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Studies of some Nutritional and Managerial requirements for laying hens

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LAYERS of Fayoumi (F) and White Leghorn (L) in their pullet year totaled 280, cage and floor housing, and five dietary protein levels of 17.3, 18.9, 20.2, 21.3 and 23.1% crude protein (CP) were used in this study. It was intended to study the effect of breed, housing system and dietary protein level on the laying performance. Statistical analyses on factorial design basis were practised. Egg number, egg weight, live weight at sexual maturity and at end of laying, efficiency of feed utilization and net return were discussed.

The F layer produced 13.3% and 15.1% more egg number and egg weight, respectively, than the L layer. At sexual maturity and at the end of laying the L layer was significantly heavier in live weight than the F one. There was significant interaction effect on live weight at sexull maturity between breeds and diet. The F layer was of lower mortality than the L one. The F layer was more efficient either in feed intake or in feed conversion.

The cage layers produced more eggs of heavier weight than the floor layers, however, the difference in the former traits and in live weight either at sexual maturity or at the end of laying was not significant. The annual mortality rate in cage laying system was 23.5% higher than in floor system.

Dietary protein level of 17% was of favourable effect on egg production, live weight during laying,mortality rate, feed conversion protein and energy efficiency and as a conclusion resulted in the best net return in comparison with the other levels of protein.

Choosing a breed for egg production is not an independent process from the favourable nurient requirements or the housing problem for such a breed,

It was intended to investigate the laying performance and feed efficiency of the Fayoumi, and the White Leghorn layers under floor and cage housing system on five rations differed in dietary protein level. It may be profitable to find out the efficient breed managed under the favourable housing system and the proper laying ration in Egypt based mainly on local available concentrates and by-products.

Material and Methods

The birds used in this study included 280 females and 24 males from each of the Fayoumi and White Leghorn breeds. The experimental birds were hatched during April, reared and treated under the same environmental and managerial conditions. The birds in each breed were divided into floor and cage groups. Each group was divided into five subgroups. The subgroups were fed rations of different crude protein level. The five experimental rations of 17·3, 18·9, 20.2, 21·3 and 23·1% crude protein were provided to the *1st*, *2nd*, *3rd*, *4th* and *5th* subgroups, respectively. Each subgroup was divided into two replicates, each of 13 hens and one cock.

The five mash rations were formulated and processed from the prevailing local ingredients and were almost isocaloric but differed in crude protein level.

The formula and feeding value of the used rations are presented in Table1.

The birds were kept in individual cages of 38x30x30 cm. or in pens of 1·0x2·52x2·90 m. Waterers and feeding troughs were provided. The food was provided *ad. lib*. The lighting program was similar for all treatments as daily natural light. The floor houses were provided with trapnests. All the birds were wing banded.

Live weight (Kg.) at sexual maturity and at the end of laying, egg number, egg weight (g) were reccorded on individual basis throughout the pullet year. Annual mortality rate was recorded. Feed intake and feed efficiency, energy and protein intake and efficiency per hen were also calculated. The economical efficiency and the net return were comparable between the five experimental rations.

This work was conducted on factorial design basis (2 breeds x 2housing system x 5 rations). The statistical analysis was performed after Snedecor (1959).

Results and Discussion

1-*Effect of breed of laying performance*

Results shown in Table 2 illustrated the effect of breed on the performance of the studied traits. The F layer surpassed the L in egg yield. The difference in egg number and egg weiht between the two breeds was as much as 13·3% and 15·1%, respectively. The difference between the two breeds in egg number was, statistically, significant, while this difference was highly significant in egg weight.

It is noteworthy that a local breed such as the F was more efficient in egg production than the L as it was indicated in this study. However, the superiority of F layer may be due to its adaptation to the local managerial conditions as its susceptability may be less than the L layer. It may be suggested that trials should be practised on F layers to improve their laying capacity as their response for better laying performance may be more reliable than the L layers under the local environmental conditions in Egypt as a subtropic zone.

