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EFFECT OF DIFFERENT DIETARY ENERGY AND PROTEIN LEVELS ON PRODUCTION PERFORMANCE OF HY-LINE W36 LAYERS IN EGYPT AT FIRST STAGE OF PRODUCTION

Alaily, H.A.EL; M.M. Fathi ; SH.F.EL Afifi and M.M. Elsied
Dept. Poultry Prod.,Fac.Agric.,Ain Shams University, Cairo, Egypt

ABSTRACT

An experiment was conducted to investigate the effect of different dietary energy and protein levels on performance of Hy-Line W36 white layers. One hundred and eighty laying hens at 18weeks of age were fed on nine experimental diets containing 3 levels of crude protein (16, 18 and 20%) and 3 levels of metabolizable energy (2750,2850,and 2950kcal ME/kg feed) in a factorial arrangement design (3 protein levels X 3 energy levels).

The results indicated that; feed consumption of layers decreased significantly due to increasing dietary energy levels, while dietary protein levels had no effect. Dietary energy or protein levels did not affect significantly egg production percentage. Increasing dietary energy and protein levels had a positive effect on average egg weight, while average egg mass (g. /hen/day) was not affected significantly. Efficiency of feed utilization was improved as dietary energy level increased, while dietary protein level had no effect on efficiency of feed utilization. The results indicated that, under Egyptian conditions, the layers can tolerate a wide range of dietary energy and protein levels without any adverse effect either on egg production or egg mass. Dietary energy level is the main effect in determining the efficiency of feed utilization

KeyWords: layer performance – energy levels - protein levels.

INTRODUCTION

Dietary energy and protein levels have the greatest effect on the feeding and laying performance of laying hens. Dietary energy level is the most important factor in determining feed intake of layers which consume feed to satisfy an inner craving for energy (Scott *et al.*,1982, and Leeson *et al.*, 2001). As well as the increase in the metabolizable energy (ME) level in laying hens diets leads to an improvement in the efficiency of feed utilization (Doran *et al.*, 1980 and Leeson *et al.*, 2001). Average egg weight of layers increased also by increasing the ME level of diet (Doran *et al*, 1980, Summers and Leeson, 1993, and Harms *et al.*, 2000). There was an inclusive effect on egg production rate due to varying dietary energy level. Brown *et al*, (1965), and Summers (1993) showed that egg production percentage reduced by increasing dietary energy level, while Harms *et al.*, (2000), didn't find any effect on egg production due to increasing dietary energy level.

Because of the inverse relationship between dietary energy level and feed intake of layers, the intake of other dietary nutrients especially protein must be related to the energy density of diet. Dietary protein content takes much consideration due to its high cost and its great effect on the production parameters of laying hens. Aitken *et al.*, (1973) and Fernandez *et al.*, (1973), reported that increasing dietary protein level lead to an increase in egg

production percentage. Also, average egg weight of layers increased as dietary protein level increased (Nivas and Sunde 1969, and Summers 1993). Moreover, Aitken *et al.*, (1973), and Calderon and Jensen (1990) observed an improvement in feed efficiency ratio due to increasing dietary protein level.

At present the commercial strain of Hy-line W36 white layers is used widely for producing table eggs in Egypt. In their international guidebook producers of Hy-line W36 white layers suggested a requirements of 2950 Kcal/Kg diet and 19% protein for laying eggs at the first stage of production (21-44 wk). However this recommendation is general guide, which may not be valid under different conditions and in various countries.

It doesn't appear in the literature information on nutrients requirements of this particular strain under Egyptian conditions except for the work of Soliman (1996) on energy requirements therefore, the present work aimed to investigate the effect of varying energy and protein levels on performance of Hy line w36 layers under Egyptian conditions during the first stage of production (21-40 wk).

MATERIALS AND METHODS

This study was carried out at the "Layer Nutrition Research Unit" Faculty of Agriculture, Ain Shams University during the period from November 2000 to April 2001. The study aimed to investigate the effect of different dietary levels of crude protein, and metabolizable energy (ME) on feeding and laying performance of Hy-Line W36 layers during the first stage of production (21-40wk).

Experimental birds and design.

