Egypt. Poult. Sci. Vol (29) (II): (527- 564)

INFLUENCE OF NUTRIENT DENSITY ON PRODUCTIVE AND REPRODUCTIVE PERFORMANCE OF SOME LOCAL LAYING HEN STRAINS.

By

Y.A. Marie; M.A. Ibrahim.; M.A. Mahmoud and H.A. Abou Khashaba

Animal Production Research Institute, Agricultural Research Center.

Received**: 01/06/2009** Accepted: **15/06/2009**

Abstract: *The present study was conducted to evaluate the productive and reproductive performance of some local laying hen strains (Sinai, S; Silver Montazah, SM; Mamourah, M and Gimmizah, G) fed different dietary nutrient densities. Birds were fed ad lib. on five experimental diets containing 5 nutrient densities from 24 to 44 wk of age. The formula of the control diet (diet 3) was ME, 2743 kcal/kg; CP, 16.4%; Ca, 3.29%; Av. P, 0.344%; Lys, 0.914%; Met, 0.364% and Met.+Cys., 0.639%. Diets 1 and 2 contained nutrient density of 10 and 5% less than the control diet, respectively. However, diets 4 and 5 contained nutrient density of 5 and 10% more than the control diet, respectively. All birds were kept under similar conditions. Results show that 5 and 10% less than the control diet decreased (P<0.05) LBW of hens. However, LBW was not affected significantly by increasing nutrient density to 5%, and increased (P<0.05) for hens fed 10% more than the control. Feed intake increased and nutrient intake decreased (P<0.05) due to decreasing nutrient density, while an opposite trend was observed by increasing nutrient density. Egg production, egg number, egg weight, egg mass, feed conversion, yolk index and Haugh Unit score were improved (P<0.05) due to increasing nutrient density. Fertility and hatchability percentages increased (P<0.05) by increasing nutrient density and reversible situation was observed by decreasing nutrient density. Strain had a significant effect on body weight, feed and nutrient intakes, feed conversion, egg production and average egg weight, egg mass, egg shape index and Haugh Unit score. Also, significant differences were observed among strains in fertility and hatchability percentages significantly, being almost the highest in Sinai and Gimmizah strains.*

In conclusion, economically, feeding diet of nutrient density 5% higher than the recommendations of local laying hens is more applicable in order to optimize their productive and reproductive performance and/or egg

quality. Sinai hens were more adapted under the experimental conditions of this study.

INTRODUCTION

Nutrient density is defined as a ratio of nutrient content to the total energy content**.** Dietary nutrient density is one of several nutritional factors that have a significant impact on the growth of chickens **(Campbell *et al.*, 1988)**. It has been demonstrated that chickens will attempt to adjust their feed intake to satisfy their energy requirements, thereby affecting the efficiency of feed utilization **(Plavnik *et al.*, 1997)**. In addition, manipulation of nutrient density has been shown to affect growth performance **(Jones and Wiseman, 1985)**, and animal health **(Scott, 2002)**.

Feed intake is an important index in formulating poultry diets. Feed intake can significantly affect the cost of production. Regulating dietary energy is believed to be one of the most effective ways to adjust feed intake of laying hens. Feed intake has been reported to increase with the dilution of nutrient density **(Nielsen, 2004)**. Several studies showed that increasing dietary energy or fat decreased feed intake and improved feed conversion of laying hens (**Harms *et al*., 2000; Bryant *et al*., 2005 and Wu *et al*., 2005 a and b). Valkonen *et al.* (2008**) reported that the hens received the low-energy diet consumed more feed and produced fewer eggs than the birds fed the high-energy diet. However other studies observed no dietary energy effect on feed intake (**Jalal *et al*., 2006)**.

Pell and Polkinghorne (1986) reported that birds fed the high nutrient density diet (19% protein, 12.6 MJ ME/kg) had significantly higher intakes of ME (3% higher) and other nutrients than did those on the medium nutrient density (18% protein, 11.7 MJ ME/kg) and low nutrient density (16% protein, 11.4 MJ ME/kg) diets. They also found that egg weight, egg mass and feed efficiency were better on the high-nutrient density than on the medium and low nutrient density diets.

Many studies have shown that early egg weight was increased by increasing dietary energy **(Bohnsack *et a*l., 2002; Sohail *et al*., 2003 and Wu *et al*., 2005 b)**, dietary protein **(Liu et *al*., 2005 and Wu *et al*., 2005 a)**, methionine **(Keshavarz, 1995)** and lysine **(Novak *et al*., 2004 and Liu *et al*., 2005)**. Recently, **Wu *et al*. (2005a and b and 2007)** reported significant effect of nutrient density, on egg mass, egg specific gravity, yolk and albumen weight, Haugh unit and feed conversion.

Egg producers for the production of either table or hatching eggs currently use several commercial laying strains. Different strains of laying hens can have different production and egg quality characteristics, depending upon their genetic potential, nutritional and managerial conditions **(Wu *et al.*, 2005 a and b and 2007)**, Some local strains of hens may be more beneficial when kept for the production of table eggs whereas others may be beneficial if they are kept for the production of hatching eggs.

