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Effect of Rearing Regimen and Age of Bird on Egg Weight and Weight of the Component Parts of Saudi Arabian Baladi Chicken Eggs

F.M. Attia, A.A. Alsobayel, M.S. Bayoumi and **M.A. El-Badry**
Animal Production Department, College of Agriculture, King Saud University, Riyadh, Saudi Arabia.

Abstract. A total number of 1410 eggs was obtained from Saudi Arabian Baladi hens, that had been subjected to the following rearing regimens: Conventional, (C); Reverse protein, (RP); single-stage low-protein 1 (15%CP), (SS_1) and single-stage low-protein 2 (12%CP), (SS_2). From 20 weeks of age, pullets were fed on a commercial layer diet. The birds were kept in a controlled environment house.

Eggs per hen were significantly ($P \leq .05$) reduced only for the RP regimen. Pullets fed on the C regimen laid more eggs compared with the other regimens. However, the difference was not significant in every case.

Egg weight was significantly depressed for pullets on SS_2 regimen. Egg weight increased significantly ($P \leq .05$) with age.

Among the 4 regimens used, SS_2 was the only regimen that reduced yolk weight, albumen weight and shell weight either significantly or numerically. Yolk weight, yolk percent and albumen weight increased while percent albumen decreased as the birds aged. The four rearing regimens had no effect on shell thickness.

No significant differences were found in shell weights at 33 and 44 weeks however, there was a significant ($P \leq .05$) increase at 54 weeks. Percent shell decreased significantly ($P \leq .05$) between 33 and 44 weeks, and thereafter increased significantly ($P \leq .05$) with age. The shell weight per unit of egg surface area (SWUSA) did not differ significantly ($P \leq .05$) among the four rearing regimens. There was a significant decrease ($P \leq .05$) in SWUSA between 33 and 44 weeks followed by a significant increase at 54 weeks.

Introduction

One of the most important concerns to egg producers and consumers is the overall egg quality. Among the many factors that contribute to the overall quality of an egg are shell quality and weight of component parts of the egg. Research conducted on the egg weight per se, while information concerning related changes in egg composition is lacking.

Reverse protein diets decreased egg weight [1-3] while feeding 16% or 18% crude protein (CP) for the first week followed by a reverse protein regimen had no significant effect on egg weight or percentage of egg size. Christmas *et al.* [4] stated that average egg weight for the year was significantly greater when the birds had been grown on low protein growing regimen (9.1% CP from 8 to 18 week) compared with those fed high protein diets (15.4% CP).

Significantly poorer egg shell quality was reported from reverse protein-fed birds [1]. Leeson and Summers [5] indicated that egg size was not adversely affected with single - stage low protein (14% CP) diets. Blair *et al.* [6] reported that 11.5% CP grower diets were adequate for subsequent egg numbers whereas egg size was slightly reduced. However, no data are available on changes that may occur in the weight of the component parts of eggs concurrent with changes in the whole egg due to rearing regimens.

A typical egg weighs 60.9g and consists of 5.8g dry shell (9.5%), 38.4g albumen (63.1%), and 16.7g yolk (27.4%) [7]. Wolford and Tanaka [8] reported that strain and nutrional regimen are major factors affecting shell quality.

Measures for egg shell quality which relate to shell breakage under commercial conditions are of value to industry [9]. Shrimpton and Hann [10] and Bowman and Challendar [9] reported that shell thickness and shell deformation were both major factors accounting for egg breakage from egg facility to the packing station.

Holder and Bradford [11] suggested that percentage of shell weight to the whole egg weight was a reliable indicator of shell quality. Stadelman [12] indicated that shell thickness could be used as a direct measure of shell strength. Shell thickness depends on shell weight relative to egg surface area [13]. Tyler and Geake [14-16] stated that shell weight per unit surface area was an accurate indicator of the mean value of the whole shell than the direct shell measurement. Nordstrom and Questerhout [17] reported that shell weight/unit surface area (SWUSA) could be used more effectively than other measures to compare shell quality in birds of different ages. On the other hand Curtis *et al* [18] had shown that changes in shell thickness and shell weight per unit surface area were similar indicating that one measurement was as accurate as the other, Nordstrom and Questerhout [17] found that shell weight increased .055 g for each 1 g increase in egg weight. On the other hand, Buss [19] stated that egg shell quality was independent of rate of production and egg weight. Curits *et al.* [18] observed small but positive correlation between hen day production and shell thickness in brown and white shell groups and in combined groups. This suggests that as production increased before peaking so did shell thickness.