One hundred and eighty Hy-Line pullets at 18weeks old were used to examine the effect of feeding three different levels of ME and crude protein in a factorial arrangement design (3 protein levels X 3 ME levels) on feeding and laying performance. The pullets were assigned randomly at the nine experimental treatments as 20 hens per treatment. Hens were kept in an individual cages and each individual hen was considered as an experimental unit or replicate.

Birds' management and diets.

Feed was offered ad-lib in individual feeders and water was supplied through automatic nipples. The pullets at 18weeks old were subjected daily to 13 lighting hours which were increased 30 minutes every two weeks until reaching 17 lighting hours. Nine experimental corn-soy diets were formulated to contain three protein levels 16,18 and 20%, and three metabolizable energy levels 2750,2850 and 2950 kcal in a factorial arrangement (3 x 3). The diets were formulated according to NRC (1994), and their composition is shown in Table (1). Pullets were fed on the experimental diets starting from 18weeks old, while records of feeding and laying performance was obtained starting from 21weeks old.

Table 1. Composition and calculated analysis of experimental diets:

Ingredients (%kg diet)	Treatments								
	T1	T2	T3	T4	T5	T6	T7	T8	T9
Corn yellow	64.63	62.24	59.84	57.55	55.15	52.76	50.52	48.12	45.72
Soy bean 44%	23.56	24.01	24.51	29.64	30.10	30.56	35.58	36.04	36.50
Calcium carb.	8.43	8.43	8.42	8.42	8.42	8.41	8.42	8.41	8.41
Di-Ca phos.	1.86	1.86	1.87	1.80	1.80	1.81	1.74	1.75	1.75
Veg. oil	0.61	2.54	4.47	1.78	3.71	5.64	2.96	4.89	6.82
Salt (NaCl)	0.40	0.40	0.40	0.40	0.40	0.41	0.41	0.41	0.41
Hy Mix @	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
DL-Meth.	0.13	0.14	0.14	0.11	0.11	0.11	0.08	0.08	0.09
Lys. HCl	0.07	0.07	0.06	0.00	0.00	0.00	0.00	0.00	0.00
	Calculated analysis*								
(%CP)	16	16	16	18	18	18	20	20	20
ME kcal/ kg	2750	2850	2950	2750	2850	2950	2750	2850	2950
C/P ratio	172	178	184	153	158	164	138	143	148
Ca (%)	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75
Av. e Pho.(%)	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
Na (%)	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18
Lys. (%)	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86
Meth.	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42
S. A. A. (%)**	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73

@Each one kilogram of the premix contain the following :
Vit. A=7500000 I.U., Vit. D3=16500000I.U, Vit. E=33000mg., Vit. K3=2500mg., Vit.B1=1250mg. Vit. B2=4950mg., Vit. B6=3300mg., Vit. B12-=10mg., Ca.D-pantothenate =9000mg., Niacin=20000mg., Folic Acid=400 mg., Manganese=50gm., Zinc=30gm., Iron=40gm., copper=4gm., Iodine=0.4gm. Selenium Chloride=0.24gm., and Choline Chloride=600gm., CaCO3 was used as a carrier.
***calculated analysis was done according to N RC(1994).**
****S.A.A =sulfur amino acid**

Traits studied

Feed intake of layers was recorded weekly in grams. Daily egg weight (g.) and egg number were recorded while percentage of egg production, average egg weight (g.) and egg mass (g. /hen/day) were calculated. Efficiency of feed utilization values were calculated as gram feed intake per gram egg produced. The experimental data were averaged into two periods (21-30and 30-40 week) and overall values were calculated for the entire experimental period. Seemingly, the data were modified to calculate the overall values for the three ME levels and the three protein levels, irrespective of each other.

Statistical analysis.

The values were analyzed statistically using two-way analysis of variance method according to SAS (1988). Duncan's new Multiple Range procedure was followed to separate means (Duncan, 1955).

The model applied was:

$Y_{ijk} = \mu + P_i + E_j + (P \times E)_{ij} + e_{ijk}$

Where: μ=general mean.

P_i=dietary protein effect.

E_j=dietary ME effect.

$(P \times E)_{ij}$= protein by energy interaction effect.

E_{ijk}= experimental error.

RESULTS AND DISCUSSION

Effect of dietary metabolizable energy and protein levels on feeding and laying performance.:

Daily feed consumption.