As far as the researchers aware, there were no reports on the effect of dietary nutrient density on productive and reproductive performance and egg quality of local laying hens. Therefore, the present study was conducted to investigate the effect of different dietary nutrient density (low and high 5 and 10% of that in the control diet) on the productive and reproductive performance of four local strains of laying hens.

MATERIALS AND METHODS

This study was carried out at El-Gimmizah Poultry Station, Animal Production Research Institute, Ministry of Agriculture, Egypt during the period from September 2008 to January 2009.

A factorial experiment was designed (4 hen strains x 5 experimental diets with different nutrient density) was performed. Four local strains of laying hens used in this study were [Sinai (S), Silver Montazh (SM), Mamorah (M) and Gimmizah (G)] from 24 to 44 weeks of age. Six hundred pullets and 60 cocks were divided into five groups fed five experimental diets containing 5 nutrient densities. Total of 150 pullets and 15 cocks of each strain in 3 replicates of 10 hens and one cock/replicate were fed each experimental diet (30 hens and 3 cocks/diet).

The analysis of diet 3 was (ME, 2743 kcal/kg; CP, 16.4%; Ca, 3.29%; available P, 0.344%; Lysine, 0.914%; Methionine, 0.364% and Methionine+ Cystine, 0.639%) was used to serve as a control diet for the local strains of laying hens. However, diets 1 and 2 were formulated to contain nutrient density contents of 10 and 5% lower than those of the control diet, respectively. While, diets 4 and 5 were formulated to contain nutrient density contents of 5 and 10% more than that of the control diet, respectively. Nutrient compositions of the experimental diets were calculated according to **NRC (1994)**, as shown in Table (1). All birds were kept under similar conditions, fresh water was supplied all the time and all hens were fed *ad libitum* for 20 weeks of production. Also, the birds were exposed to 16 h of continuous light per day.

Throughout the experimental period, live body weight, egg production rate, egg weight, daily egg mass, daily feed intake and feed conversion ratio every four weeks were recorded.

At 36 weeks of age, an egg quality test was performed to examine certain traits of egg quality, including egg shape index, egg components (relative weights of shell, yolk and albumen), yolk index, Haugh unit **(Haugh, 1937)** and yolk color score using the Roche yolk color fan. All settable eggs per group were collected and incubated. Fertility percentage was estimated as a percentage of fertile eggs to the total number of eggs set. Individual weights of hatched chicks were recorded.

Economic efficiency was also calculated according to the following formula: Net return / Price of feed cost

A completely randomized design, with a factorial arrangement of treatments (4 x 5) was used. Data were analyzed using the General Linear Model procedure of Statistical Analysis System by using **SPSS V.10 (1997)**. Significant differences among means were separated by Duncan's Multiple Range Test **(Duncan, 1955).**

RESULTS AND DISCUSSION

Live body weight:

Data of live body weight at 20 weeks of age and change in body weight between 24 to 48 weeks presented in Table (2) showed that decreasing nutrient density by 5 and 10% in diets 2 and 1 lower than the control (diet 1) significantly ($P<0.05$) decreased LBW of laying hens, showing loss in LBW of hens fed diet 1 (the lowest nutrient density). Although, LBW was not affected significantly by increasing nutrient density to 5% (diet 4) more than the control diet, increasing this density to 10% significantly ($P<0.05$) increased LBW of hens to 1534.2 g as compared to 1486.6 g for those fed the control diet.

The present results are in agreement with those reported by **2005 b and 2007)**, who found that increasing nutrient density (dietary energy or Lys. Intake) significantly increased hen weight and weight gain. **Hassan *et al*. (2000)** reported that hens fed high protein diets had higher final body weight than those fed on lower protein diets.

Also, **El-Sayed *et al*. (2001)** found that body weight of birds fed diets with high protein levels were significantly heavier than those fed diets of high energy level. Moreover, **Tollba and El-Nagar (2008)** reported that live weight gain and mortality rate significantly improved with increasing dietary protein level to 18% compared to the basal diet, which contain 16% crude protein. Similar findings were noted by **Essa et al. (2003)** in response to increasing dietary protein level.

Regarding the strain effect, there were significant differences in final body weight and body weight change among the different strains of hens. Mamourah strain recorded the heaviest body weight, while Sinai recorded the lightest one (Table 2). **Sailer (1985)** mentioned that the variation in body weight among strains could be attributed to their genetic variation, which affected their growing potential capacity, indicated the significant variation in LBW of strains.

Feed intake:

Data presented in Table (3) showed that average total daily feed intake (as fed) significantly ($P<0.05$) increased by decreasing nutrient density in D1 and D2 and decreased by increasing nutrient density in D4 and D5 as compared to the control died (D3). Feed intake increased by 2.3 and 5.1% with decreasing nutrient density 10 and 5%, while it decreased by 3.1 and 4.1% with increasing nutrient density 5 and 10%, respectively.

The present trend of change with nutrient density is in agreement with those obtained by **Wu *et al*. (2005 a and b and 2007) and Valkonen *et al*. (2008),** who observed that birds fed high-energy diets significantly decreased feed intake. However, other investigators observed no significant effect of dietary energy on feed intake **(Jalal *et al*., 2006)**.

