

EFFECT OF ORGANIC AND INORGANIC SOURCES OF CALCIUM AND PHOSPHORUS ON LAYING HENS PERFORMANCE

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ABSTRACT

Three hundred White Bovans laying hens aged 24 weeks were used , to evaluate the effects of dietary organic and inorganic sources of calcium (Ca) and phosphorus (P) on laying performance and egg quality. Hens were randomly divided into four experimental treatments . Thus four isocaloric (ME ; 2850 kcal / kg) and isonitrogenous (18 % CP) experimental diets were formulated , having equal Ca (4%) and available P (0.45%) contents . Hens in (Tr1) received 2.6% bone meal (BM) and 8.5% limestone (LS); those in (Tr2) received 2.6% BM and 8.5% eggshell meal (ESM); those in (Tr3) received 1.6% dicalcium phosphate (DCP) and 9.5% LS ; and those in (Tr4) received 1.8% DCP and 9.5% ESM. The experiment was terminated at forty weeks of age.

The obtained results revealed that, layers feed a diet containing a combination of BM as a source of P and LS as a source of Ca (Tr1) , attained a better performance for of egg production, and feed conversion compared the other treatments . Means of egg weight, feed intake and Haugh unit were not significantly affected by the dietary treatments. However , those layers feed a diet containing a combination of DCP as a source of P and ESM as a source of Ca (Tr4) , achieved the lowest performance for egg production , and produced eggs of thinner shells compared with the other treatments .

The highest values of nutrients digestibility and retention rates of Ca and P were obtained with diets of (Tr1) and (Tr3) , followed by intermediate values for (Tr2) , while that of (Tr4) gave the lowest ones .

Generally , the consistent trends of egg production and shell thickness showed beneficial effects of BM : as an organic source of P , and LS ; as an inorganic source of Ca ; when being added to laying hen diets , in comparison with DCP and ESM .

Keywords: Calcium, phosphorus, limestone, bone meal, dicalcium phosphate, laying hen , egg production

Table (1) : Expremental design :

Distary Treatments	Source of Calcium		Source of Phosphorus	
	Organic (ESM) %	Inorganic (LS) %	Organic (BM) %	Inorganic (DCP) %
Tr 1		8.5	2.6	
Tr 2	8.5		2.6	
Tr 3		9.5		1.8
Tr 4	9.5			1.8

ESM Contained 35.35 Ca 0.12 P
 LS Contained 36.57 Ca 0.00 P
 BM Contained 28.29 Ca 11.34 P
 DCP Contained 22.31 Ca 15.46 P

Table (2): Compositions and calculated analysis of the experimental diets.

Ingredient %	Tr1	Tr2	Tr3	Tr4
	2.6%BM+ 8.5%LS	2.6%BM+ 8.5%ESM	1.8%DCP +9.5%LS	1.8%DCP+ 9.5% ESL
Ground yellow corn	58.25	58.25	58.17	58.17
Soybean meal (44%)	24.50	24.50	24.00	24.00
Corn Gluten meal (60%)	3.00	3.00	3.38	3.38
Vegetable Oil*	2.35	2.35	2.35	2.35
Bone meal ; BM	2.60	2.60	---	---
Dicalcium phosphate ;DCP	---	---	1.80	1.80
Limestone ; LS	8.50	---	9.50	---
Egg Shell meal ; ESM	---	8.50	---	9.50
Premix**	0.30	0.30	0.30	0.30
NaCl	0.35	0.35	0.35	0.35
DL-Methionine	0.15	0.15	0.15	0.15
Total	100	100	100	100

*****Calculated analysis**

CP%	18	18	18	18
ME ; Kcal / Kg	2850	2850	2850	2850
Calcium ; Ca%	4.00	4.00	4.00	4.00
Available Phosphorus:AP%	0.45	0.45	0.45	0.45
Methionine %	0.47	0.47	0.47	0.47
Lysine %	0.88	0.88	0.88	0.88

Determined analysis

Moisture %	09.43			
Ash %	17.31	09.89	09.97	10.47
CP %	17.64	16.85	17.45	18.98
EE %	04.95	17.42	17.84	17.80
CF %	03.74	04.87	05.36	05.47
Ca %	04.27	03.77	03.68	03.58
P %	00.58	04.39	04.10	04.23
		00.55	00.57	00.56

Price (L.E / Ton)

