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EFFECT OF CRUDE FIBER LEVELS IN THE RATION OF LAYING HENS ON THEIR EGG PRODUCTION

By

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This experiment included 240 Baladi White (BW) and 240 Rhode Island Red (RIR) hens. Hens of each breed were divided into 4 groups containing 60 pullets each, equal in their average egg production and body weight. This experiment lasted for 52 weeks. The experimental rations fed to the BW hens had 4, 7, 12 and 17% crude fiber (CF). The levels of CF in the RIR rations were: 4,9, 12.5 and 16%. Rations given to each breed were nearly iso-nitrogenous and iso-caloric. Feed and water were offered *ad libitum*.

This experiment was undertaken to study the effect of crude fiber level on the egg production of BW and RIR layers and to determine the maximum level beyond which egg production is affected.

Results of this investigation can be summarized as follows:

The BW pullets can tolerate up to 7.0% CF in their rations without affecting egg production. Hens of the RIR were observed to tolerate up to 9.0% CF in their rations with no apparent effect on egg production. However, raising the CF level to 12–12.5% resulted in marked decrease in the number of eggs produced from BW or RIR layers.

The kilograms of SE required to produce 1.0 kg. eggs was calculated to denote the efficiency of converting feed energy into eggs. In the RIR layers it was found that up to 9% CF did not effect the efficiency of feed conversion. However, feeding BW layers a ration containing 7% CF resulted in moderate reduction in efficiency of feed conversion.

The average egg weight showed no difference due to the level of CF in the rations of layers.

Literature on the effect of crude fiber on egg production is limited. Morris *et al.* (1932), reported that the amount of fiber in a chick ration could be increased to as much as 8 to 9% of the ration without harmful effect on feed consumption, age of maturity and egg production. Heuser (1945); and Bird and Whitson (1946), reported that fibrous feed did not affect the rate of egg production. Furthermore, lillie *et al.* (1951), found that adding oat hull cellulose in a diet even at a level of as high as 64% did not reduce the rate of egg production but did actually decrease feed utilization.

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Although there may be some recommendations on the best crude fiber levels in the rations for layers in the U.A.R. (Abou-Raya, 1967), yet these were not based on actual experiments devoted to study the suitable fiber level alone. This research was undertaken to study the effect of crude fiber levels, apart from SE, on the egg production of (BW) and RIR layers.

Material and Methods

Pullets of BW and RIR breeds used in this experiment were beginning their first laying season. Pullets of each breed were divided into 4 experimental groups containing 60 birds each, equal in their average monthly egg production and body weight. This experiment lasted for 52 weeks. Eggs were collected every hour and the total weight and number was recorded every day for each group. Pullets were weighed at the beginning of the experiment and at monthly intervals. Feed and water were offered *ad libitum*.

Table 1 shows the composition of the experimental rations. Rations 1-4 fed to BW hens had 14.58 — 15.08% crude protein and 63.45 — 64.90 S.E. The CF level in these rations was : 4.24, 7.12, 11.96 and 16.84% for rations fed to group 1, 2, 3 and 4 respectively. These levels will be referred to in the text as 4, 7, 12 and 17% respectively. Rations 5—8 fed to RIR hens had 17.80 — 18.30% crude protein and 66.90 to 68.37 SE The CF level in these rations was : 4.34, 8.87, 12.55 and 16.29% for rations fed to group 5, 6, 7 and 8 respectively. These fiber levels will be referred to in the text as 4, 9, 12.5 and 16% respectively. Sawdust was used to raise the level of crude fiber while cotton seed oil was added to keep the rations iso-caloric as possible (Table 1). Thus it can be seen that the rations offered to each breed although contained graded levels of CF but were nearly iso-nitrogenous and iso-caloric.