Izat *et al.* [20] reported that egg weight increased with age. It was also reported that yolk weight and percentage of yolk both increased significantly as the bird aged

[20,21]. Albumen weight increased, however, when expressed as a percentage of total egg weight, it decreased with age. [20].

The research reported here was therefore designed to evaluate the influence of different protein feeding regimens during the rearing period and age of bird on the egg weight and weights of yolk, albumen, and shell concurrent with changes in the whole egg weight.

Materials and methods

In this investigation a total number of 1410 eggs was collected from 461 Saudi Arabian Baladi (SAB) hens, of the same age, which have been subjected to four feeding regimens: conventional, (C); reverse protein, (RP), single-stage low-protein 1(15%CP), SS_1 and single-stage low-protein 2(12%CP), SS_2 (Table 1). The C regimen was fed in a step-down manner [22] wherein an 18% CP was fed from 1 to 6 weeks, 15% from 6 to 14 weeks, and 12% from 14 to 20 weeks. The RP regimen consisted of 12%CP diet offered from 1 to 6 weeks followed by a 15%CP up to 14 weeks and 18% CP from 14 to 20 weeks of age. The single-stage low protein regimens:SS_1 15%CP and SS_2 12%CP were fed from 1 to 20 weeks of age.

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

Ingredient	Protein 18%	15%	12%
Corn, yellow ground	43.65	45.57	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	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[1]	.15	.15	.15
DL-methionine	.03	.05	.04
Lysine	---	---	.03
Calculated analysis:			
Metabolizable energy, kcal/kg	2900	2900	2900
Protein %	18	15	12

1 Supplied per kilogram of diet: vitamin A, 10.000 IU; vitamin D_3 2000ICU; vitamin E, 10 mg; vitamin B_1, 0.5 mg; vitamin B_2, 3mg; Pantothenic acid, 61mg; Niacin, 10 mg; vitamin K_3, 0.2mg; vitamin B_{12}, 0.01mg; cholin, 200mg; Manganese, 30mg;Zinc, 30mg; Iron, 10mg; Copper, 1mg; Iodine, 0.3mg; Cobalt, 0.1mg; Selenium, 0.03mg.

Otherwise, all birds were maintained under normal managerial conditions during the entire experimental period. Birds were grown under 10 hr natural light till 14 weeks of age. At this age, birds were transferred to 16 pens in a controlled environment house where they received 10 light hours per day until 20 weeks of age. Light was then increased by 0.5 hr each week to reach 15/hr/day at 30 weeks and maintained at this level to end of lay. Starting from 20 weeks of age, all birds were fed on a commercial layer diet (Table 2). Feed and water were supplied ad libitum during the rearing and laying periods.

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
Met energy kcal/kg.		2695.00

* Manufactured by:
Grain silos and flour mills organization, Riyadh, saudi Arabia.

Individual egg weights, and weights of their component parts were measrued at three age periods, i.e, at 33 weeks, (period 1) at 44 weeks (period 2), and at 54 weeks (period 3) of age. Thirty eggs, if available, from each pen were collected during the last 3 days of each age period, and subjected to physical evaluation. The eggs were gathered in late afternoon, kept in laying house overnight and broken out for measurement the following morning. Individual measurements included: egg weight, shell weight (including membranes), shell thickness, and wet yolk weight. The yolk was separated from the albumen, and then rolled on paper towels to remove adhering albumen. The weight of the albumen was obtained as the difference between total weight of the egg and weight of the yolk and shell plus membranes. Percentages of the compoenent parts were calculated for each egg. The shell thickness was obtained from the midsection of the shell with membranes intact. The surface area (cm^2) of each egg was calculated according to the following formula [13].

$$\text{Surface area} = 3.9782 \times W^{7056}$$

where W is the egg weight in grams.

The shell weight per unit of egg surface area (SWUSA) was calculated for each egg as suggested by Nordstrom and Questerhout [17]

$$SWUSA = \text{Shell weight} \times 1000/\text{ surface area}$$

In this equation, shell weight is expressed in grams and surface area in cm^2, SWUSA is therefore reported as milligrams of shell per square centimeter of surface area.

The data has been subjected to statistical analysis using general linear model of SAS packages [23].