It is clear (Table 2) that daily feed consumption values of layers decreased significantly due to increasing dietary energy levels, and the values of 96.93, 94.43 and 92.11 g. /hen /day were recorded for feed consumption of layers fed 2750, 2850, and 2950 kcal ME / kg feed, respectively. This inverse relationship between feed consumption and dietary energy levels have been established early by Morris and Fox (1963) and recently by Leeson *et al.*, (2001). On the other hand, dietary protein levels had no significant effect on dietary feed consumption values, which were approximately similar (94.81,94.35, and 94.32 g. /hen/ day), when represented overall means for dietary protein levels (16,18, and 20%). These results are in accordance with the results of Fernandez *et al.*, (1973), and Leeson and Caston (1997) who didn't find any significant effect on feed intake of layers due to feeding dietary protein levels.

Egg production rate.

Egg production percentage was not affected significantly by feeding different energy and protein levels (Table 3). This result indicated that, hens under the different experimental energy and protein levels were able to obtain a sufficient amount of different nutrients needed for maximum egg production. This result is in agreement with Summers (1993), who didn't find significant difference in egg production of layers either fed different energy or protein levels. Similarly, Miller *et al.*, (1957), and Brown *et al.*, (1965), showed that laying hens can tolerate a wide range of dietary calorie-protein ratios without affecting egg production. However, the energy level of 2850 Kcal/Kg M.E. has the highest effect on egg production with the different three levels of protein 16%, 18%, and 20%, which recorded 94.71%, 92.15%, and 93.37% respectively.

The current result is in agreement with those obtained by Soliman (1996) who reported that, Hy line w36 layers fed on 2850Kcal/Kg M.E. gave the highest egg production percentage during winter season under Egyptian conditions.

It can be concluded that the dietary energy level of 2850 Kcal/Kg M.E with 16% protein was satisfactory for egg production of Hy line W36 layers at the first stage of production. This level was less than those recommended by the international guide of Hy line W36 strain being 2950 Kcal/Kg M.E with 19% protein level.

Table (2) Effect of the experimental treatments on feed consumption

%Protein	16			18			20		
Dietary ME kcal/kg.	2750	2850	2950	2750	2850	2950	2750	2850	2950
Hen's age (wk)	Feed consumption (g./hen/day)								
21to30	92.48^{ab}	90.90^{abcd}	88.51^{bcd}	94.15^{a}	89.83^{abcd}	87.31^{d}	92.24^{abc}	90.34^{abcd}	87.78^{cd}
31to40	101.01^{a}	99.25^{ab}	96.72^{cd}	101.24^{a}	97.81^{bc}	95.72^{d}	100.53^{a}	98.52^{bc}	96.71^{cd}
21to40	96.74^{ab}	95.07^{abcd}	92.62^{def}	97.67^{a}	93.77^{cdef}	91.51^{f}	96.38^{abc}	94.43^{bcde}	92.20^{ef}
Overall protein effect		94.81 (16%)			94.35 (18%)			94.32 (20%)	
Overall ME effect		96.93^{a} (2750)			94.43^{b} (2850)			92.11^{c} (2950)	**

^{abcdef}, Means with different letters within the same row are significantly different.** significance at p<0.01 *significant at p<0.05.

Table (3) Effect of the experimental treatments on egg production:

%Protein	16			18			20		
Dietary ME kcal/kg	2750	2850	2950	2750	2850	2950	2750	2850	2950
Hen's age (wk)	Egg production percentage (hen -day)								
21to30	87.08	92.51	86.91	89.07	88.43	86.81	86.39	89.64	86.91
31to40	95.14^{c}	96.86^{ab}	95.21^{bc}	95.64^{abc}	95.79^{abc}	95.94^{abc}	95.80^{abc}	96.93^{a}	96.21^{abc}
21to40	91.11	94.71	91.08	92.39	92.15	91.49	91.16	93.37	91.52
Overall protein effect		92.29 (16%)			92.01 (18%)			92.02 (20%)	
Overall ME effect		91.55 (2750)			93.41 (2850)			91.38 (2950)	

^{abc}, Means with different letters within the same row are significantly different.* significant at p<0.05.

Egg weight (g.)

