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The Effect of Different Protein Rearing Regimens on Growth and Egg Production of Saudi Arabian Baladi Chickens

F.M. Attia, A.A. Alsobayel and Z.H. Al-Ogaily

Department of Animal Production, College of Agriculture,
King Saud University, P.O.Box 2460, Riyadh 11451, Saudi Arabia

ABSTRACT:

An experiment was conducted to study the effects of four protein rearing regimens on growth and egg production of Saudi Arabian Baladi chickens. One Conventional (C); one reverse protein, (RP); and 2 single-stage low-protein regimens (SS1, 12% and SS2 15% CP). From 20 to 56 wks of age, all birds received a commercial layer diet containing 17% CP and 2695 Kcal NE/Kg.

At 20 weeks of age, the RP and SS2 birds were significantly ($P<.05$) lighter than the C and SS1 fed birds. The SS2 regimen significantly reduced body weight, feed, protein, and energy intake and delayed age to sexual maturity compared to other regimens. By 56 weeks of age, there were no significant body weight differences among the rearing regimens. During the subsequent 36-wk laying period, rearing regimens had no effect on egg production and total feed intake. However, average egg weight was significantly ($P<.05$) smaller for SS2 birds than for other regimens. It appears that the required level of protein for Saudi arabian Baladi pullets under the experimental conditions of this study, falls somewhere between 12 and 15% CP.

Key words: Protein rearing regimens, Saudi arabian Baladi chickens, sexual maturity, body weight, egg production.

INTRODUCTION

An increasing number of reports have been cited on different feeding regimens to produce ready to lay pullets. This objective can be achieved by feeding a conventional protein regimen as well as a reverse protein regimen. The conventional regimen of feeding egg-type pullets consists of feeding a high protein diet and reducing it stepwise at 6 and 14 weeks (NRC, 1984) or at 8 and 12 weeks of age (Scott et al. 1982). A reverse protein regimen involves increasing the protein level of the diet in a step-wise manner, which is the reverse of NRC (1984) recommendations (Lesson and Summers, 1979, 1980, 1982; Doran et al., 1983). Reverse protein regimens significantly reduced pullet weight at 20 weeks of age (Leeson and Summers, 1979, 1982; Doran et al., 1983; Bish et al., 1984; Robinson et al., 1986). On the other hand, Maurice et al. (1982) reared brown egg-type strains using a reverse protein regimen no significant reduction in weight gain. Chicks reared on reverse protein regimens consumed less feed up to 20 weeks (Leeson and Summers, 1982; Bish et al., 1984) and less protein (Leeson and Summers, 1982) relative to a conventional step-down regimen.

Alsobayel (1985) noted that body weight means of Saudi Arabian Baladi chickens were inferior to those of Leghorn at 4, 12, and 16 weeks of age. Similarly was reported by Shawer (1984).

Bish et al (1984) used a modified protein regimen, with initial bonus of 18% crude protein (CP) during the first three weeks of life. A similar study was conducted by Robinson et al (1986) using 16-20% CP as a bonus during the first weeks of age only. In both cases, body weight reductions occurred at 20 weeks of age, but without effect on egg production .

There is evidence that sexual maturity is closely associated with body weight (Leeson and Summers, 1983; Dunnington et al., 1983). Egg production does not appear to be affected by reverse protein regimens (Maurice et al., 1982; Leeson and Summers, 1982; Doran et al., 1983; Bish et al., 1984). It was reported that differences in pullet body weight have a substantial effect on egg weight (Robinson and Sheridan, 1982; Summers and leeson, 1983). Bish et al (1984) claimed comparable average egg weight for conventionally and reverse fed pullets.

Low protein diets for egg-type pullets have been tested during the last 20 years. The majority of these studies, however, do not involve the entire rearing period (Summers et al, 1972; Lillie and Denton, 1966; Summers et al., 1972; Balnave, 1974; Kim and McGinnis, 1976). Christmas et al. (1982) indicated that low protein (9.1% CP) given to growing pullets delayed sexual maturity as compared to 15.4% CP given from 8 to 18 weeks of age.

The objectives of this study were growth and production responses of Saudi Arabian Baladi chickens to different protein rearing regimens.