	1078	1075	1083	1078
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*Oil used is third grade

** Each 3 kg of vitamins and minerals mixture contains:

12000,000 IU vitamin A acetate; 2000,000 IU vitamin D3; 10,000 mg vitamin E acetate; 2000 mg vitamin K3; 100 mg vitamin B1; 4000 mg vitamin B2; 1500 mg vitamin B6; 10 mg vitamin B12; 10,000 mg Pantothenic acid; 20,000 mg Nicotanic acid; 1000 mg Folic acid; 50 mg Biotin; 500,000 mg Choline; 10,000 mg Copper; 1000 mg Iodine; 3000 mg Iron; 65,000 mg Manganese; 55,000 mg Zinc, and 100 mg Selenium..

*** Calculated analysis according to NRC (1994)

RESULTS

1- Productive performance:

Obtained results (Table 3) showed that the average values of egg production (%) and feed conversion ratio (FCR) were improved significantly ($P < 0.05$) by using of either LS as a source of inorganic Ca or BM as a source of organic P, while, there were no significant differences for average values of egg weight and daily feed intake due to experimental treatments. Interaction results (Table 4) indicated that throughout the experimental period, hens received BM (Tr1 and Tr2.) recorded significantly the higher egg production rates than those received DCP (Tr3 and Tr4). These results may indicate a beneficial effect of BM; as a source of P in laying hen diets, on egg production. However, hens received BM as an organic source of P performed well compared with those received DCP as an inorganic source of P. Similar trends were clearly surpassed those given LSM as an organic source of Ca in egg production (Tr1 versus Tr2, and Tr3 versus Tr4). Generally, BM as a source of P and LS as a source of Ca resulted in an improvement of egg production rate

Table 3: Means \pm SE of egg production, egg weight, feed intake and feed conversion as affected by the dietary treatments.

Items	period	Ca			Ph		
		Organic Tr2&Tr4	Inorganic Tr1 &Tr3	Sig.	Organic Tr2&Tr4	Inorganic Tr1 &Tr3	Sig.
Egg production%	1	91.20 \pm 1.14	92.90 \pm 0.15	**	93.25 \pm 0.24	90.83 \pm 0.98	**
	2	92.67 \pm 1.71	92.80 \pm 1.96	NS	96.82 \pm 0.21	88.65 \pm 0.19	**
	3	87.85 \pm 2.70	89.73 \pm 0.95	**	92.85 \pm 0.50	84.73 \pm 1.31	**
	4	84.48 \pm 4.05	90.03 \pm 2.90	**	95.00 \pm 0.67	79.52 \pm 1.83	**
	5	82.62 \pm 4.57	90.05 \pm 2.42	**	94.15 \pm 0.60	78.52 \pm 2.74	**
	Overall	87.76 \pm 2.83	91.10 \pm 1.63	**	94.41 \pm 0.18	84.45 \pm 1.35	**
Egg weight ; g	1	55.17 \pm 0.60	55.17 \pm 0.87	NS	55.67 \pm 0.71	54.67 \pm 0.71	NS
	2	56.67 \pm 0.61	57.00 \pm 0.58	NS	56.83 \pm 0.60	56.83 \pm 0.60	NS
	3	58.33 \pm 0.61	58.33 \pm 0.56	NS	58.50 \pm 0.43	58.17 \pm 0.70	NS
	4	59.00 \pm 0.37	60.00 \pm 0.37	NS	59.50 \pm 0.43	59.50 \pm 0.43	NS
	5	62.33 \pm 0.76	62.17 \pm 0.60	NS	61.33 \pm 0.49	63.17 \pm 0.60	NS
	Overall	58.30 \pm 0.53	58.53 \pm 0.50	NS	58.37 \pm 0.50	58.47 \pm 0.54	NS
Daily feed intake ; g	1	110.7 \pm 0.71	112.0 \pm 0.93	NS	111.5 \pm 0.89	111.1 \pm 0.87	NS
	2	112.7 \pm 0.76	112.1 \pm 0.79	NS	112.0 \pm 0.82	112.8 \pm 0.70	NS
	3	112.7 \pm 0.55	114.0 \pm 0.77	NS	112.8 \pm 0.79	113.8 \pm 0.60	NS
	4	114.7 \pm 0.71	115.0 \pm 0.73	NS	114.3 \pm 0.71	115.3 \pm 0.67	NS
	5	116.8 \pm 0.48	115.7 \pm 0.90	NS	116.2 \pm 0.60	116.3 \pm 0.99	NS
	Overall	113.1 \pm 0.32	113.8 \pm 0.34	NS	113.7 \pm 0.37	113.9 \pm 0.25	NS
Feed conversion (g feed/g eggs)	1	2.20 \pm 0.02	2.19 \pm 0.04	NS	2.15 \pm 0.02	2.24 \pm 0.02	**
	2	2.15 \pm 0.04	2.13 \pm 0.05	NS	2.05 \pm 0.03	2.23 \pm 0.03	**
	3	2.21 \pm 0.07	2.15 \pm 0.05	NS	2.05 \pm 0.03	2.30 \pm 0.04	**
	4	2.33 \pm 0.12	2.14 \pm 0.07	**	2.03 \pm 0.02	2.44 \pm 0.07	**
	5	2.30 \pm 0.11	2.07 \pm 0.06	**	2.01 \pm 0.03	2.35 \pm 0.09	**
	Overall	2.24 \pm 0.07	2.13 \pm 0.05	**	2.06 \pm 0.02	2.31 \pm 0.04	**

