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EFFECT OF MONTH OF PRODUCTION ON EXTERNAL AND INTERNAL OSTRICH EGG QUALITY, FERTILITY AND HATCHABILITY.

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Abstract:*497 ostrich eggs were collected from the breeding flock in Nuclear Research Center from January to October 2006 to study the effect of month of production on internal (Yolk weight, yolk diameters, yolk height, yolk index, albumin weight, albumin height and Haugh unit) and external egg quality (egg weight, egg width, egg length, egg shape index, shell weight, shell %, shell thickness, and shell pore number), egg number, fertility and hatchability percentage. It was found that average of egg number per hen per month, fertility and hatchability were significantly increased with the advancement of laying month. The peaks were observed in July, while the lowest values were recorded in the beginning and the end of the season. The heaviest egg weight was laid in May while the lowest one was observed in January, although there was no obvious trend in the present trait. Egg weight at 39 days of incubation increased from February to May, decreased from June to August, then increased again. However, the opposite trend was observed in egg weight loss percentage. And it was found that egg width, egg length and egg shape index were significantly lower at the start of egg production season (January to March). While there are no highly significant differences between other months. Yolk weight and yolk diameter were increased gradually with the progressive month of production. In addition, yolk height had the higher value in March and April, while it was significant decreased in May, June and July. And the lowest value was observed in other months. Yolk index had the significantly highest value during March, April and July, while this value occupied intermediated with significant differences during May and June as compared to other months that had the significantly the lowest values. Albumen weight was significantly elevated in May, June, July and October. While April, August and September had occupied intermediate value with significant differences. While, the lowest albumen weight value was observed in other months. While, albumen height was significantly lowered at the start of season (January and February), and the end of season*

(September and October) while it was significantly higher in the other months especially in April. Egg shell weight and its percentage of egg weight and shell thickness tended to decrease with the advance of the egg production season being significantly highest at the start (January and February) than all of the season. Meanwhile, shell pore number increased with the advance of being significantly lower at the start of egg production (January to April) than at the end of production in August to October.

INTRODUCTION

Birds are homeotherms so they are less vulnerable to environmental temperature changes than poikilotherms in respect of both functional efficiency and danger of tissue damage. There is evidence that throughout the whole range of practical environmental temperature, laying hens have physiological responses that affects their productive performance (Keener et al., 2006). The relationship between ambient temperature and egg formation and production has been much studied specially in ostrich. Wilson, et al., (1972) and Rozenboim et al., (2007) reported that decreased egg production and weight and shell thickness have been reported to result from naturally and experimentally high temperature. These changes were generally be accompanied by decreased food intake. It has thus been supposed that the decrease in food intake is the primary response to high temperature (Payne, 1966). In some studies increasing the nutrient concentration of the food diet did partially counteract the effect of high ambient temperature on egg production and shell thickness or hatchability (Andrade et al., 1976). However, it has been claimed that there is a direct effect of high temperature on egg production which cannot be reversed by concentration the diet (Mueller, 1967).A destination between direct effect (ambient temperature) and indirect effect (food intake) is to use periods of heat stress too short to allow expression of effects of decreased food intake. Exposure of birds to high ambient temperature (above 38°C) for about 24 hr resulted in decreased egg production and weight and egg – shell quality and food intake for 1 to 2 days (Compose et al., 1960). Similar effects have been noted during the 1 st day after transfer to high temperature whether it was cyclic or constant (Mueller and Sunde, 1975 and Olanrewaju et al., 2006). Yolk formation is essentially a continuous process, while oviposition, ovulation and formation of other egg components are discrete events within the cycle. It is thus possible that the latter events are more susceptible to extreme temperature within the 24 – h cycles. The aim of this study was to examine the effect of month of production on internal and external egg quality, hatchability percentage and pre and post hatching mortality.

MATERIAL AND METHODS

Four hundred ninety seven ostrich eggs were collected from the breeding flock in Nuclear Research Center from January to October 2006. The age was about 6 year for males and 5 years for females. The effect of month of production on internal and external eggs quality, hatchability percentage and pre and post hatching mortality was measured. All breeding birds were daily fed 2.1 Kilograms per bird (divided on two times per day) a completed diet containing 20 % crude protein and 2300 Kcal/Kg diet of metabolizable energy throughout the breeding season (composition and calculated analysis of the experimental diet are presented in table 1).

Table (1): The ingredients and the chemical analysis of the experimental commercial diet.