MATERIALS AND METHODS

Straight-run-day old Saudi arabian Baladi chicks, hatched on October 1986, of a random bred closed flock, were used in this study. The Baladi chicken in Saudi Arabia, comprise a heterogenous population which have been mainly subjected to natural selection (Alsobayel, 1985). The chicks were housed in electrically heated batteries and fed, for the first week of age, a starter 18% CP and 2900 Kcal ME/Kg. Chicks were vaccinated for Marek's disease at one day of age. At one week of age, all chicks were individually weighed, wing

banded and randomly distributed to 16 floor pens, representing 4 dietary protein regimens, each of which comprising 4 replicates of 67 chicks. The 4 regimens used were : a conventional (C) (NRC, 1984), a reverse protein (RP), consisting of 12% CP diet offered from 1 to 6 weeks followed by a 15% CP diet up to 14 weeks and 18% CP diet from 14 to 20 weeks of age; and 2 single stage low protein regimens (SS1, 15% CP diet) and SS2, 12% CP diet) fed from 1 to 20 weeks of age as illustrated in Fig. 1. The composition of the experimental diets used in the rearing period are shown in Table 1.

Sexing at hatching was not possible and hence the males were removed at 6 weeks of age. Birds were grown under decreasing natural light conditions till 14 weeks of age. At this age they were transferred to their respective floor pens in a controlled environment housewhere they received 10 light hr/day till 20 weeks of age. Light was then increased by 0.5 hr each week to reach 15 hr/day at 30weeks and was maintained so until the end of lay. House temperature ranged, on the average , from 21 to 28oC throughout the year. Beaks were trimmed at 3 weeks of age and retrimmed at 8 and 14 weeks. Otherwise, all birds were maintained under normal management conditions during the entire experimental period. From 20 to 56 weeks of age, all birds were fed a crumbled commercial layer diet containing 17% CP (Table 2). Feed and water were offered ad libitum. Close attention was paid to feed wastage. Mortality was recorded for the rearing and laying periods. Individual body weights and feed intake on pen basis were recorded at 6, 14, and 20 weeks of age. Thereafter, body weights were recorded at 24 and 56 weeks of age. A record for the daily total number of eggs laid per pen was maintained and percentage hen-day production was summarized for each 28-day period throughout the laying period. Records were kept for egg weights up to 56 weeks of age.

C	18 %	18 %	15 %	12 %
RP	18 %	12 %	15 %	18 %
SS1	18 %	15 %	15 %	15 %
SS2	18 %	12 %	12 %	12 %

0 1 6 14 20

Age (weeks)

Fig. 1 : Design of experiment. Each horizontal strip represents a dietary regimen identifying the crude protein level fed for the respective weeks indicated.

Table 1. Composition of experimental diets used in the rearing period (0 – 20 weeks)

Ingredient	% Protein		
	18%	15%	12%
Corn, yellow ground	43.65	54.57	43.05
Barley	30.52	35.50	47.00
Soybean meal	14.20	12.00	3.00
Fish meal	5.00	– –	– –
Animal fat	1.00	1.00	1.00
Alfalfa meal	2.50	2.50	2.50
Dicalcium phosphate	1.25	1.55	1.55
Limestone	1.35	1.33	1.33
Salt	.25	.25	.25
Sodium bicarbonate	.10	.10	.10
Micro-mix*	.15	.15	.15
DL-Methionine	.03	.05	.04
Lysine	– –	– –	.03
Calculated analysis :			
Metabolizable energy Kcal/kg	2900	2900	2900
Protein %	18	15	12

* Supplied per kilogram of diet : vitamin A, 10.000 IU; vitamin D3, 2000 ICU; vitamin E, 10 mg; vitamin B1, 0.5 mg; vitamin B2, 3 mg; pantothenic acid, 61 mg; niacin, 10 mg; vitamin K3, 0.2 mg; vitamin B12, 0.01 g; choline, 200 mg; manganese, 30 mg; zinc, 30 mg; Iron, 10 mg; copper, 1 mg; iodine, 0.3 mg; cobalt, 0.1 mg; selenium, 0.03 mg.

Table 2. Nutrient composition of the laying ration*

Nutrient		%
Crude protein	(Min)	17.00
Crude fat	(Min.)	3.00
Crude fiber	(Max.)	5.00
Calcium	(Min.)	3.50
Phosphorus	(Min.)	0.60
Salt	(Max.)	0.35
Net Energy Kcal/Kg.		2695.00

* Manufactured By :

Grain Silos and Flour Mills Organization, Riyadh, Saudi Arabia.