* P < 0.05

** P < 0.01

Results of egg weight and feed intake (Table 4) indicated that there were no significant differences in both parameters among treatments. The enhanced egg production of Tr 1 and Tr 2 compared with Tr 3 and Tr 4 ; without differences in feed intake , may be attributable to the improvement of the Ca and P by the laying hens of these two treatments .

The values of feed conversion (Table 4) showed also that the hens received BM (Tr 1 and Tr 2) as source of P converted the feed significantly better than those received DCP (Tr 3 and Tr 4) .

Table 4 : Means ± SE of interaction due to dietary treatments .

Items	Peariod	Experimental Treatments				Sig.
		Tr1 2.6%BM+8.5 %LS	Tr2 2.6%BM+8.5% ESM	Tr3 1.8%DCP+9.5 %LS	Tr4 1.8%DCP+9.5 %ESM	
Egg production %	1	92.80±0.17 ^b	93.70±0.25 ^a	93.00±0.26 ^{ab}	88.67±0.23 ^c	**
	2	97.17±0.24 ^a	96.47±0.20 ^b	88.43±0.18 ^c	88.87±0.33 ^c	**
	3	91.83±0.26 ^b	93.87±0.38 ^a	87.63±0.26 ^c	81.83±0.20 ^d	**
	4	96.47±0.18 ^a	93.53±0.18 ^b	83.60±0.30 ^c	75.43±0.23 ^d	**
	5	95.47±0.17 ^a	92.83±0.20 ^b	84.63±0.24 ^c	72.40±0.23 ^d	**
	Overall	94.75±0.11 ^a	94.08±0.21 ^b	87.46±0.23 ^c	81.44±0.16 ^d	**
Egg weight ; g	1	56.67±0.88	54.67±0.88	53.67±0.88	55.67±0.88	NS
	2	57.33±0.88	56.33±0.88	56.67±0.88	57.00±1.00	NS
	3	59.00±0.58	58.00±0.58	57.67±0.88	58.67±1.20	NS
	4	60.00±0.58	59.00±0.58	60.00±0.58	59.00±0.58	NS
	5	61.67±0.88	61.00±0.58	62.67±0.88	63.67±0.88	NS
	Overall	58.93±0.71	57.80±0.64	58.13±0.77	58.80±0.87	NS
Daily feed intake ; g	1	111.3±1.76	111.7±0.88	112.7±0.88	109.7±0.88	NS
	2	112.7±1.45	111.3±0.88	111.7±0.88	114.0±0.58	NS
	3	113.7±1.45	112.0±0.58	114.3±0.88	113.3±0.88	NS
	4	115.0±1.15	113.7±0.88	115.0±1.15	115.7±0.88	NS
	5	115.3±0.88	117.0±0.58	116.0±2.00	116.7±0.88	NS
	Overall	113.6±0.70	113.1±0.37	113.9±0.27	113.9±0.48	NS
Feed conversion (g feed /g eggs) :	1	2.12±0.00 ^b	2.18±0.03 ^{ab}	2.26±0.04 ^a	2.23±0.04 ^a	**
	2	2.02±0.03	2.07±0.05	2.23±0.05	2.23±0.03	NS
	3	2.06±0.06	2.06±0.03	2.24±0.04	2.36±0.05	NS
	4	1.99±0.02 ^d	2.06±0.02 ^c	2.29±0.02 ^b	2.60±0.01 ^a	**
	5	1.96±0.05 ^c	2.07±0.01 ^{bc}	2.17±0.05 ^b	2.53±0.05 ^a	*
	Overall	2.03±0.02	2.09±0.02	2.24±0.03	2.39±0.03	NS

* P < 0.05 ** P < 0.01

Means in the same row with no common superscripts are differ significantly (P<0.05).