Items	**(kg/ton food)**
Ingredients:	
Yellow corn	247
Soybean meal	295
Lucerne	350
Dicalcium phosphate	29
Limestone	45
Salt	5
Synthetic lysine	1
Synthetic methionine	1
Antitoxic	2
Min.[1] & Vit. Premix [2]	12
Oil	12
Zinc pastracine	1
Total	1000
Chemical analysis (g/Kg) food:	
ME (K cal/ Kg)	2300
Protein%	20
Crude fiber g/Kg	6
Calcium, g/Kg	3.5
Phosphorus, g/ Kg	0.70

1- The mineral premix provides the following (per 4 kg): choline chloride 1800gm; manganese 225 gm; zinc 150gm; iron 60gm; copper 13gm; iodine 1.5 gm; selenium 0.60 gm; cobalt 0.90 gm; magnesium 250 gm ; Caco3 add to 4 kg (inclusion rate 4 kg / ton).

2 - The vitamin premix provides the following (per 2 kg): vitamin A 37500000 MIU; vitamin D3 11250000 MIU; vitamin E 300 gm; vitamin B1 3300 mg; vitamin B2 3300 mg; vitamin B6 4400 mg; vitamin B12 100 mg; pantothenic 20000 mg; nicotinic 60000 mg; folic acid 2000 mg biotein 200 mg; Caco3 add to 2 kg (inclusion rate 4 kg / ton).

Egg laying started in February and completely ended in October. Collection eggs were took place from 1600 to 1800 h. to minimize the time in the nest and prevent eggs infection.

Eggs were placed in storage racks (stored for four days) after the surface of the eggs were cleaned with brush. The eggs were rotate 180 degree once daily until were placed in the setter. After the eggs were sprayed with suitable disinfectant, as TH_4, they were weighed on an electric balance (± 0.01 gm). Eggs were divided into two groups. The first group (50 eggs as 10 eggs four each month) was assigned to study the effect of month of production on external egg quality (egg weight, egg width, egg length, egg shape index, shell weight, shell %, shell thickness, and shell pore number), and internal egg quality (Yolk weight, yolk diameters, yolk height, yolk index, albumin weight, albumin height and Haugh unit).

The external egg quality was measured as:

1- Both egg weights were measured by an electric balance to the nearest gram .

2- Egg width and egg length were measured with venire.

3- Egg shape index was calculated as egg width over egg length multiplied by 100.

4- The egg contents were evacuated then the shell and its membranes were washed to remove all albumins and carefully dried then shell weight was recorded to the nearest 1 gm using a scale balance (0.1 gm). The weight of the shell included the shell membrane.

5- Shell percentage was calculated as a percent of shell weight over egg weight.

6- Shell thickness was measured by micrometer to the nearest 0.01 millimeter (mm) using the average of three points at the equatorial region, at the broad end and at the narrow end of the egg after the shell membrane had been removed.

7- Shell pore number was calculated as the pore number in one centimeter in the shell.

While the internal egg quality were measured as:

1- Albumin height (cm) was determined using three legs micrometer.

2- Albumin weight was obtained after the eggs were broken by subtracting the egg weight minus both yolk weight plus shell weight.

3- Yolk diameter (cm) was determined using calibrator (0.1 mm).

4- Yolk height was measured by using tripod micrometer and reading to the nearest cm.

5- Yolk weight: The yolk was weighed separately to the nearest 0.1 gm for each egg.

6- Yolk index was calculated as yolk height over yolk diameter

7- Haugh unit was calculated as:

H.u = log 100 (Alb. Height + 7.57 – 1.7 x egg wt) $^{0.37}$

While the second group (447 eggs) was assigned to study the effect of month of production on egg weight loss and hatchability percentage. After removed eggs from storage chamber and weighed, eggs were placed in setter for 39 day at 36 - 36.6 °C and 20-25 relative humidity. The eggs were examined by light candling at the 7th day to remove the infertile eggs and at the 14th day to remove the early embryo dead. The candling was repeated at 21 and 36 days to measure the late dead embryos. From 36th day, eggs were candled daily then weighted at the 39th day to measure the weight loss percentage that calculated as the equation: $\left(\frac{\text{Final egg wight - initial egg weight}}{\text{initial egg weight}} \text{X100}\right)$. At the 39th day, eggs were transferred to hatcher machine (35 – 35 °C air temperature and from 40 - 45 % relative humidity) until hatch (43 day).