Age at sexual maturity was estimated as the age in days, when 50% production was attained. (Proud foot and Hulan, 1988; Bish et al., 1984). Percent livability, and hen-day production, were transformed to arcsin Y% (Snedecor and Cochran, 1980) prior to analysis of variance. Data were subjected to statistical analysis at King Saud University Computer Center. The statistical model used during the 20 week rearing period was :

$$Yij = U + Ti + eij$$

where U = the overall mean; Ti = the fixed effect of treatment (i = 1, ..., 4) and eij = the random error distributed with mean zero and variance C2e; and during the laying period the model was :

$$Yijk = U + Ti + Pj + (TP)ij + eijk$$

where U = the overall mean; Ti = the fixed effect of treatment (i = 1, ..., 4); Pj = the fixed effect of periods (j = 1,....., 9); (TP)ij = the interaction of treatment and period effects; eijk = the random error distributed with mean zero and variance C2e.

RESULTS AND DISCUSSION

Rearing Period :

Body weight :

The C birds maintained a significantly (P<.05) heavier weight than the other regimens throughout the growing period. The results are in line with previous observations of pullets reared on conventionally high protein diets (Leeson and Summers, 1979; Douglas and Harms, 1982). At all ages, body weights of SS2 birds were significantly (P<.05) lighter than the

other regimens. The only exception was at 6 weeks of age, wherein the mean body weight of RP chicks was, as expected, comparable to the SS2 birds. These findings support the results of leeson and Summers (1982), Keshavarz (1984), and Douglas et al. (1985). The significant reduction in body weight of the RP fed birds during the early starting period was maintained until 20 weeks of age. These data are in agreement with many previous reports (Leeson and Summers, 1979, 1982; Doran et al., 1983; Bish et al., 1984; Robinson et al., 1986). On the other hand, Maurice et al. (1982) found no significant reduction in 20 week body weights of birds fed a reverse protein regimen. Birds on the SS1 (15%CP) regimen did not limit early growth to the same extent as the RP and SS2 (12%CP) birds. However, the SS1 birds recovered this reduced weight at 20 weeks to approximate the C birds. Previously, Sunde and Bird (1959) demonstrated that 15% CP diets throughout rearing had no adverse effect on body weight at maturity.

No significant regimen differences were observed in livability during the rearing period (Table 2). Similar results were obtained by other workers (Sunde and Bird, 1959; Maurice et al, 1982; Bish et al., 1984; Keshavarz, 1984; Robinson et al. 1986).

Feed intake :

As sexing at hatching was not possible, data concerning feed, energy, protein intakes and feed conversaion for pullets started at 6 weeks of age. During the 6–14 wk period the SS2 regimen resulted in significantly ($P<.05$) lowered feed intake compared to other regimens (Table 4). This might be partly due to the slower growth rate of the SS2 birds when the 12% CP diet was fed during the entire rearing period. These findings are at variance with Bish et al. (1984). All birds, regardless of

Table 3. Effect of different protein rearing regimens on body weight (BW) and livability (L) of Saudi Arabian Baladi chickens up to 20 weeks of age.

Dietary regimen	Initial	(BW, g) 6	14	20	L*
C	48	302 ± 3.7 a	755 ± 8.7 a	1004 ± 10.7 a	97
RP	54	194 ± 3.7 b	667 ± 9.0 b	973 ± 10.8 b	96
SS1	48	242 ± 3.7 c	688 ± 8.8 b	980 ± 10.8 ab	93
SS2	51	200 ± 3.7 b	520 ± 8.6 c	805 ± 10.6 c	90

a, b, c. Means within columns followed by different letters are significantly different ($P < .05$).

* Livability was calculated to exclude all mortality attributed to mechanical reasons.

Table 4. Effect of different protein rearing regimens on feed, energy, protein intake and feed conversion of Saudi Arabian Baladi chickens.