It is obvious (Table 4) that average egg weight of layers fed the highest energy diet (2950 kcal ME/kg. diet), was significantly ($p<0.01$) higher (55.07 g./hen) than those fed the lowest one (53.73 g./hen). This finding is in agreement with those obtained by DeGroote (1972), who observed an increase in egg weight of layers fed high-energy diet in the range of 2 500 to3200kcal ME/kg feed levels. Simultaneously, increasing of dietary protein levels have a positive effect ($p<0.05$) on average egg weight of layers. In this connection, Doran *et al.,* (1980), and Summers (1993), reported that, egg weight increased as dietary protein levels increased.

Egg mass (g. egg /hen/day).

Daily egg mass (g.) of layers was not affected significantly by feeding different levels either of metabolizable energy or crude protein (Table 5). This result is well accepted since daily egg mass is calculated as egg production multiplied by egg weight, therefore egg mass values depend mainly upon egg production values which were not affected by dietary energy and protein levels.

Efficiency of feed utilization (g. feed /g. egg mass).

Efficiency of feed utilization was significantly improved due to increasing dietary energy levels. This improvement was pronounced along both experimental periods, as well as through all experimental period (21 to 40 weeks) (Table 6). Differences between the 3 levels of ME (as overall means) were clearly obvious especially between 2750 and 2950 kcal ME /kg feed levels. A large part of this improvement was attributed to the reduction in feed intake associated with increasing dietary metabolizable energy level (Table 2) This result is in harmony with those obtained by D'alphonso *et al.,* (1996), who reported that feed efficiency of high-energy diet was improved due to reduced feed consumption.Dietary protein levels had no effect on efficiency of feed utilization(Table6). This result is in agreement with those obtained by Ried (1976), who didn't find significant effect on feed efficiency ratio of layers due to feeding different protein levels.

CONCLUSION

As a general conclusion, egg production was not significantly affected by feeding the different three levels of either ME or protein, therefore layers under the nine experimental diets were able to obtain their requirements needed for egg production, whereas, they can tolerate a wide range of calorie- protein ratio without any adverse effect either on egg production or egg mass.

Dietary energy level is the main effect in determining the efficiency of feed utilization. Therefore, the price of high intensive energy sources (oils) and calorie / nutrients ratios should be taken in our consideration to determine the optimal diet for feed efficiency.

From the results of egg production it is recommended that level of 2850 kcal / kg dietary metabolizable energy and 16% crude protein, were adequate for egg production of Hy–line W36 layers through the first stage of production under Egyptian conditions.

Table (4) Effect of the experimental treatments on egg weight

%Protein	16			18			20		
Dietary ME kcal/kg	2750	2850	2950	2750	2850	2950	2750	2850	2950
Hen's age (wk)	EGG WEIGHT								
21to30	50.88^{ab}	50.82^{ab}	50.65^{ab}	50.39^{ab}	50.97^{ab}	51.66^{ab}	49.91^{b}	51.42^{ab}	52.43^{a}
31to40	56.71^{d}	56.92^{cd}	57.51^{bc}	56.63^{d}	57.50^{bc}	58.13^{b}	57.66^{b}	58.18^{b}	59.87^{a}
21to40	53.79^{b}	53.87^{b}	54.08^{b}	53.56^{b}	54.27^{b}	54.98^{ab}	53.83^{b}	54.89^{ab}	56.14^{a}
Overall protein effect			53.91^{b} (16%)		54.27^{ab} (18%)		54.95^{a} (20%)		*
Overall ME effect			53.73^{b} (2750)		54.34^{ab} (2850)		55.07^{a} (2950)		**

[abcd], Means with different letters within the same row are significantly different. ** Significant at p<0.01. * Significant at p<0.05.

Table (5) Effect of the experimental treatments on egg mass

%Protein	16			18			20		
Dietary ME kcal /kg	2750	2850	2950	2750	2850	2950	2750	2850	2950
Hen's age (wk)	Egg mass (g./hen/day)								
21to30	4.70	47.46	44.72	45.32	45.75	45.53	43.67	46.58	46.34
31to40	53.92^{e}	55.11^{cd}	54.76^{cde}	54.17^{de}	55.08^{cd}	55.77^{bc}	55.14^{cd}	56.37^{b}	57.61^{a}
21to40	49.32	51.34	49.74	49.80	50.48	50.78	49.48	51.60	51.98
Overall protein effect			50.13(16%)		50.36(18%)		51.01(20%)		
Overall ME effect			49.53(2750)		51.13(2850)		50.83(2950)		

[abcde], Means with different letters within the same row are significantly different.

