Behera, T.; Swain, P.; Behura, N.C.; Sahoo, G.; Sethy, K.; Bhol, B.P.

and Dhama, K. 2014. Effects of Dietary Nano-Selenium Supplementation on the Performance of Layer Grower Birds.Asian J. of Anim. and Vet. Advances, 9: 641-652.

NRC 1994. Ninth Revised Edition, 1994, National Academy Press, Washington D.C.

Powers, W.J. and Angel, R. 2008.A review of the capacity for nutritional strategies to address environmental challenges in poultry production.Poult. Sci., 87:1929–1938.

Rajendran, D. 2013. Application of nano minerals in animalproduction system. Res. J. Biotechnol., 8(3): 1-3.

Rodehutscord, M. 2009. Approaches and Challenges for Evaluating Phosphorus Sources for Poultry. Proc. 17th European Symposium on Poultry Nutrition. Edinburgh, Scotland.

SAS 2001.SAS/STAT User's Guide.Release 8.1, SAS Institute Inc., Cary, NC.USA.,pp: 554.

Selle, P.H. and Ravindran, V. 2007. Microbial phytase in poultry nutrition. Anim. Feed Sci. Tech., 135:1–41.

Sharpley, A. 1999. Agricultural phosphorus, water quality, and poultry production: Are they compatible? Poult. Sci., 78:660–673.

Shastak, Y. 2012. Evaluation of the availability of different mineral phosphorus sources in broilers. A thesis.Institute of animal nutrition, university of hohenheim, 155p.

Sirirat, N.; Lu, J.; Hung, A.T.; Chen, S. and Lien, T. 2012. Effects Different Levels of Nanoparticles Chromium Picolinate Supplementation on Growth Performance, Mineral Retention, and Immune Responses in Broiler Chickens. J. of Agric. Sci., 4 (12): 48-58.

Swain, P.S.; Rajendran, D.; Rao, S.B.N. and Dominic, G. 2015. Preparation and effects of nano mineral particle feeding in livestock: A review. Vet. World, 8: 888-891.

Vijayakumar, M.P. andBalakrishnan, V. 2014. Effect of Calcium Phosphate Nanoparticles Supplementation on Growth Performance of Broiler Chicken. Indian Journal of Science and Technology, 7(8), 1149–1154.

Weiss, J.; Takhistov, P. and McClements, J. 2006. Functional Materials in food Nanotechnology. J. Food Sci., 71(9):107–16.

Williams, B.; Waddington, D.; Solomon, S.; Thorp, B. and Farquharson, C. 2000. Skeletal development in the meat-type chicken. Br. Poult. Sci., 41:141-149.

الملخص العربى

استخدام النانو كالسوم فسفور فى تغذية بدارى التسمين

سهير أحمد عرفه[1] ، محمد أحمد فؤاد المنيلاوى[1] ، منى بكر[2] ، عمرو عرفه على[1]
1- قسم الإنتاج الحيوانى – كلية الزراعة – جامعة القاهرة– مصر.
2- المعهد القومى لعلوم الليزر – جامعة القاهرة– مصر.

تم تصميم تجربة نمو على كتاكيت اللحم من نوع هبرد لدراسة تأثير التغذية علي علائق تحتوي على ثنائي فوسفات الكالسيوم التقليدي مقارنة بالنانو الهيدروكسى هيباتيت وقياس الأداء الإنتاجى ، معاملات الهضم ، خصائص الذبيحة والكفاءة الإقتصادية على دجاج اللحم من عمر يوم لعمر 42 يوم. تم تكوين ستة علائق احتوت علي خمس مستويات مننانو الهيدروكسى هيباتيت وهم 2% و 4% و 6% و8% ومستوي اعلى من نانو الهيدروكسى هيباتيتوهو 10%. هذة المستويات تمثل نسبة مئوية من احتياجات الفوسفور الموصي بها.أعتبرت العليقة التي تحتوي علي ثنائي فوسفات الكالسيوم التقليدي بنسبة 100% هي عليقة المقارنه (الكنترول).
تم تصنيع الجسيمات النانوية الفوسفاتية في المختبر بالطريقة الكيميائية الرطبة وتم تحديد حجم الجسيمات باستخدام الميكروسكوب الإلكتروني حيث تراوحت جسيمات النانوية الفوسفاتية الكالسيوم بين 20 و 90 نانومتر. تم إجراء تجارب التغذية باستخدام 360كتكوت هبرد عمر يوم تم تقسيم الكتاكيت عشوائيا إلى 6 مجموعات كل مجموعة مقسمة الى 3 مكررات يحتوى كل مكرر على 20 كتكوت. وأستمرت التجربة حتى الأسبوع السادس من العمر تحت نفس الظروف من الرعاية.
أظهرت النتائج أن تخفيض ثنائى فوسفات الكالسيوم له تأثير سلبي على وزن الجسم وكمية الغذاء الماكول وكفاءة التحويل الغذائى لبدارى التسمين ولكن عند استخدام نانو-هيدروكسي هيباتيت بمستوى أقل بكثير أدى الى تحسن الانتاج عن مجموعة الكنترول بفرق معنوى فى وزن الجسم وكمية الماكول من الغذاء .كان هناك تحسن غير معنوى فى قيم معاملات هضم المركبات الغذائية نتيجة إستخدام نانو-هيدروكسي هيباتيت مقارنة بمجموعة الكنترول. لم تكن هناك فروق ذات دلالة إحصائية في متوسط قيم خصائص الذبيحة وتحليل اللحم بين المعاملات المختلفة. حدث تحسن فى قيم متوسط الكفاءة الاقتصادية مع بدارى التسمين التى تمت تغذيتها على العلائق التي تحتوي على نانو -هيدروكسي هيباتيت مقارنة مع عليقة الكنترول.
وخلصت النتائج إلى أن استخدام نانو-هيدروكسي هيباتيت بمستوى 6٪ من ثنائي فوسفات الكالسيوم التقليدى في علائق دجاج اللحم أدى إلى تحسن الأداء الإنتاجى والكفاءة الإقتصادية لأنتاج اللحم.