Age (wk) Dietary regimen	6 - 14	14 - 20	6 - 20
Feed intake (g)		g/pullet	
C	2370 ± 108.90a	2238 ± 81.90	4441 ± 13.90a
RP	2254 ± 108.90a	2257 ± 81.90	4442 ± 14.20a
SS1	2230 ± 108.90a	2084 ± 81.90	4319 ± 14.00b
SS2	1748 ± 108.90b	2031 ± 81.90	3784 ± 13.90c
Energy Intake (Kcal)		Kcal ME/Pullet/period	
C	6872 ± 292.70a	6489 ± 237.40	13361 ± 372.40a
RP	6536 ± 292.70a	6546 ± 237.40	13082 ± 327.40a
SS1	6467 ± 292.70a	6044 ± 237.40	12511 ± 327.40a
SS2	5069 ± 292.70b	5891 ± 237.40	10960 ± 327.40b
Protein Intake (g)		g/pullet	
C	356 ± 15.00a	269 ± 11.00a	624 ± 16.50a
RP	338 ± 15.00a	406 ± 11.00c	744 ± 16.50b
SS1	334 ± 15.00a	313 ± 11.00b	647 ± 16.50a
SS2	210 ± 15.00b	244 ± 11.00a	454 ± 16.50c
Feed conversion*		(g/g)	
C	5.23 ± 0.17a	8.99 ± 0.47a	6.46 ± 0.09a
RP	4.67 ± 0.17b	7.78 ± 0.49ab	5.86 ± 0.10b
SS1	5.00 ± 0.17ab	7.21 ± 0.49b	5.96 ± 0.09b
SS2	5.46 ± 0.17a	7.05 ± 0.49b	6.43 ± 0.09a

a,b,c Means for each parameter within columns and within periods followed by a different letter are significantly ($P \leq .05$) different.

* Ratio of grams feed consumed to grams gain in body weight.

dietary protein level, consumed comparable amouns of feed during 14 to 20 week period.Cumulative feed consumption during the 6-20 wk period indicated that feed consumption was greatest for the C and RP regimens followed by the SS1 regimen while the SS2 fed birds showed the least amount of feed consumed.

Energy intake:

The energy intake pattern was identical to that of feed intake (Table 4).

Protein intake :

The reduction in protein intake for the SS2 birds was maintained throughout the different age periods. These findings support the observations of Bish et al. (1984). Over the 6 - 20 wk period, significantly (P<.05) more protein was consumed by the RP birds. These results are in accordance with Bish et al. (1984) and Proudfoot and Hulan (1986).

Feed conversion ratio :

During the 6 - 14 wk period the RP and SS1 fed birds showed the most efficient conversion ratio compared to those of the C and SS2 birds. Thereafter, (14-20 wk) the C fed birds showed the poorest value, though not significant in each case, over the 6-20 wk period the C and SS2 birds, were significantly (P<.05) poorer relative to the RP and SS1 values.

Laying Performance :

Sexual maturity :

The SS2 was the only regimen that significantly (P<.05) delayed age to sexual maturity (Table 5). Sexual maturity was inversely related to feed consumption and 20 wk body weights. The delay in sexual maturity of the SS2 birds is in general agreement with previous investigations (Wright et al., 1968; Christmas et al., 1974, 1982; Carlson and Nelson, 1981; Robinson and Sheridan, 1982; Proudfood and Hulan, 1986). Contrary to these findings, Maurice et al. (1982) indicated that the reverse and the low protein regimens did not significantly affect age at 50% production relative to a standard conventional rearing regimen.

Body weight :

At point of lay, the RP and SS2 birds were signiicantly (P<.05) lighter than the C and SS1 fed birds (Table 5) Nevertheless when the RP and SS2 birds were given layer diet, their body weights were comparable to the C birds at 24 and 56 weeks of age, respectively. Several reports confirm these results (Lillie and Denton, 1966; Bish et al., 1984, Robinson et al., 1986). Differences in body weight at 56 weeks of age were small and nonsignificant. These findings suggest that the effect of low or reverse protein regimens, used in this study, are transitory and once these regimes are withdrawn, the birds undergo growth to attain normal body weights. It is worthy to note that this compensatory growth occurred without any significant increase in feed intake (Table 5). These results are in accordance with the findings of Garlich and McCabe (1983) and Keshavarz (1984). Proudfoot and Hulan (1986) reported that differences among conventional and reverse

Table 5. Age at 50% production (AP), hen-day (H/D), egg weight (EG), livability (L), body weight (BW), feed intake (FI), and feed conversion (FC) during the 36 week of production

Dietary regimen	Production			L	BW, wk			FI*	FC**
	AP%	H/D	EG		20	24	56		
	(days)	%	(g)	%	---------- (g)------- ---			(g/HD)	Kg/12 eggs
C	159 a ± 1.2	52.5 ± 2.4	44.0 a ± .2	91.0 a ± .04	1004 a ± 10.7	1179 a ± 11.8	1345 ± 22.3	78 ± 2.4	1.76 ab ± .08
RP	160 a ± 1.2	49.9 ± 2.4	43.9 a ± .2	93.0 ab ± .04	973 b ± 10.8	1178 a ± 12.6	1369 ± 22.9	82 ± 2.4	2.06 a ± .08
SS1	158 a ± 1.2	53.1 ± 2.4	43.8 a ± .2	98.0 bc ± .04	980 ab ± 10.8	1158 a ± 11.7	1320 ± 21.7	76 ± 2.4	1.67 b ± .08
SS2	166 b ± 1.2	50.1 ± 2.4	43.1 b ± .2	97 ac ± .04	805 c ± 10.6	1071 b ± 11.9	1314 a ± 22.2	77 ± 2.4	1.86 ab ± .08

a,b,c Within columns, means followed by different letters are significantly different ($P < .05$).