It is of interest to note that increasing feed intake by decreasing nutrient density of D1 and D2 was associated with significant ($P<0.05$) reduction in nutrient intakes as ME, CP, Ca, Av. P, lysine and methionine, particularly by decreasing nutrient density to 10% less than the control diet. An opposite trend was observed by increasing nutrient density more than 10% of the control diet (Table 3).

These results might indicate that the rate of increase/decrease in nutrient density of the diets was greater than the rate of changes in nutrient intakes. These results are in agreement with the findings of **Pell and Polkinghorne (1986),** who reported that birds fed the high nutrient density diet had significantly higher intakes of ME and other nutrients than did those fed on the medium or low nutrient density diets.

With respect to hen strain, average daily feed (as fed) and nutrient intakes was significantly ($P<0.05$) lower in Sinai than those in the other strains (Table 3). The strain differences in feed intake may be related to variations in their nutrient requirements for maintenance and production.

In this respect, **Abd El-Ghani (1996)** attributed the variation in feed intake among strains to LBW. He reported that the lightest BW birds consumed less feed than the other BW groups. In addition, **El Alaily *et al.***

(2003) found that the daily feed intake of Hy Line layers decreased significantly due to increasing dietary energy level (2750, 2850 and 2950 kcal/kg diet). Similarly, **Wu *et al.* (2007)** recorded that increasing nutrient density had a significant reduction in feed intake. Recently, **Valkonen *et al*. (2008)** found that hens received low-energy diet consumed more feed and produced fewer eggs per day than birds fed the high-energy diet. Generally, increasing dietary energy significantly decreased feed intake **(Wu *et al*. 2005 a and b)**.

Laying performance and feed conversion:

Data presented in Table (4) showed that egg characteristics in term of percentage of production, number, weight and mass were significantly ($P<0.05$) decreased by decreasing nutrient density in D1 and D2 and increased by increasing nutrient density in D4 and D5 as compared to the control diet (D3). Increasing nutrient density to 10% more than the control diet showed significantly ($P<0.05$) the highest egg characteristics.

Feed conversion significantly ($P\leq0.05$) improved with increasing nutrient density (Table 4). Feeding the highest nutrient density diets (+10%) significantly ($P<0.05$) improved feed conversion of hens by 10%. However, feed conversion of low nutrient density levels (-10 and -5%), were lower by 39.5 and 11.2% compared with control level, respectively. The improved feed conversion, observed herein by increasing nutrient density, may be related, to an improvement in egg mass in response to increasing dietary energy and other nutrient (amino acids, Ca, and available P).

In accordance with the present results, **Pell and Polkinghorne (1986)** found that egg weight, egg mass and feed efficiency were better on the high-nutrient density than on the medium and low nutrient density diets. Several authors showed that increasing dietary energy or fat improved feed conversion of laying hens (**Harms *et al*., 2000; Bryant *et a*l., 2005** and **Wu *et al*., 2005 a and b).**

The present results are in harmony with those obtained by **El Alaily *et al*. (2003)** who reported that a large part of improvement in feed conversion was attributed to the reduction in feed intake associated with increasing ME level. They also found that increasing nutrient density linearly improved feed conversion. In addition, **Wu *et al.* (2005 b)** reported that increasing dietary energy linearly improved feed conversion. They also suggested that increasing both dietary energy and other nutrients (amino acids, Ca, and available P) would be more effective in improving egg mass and feed conversion than just increasing dietary energy. Moreover, **Hassan *et al.* (2000)** found that egg production percentages were significantly higher with 17.5% CP than with 13.67% CP. **El Alaily *et al.* (2003**) found that ME level of 2850 kcal/kg had the highest effect on egg production with the different levels of protein (16,18 and 20% in diet) in Hy Line W36 layers. **Bunchasak *et al*. (2005)** reported that high dietary crude protein tended to have better egg production, egg weight and egg mass than the lower level of crude protein.

Recently**, Wu *et al*. (2007)** found that nutrient density linearly increased egg mass due to the increased egg weight. Egg weight may be maximized to genetic potential by increasing both dietary energy and other nutrients (amino acids, Ca, and available P) during early egg production.

There was a significant effect of strain on egg production percentage, egg weight and egg mass. Sinai hens produced significantly ($P<0.05$) the highest egg production and egg mass, while Gimmizah significantly ($P<0.05$) laid the heaviest eggs as compared to other strains. Increased egg mass, reported herein, may be related to higher egg weight and egg production rate (Table 4).

Egg quality traits:

Data given in Table (5) show that the experimental diets had no significant effects on all egg quality traits studied, except on yolk index and Haugh Unit score. Increasing dietary nutrient density to 5% significantly ($P<0.05$) increased yolk index, whereas an opposite trend was observed by decreasing nutrient density to 10%. However, increasing nutrient density to 10% or decreasing it to 5% did not affect yolk index. On the other hand, Haugh Unit score was negatively ($P<0.05$) affected by nutrient density in the experimental diets.

These results are in agreement with the findings of **Wu *et al*. (2007)**, who reported that increasing nutrient density had no significant effect on shell weight, percentage of yolk and albumen. Also, **Hassan *et al.* (2000)** reported that increasing the dietary protein had no effect on egg shell thickness. Moreover, **Camps and Edghill (1999)** observed that decreasing dietary crude protein level produced no negative effects on egg quality traits.