Table (6) Effect of the experimental treatments on efficiency of feed utilization:

%Protein	16			18			20		
Dietary ME kcal/kg	**2750**	**2850**	**2950**	**2750**	**2850**	**2950**	**2750**	**2850**	**2950**
Hen's age (wk)	**Efficiency of feed utilization (g. feed /g. egg mass)**								
21to30	2.069^{a}	1.915^{cd}	1.979^{b}	2.077^{a}	1.963^{bc}	1.918^{cd}	2.112^{a}	1.939^{bcd}	1.894^{d}
31to40	1.873^{a}	1.801^{bc}	1.766^{cd}	1.869^{a}	1.776^{cd}	1.716^{ef}	1.823^{b}	1.748^{de}	1.679^{f}
21to40	1.961^{a}	1.852^{b}	1.862^{b}	1.961^{a}	1.857^{b}	1.802^{cd}	1.948^{a}	1.830^{bc}	1.774^{d}
Overall protein effect	1.890 (16%)			1.873 (18%)			1.851 (20%)		
Overall ME effect	1.956^{a} (2750)			1.846^{b} (2850)			1.813^{c} (2950)**		

^{abcdef}, Means with different letters within the same row are significantly different.** significant at p<0.01

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تاثير مستويات مختلفة من الطاقة والبروتين على الاداء الآنتاجى للدجاج البيـــاض من سلالة الهاى لاين الأبيض خلال المراحل الاولي من انتاج البيض

حسين عبد الله العلايلي- معتز محمد فتحي- شعبان فتوح العفيفي.- محمد مصطفى السيد
قسم انتاج الدواجن- كليةالزراعة- جامعة عين شمس.

اجريت هذه الدراسة لمعرفة تاثير مستويات مختلفة من الطاقة وبروتين العليقـــة علـــى الاداء الغذائي والانتاجي للدجاج البياض خلال الفترة من ٢١الى٤٠اسبوع من الانتاج، واستخدم في هذه التجربة ١٨٠دجاجة بياضة من سلالة الهاي لاين ٣٦الابيض بداية من عمر ١٨اسبوع. غذيت الطيور على ٩علائق تحتوي على ٣مستويات مختلفة من الطاقة الممثلة هـــي ٢٧٥٠ و٢٨٥٠ و ٢٩٥٠ كيلو كالوري لكل كجم عليقة ، كل مع ٣ مستويات من البـــروتين الخـــام هـــي ١٦و ١٨و ٢٠ % في تصميم احصائي متداخل (٣ مستويات طاقة x٣ مستويات بروتين).

أوضحت نتائج التجربة ما يلي:

١- انخفض الاستهلاك الغذائي اليومي للدجاجات بزيادة مستوى الطاقة بالعلائق، بينما لـــم يتـــأثر باختلاف مستويات البروتين بها.

٢- تحسنت كفاءة الاستفادة من الغذاء بزيادة الطاقة بالعليقة. بينما لم يكن لبروتين العليقـــة تـــأثير معنوي على الكفاءة الغذائية.

٣- لم يتأثر معدل إنتاج البيض سواء باختلاف مستوى الطاقة أ و مستوى البروتين بالعلائق خلال فترتي التجربة.

٤- تحسن وزن البيضة بصورة معنوية بزيادة كل من طاقة وبروتين العليقة ، في حين أن كتلـــة البيض(جم/ دجاجة / يوم) لم تتأثر باختلاف الطاقة والبروتين بين العلائق.

٥- أشارت الدراسة إلى انه يمكن الحفاظ على مستوى مناسب من إنتاج البيض في مـــدى واســـع نسبيا من الطاقة والبروتين بالعليقة.

٦- مستوى الطاقة بالعليقة هو العامل المحدد لكفاءة الاستفادة من الغذاء.

٧- مستوى الطاقة الممثلة ٢٨٥٠كيلو كالورى ومســـتوى البـــروتين الخـــام ١٦% همـــا أفضـــل المستويات لانتاج البيض خلال هذه المرحلة.مع هذه السلاله تحت الظروف المصريه