TABLE 1. **Composition and proximate analysis of texperimental rations. (Calculated aftes Abou Raya, 1967 and Abou Raya and Galal, 1971),**

Ingredients	**Rations**				
	1	2	3	4	5
	%	%	%	%	%
Ground barley	10.5	10.5	10.0	7.5	8.0
Ground yellow corn	30.0	30.0	30.0	23.0	18.0
Wheat bran (fine)	20.0	23.0	22.0	22.0	26.0
Rice bran	15.0	8.0	5.0	10.0	7.0
Cotton seed meal (Dect.-41 %CP)	17.5	21.5	26.0	30.5	34.0
Fish meal (56 % CP).	3.0	3.0	3.0	3.0	3.0
Limestone	1.5	1.5	1.5	1.5	1.5
Bone meal	1.5	1.5	1.5	1.5	1.5
Salt	0.5	0.5	0.5	0.5	0.5
Vitamin premix	0.1	0.1	0.1	0.1	0.1
Mineral salt	0.4	0.4	0.4	0.4	0.4
	100.0	100.0	100.0	100.0	100.0
Calculated feeding value :					
CP%	17.3	18.8	20.2	21.3	23.1
DP%	13.8	14.6	15.7	16.9	17.9
CF%	7.1	7.0	7.6	7.9	7.7
ME Kcal-Kg	2475	2459	2473	2415	2355
C/P ratio	143.1	130:1	123:1	118.1	102:1
TDN%	58.9	58.5	58.8	57.5	56.0

At sexual maturity the L layer was significantly (<0.01) heavier in live weight than the F one (Table 2). Although the two studied breeds are considered light breeds, it seems that the L pullet is heavier than the F one at this age.

age. The results indicated a significant interaction effect on live weight at sexual maturity between breeds and diet (Table2). Duncan Multiple Range Test (D·M·R·T·) demonstrated that R_1 gave a highly significant difference in F live weight if it was compared to R_4 for the same breed (Table 3). The L pullet with all the five experimental rations was heavier in body weight when it was compared to F pullet on R_5 .

TABLE 2. **Effect of breed and housing system on different studied traits.**

	Breed			Housing system		
	Fayoumi	W.Leg h-orn	Signi-ficance	Floor	Cage	Signi-fican ce
Egg no./hen/year	119.000	105.000	*	106.700	114.100	N.S.
Egg wt./hen/year (Kg)	5.692	4.947	**	5.163	5.475	N.S.
Live wt. at sex. mat. (g)	1132.600	1191.300	**	1158.700	1163.300	N.S.
Live wt. at end of laying (g)	1422.200	1419.400	**	1447.500	1440.100	N.S.
Annual mortality rate (%)	17.700	27.300		19.600	24.200	
Feed intake/hen/year (Kg)	40.671	44.610		42.385	43.225	
Feed conversion (feed in Kg/ Kg eggs)	7.161	8.969		8.209	7.895	
Feed efficiency (Eggs in Kg/Kg feed	0.141	0.111		0.122	0.127	

* Sig. (≤0.05) ** Sig. (≤0.01) N.S. Not significant

TABLE 3. **Interaction effect on live weight at sexual maturity between breed and diet (Fayoumi F, Leghorn L, Rations R).**

Items	Live weight of breeds at different dietary levels (g)	DMRT*
FR_1	1229	a
LR_4	1206	ab
LR_2	1200	ab
LR_5	1196	ab
LR_3	1186	ab
LR_1	1167	ab
FR_2	1155	ab
FR_3	1127	ab
FR_5	1101	bc
FR_4	1050	b

* Duncan multiple range test. The appearance of the same letters with 2 means significance that they do not differ significantly ($P_{\alpha} < 0.05$), otherwise they do.

It could be concluded that the F pullet might require 17.3% CP to attain the heaviest weight at sexual maturity, while the L pullet needed a ration of 21.3% CP for this respect.

The difference in body weight at the end of the laying between the two breeds was statistically, highly significant (Table 2). Although the contradiction between body weight and egg number, the F hen laid more eggs than the L one at similar live weight.

The results in Table 2 indicated that the F hen proved itself in viability as it was of lower mortality rate than the L under the environmental conditions of this study. The annual mortality was 17.7% for F and 27.3% for the L groups being 54.2% higher. Such high mortality rate in the latter should be considered from the economical point of view if it was compared to the former breed. With each 100 starting birds, 9.6 birds were saved from mortality with F, i.e., about one tenth of the experimental birds.