On the other hand, **Tollba and El-Nagar (2008)** found a significant increase in Haugh unit and shell thickness by increasing dietary protein level. Several authors found that decreasing amino acid (Lys or Met) intake significantly decreased albumen weight or percentage of albumen **(Prochaska *et al*., 1996; Shafer *et al*., 1998; Novak *et al.*, 2004).**

Results in Table (5) also showed significant ($P<0.05$) effect of strain on all egg quality traits studied, except on egg shape index and Haugh Unit score. Mamourah hens laid eggs of significantly (P≤0.05) the highest shell thickness, shell weight percentage and albumen weight percentage. Meanwhile, yolk index and yolk weight% were significantly (P<0.05) the highest for Sinai and Silver Montazah hens, respectively.

The present results are in line with those obtained by **Abd El-Ghani (1996),** who reported that hen strain had a significant effect on shell thickness, shell percentage, albumen percentage and yolk percentage.

Fertility and hatchability percentage:

Data of egg fertility and hatchability as well as weight of one-day old chicks presented in Table (6) revealed that, fertility percentage was significantly (P<0.05) reduced by decreasing nutrient density to 5 or 10% in the experimental diets to 93.27 and 88.00% as compared to the control diet (95.23%).However, it was insignificantly increased to 96.07 and 96.68% by increasing nutrient density to 5 or 10%, respectively. Hatchability percentage significantly (P<0.05) improved to 96.70% by increasing nutrient density to 10%, but decreased to 86.21% by decreasing nutrient density to 10% as compared to the control diet (94.41%).

On the other hand, only decreasing nutrient density to 10% significantly (P<0.05) reduced hatched chick weight to 30.83 g as compared to the control (32.29 g). However, decreasing nutrient density to 5% or increasing it to 5 or 10% did not affect chick weight at hatching value ranged between 31.18 and 32.85 g.

These results confirmed by **Gabreil *et al*. (2006)**, who reported that level of dietary protein significantly affected egg fertility and hatchability of hens. Also, **Jones *et al*. (1976)** found that hens fed the high-energy diet had significantly higher egg fertility than those fed the lower energy levels.

There was a significant (P≤0.05) effect of strain on egg fertility and hatchability (Table 6). Sinai and Gimmizah significantly (P<0.05) achieved superior means of fertility and hatchability percentage, while Mamourah and Silver Montazah hens had inferior means of egg fertility and hatchability. However, strain had no significant effect on chick weight at one day old. **Islam *et al*. (2002)** reported that breed had little effect on hatchability of fertile eggs. It was clear that chick weight as percent of egg weight was not just a function of egg weight, but also genotype played an important role favoring the heavier breeds.

Economic efficiency:

Results given in Table (7) showed that increasing nutrient density to 5% more than the control (diet 3) showed the highest economic efficiency (43.9%), followed by those of birds fed the control +10% nutrient density (43.3%) as compared to the control diet (41.6%). Additionally, Sinai hens showed the best economic efficiency as compared to the other hen strains.

In conclusion, from stand point of economic view, feeding diet of nutrient density 5% higher than the recommendations of local laying hens is more applicable in order to optimize their productive and reproductive performance and/or egg quality. Sinai hens were more adapted strain under the experimental conditions of this study.

Table (1): Composition and chemical analysis of the basal diets.

Ingredient (%)	**Diet 1 (-10%)**	**Diet 2 (-5%)**	**Diet 3 (control)**	**Diet 4 (+5%)**	**Diet 5 (+10%)**
Yellow corn	56.00	60.00	64.00	62.00	57.31
Soybean (44%)	17.25	22.00	26.00	23.00	19.00
Wheat bran	18.00	8.78	00.00	00.00	00.00
Gluten (60%)	00.00	00.00	00.00	3.50	8.00
Vegetable oil	00.00	00.00	00.20	1.00	4.30
Limestone	7.50	7.70	8.00	8.39	9.00
Di-calcium phosphate	0.5	0.82	1.13	1.30	1.40
Nacl	0.30	0.30	0.30	0.30	0.30
Premix*	0.30	0.30	0.30	0.30	0.30
Lysine	0.10	0.05	0.00	0.14	0.30
Methionine	0.05	0.05	0 .07	0.07	0.09
Total	100	100	100	100	100
Calculated chemical composition (%):					
Crude protein	14.70	15.60	16.40	17.30	18.10
Crude fiber	4.52	3.9.0	3.36	3.17	2.86
Ether Extract	2.98	2.81	2.64	2.62	2.51
Ca	2.97	3.11	3.29	3.47	3.71
Available P	0.302	0.320	0.344	0.372	0.392
Lysine	0.618	0.875	0.914	0.961	0.999
Methionine	0.327	0.334	0.364	0.370	0.393
Methionine+cystine	0.584	0.605	0.693	0.686	0.720
Metabolizable energy					
ME (Kcal)	2500.36	2618.73	2743.00	2812.65	3031.30
Price of ton (LE)	1410	1460	1520	1550	1650

* Each kg premix contained the following: vit. A, 10000 IU; vit. D3, 2000 IU; vit. E, 10 mg; vit. K, 1 mg; vit. B1, 1 mg; vit. B2, 5 mg; vit. B6, 1.5 mg; vit. B12, 0.01 mg; folic acid, 0.35 mg; biotin, 0.05 mg; pantothenic acid, 10 mg; niacin, 30 mg; choline, 250 mg; Fe 30, mg; Manganese,60mg; Zn, 50 mg; Cu, 4 mg; I, 1 mg and Se, 0.1 mg.