Statistical analysis:

Data were statistically analyzed using the general linear models procedure (GLMP) of SAS (1997). ANOVA model (one way) was used according to Snedecor and Cochran (1982) to test the effect of month of production on parameters. The statistical model used was:

$$\mathbf{Y_{ij} = \mu + S_i + e_{ij}}$$

Where $\mathbf{Y_{ij}}$ is the trait under study, μ is the general mean, Si is the effect of month of production, and eij term denotes the random variation among individuals within each group. Differences between means were assessed by multiple range test (Duncan, 1955).

Results and discussion:

In generally there are many factors influence the number of seasonal egg produced. Some are environmental (such as weather, nutrition and obesity, health and physiological factors) while other are genetic once

(Cooper, 2000 and Agana et al., 2003). Egg production of individual ostrich is extremely variable (Bunter, 2002). At good farms, egg production can reach as much as 50 – 70 eggs during the season of 6 – 9 months (Buznitsky, 2005). Egg production figures tend to fluctuate from birds to bird and from farm to farm (Bronneberg et al., 2007). Table (2) demonstrated the effect of month of production on egg production, fertility percentage, and hatchability rate. Our data shown that average of egg number per hen per month significantly ($p < 0.05$) increased per hen with the advancement of laying month. The peak of egg production per hen per month was in July (8.94 eggs), while the lowest number of egg production was recorded in the beginning and the end of the season (2.63 and 5.92 eggs for January and October, respectively). However, the average of monthly egg production for hen averaged 6.34 eggs (Table 2). Similar data was found by Madzingira et al., (2000), Ipek and Sahan (2004) and Wohr and Erhard (2005) who reported that egg production significantly differed regarding to month of laying. And the breeding season commended in January and extended to October, and reached the peak during May and June, then declined again to the end of the season. While Zoccarato et al., (2004) and Fair et al., (2005) demonstrated that the peak of ostrich egg production was from August to September followed by a general slump or rest period with a second lower peak from November to December in South Africa. The variation mentioned between the present results and those from different research in ostrich of egg production suggests that climatic conditions are important factors affecting the present trait. Additionally, fertility in the ostrich was low at the beginning of the season (30.2 and 44.7 at January and February respectively), then increased steadily each month and peaked in June (87.6 %) then declined again until the end of the season (Table 2). similar data was found by Bowsher, (1992), and Lambrechts et al., (2004). Fertility % of the ostrich is a very important measure of the reproductive efficiency Malecki et al., (2004). According to Gowe et al., (1993) egg fertility is generally considered as a trait of both parents and their ability to interact and produce a viable zygote. Fertility percentage in ostrich is very poor as ranged from ≤ 50 % through to good > 85 %, as reported by Deeming and Ar (1999). The obvious from Table (2) that hatchability percentage steadily increased from the start of the season, until reached the peak in June (85.3 %), then declined again until the end of the season. This data was agreed by More et al., (1994), Wilson et al., (1997) and Lamberecgts et al., (2004) who reported that hatchability of ostrich eggs dropped as the breeding season progressed. At the start and end of the season the egg number were low and hatchability was very low, although this may reflect low rates of fertility or unfavorable conditions in partially empty incubators.

Table (2): Effect of month of production on ostrich egg numberfertility % and hatchability rates.

Month	Egg Number	Fertility %	Hatchability %
January	*2.63^{j} ± 1.19	30.2	41.7
February	3.66^{i} ± 0.99	44.7	49.9
March	4.95^{h} ± 0.69	72.2	59.6
April	6.22^{f} ± 0.65	79.8	75.6
May	7.00^{e} ± 0.66	85.3	76.2
June	8.21^{c} ± 0.62	87.6	85.3
July	8.94^{a} ± 0.63	83.2	82.4
August	8.63^{b} ± 0.52	79.5	78.1
September	7.43^{d} ± 0.62	66.8	72.1
October	5.92^{g} ± 0.73	62.2	67.6

* Values are means ± SE.
A, b, c, ….. Means with different superscripts in the same column are significantly different (P< 0.05).