Results and Discussion

Egg production

Pullets on the RP regimen laid significantly ($P \leq .05$) fewer eggs than those on other regimens. The only exception was egg production of the RP pullets at 44 weeks of age which was not significantly different from that of the SS_1 (15%) regimen (Table 3). These findings are in agreement with Leeson and Summers [1] but are contradicatory with Bish *et al.* [24]. The latter authors reported that early egg production rates of the modified step-up protein birds were equivalent to those of conventionally fed birds, and that the modified step-up protein regimens at older ages resulted in higher production rate. Except for the first 33-week age period, pullets reared on the C regimen laid more eggs than the other three rgimens. However, the difference was not significant in every case.

It was interesting to note that the two single-stage protein regimens were at higher levels of production at 33-week age period and also did not depress poroduction rates from 44 weeks to up to 54 weeks in contrast to RP regimen. This may indicate that a low protein starter diet per se is not responsible for the depression in egg production. These results support the findings of Carlson and Nelson [25] who noted that using low protein grower diets is economical and that the only disadvantage of such diets is the slight reduction in egg production. Up to 54 weeks, egg production did not differ significantly ($P \leq .05$) among pullets on the C, SS_1, and SS_2 regimens, suggesting that the two single-stage low-protein regimens are suitable for SAB pullets and/or that conventionally fed pullets consume excessive amounts of protein during the rearing period.

Egg production was significantly ($P \leq .05$) decreased with age. However, SS_1, and SS_2 regimens resulted in a significant decrease up to 44 weeks, after which time they remained fairly constant up to 54 weeks. In general differences in egg production rates for the C, SS_1, and SS_2 regimens became insiginificant as the birds aged.

Egg weight

Although all birds received the same layer diet after 20 weeks of age, those pul-

Table 3. Effect of rearing and age of bird on hen-day production, weights of yolk, albumen and total egg weight

Rearing[1] regimen	No. hen[2]	Hen-day production (%)			Egg weight (g)			Yolk weight (g)			Albumen weight (g)		
		Age in weeks											
		33	44	54	33	44	54	33	44	54	33	44	54
C	118	62.0^{a,w} ±6.2	53.0^{a,x} ±5.02	50.4^{a,y} ±5.02	41.8^{ac,w} ±.34	44.7^{a,x} ±.34	49.1^{a,y} ±.35	13.0^{a,w} ±.20	14.1^{ab,x} ±.20	16.6^{a,y} ±.20	23.5^{a,w} ±.26	24.9^{b,x} ±.26	26.3^{a,y} ±.27
RP	113	56.8^{b,w} ±4.7	48.3^{b,x} ±7.7	41.8^{b,y} ±1.3	42.2^{c,w} ±.34	43.9^{a,x} ±.34	48.6^{a,y} ±.34	12.8^{ab,w} ±.19	14.4^{b,x} ±.20	16.3^{a,y} ±.20	24.4^{b,w} ±.26	24.3^{a,w} ±.26	25.9^{a,y} ±.26
SS[1]	117	64.3^{c,w} ±3.3	49.3^{bc,x} ±6.9	50.2^{a,x} ±5.8	41.1^{a,w} ±.34	44.0^{a,x} ±.34	48.8^{a,y} ±.34	12.8^{ab,w} ±.19	14.3^{ab,x} ±.20	16.6^{a,y} ±.20	23.3^{a,w} ±.26	24.4^{ab,x} ±.26	26.0^{a,y} ±.26
SS[2]	117	61.2^{a,w} ±6.1	49.8^{c,x} ±5.7	49.9^{a,x} ±15.4	40.2^{b,w} ±.34	42.9^{b,x} ±.34	47.0^{b,y} ±.34	12.4^{b,w} ±.20	13.8^{a,x} ±.19	16.1^{a,y} ±.20	22.8^{a,w} ±.26	24.1^{a,x} ±.26	24.8^{b,y} ±.26
$\bar{X}$[3]	465	61.0^{w} ±5.8	50.1^{x} ±6.6	48.03^{y} ±10.2	41.3^{w} ±.17	43.9^{x} ±.17	48.4^{y} ±.17	12.7^{w} ±.10	14.2^{x} ±.10	16.4^{y} ±.10	23.5^{w} ±.13	24.4^{x} ±.13	25.7^{y} ±.13

a,b,c Means within a column having the same letter are not significantly different (p<05)

w,x,y Means within a row for each parameter having the same letter are not significantly different (P<.05).