Results and Discussion

Average Body Weight of Pullet :

It can be seen from Table 2 that BW pullets maintained their average body weight during the experimental period as evidenced by comparing their initial and final average body weight. However, RIR pullets of groups 5 and 6 gained 310 and 382 g. respectively. The other two groups of the RIR showed no significant body weight change during the experimental duration.

TABLE 1.—Composition of the Experimental Rations

Breed	Baladi White				Rhode Island Red			
Ration No.	1	2	3	4	5	6	7	8
	%	%	%	%	%	%	%	%
Corn	47.8	49.8	44.8	34.8	46.8	47.8	42.3	30.8
Wheat bran	30.0	27.0	20.0	13.0	15.0	5.0	—	—
Horse beans	—	—	—	—	10.0	13.0	14.0	15.0
Decorticated cotton seed meal	15.0	12.0	15.0	19.0	19.0	19.0	20.0	21.0
Dried skimmilk	5.0	5.0	5.0	5.0	7.0	7.0	7.0	7.0
Cotton seed oil	—	—	2.5	6.0	—	—	2.5	6.0
Sawdust	—	4.0	10.5	20.0	—	6.0	12.0	18.0
Ca CO_3	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Na Cl	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Vitamin A D_3 mixture[1]	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Chemical Composition:								
Crude protein	14.58	14.81	15.08	14.91	17.80	18.02	18.30	17.81
Crude fiber	4.24	7.12	11.96	16.84	4.34	8.87	12.55	16.29
Starch equivalent[2]	64.90	63.64	63.90	63.45	68.37	66.90	67.25	67.23

TABLE 2.—AVERAGE BODY WEIGHT, SE CONSUMED AND FEED EFFICIENCY OF BW AND RIR LAYERS.

Breed / Ration No.	Baladi White				Rhode Island Red			
	1	2	3	4	5	6	7	8
Initial number of hens	60	60	60	60	60	60	60	60
Initial average body weight, kg. .	1.152	1.132	1.144	1.135	1.575	1.551	1.551	1.543
Final average body weight, kg. . .	1.218	1.167	1.074	1.006	1.885	1.933	1.544	1.557
Feed consumed/hen/year, kg. . . .	36.537	34.580	34.027	32.190	45.813	44.852	42.008	38.397
S.E. consumed/hen/year, kg. . . .	23.566	21.938	21.743	20.424	31.322	30.006	28.250	25.814
S.E. required to produce 1.0 kg. eggs, kg.	5.493	6.444	7.087	6.638	8.044	8.138	9.089	9.705

Average Number of Eggs Produced Monthly Per Pullet :

A. *Baladi White :*

As can be seen from Table 3 and Figure 1, the number of eggs produced monthly per pullet was higher during the first 6 month (from October to April) in all groups and then began to decrease therafter. The total number of eggs per pullet during the season (52 weeks) was 103.27, 81.92, 74.06 and 74.31 egg for group 1, 2, 3 and 4 respectively. The corresponding monthly average was 8.60, 6.83, 6.17 and 6.19 eggs. Assuming the lowest production (group 3) equals 100, it would be 139.4, 110.6 and 100.3 for group 1,2 and 4 respectively, showing that group 1 (4% CF and 2 (7% CF) surpassed group 3 (12% CF) and 4 (17% CF) to the extent of 10 to 39%. This indicates that raising the CF to the level of 12% or higher has depressing effect on egg production of BW layers.

B. *Rhode Island Red :*

Table 3 and Figure 1 show that the number of eggs produced per pullet assumed a similar trend as in theBW pullets, being high until March and decreased thereafter. The total number of eggs per pullet during the whole season was : 76.56 (gp. 5 : 4% CF), 73.18 (gp. 6 : 9% CF), 61.34 (gp. 7 : 12.5% CF) and 52.62 (gp. 8 : 16% CF). The corresponding monthly average was : 6.38, 6.10, 5.11 and 4.33 eggs. Assuming the lowest equals 100 (gp. 8), it would be 145.5, 139.1 and 116.6 for group 5, 6 and 7 respectively. This shows that raising the level of CF to 12.5% or higher resulted in reducing the number of eggs produced.