Table (2): Effect of experimental diet and strain on live body weight of local laying hens

Factors	Initial body weight	Final body weigh	Change of body weight
Experimental diet:			
Control-10%	1391.75±17.71	1387.37±18.35c	-4.34±2.44e
Control-5%	1371.50±15.29	1380.60±16.07c	9.10±2.59d
Control	1390.12±18.62	1486.63±20.20b	96.51±2.08c
Control +5%	1369.87±18.45	1480.06±19.66b	110.18±1.93b
Control+10%	1407.12±15.74	1534.22±16.62a	127.10±1.49a
Hen strains:			
Sinai	1287.00±12.01c	1345.48±13.34c	58.48±5.11c
Silver Montazah	1351.60±11.93b	1417.88±14.36b	66.28±5.79a
Mamourah	1547.20±10.43a	1618.75±13.08a	71.55±6.42a
Gimmizah	1358.50±13.32b	1433.01±15.59a	74.51±5.74a

Means with different letters within the same column for each factor are significantly different at P<0.05.

Table (3): Effect of experimental diets and strains on the average daily feed intake, as fed (total) and as metabolizable energy (ME), CP, calcium (Ca), available phosphorus (Av. P), lysine and methionine.

Item	Average daily intake/hen						
	Total (g as fed)	ME (kcal)	CP (g)	Ca (g)	Av. P (g)	Lysine (g)	Meth. (g)
Experimental diet:							
Control-10%	119.96± 1.19a	299.90± 2.98c	17.66± 0.17c	0.356± 0.003e	0.036±0.0003e	0.097±0.0009c	0.039±0.0003c
Control -5%	118.78± 1.21a	310.98± 3.18b	18.64±0.10b	0.369± 0.004d	0.038±0.0004d	0.103±0.0010b	0.039 0.0004c
Control	115.07± 2.10b	315.65± 5.76b	18.88±0.34b	0.378± 0.006c	0.039±0.0007c	0.105±0.0019b	0.041±0.0007b
Control +5%	112.45± 1.56c	316.72± 4.51b	19.54± 0.27a	0.390± 0.005b	0.040±0.0005b	0.108±0.0015a	0.042±0.0005b
Control 10%	109.17± 1.71d	329.49± 5.18a	19.69± 0.31a	0.418± 0.006a	0.041± .0006a	0.109±0.0017a	0.043±0.0006a
Hen strains:							
Sinai	108.55± 1.80b	296.34±2.41b	17.98±0.19b	0.357± 0.004b	0.037± .0004b	0.098±0.0010b	0.038±0.0003b
Silver Montazah	117.25± 1.23a	320.61±4.16a	19.25± 0.31a	0.386± 0.006a	0.040± .0007a	0.107±0.0017a	0.042±0.0007a
Mamourah	116.86± 1.31a	319.52±4.13a	19.18± 0.29a	0.385± 0.006a	0.039± .0007a	0.106±0.0016a	0.041 0.0006a
Gimmizah	117.70± 1.45a	321.72±3.58a	19.31± 0.25a	0.388± 0.005a	0.040± .0006a	0.107±0.0013a	0.042±0.0005a

Means with different letters within the same column for each factor are significantly different at P<0.05.

Table (4): Effect of experimental diets and strains on the productivity of local laying hens.

Item	Egg characteristics				Feed conversion (g/g)
	Production (%/hen/day)	Egg number	Weight (g)	Mass (g/hen/d)	
Experimental diet:					
Control-10%	46.50± 1.72d	65.11± 2.41d	48.29± 0.34c	22.74± 0.73d	5.08± 0.11a
Control-5%	55.26± 1.56c	77.37± 2.18c	49.36± 0.40b	27.58± 0.64c	4.05± 0.16b
Control	59.32± 1.81b	83.05± 2.54b	51.49± 0.41a	30.91± 0.89b	3.64± 0.09c
Control +5%	61.83± 1.73ab	86.57± 2.42ab	51.84± 0.38a	32.43± 0.84a	3.46± 0.08cd
Control+10%	62.91± 1.99a	88.08± 2.79a	52.01± 0.38a	32.99± 0.83a	3.28± 0.09d
Hen strain:					
Sinai	62.94±2.18A	88.12± 3.06A	49.28± 0.50C	31.26± 1.33A	3.25± 0.21B
Silver Montazah	53.04±1.73C	74.26± 2.43C	50.84± 0.51B	27.53± 1.09B	4.03± 0.19A
Mamourah	53.23±2.30C	74.53± 3.22C	50.72± 0.47B	27.54± 1.38B	3.94± 0.22A
Gimmizah	59.46±2.11B	83.25± 2.96B	51.55± 0.64A	31.00± 1.43A	4.12± 0.25A

Means with different letters within the same column for each factor aresignificantly different at P<0.05

Table (5): Effect of experimental diets and strains on the egg quality of local laying hens.