The effect of month of production on ostrich egg weight and egg weight loss percentage at 39 day of incubation was observed in Table (3). The heaviest egg weight was laid in May (1478.9 gm) while the lowest one was observed in January (1233.2 gm) although there was no obvious trend in the present trait. It could be seen that laying month has a significant effect on ostrich egg weight. Madzingira et al., (200) demonstrated that the increase in egg weight towards the end of the breeding season can be explained by the fact that it takes some time for the body conditions of the birds to improve after the improvement in nutrition at the start of the season, especially when little effort was made to maintain the bird's condition during the off season. The present results are in accordance with those obtained by Saha (2003), and Zoccarato et al., (2004). And they added that it is important to highlight that the weight of eggs depends on many factors such as genetics, management, and sequence of laying, feeding and nutrition. It is observed from Table (3) that egg weight at 39 days of incubation increased from February to May, decreased from June to August, hence then increased again. However, the opposite trend was observed in egg weight loss percentage. Its mean that differences in egg weight at 39 days of incubation and egg weight loss percentage were significantly affected by month of laying. Ostrich eggs starts to loss water as soon as they are laid and amount of loss during storage will depend partly on storage relative humidity and temperature (Badley, 1997). During incubation , water is lost across the egg shell at a rate that is dependent on the number and area of pores, the length of the pores (shell thickness) and the water vapor pressure gradient (humidity gradient) between the inside of the egg and the nest or incubation environment. Badley, (1997) documented that low weight loss reduces oxygen uptake and calcium metabolism and causes oedema in chicks, while excessive weight loss causes dehydration in the embryo. Both either high or low weight loss reduce hatchability % and survival of the hatching. Most successfully hatching under artificial incubation condition has been reported for eggs that lost 12 % of their water (Bowsher, 1992). Egg weight loss did not change from year to another, varying only between 12.24 and 12.97 % (Ipek and Sahan, 2004).

Table (3): Effect of month of production on ostrich egg weight and egg weight loss percentage at 39 day of incubation:

Month	Egg weight (gm)	Egg weight at 39 day (gm)	Egg weight loss (gm) %
January	$^*1233.2^{j} \pm 10.19$	$1055.60^{g} \pm 17.22$	14.44
February	$1312.4^{i} \pm 10.99$	$1127.09^{f} \pm 16.39$	14.12
March	$1393.2^{h} \pm 10.69$	$1194.81^{e} \pm 17.12$	14.24
April	$1407.7^{g} \pm 11.65$	$1212.17^{d} \pm 17.22$	13.89
May	$1478.9^{a} \pm 11.66$	$1305.57^{a} \pm 17.19$	11.72
June	$1432.3^{d} \pm 10.62$	$1254.55^{b} \pm 17.15$	12.41
July	$1440.9^{c} \pm 11.63$	$1239.32^{c} \pm 17.26$	13.99
August	$1412.2^{f} \pm 10.52$	1202.49 ± 16.15	14.85
September	$1424.5^{e} \pm 11.62$	$1218.66^{d} \pm 16.15$	14.45
October	$1459.6^{b} \pm 11.73$	$1252.49^{b} \pm 17.15$	14.19

* Values are means ± SE.
A, b, c, ….. Means with different superscripts in the same column are significantly different ($P< 0.05$).

Table (4) demonstrated the effect of month of production on egg width, egg length and egg shape index. It was found that egg width, egg length and egg shape index were significantly lower at the start of egg production season (January to March). While there are no highly significant differences between other months. Ostrich lay the biggest egg of any living bird, about 1500 gm, with a maximum length and breadth of 16 and 13 cm. Ostrich's egg represents 1.25 – 1.5 % of the weight of female compared with the average 3.5 kg chicken which lays a 60 gm egg and is 1.7 % of its body weight (Deeming, 1996). The ostrich egg is oval shaped and very difficult to define visually the round end from the sharp one (Zaharchenko, 2005). Similar data was observed by Sales et al., 1996 and Di Meo et al., 2003 who reported that the values of the length and width are affected by egg weight. The ostrich egg is an exception with a high shape index of 80 % more than other birds (Franco and Beck, 2007).

Table (5) demonstrates the effect of month of production on some internal ostrich egg quality. It was found that yolk weight increased gradually with the progressive month of production except at June and August. Similar pattern were observed in yolk diameter except at May and July it was significantly lowered (Table 5). In addition, yolk height had the higher value in March and April, while it was significant decreased in May, June and July. And the lowest value was observed in other months. As shown in Table (5), yolk index was significantly the highest value during March, April and July, while this value occupied intermediated with significant differences during May and June as compared to other months that had the significantly the lowest values. In addition, Table (5) suggests the effect of month of production on albumen quality. It was found that albumen weight was significantly elevated in May, June, July and October. While April, August and September had occupied intermediate value with significant differences. While, the lowest albumen weight value was observed in other months. While, albumen height was significantly lowered at the start of season (January and February), and the end of season (September and October) while it was significantly higher in the other months especially in April. Similar data was observed by Madeiros (2005) and Cloete et al., (2006) and Keener et al., (2006) who observed that all internal egg quality traits studied did not significantly change at different laying periods studied and there was no obvious trend for these traits. These insignificant differences in internal egg quality traits may be due to that ostrich egg has unique characteristics along the breeding season. Finally, it was found that Haugh unit was significantly low in May, while no significant differences were found between the other months (Table 5).