2- Egg quality:

The effects of both Ca and P sources on egg quality are shown in Table 5 . Results indicated that the average values of eggshell thickness and shell-less egg(%) were improved significantly (P < 0.05) by using of either inorganic source of Ca or organic source of P . While, Hough Units values were not affected due to this dietary treatments .

The effect of interaction due to dietary treatments are illustrated in Table 6. Obtained results revealed that there were no significant effects of

either Ca or P source on the interior egg quality as assessed by the Haugh Unit score .. However, data on percentage of shell-less eggs and eggshell thickness indicated that layers fed BM with LS (Tr 1) generally recorded the lowest percentage of shell-less eggs and produced eggs with thicker shells compared with those of the other treatments. On the other hand, the highest value of shell-less eggs was recorded for those layers received DCP and ESM (Tr 4), which also produced eggs having a somewhat thinner shells .

Table 5: Means ± SE of som parameters of egg quality of layers as affected by dietary treatments .

Item	Period	Source of calcium			Source of phorsphorus		
		Organic T2 & T4	Inorganic T1 & T3	Sig.	Organic T1 & T2	Inorganic T3 & T4	Sig.
Haugh Units	1	88.00±0.63	88.33±0.49	NS	88.33±0.49	88.00±0.63	NS
	2	87.33±0.56	87.67±0.49	NS	87.00±0.58	88.00±0.37	NS
	3	87.17±0.48	86.67±0.42	NS	87.00±0.58	86.83±0.31	NS
	4	86.00±0.37	87.17±0.48	NS	86.67±0.56	86.50±0.43	NS
	5	87.17±0.60	87.50±0.56	NS	87.50±0.43	87.17±0.70	NS
	Overall	87.13±0.20	87.47±0.26	NS	87.30±0.28	87.30±0.10	NS
Shell-less egg %	1	1.00±0.39	0.17±0.03	**	0.13±0.02	1.03±0.38	**
	2	1.32±0.43	0.22±0.04	**	0.28±0.07	1.25±0.46	**
	3	1.65±0.43	0.28±0.08	**	0.43±0.14	1.50±0.50	**
	4	1.78±0.46	0.50±0.17	**	0.45±0.15	1.83±0.44	**
	5	2.38±0.67	0.67±0.23	**	0.53±0.17	2.52±0.61	**
	Overall	1.63±0.47	0.37±0.01	**	0.37±0.10	1.63±0.47	**
Eggshell thickness ; mm x 100	1	37.17±0.95	39.00±0.37	*	39.00±0.37	37.17±0.95	*
	2	36.83±0.95	39.50±0.62	*	39.33±0.56	37.00±1.06	*
	3	36.33±1.33	37.83±0.60	NS	38.67±0.49	35.50±1.06	**
	4	36.17±0.87	38.50±0.76	*	38.83±0.70	35.83±0.70	**
	5	34.00±0.58	35.00±1.00	NS	35.83±0.70	33.17±0.48	*
	Overall	36.10±0.85	37.97±0.41	**	38.33±0.29	35.73±0.70	**

*P < 0.05 **P < 0.01

The consistency of egg production and shell thickness trends showed beneficial effects of BM , as an organic source of P and LS as an inorganic source of Ca . Increasing the efficiency of Ca utilization in laying hen diets resulted in improved egg production and shell quality (Kuchinski and Harms, 1997 and Scheideler and Robeson, 1997).

3- Digestibility coefficients and minerals retention:.

Effects of different sources of Ca and P and their interaction on the digestibility coefficients and minerals retention are presented in Tables 7 and 8. Obtained results revealed that using LS as a source of Ca with either BM or DCP (Tr 1, Tr 3) improved (P<0.05) the digestibility coefficients of OM , CP, and EE , as well as Ca and P retention , while using ESM with DCP (Tr 4) recorded the lowest (P<0.05) coefficients of nutrients digestibility. However, CF digestibility was not affected by the dietary treatments .