Item	Shape index	Shell thickness (mm)	Shell weight (%)	Yolk index	Yolk weight (%)	Albumen weight (%)	Haugh Unit
Experimental diet:							
Control-10%	74.86± 0.52	34.79± 0.53	12.76± 0.15	38.79± 0.47c	31.46± 0.43	55.77± 0.42	89.94±0.55a
Control-5%	74.77± 0.46	35.60± 0.67	13.00± 0.14	40.98± 0.40b	31.89± 0.34	55.09± 0.38	87.98±0.72a
Control	75.59± 0.52	34.79± 0.45	13.20± 0.19	41.77± 0.41b	32.07± 0.40	54.72± 0.49	85.68±0.78b
Control +5%	75.41± 0.51	34.12± 0.54	12.95± 0.17	42.35± 0.40a	31.82± 0.40	55.21± 0.37	83.36±0.63c
Control+10%	74.96± 0.42	34.62± 0.63	12.95± 0.20	41.63± 0.42b	32.08± 0.27	54.96± 0.36	82.73±0.84c
Hen strain:							
Sinai	75.67±0.53	34.66± 0.48B	12.90± 0.12AB	41.86±0.54A	31.94± 031A	55.14± 0.34AB	85.50± 0.85
Silver Montazah	75.13±037	34.36± 0.45B	13.26± 0.17A	41.33±0.48AB	32.29± 0.37A	54.44± 0.39B	86.38± 0.91
Mamourah	75.23±0.39	36.11± 0.59A	13.13± 0.15A	40.27± 0.34B	30.93± 0..34B	55.92± 0.35A	86.05± 0.76
Gimmizah	74.44±0.41	34.00± 0.43B	12.59± 0.14 B	40.96±0.28AB	32.30± 0.32A	55.10± 0.34AB	85.83± 0.69

Means with different letters within the same column for each factor are significantly different at P<0.05

Table (6): Effect of experimental diets and strains on the reproductive performance of local laying hens.

Item	Fertility (%)	Hatchability (%)	Chick weight (g)
Experimental diet:			
Control-10%	88.00±1.35c	86.21±2.02d	30.83±0.31c
Control-5%	93.27±0.99b	93.31±0.84c	31.18±0.34bc
Control	95.23±0.54a	94.41±0.95bc	32.29±0.30ab
Control +5%	96.07±0.63a	95.90±0.81ab	32.52±0.38a
Control+10%	96.68±0.42a	96.70±0.57a	32.85±0.37a
Hen strain:			
Sinai	95.79±0.77A	95.75±0.78A	31.36±0.31
Silver Montazah	92.82±1.15B	90.88±1.94B	31.87±0.36
Mamourah	91.72±1.65B	91.59±1.81B	32.08±0.42
Gimmizah	95.09±0.90A	95.00±0.86A	32.42±0. 41

Means with different letters within the same column for each factor are significantly different at P<0.05.

Table (7): Economic efficiency of local laying hens as affected by experimental diet and strain.

	Experimental diet					Strain			
	D1 (-10%)	D2 (-5%)	D 3 (C)	D4 (+5%)	D5 (+10%)	S	SM	M	G
Total feed intake of hen(kg)	16.8	16.6	16.1	15.7	15.3	15.2	16.4	16.3	16.4
Price of feed cost	23.6	24.3	24.5	24.4	25.2	15.2	16.4	16.4	16.5
Number of egg/hen	66	78	84	87	89	88	74	75	83
Total Price of eggs/hen	33.0	39.0	42.0	43.5	44.5	44.0	37.0	37.5	41.5
Net return*	9.4	14.7	17.5	19.1	19.3	28.8	20.6	21.1	25.0
Economic efficiency (%)**	28.4	37.6	41.6	43.9	43.3	65.4	55.6	56.2	60.2

* Net return = Price of eggs/hen - Price of feed cost

** Economic efficiency = Net return / Price of feed cost

Price of feed was 1410, 1460, 1520, 1550 and 1650 L.E. /ton of diet 1, 2, 3, 4 and 5, respectively. and price of each egg was 0.5 L.E. according to marketing price 2008

REFERENCES

Abd El-Ghani. A. I. (1996). *Influence of body weight and strain on productive and reproductive performance of some new developed Egyptian chickens. Egypt. Poult. Sci., 16: 601-619.*

Bohnsack, C. R., R. H. Harms, W. D. Merkel, and G. B. Russell. (2002). *Performance of commercial layers when fed diets with four contents of corn oil or poultry fat. J. Appl. Poult. Res. 11:68–76.*

Bryant, M., G. Wu and D.A. Roland, Sr. (2005). *Optimizing dietary energy for profits and performance of two strains of White Leghorns. Page 23 in: International Poultry Scientific Forum Abstracts, Atlanta, GA, USA.*

Bunchasak, C., Poosuwan, K. and Nukraew, R. (2005). *Effect of dietary protein on egg production and immunity responses of laying hens during peak production period. Int. J. Poult. Sci., 4: 701-708.*