Finally, Table (6) demonstrates the effect of month of production on external egg quality. It was found that egg shell weight and its percentage of egg weight and shell thickness tended to decrease with the advance of the egg production season being significantly highest at the start (January and February) than all of the season. Meanwhile, shell pore number increased with the advance of being significantly lower at the start of egg production (January to April) than at the end of production in August to October. Madeiros (2005) considered egg quality as one of the essential factors for ostrich egg incubation. He added that the quality of the laid egg is directly proportional to the genetically quality of the hen and its overall proper management.

The latter author added that shell weight percentage averaged 19 % and the higher shell percentage caused a decrease in the percentage of albumin and yolk. They also added that these components did not affect by laying period, unlink the chicken hen, where as laying progresses, there is a lower percentage of albumin and higher percentage of yolk. The results of the present study are partially agreed with those obtained by Cloete et al., (2006) who observed that shell thickness decreased during the hot month (May and July) and at the end of season (September and October). While, the present results disagree with those reported by Brown et al., (1996)and Sahan, (2003) who observed that shell thickness was significantly correlated with egg weight, where the heavier eggs having thicker shells and the egg quality traits as egg length, egg width, egg shape index, shell thickness, percentage of yolk, albumin and shell were significantly differences due to thelayingperiod.

Table (4): Effect on month of production on ostrich egg width, egg length and egg shape index

	1 January	2 February	3 March	4 April	5 May	6 June	7 July	8 August	9 September	10 October
Egg width (cm)	*11.6±0.12^{b}	11.93±0.11^{b}	11.9±0.11^{b}	12.2±0.11^{ab}	12.9±0.12^{b}	12.6±0.11^{a}	12.5±0.11^{a}	12.3±0.11^{a}	12.5±0.11^{a}	12.7±0.12^{a}
Egg length(cm)	14.4±0.17^{bc}	14.4±0.16^{bc}	14.4±0.16^{bc}	14.7±0.16^{ab}	15.2±0.13^{c}	15.0±0.15^{ab}	15.05±0.16^{a}	14.9±0.15^{ab}	15.15±0.16^{a}	15.04±0.16^{ab}
Egg shape index	80.6±0.01^{b}	82.8±0.01^{a}	82.5±0.01^{a}	82.1±0.01^{a}	84.9±0.01^{a}	83.9±0.01^{ab}	83.1±0.01^{b}	81.6±0.01^{ab}	81.6±0.01^{ab}	84.4±0.01^{b}

* Values are means ± SE.

A, b, c… Means with different superscripts in the same row are significantly different (P< 0.05).

Table (5): Effect on month of production on internal ostrich egg quality.

Parameters	1 January	2 February	3 March	4 April	5 May	6 June	7 July	8 August	9 September	10 October
yolk wt (gm)	242.6±9.78e	259.0±9.28d	367±9.29c	387.6±9.28a	391±9.37a	365.5±9.28c	379±9.28ab	365.9±9.28c	75.6±37.6b	382.1±9.79a
yolk diamet.(mm)	13.77±0.24d	13.06±0.23e	14.21±0.24c	14.2±0.24bc	13.07±0.25e	14.74±0.23b	13.87±0.23d	14.75±0.23b	15.25±0.23a	15.08±0.25a
yolk hight.(mm)	2.04±0.16e	2.21±0.14e	3.25±0.15ab	3.62±0.15a	2.73±0.14cd	3.10±0.15bc	3.22±0.15ab	2.06±0.14e	2.35±0.14de	2.34±0.16de
yolk index	0.150±0.01c	0.170±0.01c	0.229±0.01ab	0.254±0.01a	0.209±0.01b	0.210±0.01b	0.232±0.01ab	0.140±0.01c	0.155±0.01c	0.156±0.01c
Alb. Wt. (gm)	666.8±27.4f	719.7±25.9e	724.4±25.9e	782.4±25.9d	851.5±26.2a	810.7±25.9b	821.5±26.0b	801.6±26.0c	818.6±26ab	856±27.4a
Alb. Hight.(mm)	1.63±0.094c	1.67±0.09c	1.99±0.09b	2.28±0.09a	2.08±0.09ab	2.1±0.09ab	1.7±0.09ab	1.92±0.09b	1.6±0.09c	1.54±0.09c
H. unit	34.9±0.41ab	35.10±0.39a	35.39±0.39a	35.58±0.39a	34.05±0.39b	35.15±0.39a	36.43±0.39a	36.42±0.39a	36.43±0.39a	36.25±0.41a

* Values are means ± SE.