1- Feeding regimens: C, conventional, RP, reverse protein, SS_1, single-stage low-protein 1, SS_2, Single-stage low protein 2

2- Number of hens at the begining of lay.

3- Overall average of all rearing regimens.

lets reared on the SS_2 regimen produced significantly ($P \leq .05$) smaller eggs than the C,RP, and SS_1 pullets (Table 3). These findings are in agreement with Douglas and Harms [26] who concluded that feeding low protein diets to replacement pullets resulted in dereased egg weights. On the other hand, it was reported that the egg weight was significantly depressed by the RP regimen but not by the low protein regimen [2]. Blair *et al* [6] noted that 11% protein in the rearing diet reduced egg size.

Except for the 33 week period, the conventionally fed pullets produced the largest eggs among the four regimens used. However differences were not significant ($P \leq .05$). These results confirm previous studies showing comparable average egg weights for step-up and conventionally fed pullets [23]. Leeson and Summers [5] demonstrated that conventional and single-stage low-protein (14%) regimens showed comparable laying perfomances.

Egg weight increased in a continuous significant manner as the birds aged, with rates of increase being greater between 44 and 54 weeks. These data support the findings reporting that egg weight increases with increasing age of bird [20].

Component parts of the egg

Data concerning the influence of protein rearing regimens and age of bird on chicken egg are focused on egg weight. However, information on egg components related to the previous factors are lacking. Among the rearing protein regimens used, SS_2 was the only regimen that reduced the yolk weight, albumen weight, and shell weight either significantly or numerically with the any period of measurement (Tables 3 and 5). Yolk weight and albumen weight increased as the bird aged, with the rate of increase being greater between 44 and 54 weeks. However, the rate of increase in yolk weight was relatively higher than the increase in albumen weight. These results are in agreement with previous studies [20,21].

Differences in percent yolk and percent albumen for the different regimens were not consistent (Table 4). Changes in percent yolk increased significantly with age. The only exception was that of the C regimen at 44 weeks which showed a numerical but non significant increase. The increase was more pronounced between 44 and 54 weeks. It is of interest to note that small eggs obtained from older birds (54 weeks) on the SS_2 regimen, tend to contain a higher percent yolk than do larger eggs from other regimens at the same age. Similar results are reported in the literature [20, 21]. Although albumen weight increased with age, percent albumen to total egg weight decreased with the increase in age of bird. Similar results were noted in the literature indicating that such changes in albumen weight and percentage might be a direct result of the greater rate of increase in yolk weight than albumen weight associated with increasing age of bird [20].

Table 4. Effect of rearing regimen and age of bird on percent of yolk, percent of albumen and percent of shell

Rearing[1] regimen	No. hens[2]	% Yolk			% Albumen			% Shell		
		Age in weeks								
		33	44	54	33	44	54	33	44	54
C	118	$31.17^{a,w}$ ±1.97	$31.65^{a,w}$ ±2.29	$33.90^{ab,y}$ ±2.62	$56.16^{a,w}$ ±2.12	$55.73^{a,w}$ ±3.41	$53.37^{a,y}$ ±2.75	$12.69^{a,y}$ ±.92	$11.74^{a,x}$ ±1.15	$12.62^{a,w}$ ±1.22
RP	113	$30.32^{b,w}$ ±2.21	$32.97^{b,x}$ ±2.82	$33.61^{a,y}$ ±3.18	$57.73^{b,w}$ ±5.41	$55.15^{a,x}$ ±4.03	$53.26^{a,y}$ ±4.23	$12.30^{c,w}$ ±1.18	$11.80^{a,x}$ ±1.31	$13.10^{b,y}$ ±1.47
SS^1	117	$31.16^{a,w}$ ±2.09	$32.67^{b,x}$ ±2.87	$34.14^{ab,y}$ ±2.40	$56.72^{ab,w}$ ±2.87	$55.46^{a,x}$ ±3.23	$53.15^{a,y}$ ±2.91	$12.39^{bc,w}$ ±1.06	$11.76^{a,x}$ ±1.10	$12.75^{ac,y}$ ±1.27
SS^2	117	$30.94^{ab,w}$ ±1.87	$32.31^{b,x}$ ±2.37	$34.41^{b,y}$ ±3.64	$56.73^{ab,w}$ ±2.51	$55.94^{a,w}$ ±4.16	$52.64^{a,y}$ ±4.12	$12.56^{ac,w}$ ±0.87	$11.87^{a,x}$ ±1.18	$12.96^{bc,y}$ ±1.15
$\bar{X}^3$	465	30.9^{w} ±2.1	32.4^{x} ±2.6	34.02^{y} ±3.01	56.80^{w} ±3.5	55.60^{x} ±3.7	53.10^{y} ±3.6	12.50^{w} ±1.02	11.80^{x} ±1.20	12.90^{y} ±1.30