Campbell, G. L., R. E. Salmon, and Classen, H. L. (1988). *Effect of nutrient density on broiler carcass composition as influenced by age. Nutr. Rep. Int. 37:973–981*

Camps DM and Edghill E. Niveles (1999). *de proteina en dietas para ponedoras. Revista Cubana de Ciencia Avícola; 23(1):35-40.*

Duncan, D. (1955). *Multiple range and multiple F test Biometrics, 11:1-42.*

El Alaily, H.A.; M.M. Fathi; SH.F.EL Afifi and M.M. ELSied (2003). *Effect of different dietary energy and protein levels on prodution performance of Hy-Line W36 layers in Egypt at first stage of production. J. Agric. Sci. Mansoura Univ., 28:2633-2642.*

El-Sayed A. Nadia; R.E. Rizk; M. Bahie El-Deen and M. Hedaia (2001). *Effect of strain and dietary regimen on the performance of local chickens. Egypt. Poultry Sci., 21:1021-1038.*

Essa, E. E. M.; Assaf, I. M. M.; Khashaba, B. M. and El-Koteat, A. H. A.(2003). *Optimum dietary energy and protein requirements of local Inshas chicken strain during the growing period. Egypt. Poult. Sci. 23: 541-556*

Gabreil M. Babatunde, Babatunde and Fetuga, L. (2006). *Effects of different dietary oils superimposed on different dietary protein levels on the laying performance, egg weights, fertility and hatchability in the tropical environment Journal of the Science of Food and Agriculture 27 , 54 – 62.*

Hens, Strain, Nutrient Density, Weight, Egg Production, Reproduction.

Harms, R.H.; G.B. Russell and D.R. Sloan (2000). *Performance of four strains of commercial layers with major changes in dietary energy. Journal of Applied Poultry Research, 9:535-541.*

Hassan, G.M; M. Farghaly; F.N.K. Soliman and H.A. Hussain (2000). *The influence of strain and dietary protein level on egg production traits for different local chicken strains. Egypt Poultry Sci. 20:49-63.*

Islam, M. S., M. A. R. Howlider, F. Kabir and Alam, J. (2002). *Comparative Assessment of Fertility and Hatchability of Barred Plymouth Rock, White Leghorn, Rhode Island Red and White Rock Hen. International Journal of Poultry Science 1:85-90.*

Jalal, M. A., S.E. Scheideler, and D. Marx. (2006). *Effect of bird cage space and dietary metabolizable energy level on production parameters in laying hens. Poult. Sci. 85:306–311.*

Jones, J,E., Cooper, J.B.and Barnett, B.D. (1976). *The effect of protein and dietary energy levels and housing regime on production and reproduction parameters of turkey hens. Poult Sci.; 55:549-53.*

Jones, R. L., and Wiseman, J. (1985*).* *Effect of nutrition on broiler carcass composition: Influence of dietary energy content in the starter and finisher phases. Br. Poult. Sci. 26:381–388..*

Keshavarz K, Jackson ME. (1992). *Performance of growing pullets and laying hens fed low-protein, amino acid supplemented diets. Poultry Science; 71(5):905-918.*

Keshavarz, K. (1995). *Further investigations on the effect of dietary manipulations of nutrients on early egg weight. Poult. Sci. 74:62–74.*

Liu, Z., G. Wu, M.M. Bryant and D.A. Roland, Sr.,(2005). *Influence of added synthetic lysine in low-protein diets with the methionine plus cysteine to lysine ratio maintained at 0.75. J. Appl. Poult. Res., 14:174-182.*

National Research Council, (N.R.C, 1994). *Nutrient Requirements of Poultry .9th revised ed. National Academy Press., Washington, D.C.,USA.*

Nielsen, B. L. (2004). *Behavioural aspects of feeding constraints: Do broilers follow their gut feelings? Appl. Anim. Behav. Sci. 86:251–260.*

Novak, C., H. Yakout, and S. Scheideler. (2004). *The combined effects of dietary lysine and total sulfur amino acid level on egg production* *parameters and egg components in Dekalb Delta laying hens. Poult. Sci. 83:977–984.*

Pell A.S and RW Polkinghorne (1986). Effect of dietary nutrient concentration on the performance of hens beginning lay in early summer Australian Journal of Experimental Agriculture 26(4) 405 – 411.

Plavnik, I., E. Wax, D. Sklan, I. Bartov, and Hurwitz,S. (1997). *The response of broiler chickens and turkey poults to dietary energy supplied either by fat or carbohydrates. Poult. Sci. 76:1000–1005.*

Prochaska, J. F., J. B. Carey, and D. J. Shafer. (1996). *The effect of L-lysine intake on egg component yield and composition in laying hens. Poult. Sci. 75:1268–1277.*

Sailer, K. (1985). *Nutzung Kompensaterischer wachstum effekte beiderprodukion schwerer Mastbroiler. Ph. D. Thesis, Hohenheim Univ., Germany.*

Scott, T. A. (2002). *Evaluation of lighting programs, diet density, and short-term use of mash as compared to crumbled starter to reduce incidence of sudden death syndrome in broiler chicks to 35 days of age. Can. J. Anim. Sci. 82:375–383.*