Therefore, it may be concluded that up to 7% and 9% CF can be tolerated in rations fed to BW and RIR hens respectively without effecting the egg production. This is in accordance with the findings of Morris *et al.* (1932), who reported that as much as 8.9% CF can be added to rations of hens without affecting egg production.

Average Egg Weight :

A. *Baladi White :*

The average monthly egg weight during the first six months (October — April) was higher than that of the last six ones (Table 3). The average egg weight during the whole year was : 41.53 (gp. 1 : 4% CF), 41.17 (gp. 2 : 7% CF), 41.23 (gp. 3 : 12% CF) and 41.37 g. (gp. 4 : 17% CF) as shown in Table 3. This shows that the egg weight was not affected to an appreciable extent by increasing the CF level of the ration.

B. *Rhode Island Red :*

The average monthly egg weight was higher during the first half of the season (October — April) than during the last half as was noted with the BW layers (Table 3). The average egg weight during the whole year was 50.02 g. (gp. 5 : 4% CF), 49.69 g. (gp. 6 : 9% CF), 49.92 g. (gp. 7 : 12.5% CF) and 49.68 g. (gp. 8 : 16% CF) showing, as noted with the BW, that the average egg weight is not affected by increasing the level of crude fiber in the ration (Table 3).

TABLE 3.—AVERAGE NUMBER OF EGGS AND AVERAGE EGG WEIGHT OF BW AND RIR LAYERS

	Ration 1		Ration 2		Ration 3		Ration 4	
	No. of Eggs	Av. Egg wt. g.	No. of Eggs	Av. Egg wt. g.	No. of Eggs	Av. Egg wt. g.	No. of Eggs	Av. Egg wt. g.
October	7.95	42.01	8.42	42.01	8.97	42.22	8.62	41.97
November	9.87	42.12	7.73	41.95	8.02	42.23	6.60	42.47
December	10.06	42.50	6.04	41.64	5.06	42.54	3.84	43.04
January	12.43	43.22	9.91	42.13	4.98	42.53	3.97	42.89
February	12.29	42.84	10.40	43.12	10.92	41.60	8.39	43.00
March	12.11	41.72	9.83	41.84	8.65	40.31	10.22	40.73
April	8.82	41.21	8.40	41.52	6.28	41.40	6.31	41.61
May	6.79	42.81	5.45	41.10	4.96	40.18	4.46	40.42
June	7.13	40.53	5.47	39.85	5.29	41.21	7.57	41.41
July	7.12	40.24	5.65	39.73	5.10	40.37	7.35	40.24
August	5.23	39.73	3.75	39.68	3.01	39.60	4.77	39.73
September	3.47	39.48	0.87	39.49	2.82	40.60	2.21	39.00
Total	103.27	—	81.92	—	74.06	—	74.31	—
Average	8.60	41.53	6.83	41.17	6.17	41.23	6.19	41.37

TABLE 3 (Cont.)

	Ration 5		Ration 6		Ration 7		Ration 8	
	No. of Eggs	Av. Egg wt. g.	No. of Eggs	Av. Egg wt. g.	No. of Eggs	Av. Egg wt. g.	No. of Eggs	Av. Egg wt. g.
October	10.15	51.03	10.81	50.51	9.69	51.18	10.62	51.13
November	11.59	52.37	9.63	51.09	7.97	50.31	7.08	51.55
December	9.47	51.64	8.46	51.18	8.31	51.14	3.31	51.06
January	9.21	50.81	8.37	50.99	5.53	50.99	3.50	52.00
February	9.71	51.39	8.77	51.31	7.16	51.12	6.52	50.92
March	8.30	51.81	7.53	51.09	6.57	52.66	5.76	51.21
April	4.16	50.72	4.09	51.59	5.52	50.72	5.03	50.50
May	3.55	49.57	4.73	49 68	3.89	49.87	4.15	50.12
June	2.79	48.39	3.84	47.91	2.07	48.31	2.24	48.66
July	2.86	47.20	4.00	48.00	2.31	48.05	2.68	47.01
August	2.90	49 31	1.90	47.37	0.98	46.94	1.29	46.51
September	1.87	45.98	1.05	45.71	1.34	47.76	0.44	45.45
Total	76.56	--	73.18	—	61.34	—	52.62	—
Average	6.38	50.02	6.10	49.69	5.11	49.92	4.38	49.68