a,b,c Means within a column having the same letter are not significantly different (p<05)

w,x,y Means within a row for each parameter having the same letter are not significantly different (P<.05).

1- Rearing regimens: C, conventional; RP, reverse protein; SS_1, single-stage low protein 1, SS_2, Single-stage low protein 2.

2- Number of hens at the begining of !ay.

3- Overall all average of all rearing regimens.

It was noted that the overall percentages of the component parts of the egg obtained in this study are somewhat different from those reported for a typical egg weighing 60.9 g [7]. This could be due to the small egg weight of the SAB fowl, ranging from 40.2 to 49.1 g.

Shell quality attributes

The four rearing regimens showed no consistent effect on shell weight, shell thickness and shell weight per unit surface area (Table 5). Within the 4 rearing regimens used, shell weight did not differ significantly ($P \leq .05$) between 33 and 44 weeks, after which time there was a significant increase up to 54 weeks. Percent shell decreased significantly from 33 to 44 weeks, however, a significant increase occurred at 54 weeks. These changes in percent shell may be due to the fact that shell weight at 44 weeks remained fairly constant as that of 33 weeks, while egg weight increased significantly ($P \leq .05$). These findings are in agreement with the conclusions of Roland [27] who stated that with abrupt increases in egg size the hen could increase the shell weight by approximately 7.5 %.

Changes in percent shell for the different regimens and within all periods of measurement were not significant ($P \leq .05$) except for the percent shell of the C regimen at 54 weeks.

Shell thickness increased significantly ($P \leq .05$) with age, except for the shell thickness value of the C regimen at 44 weeks, (Table 5). This result is at variance with that reported by Izat *et al* [20] who noted that shell thickness tended to decrease with increasing age of birds, although the decrease was not statistically significant ($P \leq .05$). SWUSA did not differ significantly ($P \leq .05$) among the 4 rearing regimens. There was a significant ($P \leq .05$) decrease in SWUSA between 33 and 44 weeks; thereafter, SWUSA significantly ($P \leq .05$) increased up to 54 week. This is at variance with that reported by Nordstrom and Questerhout [17] who noted that the change in the SWUSA due to age of bird is less than required for significance. It was noted that both percent shell and SWUSA are equally affected by age of bird and that either parameter may be used to measure effectively shell quality of eggs at different periods during laying. In conclusion, the results of this study indicate that SAB pullets may be reared on C, RP or SS_1 regimens without impairment of egg production, egg weight and component parts of the egg. However, the practical advantage of the single-stage (SS_1, 15% CP) regimen is evident for its simplicity.

Table 5. Effect of rearing regimen and age of bird on shell quality attributes

Rearing[1] regimen	No hen[2]	Shell weight (g)			Shell thickness (mm)			SWUSA[4] (mg/cm^2)		
		Age in weeks								
		33	44	54	33	44	54	33	44	54
C	118	$5.29^{a,w}$ ±.05	$5.23^{a,w}$ ±.05	$6.17^{a,y}$ ±.06	$.328^{a,w}$ ±.003	$.333^{ab,wy}$ ±.003	$.336^{a,y}$ ±.003	$95.59^{a,w}$ ±.78	$90.16^{a,x}$ ±.76	$99.59^{a,y}$ ±.80
RP	113	$5.18^{ab,w}$ ±.05	$5.16^{a,w}$ ±.05	$6.35^{b,y}$ ±.05	$.318^{b,w}$ ±.003	$.338^{a,y}$ ±.003	$.337^{a,y}$ ±.003	$92.91^{b,w}$ ±.76	$90.14^{a,x}$ ±.76	$103.08^{b,y}$ ±.78
SS^1	117	$5.09^{b,w}$ ±.05	$5.16^{a,w}$ ±.05	$6.21^{ab,y}$ ±.05	$.319^{b,w}$ ±.003	$.328^{b,xy}$ ±.003	$.335^{a,y}$ ±.003	$92.91^{b,w}$ ±.76	$89.94^{a,x}$ ±.76	$100.59^{a,y}$ ±.77
SS^2	117	$5.04^{b,w}$ ±.05	$5.09^{a,w}$ ±.05	$6.09^{a,y}$ ±.05	$.318^{b,w}$ ±.003	$.327^{b,xy}$ ±.003	$.332^{a,y}$ ±.003	$93.58^{ab,w}$ ±.76	$90.15^{a,x}$ ±.76	$101.12^{ab,y}$ ±.77
$\bar{X}^4$	465	5.15^{w} ±.03	5.16^{w} ±.03	6.21^{y} ±.03	$.321^{w}$ ±.001	$.332^{y}$ ±.001	$.335^{y}$ ±.001	93.70^{w} ±.38	90.10^{x} ±.38	101.10^{y} ±.37