* Grams feed consumed per hen-day.

** Kilogram of feed consumed per dozen eggs.

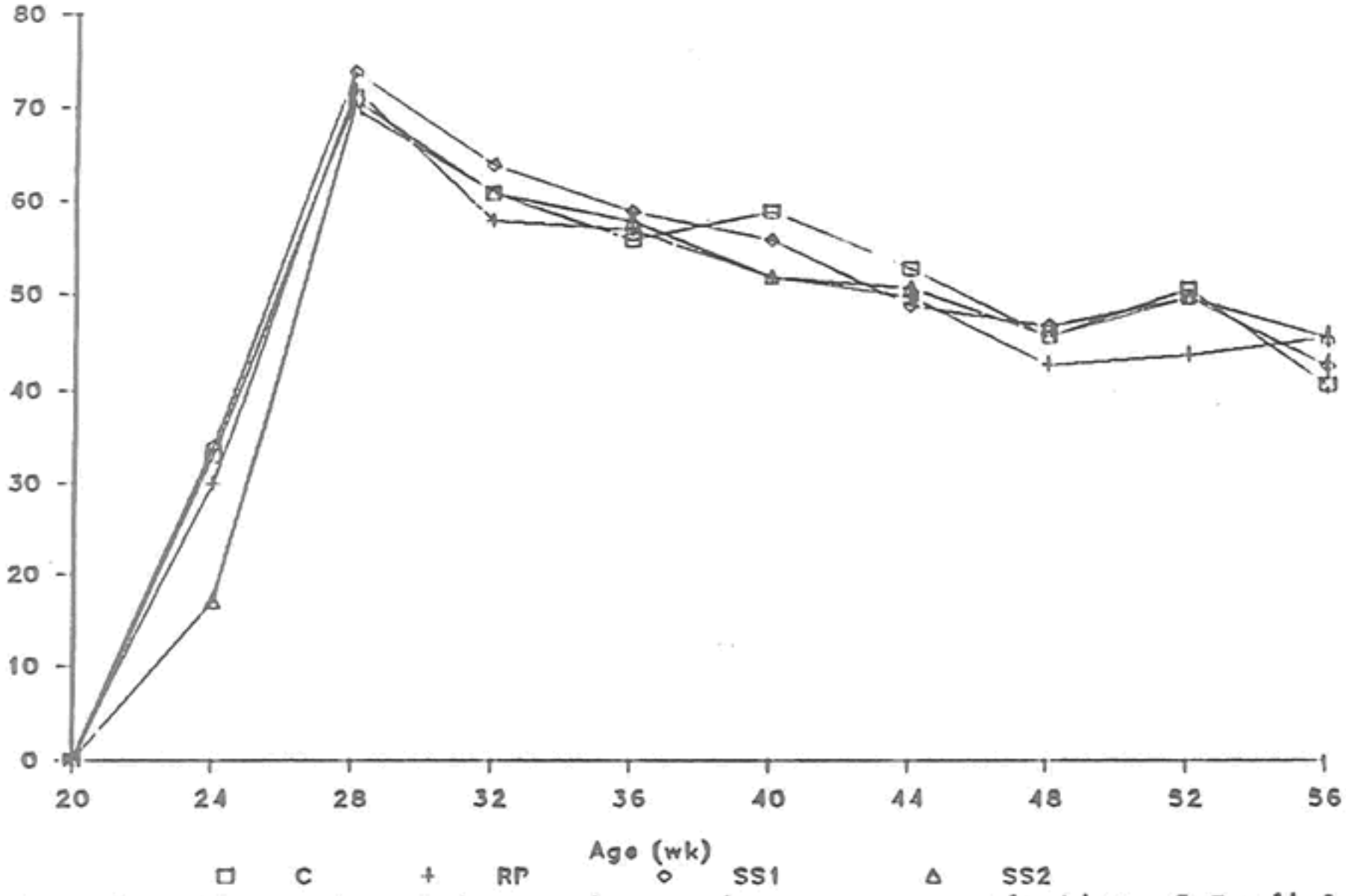

Fig. 2: Effect of protein rearing regimen on egg production of Saudi Arabian Baladi chickens.

protein regimens for body weight at 20 weeks of age tended to persist throughout the laying period.