Table 6 : As affected by interaction between due to dietary treatments

Items	Peario d	Experimental Treatments				Sig.
		Tr1	Tr2	Tr3	Tr4	
		2.6%BM+8.5% LS	2.6%BM+8.5% ESM	1.8%DCP+9.5 %LS	1.8%DCP+9.5 %ESM	
Haugh Units	1	88.00±0.58	88.67±0.88	88.67±0.05	87.33±0.88	NS
	2	87.33±0.88	86.67±0.88	88.00±0.58	88.00±0.58	NS
	3	86.67±0.88	87.33±0.88	86.67±0.33	87.00±0.58	NS
	4	87.33±0.88	86.00±0.58	87.00±0.58	86.00±0.58	NS
	5	87.00±0.58	88.00±0.58	88.00±1.00	86.33±0.88	NS
	Overall	87.27±0.48	87.33±0.41	87.66±0.24	86.93±0.07	NS
Shell-less eggs%	1	00.13±0.03 ^b	00.13±0.03 ^b	00.20±0.08 ^b	01.87±0.12 ^a	**
	2	00.20±0.06 ^b	00.37±0.12 ^b	00.23±0.07 ^b	02.27±0.09 ^a	**
	3	00.17±0.07 ^c	00.70±0.15 ^b	00.40±0.12 ^{bc}	02.60±0.12 ^a	**
	4	00.13±0.03 ^c	00.77±0.12 ^b	00.87±0.09 ^b	02.80±0.12 ^a	**
	5	00.17±0.03 ^d	00.90±0.06 ^c	01.17±0.09 ^b	03.87±0.09 ^a	**
	Overall	00.16±0.03 ^c	00.57±0.09 ^b	00.57±0.05 ^b	02.68±0.06 ^a	**
Eggshell thickness Mmx100	1	39.00±0.58 ^a	39.00±0.58 ^a	39.00±0.58 ^a	35.33±0.88 ^b	*
	2	40.00±0.58 ^a	38.67±0.88 ^a	39.00±1.15 ^a	35.00±0.58 ^b	*
	3	38.33±0.88 ^a	39.00±0.58 ^a	37.33±0.88 ^a	33.67±1.20 ^b	*
	4	40.00±0.58 ^a	37.67±0.88 ^{ab}	37.00±0.58 ^b	34.67±0.88 ^b	*
	5	36.67±1.20 ^a	35.00±0.58 ^{ab}	33.33±0.88 ^b	33.00±0.58 ^a	*
	Overall	38.80±0.35 ^a	37.87±0.27 ^{ab}	37.13±0.18 ^b	34.33±0.66 ^b	*

Means in the same row with no common superscripts are differ significantly (P<0.05).

Table 7 : Digestibility coefficient of nutrants and retention of calcium and phosphorus as affected by the dietary treatments . (%)

Item	Source of calcium			Source of phosphorus			
	Organic T2 & T4	Inorganic T1 & T3	Sig.	Organic T1 & T2	Inorganic T3 & T4	Sig.	
OM %	81.10±0.23	83.60±0.12	**	82.48±0.46	82.22±0.69	NS	
CP %	90.65±0.40	92.85±0.11	**	92.08±0.36	91.42±0.69	NS	
EE %	75.80±0.53	78.83±0.11	**	77.90±0.43	76.73±0.94	**	
CF %	26.52±0.07	26.45±0.07	NS	26.52±0.07	26.45±0.07	NS	
NFE %	84.92±0.27	86.73±0.09	**	86.15±0.31	85.50±0.52	**	
Mineral Retention (gm)	Ca	02.78±0.02	03.21±0.02	**	03.00±0.09	02.99±0.11	NS
	P	00.24±0.01	00.34±0.01	**	00.30±0.02	00.28±0.03	NS

* P < 0.05 ** P < 0.01

Table 8: Interaction effect of due to dietary treatments on the digestibility coefficients of nutrants and retention of calcium and phosphorus .(%)