The F layer was more efficient either in feed intake or feed conversion in (Table 2). The difference in feed intake between the two layers was 9.7% and much as 25.26% in feed efficiency. It is worth noting that from the economical point, the F layer showed similar body weight at the end of laying, more egg yield, less mortality and furthermore consumed less feed.

II- *Effect of floor and cage laying.*

Results obtained in Table 4 showed the effect of laying system on the performance of the studied traits. The cage layers produced more eggs of heavier weight than floor layers by 6.9% and 6%, respectively, however this difference was statistically, not significant. Body weight, either at sexual maturity or at end of laying showed no significant difference between the two laying system, which was in agreement by the findings of Oluyemi and Roberts (1975).

The annual mortality rate in cage laying system was 23.5% higher than in floor system. This may emphasize that the cage laying system is not favourable for layers under the prevailing climatic conditions in Egypt. Adams and Jackson (1970) stated that lowest egg production and highest mortality were from the large cage-high density combination.

Although the layers consumed 2% higher amounts of feed in cage laying they were 4% more efficient than in floor system. Dawan Sugandi *et al.*, (1975) found that egg production and feed conversion were significantly better in floor pens than in cages.

111-*Effect of dietary protein level on the studied traits*

Results shown in Table 5 demonstrated the effect of dietary protein level on the performance of the studied traits. The experimental layers produced significantly more eggs of heavier weight on rations of 17.3% and 18.9% CP, meanwhile the other birds produced less number of lighter weight on rations of dietary protein more than the former levels. These results were in agreement with those obtained by Dawan Sugandi *et al.* (1975) and Oluyemi and Roberts (1975). However, John and John (1962) and Smith (1967) stated that the egg weight increased as a result of increasing the protein level in the diet. The worst egg yield was produced from groups fed the ration of 23·1% CP· $Ration_1$ of 17·3% produced 46·4% more eggs and 50·2% egg weight than R_5 of 23·1% CP, respectively. Increase in dietary protein level than 19% may $impair_5$ the laying performance. It is still questionable, however, whether lower CP % would improve more egg production. Owings (1964) found that 13-14% protein level was adequate for egg production but not for egg weight.

Table 4. **Effect of dietary protein level on different studied traits.**

Traits	Rations no.					Sig	L.S.D (> 0.01)
	1	2	3	4	5		
Annual egg number/hen	126.500	126.200	114.600	103.100	86.400	**	4.50
Annual egg wt. (kg)/hen	6.191	6.116	5.272	4.898	4.120	**	4.10
Live wt. at sexual maturity (g)	1173.100	1177.700	1156.900	1128.200	1148.900	**	6.36
Live wt. at end of laying (g)	1515.100	1472.000	1466.500	1404.800	1353.200	**	15.58
Annual mortality rate (%)	15.400	20.200	28.900	27.000	22.100		
Annual feed intake (Kg)/hen	41.151	40.319	40.509	39.678	36.998		
Feed conversion (Feed in Kg Kg eggs).	6.47	6.623	7.684	8.101	8.980		
Feed efficiency (Eggs in Kg Kg feed	0.151	0.151	0.130	0.123	0.111		

** Highly significant.

The final live weiht was affected by the experimental rations than at sexual maturity. It could be observed that increasing the dietary protein level than 17-19% may induce lighter live weight and hence may produce lower egg production However, Lee *et al.*, (1976) pointed out that during the laying period pullets fed on high protein diet were significantly heavier than those fed on lower protein diet.

The lower the protein level in the ration, the lower was the mortality rate between laying groups except with R_5. The higher mortality rate in groups of R_3 and R_4 than that fed R_5 might be due to another reason rather than the dietary protein level. However, it could be concluded that increasing the dietary protein in the ration more than 17% seemed to induce higher mortality and consequently might be harmful for layers.