Livability :

Percent livability for the C birds were significantly ($P<.05$) less than SS1 birds (Table 5). This significant difference in livability could increase the cost of production for the C birds. Similar results were obtained by Maurice et al. (1982).

Feed consumption :

Only slight differences in daily feed consumption by hens fed the different rearing regimens were observed at all ages, and none of these differences were statistically significant (Table 5).

Feed conversion ratio :

Feed conversion was better for the SS1 birds compared to other regimens (Table 5). The largest significant difference was noted between the SS1 and RP birds. This is at variance with Bish et al. (1984) who reported that reverse protein fed chickens required, significantly less amount of feed to produce a dozen eggs. However, Robinson et al. (1986) indicated that feed per dozen of eggs did not differ significantly among conventional and modified reverse protein regimens.

Egg production :

During the 20 to 24 weeks of age, the SS2 birds with lightest body weights, were slow in coming into production (Fig. 2). Thereafter, they started catching up with the other

regimens. The 20 to 24 week production rates of the C fed birds were equivalent to those of RP and SS1 birds. This might indicate that the RP and SS1 birds were as mature as the C birds. Similar results were reported by Bish et al. (1984). However, Leeson and Summers (1979) noted that RP reared pullets were less mature at 20 weeks of age than the C reared pullets. The overall data on average hen-day production showed no significant differences among any of the rearing regimens. There was no significant interaction between rering regimen x age period. Several reports indicated that egg production was not afected by the reverse protein (Leeson and Summers, 1979, 1982; Maurice et al., 1982; Bish et al, 1984; Proudfoot and Hulan, 1986; Robinson et al., 1986) or low protein regimens (Maurice et al., 1982).

Egg weight :

Average egg weight for the 36 wks laying period was significantly ($P<.05$) smaller for the SS2 birds than for the other regimens. Similar reuslts were obtained by Leeson and Summers (1979) who reported that body weight at point of lay is a major factor affecting egg size.

In conclusion, under the experimental conditions of this study, the required level of rearing protein for Saudi arabian Baladi chickens falls somewhere between 12 and 15% CP.

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مجلة الأمارات للعلوم الزراعية (١٩٩١) . ٢ : ١٢٠ - ١٤١

تاثير كميات مختلفة من البروتين على النمو وانتاجية البيض في الدجاج السعودى البلدى .

ف. م . عطيه ، ا. ا . الصوبيل و ز . مـ . العقيلى
شعبه الانتاج الحيوانى - كلية الزراعة - جامعة الملك سعود - ص . ب ٢٤٦٠
الرياض ١١٤٥١

الخلاصـــــة :

اجريت التجربة لدراسة اثر اربعة مستويات من البروتين فى نمو وانتاجيه البيض فى الدجاج البلدى . وكانت المستويات هي مستوى تقليدى (C) ومستوى عكسى (RP) واثنين فردى قليل (ss_1, ss_2) . وتم تغذية الدجاج بمركزتجارى يحوى ١٧٪ بروتين خـام و ٢٦٩٥ Kc al - NE/Kg من عمر ٢٠ الى ٥٦ اسبوع .

عند عمر ٢٠ اسبوع كان الدجاج المغذى بـ (RP) و (ss_2) اخف معنويا (٠٫٠٥) مـن (C) و (ss_1) . كما وجد ان (ss_2) ادى الى نقص فى الوزنه والغذاء والبروتين والطاقه كمـا ادى الى تاخر فى العمر الجنسى مقارنه بالمعاملات الاخرى . وفى عمر ٥٦ اسبوع لوحظ عدم وجود فروق معنويه فى الوزن . واثناء عمر ٣٦ اسبوع وجد عدم وجود تاثير لملمعاملات فى انتاجيه البيض وكمية الغذاء الا ان الوزن المتوسط للبيض كان اصغر للمعاملة (ss_2) . كما تم استنتاج ان المعاملات المستعمله تقـــع فى المـــدى ١٢ - ١٥٪ بروتين خام .

كلمات مفتاحية : انتاج البيض ، بروتين ، العمر الجنسى ، الفروج البلدى السعودى ، العمر الجنسى ، وزن الجسم .