Items Treatment	OM %	CP %	EE %	CF %	NFE %	Mineral Retention	
						Ca	P
Tr1	83.470.20 ^a	92.870.12	78.83.20 ^a	26.500.12	86.800.17 ^a	3.180.01 ^a	0.330.01 ^a
Tr2	81.500.17 ^b	91.300.12	76.970.12 ^b	28.530.09	85.500.17 ^b	2.820.01 ^c	0.260.01 ^b
Tr3	83.730.12 ^a	92.830.20	78.830.15 ^a	26.400.06	86.670.09 ^a	3.250.03 ^a	0.350.01 ^a
Tr4	80.700.25 ^c	90.000.82	74.830.09 ^c	26.500.12	84.330.09 ^c	2.730.01 ^d	0.210.01 ^c
Sig.	*	NS	**	NS	**	**	**

Means in the same column with no common superscripts are differ significantly (P<0.05).

DISCUSSION

The present results showed that layers fed the diets containing combination of BM with either LS or ESM (Tr 1 and Tr 2) achieved a better performance for egg production and feed conversion , and produced eggs that had a better eggshell quality as evidenced by the shell thickness score , with a less number of shell-less eggs produced , versus DCP in combination with either LS or ESM (Tr 3 and Tr 4) . Regarding the same criteria , a similar trend was observed also when LS was incorporated in the diet in combination with either BM (Tr 1) or DCP (Tr 3), versus ESM (Tr 2 and Tr 4) . This better performance for egg production and feed conversion was attained by layers with nearly equal feed intakes , and in the absence of significant variations among treatments in egg weight (Tabel 3) .

However , Vandepopuliere (1973) showed that substitution of ESM for LS in laying hen diets supported comparable egg production , egg weight , feed efficiency and eggshell breaking strength. Also , Arvat and Hinners (1973) stated that inclusion of LS , oyster shell (OS) or ESM at two Ca level (3.7 and 5.7 %) in the diet of laying hens , failed to show significant differences in eggshell thickness or internal egg quality parameters .

It is worthnoting that the experimental diets contained equal amounts of either Ca or available P at a ratio of 9-1 . With this respect , wider ranges were reported by N.R.C (1994) and El-Gindi (1999) who suggested Ca : P ratios of 13 : 1 and 10-1 , respectively , in laying hen diets , for normal egg production and maintenance of proper Ca metabolism . On the other hand , it is well known that Ca and available P are closely related physiologically to the extent that a deficiency or an overabundance of one mineral may likely interfere with the proper utilization of the other .

It was observed that , the availability of Ca and P from diets containing LS as a main inorganic source of Ca , with either BM (Tr 1) or DCP (Tr 3) were greater , versus those containing ESM as a main organic source of Ca (Tr 2 and Tr 4) ; as evidenced by values of Ca and P retention (Tables 7 ,) .

This may show that the availability of Ca derived from LS was greater than that of ESM . Similarly , *Brister et al* (1981) reported that the availability of Ca from LS was greater than that from OS . On the other hand , the availability of Ca and P derived from the diet containing a combination of BM as a main organic source of P , with ESM (Tr 2) were greater , compared with those of the diet containing DCP as a main inorganic source of P , and ESM (Tr 4) ; as evidenced by values of eggshell thickness (Table 6) , and Ca and P retention (Table 8) . This result may give a slight indication that the availability of P derived from BM was somewhat greater than that of DCP . Differences in the availability of P , from phosphoric acid and DCP (Miller , 1980) , and even in that of P derived from various DCP sources (Potter *et al.* , 1995) , were reported .

Another part of causes of variation among treatments in the performance of the experimental layers for egg production and feed conversion ; in favour of those fed diets containing BM and LS ; to some extent , may be attributed to differences in nutrients digestibility (Table 8) .

This makes one to speculated that the different sources of dietary Ca and P may had an effect on nutrients digestibility . However , such speculation should be taken cautiously , March and Amin (1981) stated that the sources (LS and OS) and amount of dietary Ca ingested by laying hens may affected the environment in the digestive tract , and thus digestion and nutrient absorption , in ways that are not understood .

In addition , the lower egg production rates of the experimental layers fed DCP-containing diets (Tr 3 and Tr 4) compared with those fed BM-containing diets (Tr 1 and Tr 2) , may in part be due to the characteristics of the commercial DCP that was used in the present study . In this connection , Sullivan *et al.* (1994) reported that commercial sources of DCP may have some impurities and contain other heavy metals at harmful levels .