a,b, Means within a column having the same letter are not significantly different (p<05)

w,x,y Means within a row for each parameter having the same letter are not significantly different (P<.05).

1- Rearing regimens: C, conventional; RP, reverse protein; SS_1, single-stage low protein 1; SS_2, Single-stage low protein 2.

2- Number of hens at the begining of lay.

3- Shell weight per unit surface area.

4- Overall average for all rearing regimens.

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تأثير نظام الرعاية والعمر على وزن البيضة ومكوناتها في الدجاج البلدي السعودي

فؤاد محمد عطية، عبدالله العلي السبيل، محمد صبري بيومي و محمد أحمد البدري

قسم الإنتاج الحيواني، كلية الزراعة، جامعة الملك سعود، الرياض، المملكة العربية السعودية

ملخص البحث. تم الحصول على عدد ١٤١٠ بيضة من الدجاج البلدي السعودي مقسمة إلى أربع مجموعات تبعا لنظام التغذية المستخدم من تاريخ الفقس حتى عمر ٢٠ أسبوعا على النحو التالي: ١) النظام التقليدي ٢) النظام عكس التقليدي ٣) التغذية على عليقة تحتوي على ١٥٪ بروتين طوال فترة النمو ٤) التغذية على عليقة تحتوي على ١٢٪ بروتين طوال فترة النمو.

ابتداء من عمر ٢٠ أسبوعا وحتى نهاية التجربة غذيت جميع الطيور على عليقة تجارية وتم تربية الطيور في حظيرة يتم التحكم في ظروفها البيئية.

لوحظ انخفاض في إنتاج البيض بالنسبة للمجموعة المغذاة على النظام عكس التقليدي وكانت الفروق معنوية على مستوى ٥٪ بالمقارنة بالمجموعات الأخرى بينما أعطت الطيور التي غذيت على النظام التقليدي أعلى معدلات إنتاج عند مقارنتها بباقي المجموعات رغم أن الفروق لم تكن معنوية في كل الحالات.

انخفض وزن البيضة الناتج من المجموعة المغذاة على مستوى ١٢٪ بروتين ـ انخفاضا معنويا بالمقارنة بباقي المجموعات كما أن البيض الناتج من هذه المجموعة كان أقل وزنا بالنسبة للصفار والبياض وقشرة البيضة عن باقي المجموعات سواء كان هذا النقص معنويا أو رقميا. كما أدى التقدم في العمر إلى زيادة في الوزن الكلي للبيضة وكذلك الصفار والبياض مع الزيادة في نسبة الصفار وانخفاض في نسبة البياض.

لم يكن لنظم التغذية المختلفة تأثير على سمك القشرة ولم تظهر أي فروق معنوية في وزن القشرة عند عمر **٣٣** أو **٤٤** أسبوعا بينما حدثت زيادة معنوية عند **٥٤** أسبوعا.

وقد انخفضت نسبة القشرة انخفاضا معنويا عند عمر **٤٤** أسبوعا بالمقارنة بعمر **٣٣** أسبوعا أعقبها زيادة معنوية عند عمر **٥٤** أسبوعا. وكان وزن القشرة/الوحدة من سطح القشرة متماثلا في جميع المجموعات وحدث بها نقص معنوي في الفترة من **٣٣** - **٤٤** أسبوعا أعقبها زيادة معنوية عند عمر **٥٤** أسبوعا.