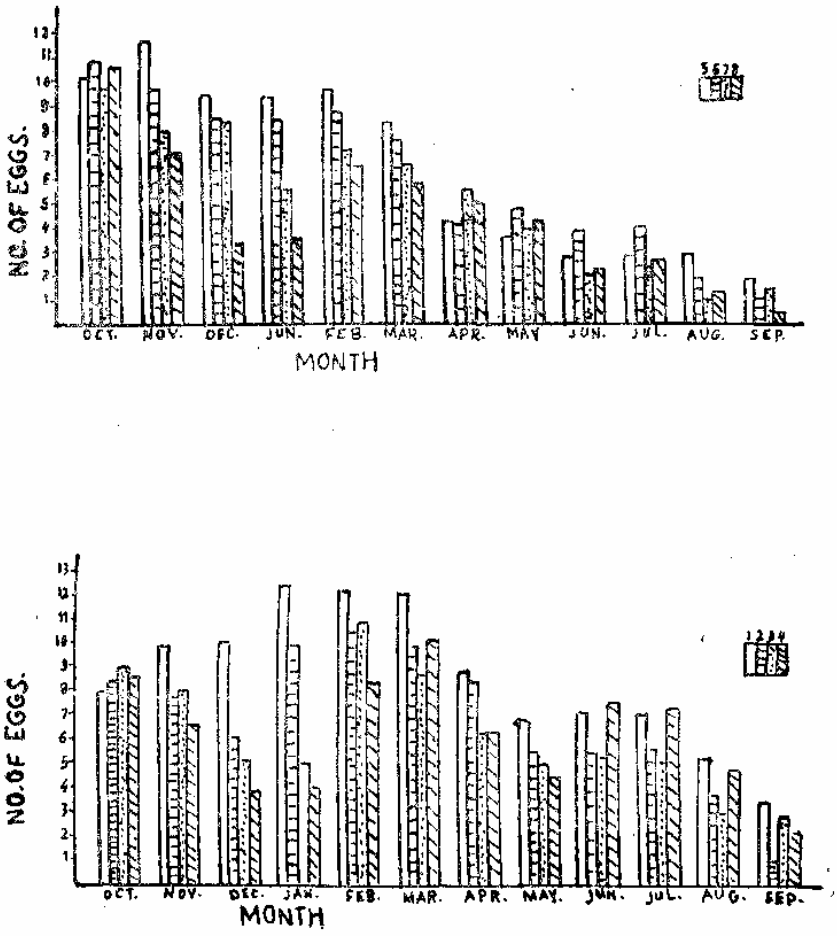

FIG. 1.—EGG PRODUCTION OF B W AND R I R LAYERS FED 4 DIFFERENT LEVELS OF CF.

Feed and SE Consumed :

A. *Baladi White :*

The amount of feed consumed per hen during the experimental period decreased as the CF percentage increased in the ration (Table 2). The SE consumed/hen/year showed the same trend. The SE required to produce 1.0 kg. egg was 5.493 kg. (gp. 1 : 4% CF), 6.444 kg. (gp. 2 : 7% CF), 7.087 kg. (gp. 3 : 12% CF) and 6.638 kg. (gp. 4 : 17% CF). This shows that hens fed on the 4% CF ration were the best in converting feed SE into eggs. Hens of group 2 (7% CF) required 17.3% more feed SE than that required by hens of group(1) to produce 1.0 kg. eggs, while groups 3 and 4 required 29.0 and 20.8% more SE respectively. This indicates that raising the CF level of the ration to 7% lowers the efficiency of converting feed SE into eggs.