Economic Efficiency (E . E)

Economic efficiency of egg production for laying hens fed the experimental diets , expressed as feed cost to produce one kg eggs during the entire experimental period , is shown in Table 9. Results indicated that the feed cost to produce one kg eggs was lower when laying hens were fed the diet containing BM and LS as sources of P and Ca respectively (Tr 1) than those of the other treatments . On the other hand, diet containing DCP and ESM (Tr 4) was of higher cost and can not be recommended .

In conclusion , in practical diets for laying hens , it is preferable to apply dietary bone meal as an organic source of phosphorus together with limestone as an inorganic source of calcium to get the best performance and economical efficiency of laying hens .

Table (9). Economic efficiency values as of affected the dietary treatments .

Treat . No	Feed intake Kg / hen	Price of feed L.E /kg	Feed cost L . E	Egg mass Kg / hen	Feed cost / Kg egg mass
Tr 1 2.6%BM+8.5%LS	15.9	1. 078	17.14	7.80	2.20
Tr 2 2.6%BM+8.5%ESM	15.8	1. 075	16.99	7.8	2.24
Tr 3 1.8%DCP+9.5%LS	16.0	1. 083	17.33	7.10	2.44
Tr 4 1.8%DCP+9.5%ESM	16.0	1. 078	17.25	6.7	2.57

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تأثير مصادر عضوية وغير عضوية للكالسيوم والفسفور على أداء الدجاج البياض

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أجريت هذه الدراسة على عدد ٣٠٠ دجاجة بياضة عمر ٢٤ أسبوع من نوع البوفانز الأبيض ، قسمت الطيور إلى أربع مجاميع متساوية العدد ، قسمت كل مجموعة إلى ثلاث مكررات وكل مكرر به ٢٥ دجاجة . وذلك لدراسة استخدام تأثير مصادر عضوية وغير عضوية للكالسيوم والفسفور على الأداء الإنتاجي للدجاج البياض وصفات جودة البيضة ومعاملات الهضم والمحتجز من الكالسيوم والفسفور وكذلك الكفاءة الاقتصادية لإنتاج البيض وتم تربية الطيور تحت نفس الظروف من الرعاية والمعاملات البيطرية طول مدة التجربة حتى الأسبوع ٤٤ من العمر وصممت العلائق بحيث تحتوي على نفس المستوى من البروتين الخام والطاقة الممتلئة والكالسيوم والفسفور المتاح . وكانت المعاملات كالتالي :-

١ - المعاملة الأولى أعطيت عليه تحتوي على مسحوق عظام بمستوى ٢,٦ % وحجر جيرى بمستوى ٨,٥ %

٢ - المعاملة الثانية أعطيت عليه تحتوي على مسحوق عظام بمستوى ٢,٦ % وقشر بيض بمستوى ٨,٥ %

٣ - المعاملة الثالثة أعطيت عليه تحتوي على ١,٨ % داي كالسيوم فوسفات مع حجر جيرى بمستوى ٩,٥ %

٤ - المعاملة الرابعة أعطيت عليه تحتوي على ١,٨ % داي كالسيوم فوسفات مع ٩,٥ % قشر بيض .

وأوضحت النتائج أن تغذية الدجاج البياض على علائق تحتوي على مسحوق العظام كمصدر عضوي للفسفور والحجر الجيري كمصدر معدني للكالسيوم أدى إلى زيادة إنتاج البيض وتحسين الكفاءة التحليلية للغذاء وحسن من سمك القشرة والمحتجز من الكالسيوم مقارنة بمجموعات الطيور المغذاة على علائق تحتوي على داي كالسيوم فوسفات وقشر البيض كمصدر للفسفور والكالسيوم . بينما لم يكن هناك تأثير معنوي على وزن البيض والغذاء المأكول وتيم وحدات هارف . كما تحسن كلاً من المحتجز من الكالسيوم والفسفور . كذلك تحسن قيم معاملات الهضم لكلاً من المادة العضوية والبروتين الخام ومستخلص الأثير وكذلك المستخلص الخالي من الأزوت . بينما لم يكن هناك اختلاف معنوي في معامل هضم الألياف . كان هناك تأثير واضح لاستخدام علائق تحتوي على مسحوق العظام كمصدر للفسفور والحجر الجيري كمصدر للكالسيوم على تكلفة الغذاء لإنتاج ١ كجم من كتلة البيض .