IV-Efficiency of feed utilization and net return

The birds fed rations of lowest protein (17%) consumed higher feed than those fed on highest dietary protein level (23%) by as much as 11%. However, on the contrary the groups fed on lower protein were 35% more efficient than those fed on higher dietary protein level (Table 5). It might be clear, that increasing CP level was associated with self-feed restriction by the birds, resulting in a higher rate of reducing efficiency of feed utilization than corresponding rate of decrease in feed intake. When considering CP intake/hen/year, it was lower with R_1 then increasing as CP% increases being 7·81 in R_1 and 8·51 in R_5. The efficiency of protein utilization was as much higher with lower protein level being 0·99 kg eggs/kg CP intake with R_1 decreasing down to almost one-half with R_5(0·48 Kg eggs/kg CP intake). It seems that the association of decreasing feed intake along with increasing CP intake as we started from R_1 up to R_5 is very effective in decreasing egg production progressively resulting in a descending decrease in feed efficiency, and more *serious* descending decrease in protein utilization . It could be observed therefore that laying ration of 17% CP was 35% more efficient than that of 23% CP and consequently the former should be recommended than the latter for laying hens.

TABLE 5. **Energy and protein intake and efficiency, economic efficiency % and net return % of the experimentsl rations during the whole experimental period.**

	Rations no.				
	1	2	3	4	5
Annual feed intake, Kg/hen	41.151	40.319	40.509	39.678	36.998
Feed intake, g/hen/day	112.700	110.500	111.000	108.700	101.400
Feed efficiency :					
Feed efficiency (eggs in Kg/Kg feed) 1	0.150	0.151	0.130	0.123	0.111
Feed conversion (Kg feed/ 1 Kg eggs)	6.647	6.623	7.684	8.101	8.980
Energy intake (ME Kcal/Kg)	278.900	271.700	274.500	262.500	238.800
Protein intake, g	19.500	20.800	22.400	23.100	23.400
Efficiency of ME, Kg eggs/Meal.	0.061	0.061	0.053	0.051	0.047
Efficiency of CP, Kg eggs/Kg CP	0.865	0.801	0.645	0.581	0.482
Selling price of eggs/hen/mills	3962.000	3914.000	3374.000	3134.000	2637.000
Selling price of feed/hen/mills	2359.000	2409.000	2822.000	2771.000	3071.000
Net return/hen/mills	1603.000	1505.000	552.000	363.000	—434.000
Economic efficiency %	167.000	162.000	120.000	110.000	87.000
Net return %	67.000	62.000	20.000	10.000	—13.000

The efficiency values for ME and CP were more or less similar in the first and second groups then decreased gradually in the *3rd.*, *4th* and *5th* experimental groups, respectively. These results indicated the same conclusions attained by Selim *et al.* (1974)on broilers which may emphasize that units of ME and CP intakes in the diet seemed to produce comparatively equal egg yield irrespective to their amount in the diet.

The economic efficiency% was the highest with R_1 decreasing from 167 down to 87% in R_5. The corresponding net return% was 67 descending down to 13 with R_5 (Table 5). This was when considering each bird. If the whole group of birds are considered, the higher mortality rate in any ration would result in higher decrease in econmic efficiency of the groups, as well as higher decrease in net return%.

In commercial laying hens, the mortality of layers would also reduce return from selling hens after the laying year. A reduction of the net profit of the hen would be also comming from the cost of feeding the growers the whole productive life (say 500 days) would relatively increase by increasing morality-at any of the productive life.

The net return per hen (difference between the selling price and feed cost) in Table 5 indicated that R_1 of 17% CP was, prominently, the most efficient one while that of the highest protein level (23% CP) was not only the worst on the performance of laying but, also, of minus return compared to the feed costs. It may be concluded that the optimum and economic ration for layers might be that of 17% CP level.

References

Abou-Raya, A.K. (1967) *"Animal and Poultry Nutrition"*, Dar Elmearif Press (Arabic Textbook).

Abou-Raya, A.K. and **Galal, A.G.H.** (1971) Evaluation of poultry feeds in digestion trials with reference to some factors involved. *U.A.R., J. Anim. Prod.* 11, 207.

Adams, A.W. and **Jackson, M.E.** (1970) Effect of cage size and bird density on performance of six commercial strains of layers. *Poult. Sci.* 49, 1712.

Dawan Sugandi, Bird, H.R. and **Didiatmadilage** (1975) The effect of different energy and protein levels on the performance of laying hens in floor pens and cages in the tropics. *Poult. Sci.* 54, 1107.