Shafer, D. J., J. B. Carey, J. F. Prochaska, and A. R. Sams. (1998). *Dietary methionine intake effects on egg component yield, composition, functionality and texture profile analysis. Poult. Sci. 77:1056 -1062.*

Sohail, S. S., M. M. Bryant, and D. A. Roland Sr. (2003). *Influence of dietary fat on economic returns of commercial Leghorns. J. Appl. Poult. Res. 12:356–361.*

SPSS (1997). *SPSS user's guide statistics Version 10. Copyright SPSS Inc., USA.*

Tollba A. A. H. and A. H. I. El-Nagar (2008). *Increasing stocking density of Egyptian laying hens by using: 3 – Increasing protein level Betaine supplementation Egypt. Poult. Sci. (28): (745-766)*

Valkonen E., E. Venäläinen, L. Rossow and J. Valaja (2008). *Effects of dietary Energy Content on the Performance of Laying Hens in Furnished and Conventional Cages Poult Sci. 87:844-852.*

Wu, G., M. M. Bryant, and D. A. Roland, Sr. (2005a). *Influences of dietary energy and protein levels on performance of Hyline W-36 hens in phase I. Poult. Sci. 84:50. (Abstr.)*

Hens, Strain, Nutrient Density, Weight, Egg Production, Reproduction.

Wu, G., M. M. Bryant, Gunawardana,and D. A. Roland, Sr. (2007). *Effect of Nutrient Density on Performance, Egg Components, Egg Solids, Egg Quality, and Profits in Eight Commercial*

Wu, G., M.M. Bryant, R.A. Voitle, and D.A. Roland Sr. (2005b). *Effect of dietary energy on performance and egg composition of Bovans White and Dekalb White hens during phase 1. Poult. Sci. 84:1610–1615.*

Zanaty, G.A.; Rady, A.S.; Abou-Ashour, A.M. and Abdou, F.H. (2001). *Productive performance of Norfa chickens as affected by dietary protein level, brooding system and season. Egypt. Poult. Sci. 21: 237-254*

الملخص العربي

تاثير الكثافة الغذائية على الآداء الإنتاجى والتناسلى فى بعض سلالات انتاج البيض المحلية

د. يحيى عزيز مرعى - د. محمد عبدالباقى ابراهيم – د. مضان مغاورى محمود-

د. حمدى عبد العزيز محمد أبو خشبة

معهد بحوث الانتاج الحيوانى- مركز البحوث الزراعية- الجيزة – مصر.

أجريت هذه الدراسة لتقدير الأداء الإنتاجي والتناسلي لأربعة من سلالات إنتاج البيض المحلية (سينا – منتزه فضي - معمورة – الجميزة) يتم تغذيتها على علائق تختلف في محتواها من كثافة العناصر الغذائية وتتم التغذية حتى الشبع على علائق تحتوى على خمس مستويات غذائية مختلفة من عمر24 الى44 أسبوع من العمر وزعت عشوائيا إلي 5 مجموعات وغذيت علي العلائق التجريبية التي تختلف في محتواها من كثافة العناصر الغذائية، العليقة رقم 3 (كنترول) تحتوي (2743 طاقة ممثلة، 16.4 بروتين خام، 3.29% كالسيوم، 0.344% فسفور متاح، 0.914 % ليسين ، 0.346% مثيونين، و 0.639% مثيونين + سيستين). العليقة رقم 1 و 2 تنخفض في محتواها من العناصر الغذائية بمقدار 10 و5% علي الترتيب. العليقة رقم4 و5 ترتفع في محتواها من العناصر الغذائية بمقدار 5 و10% علي الترتيب وكل الطيور تتعرض لظروف جوية متشابهة.

اظهرت النتائج مايلى: العلائق التى ينخفض محتواها بنسبة 5 و 10 % من عليقة الكنترول قللت معنويا وزن الجسم بينما لم يتاثر وزن الجسم معنويا مع العلائق التى تزيد بنفس النسب مقارنة بعليقة الكنترول.بتقليل الكثافة الغذائية معنويا للغذاء المتناول وتقل العناصر الغذائية المتناولة والعكس مع زيادة الكثافة الغذائية .انتاج البيض وعدد البيض ووزن البيض وكتلة البيض وكذلك معدل التحويل الغذائى ودليل الصفار ووحدة هاو تتحسن معنويا بزيادة الكثافة الغذائية.

ترتفع نسبة الخصوبة ونسبة الفقس معنويا بزيادة الكثافة الغذائية ويلاحظ العكس تماما مع انخفاض. الكثافة الغذائية.

كان للسلالة تاثيرا معنويا على كلا من ون االجسم الحي والغذاء المتناول والعناصر الغذائية المتناولة و معدل التحويل الغذائى و انتاج البيض وعدد البض ووزن البيض وكتلة البيض

ودليل كل البيضة ووحدة هاو وكذلك تؤثر السلالات معنويا على نسبة الخصوبة ونسبة الفقس . وهذة التاثير اعلى مع سلالتي سيناء والجميزة.

الخلاصة ان مستوى 5% زيادة من الكنترول في العليقة كان احسن اقتصاديا وانتاجيا وكذلك سلالة سينا كانت الأفضل من كل السلالات.

Hens, Strain, Nutrient Density, Weight, Egg Production, Reproduction.