B. *Rhode Island Red :*

The amount of feed and SE consumed per hen per year decreased with increasing the CF level of the ration. The same trend was found in the BW layers. The (RIR) consumed relatively higher feed and SE than the BW layers. It is a known fact that part of the energy of feed goes for maintenance and since the RIR are heavier in their average body weight than the BW, therefore the maintenance requirement is higher for the former than the latter.

The SE required to produce 1.0 eggs was : 8.044 kg. gp. 5 : 4% CF), 8.138 kg. (gp. 6 : 9% CF), 9.089 kg. (gp. 7 : 12.5% CF) and 9.705 kg. (gp. 8 : 16% CF) as shown in Table 2. This shows that groups fed rations containing up to 9% CF had no effect on efficiency of feed conversion. However increasing CF level to 12.5% or higher reduced this efficency. In this convection Lillie *et al.* (1951) reported that adding rice hull cellulose decreased feed utilization in laying hens.

It should be also noticed that the RIR hens fed the 4% and 9% CF rations also gained weight (Table 2). Taking this in consideration will result in obtaining lower figure for the SE required to produce 1.0 kg. eggs.

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دراسة تغذية الدجاج البياض على مستويات مختلفة من الألياف الخام وتاثير ذلك على انتاج البيض

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الملخص

شملت هـذه الدراسة ٢٤٠ دجاجة بلدى أبيض ، ٢٤٠ دجاجة رود ايلاندرد . عند بدء التجربة قسم الدجاج داخل كل نوع الى أربع مجاميع متساوية فى العدد (٦٠) وكذلك متوسط انتاج البيض . استمرت التجربة لمدة سنة (٥٢ أسبوع) وكانت العلائق المعطاة للدجاج تحتوى على النسب الآتية من الألياف الخام :

الدجاج البـلدى الأبيض : ٤٪ ، ٧٪ ، ١٢٪ ، ١٧٪ ، وفى الرود ايلاند رد : ٤٪ ، ٩٪ ، ٥ر١٢٪ ، ١٦٪ . وكانت العلائق المعطاة لـكل نوع متساوية تقريبا فى البروتين المهضوم وكذلك معادل النشا .

يمكن تلخيص نتائج البحث كالآتى :

يمكن للدجاج البلدى الأبيض أن تحتوى علائقه على ٧٪ ألياف خام بدون أن يؤثر ذلك على عدد البيض المنتج أما بالنسـبة للدجاج الرود ايلاند رد فيمكنه أن يتحمل حتى ٩٪ ألياف خام . كما وجد أن رفع نسبة الألياف الخام الى ١٢ ـ ٥ر١٢٪ بالنسبة النوعين أن ذلك سبب انخفاض ملحوظ فى عدد البيض المنتج .

أما عن كفاءة تحويل الغذاء الى بيض (يعتر عنها بعدد كيلوجرامات نشا العليقة اللازمة لانتاج كيلو جرام واحد بيض) فقد لوحظ أن الدجاج الرود ايلاند رد يمكن أن تحتوى عليقته على ٩٪ ألياف خام بدون ان يؤثر ذلك على كفاءة تحويل الغذاء الى بيض أما فى الدجاج البلدى الأبيض فقد لوحظ أن العليقة التى بها ٧٪ ألياف خام كانت كفاءة تحويل الغـذاء منخفضة نوعا ما .

أما عن متوسط وزن البيضة فلم يلاحظ هنـاك علاقة بين نسـبة الألياف الخام بالعليقة ووزن البيضة .

(*) قسم الانتاج الحيوانى « فرع تغذية الحيوان » ـ بكلية الزراعة ـ جامعة القاهرة ـ بالجيزة .