John, H.Q. and **John, W.B.** (1962) Effects of dietary protein and changes in energy levels on the laying house performance of egg production stocks. *Poult. Sci.* 41, 717.

Lee, D.F.W., Blair, R. and **Teague, P.W.** (1976) The effects on rearing and subsequent laying performance of rearer diets containing two levels of protein and dried Br. *Poult. Sci.* 17, 261.

Oluyemi, J.A. and **Yomi, O. Roberts** (1975) The cage versus the deep litter system for the management of layers in the humid tropics. *Poult. Sci.* 54, 1982.

Owings, J.W. (1964) The effects of lowering dietary protein levels of laying hens during the production period. *Poult. Sci.* 43, 831.

Selim, A.D., Abdel-Salam, F.E., Aboul-Seoud, A.A., Abou Raya, A.K. and **Ghany, M.A.,** (1974) The effect of variable dietary energy and protein with holding the caloric protein ratio on growing chicks. *Egypt. J. Anim. Prod.* 14, 1, 41.

Smith, R.E. (1967) The utilization of poultry diets containing high, low and intermediate levels of protein of esential amino acids pattern. *Poult. Sci.* 46, 730.

Snedecor, G.W. (1959) *"Statistical Methods"* Iowa State College Press, Ames,, Iowa, U.S.A.

دراسات على بعض الاحتياجات الغذائية والرعائية للدجاج البياض

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استخدم فى هذه الدراسة ٢٨٠ دجاجة بياضة من نوعى الفيومى واللجهورن الأبيض فى عمر السنة الانتاجية الأولى تحت نظامى المسكن الأرضى ولأقفاص والتغذية على ٥ علائق تمثل خمس مستويات مختلفة من البروتين الخام : ١٧ر٣ ، ١٨ر٩ ، ٢٠ر٢ ، ٢١ر٣ و ٢٣ر١٪ فى الخمسة علائق المذكورة ، على التوالى .

وكان الهدف من البحث دراسة تأثير النوع ، ونظام المسكن ومستوى البروتين الغذائى فى العليقة على مظهر صفات انتاج البيض المدجاجة فى سنتها الانتاجية الأولى حيث اتبع نظام التصميم المتعدد العوامل من الناحية الاحصائية لدراسة صفات عدد البيض ووزنه ، ووزن الجسم عند النضج الجنسى ونهاية وضع البيض ، كفاءة التحويل الغذائى وصافى الربح .

وضعت الدجاجة الفيومى بيضا أكثر بنسبة ١٣ر٣٪ وأثقل وزنا بنسبة ١ر١٥٪ من الدجاجة اللجهورن . وكانت الدجاجة اللجهورن أثقل وزنا عند النضج الجنسى وفى نهاية فترة وضع البيض عن الدجاجة الفيومى كما ثبت وجود تداخل معنوى فى صفة وزن الجسم عند النضج الجنسى بين كل من النوع والعليقة . وكانت نسبة النافق من الدجاج الفيومى أقل من نسبتها فى الدجاج اللجهورن كما كانت الدجاجة الفيومى أكفأ فى معامل التحويل الغذائى الى بيض من الدجاجة اللجهورن .

أنتج الدجاج بيضا أكثر وأثقل وزنا نسبيا تحت نظام المسكن الأرضى بالمقارنة بنظام الأقفاص ومع ذلك فقد كان الفرق بين نظامى المسكن فى هذين الصفتين وصفتى الوزن عند النضج الجنسى وعند نهاية فترة الوضع غير معنوى احصائيا . الا أن النافق تحت نظام الاقفاص كان أعلى بنسبة ٥ر٢٣٪ عن النظام الأرضى .

أثبتت الدراسة أن التغذية على عليقة بها ١٧٪ بروتين خام فقط كان له تأثير أفضل على انتاج البيض ووزن الجسم عند النضج الجنسى ونهاية فترة الوضع ، نسبة النافق ، ومعامل التحويل الغذائى الكفاءة التحويلية للبروتين والطاقة وبالتالى كان ذا عائد أفضل بالمقارنة بمستويات البروتين الأعلى المستخدمة فى هذه الدراسة .