A, b, c… Means with different superscripts in the same row are significantly different (P< 0.05).

Table (6): Effect on month of production on external ostrich egg quality.

	1 January	2 February	3 March	4 April	5 May	6 June	7 July	8 August	9 September	10 October
Shell wt	323.8±10.4a	333.7±9.87ab	301.8±9.87bc	237.7±9.87bcd	236.4±9.87e	256.1±9.87bc	240.4±9.87bc	244.7±9.87bc	230.3±9.87cde	221.5±10.4de
Shell %	26.3±0.5a	25.4±0.5a	21.7±0.5b	16.9±0.5c	16.0±0.5c	17.9±0.5bc	16.7±0.5c	17.3±0.5c	16.16±0.47d	15.2±0.5e
Shell poor No.	21.4±0.8d	20.9±0.8d	21.8±0.8d	21.8±0.8d	22.4±0.8cd	23.2±0.8cd	24.6±0.8c	33.2±0.7b	35.2±0.8ab	37.2±0.8a
Shell thick	2.4±0.06a	2.2±0.06b	2.22±0.06b	2.24±0.06ab	1.92±0.06c	2.14±0.06bc	2.21±0.06b	2.0±0.06c	1.97±0.06c	1.99±0.06c

* Values are means ± SE.

A, b, c… Means with different superscripts in the same row are significantly different (P< 0.05).

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الملخص العربى

تاثير شهر الانتاج على جودة بيض النعام الخارجية و الداخلية و الخصوبة ونسبة الفقس

تم اجراء البحث بمزرعة مشروع تربية و اكثار النعام بمركز البحوث النووية – هيئة الطاقة الذرية. حيث تم جمع 497 بيضة من بيض النعام خلال الفترة من يناير و حتى اكتوبر 2006 لدراسة تاثير اختلاف شهور الانتاج على صفات الجودة الداخلية و الخارجية و نسبة الفقس. حيث انتهت الدراسة الى النتائج التالية:

١ -وجد ان متوسط انتاج البيض لكل طائر لكل شهر و نسبة كل من الخصوبة و الفقس قد زادت معنويا من شهر لاخر خلال الموسم الانتاجى. و ان القمة فى المستوى كانت خلال شهرى يونية و يولية و ان اقل المستويات كانت خلال اول و اخر الموسم الانتاجى.

٢ -سجلت اعلى قيم لوزن البيض خلال شهر مايو بينما كانت اقل القيم فى شهر يناير. اما باقى الشهور فلم يكن هناك اتجاه واضح سواء بالانخفاض او بالارتفاع .

٣ -ارتفع وزن البيض عند عمر 39 يوم من التفريخ من شهر فبراير و حتى شهر مايو ثم انخفض من شهر يونية و حتى شهر اغسطس ثم عاود الانخفاض حتى نهاية الموسم الانتاجى. و كان ذلك عكس ما لوحظ تماما فى نتائج معدل الفقد فى وزن البيض عند عمر 39 يوم من التفريخ.

٤ –لوحظ انخفاض القياسات الماخوذة عن كل من طول و عرض البيضة و دليل شكل البيضة فى بداية الموسم من شهر يناير و حتى شهر مارس. بينما لم يكن هناك اختلافات معنوية بين بقية الشهور.

٥ –وجد ان وزن و قطر الصفار قد زاد معنويا من شهر لاخر خلال الموسم الانتاج. و كانت اعلى قيم لارتفاع الصفار فى شهرى مارس و ابريل بينما انخفضت خلال اشهر مايو و يونية و يولية.

٦ –و من ثم فقد سجلت اعلى قيم لدليل الصفار خلال شهور مارس و ابريل و يولية بينما كانت القياسات معتدلة خلال شهرى مايو و يونية ثم كانت منخفضة بقية الشهور.

٧ –ارتفع وزن البياض خلال اشهر مايو و يونية و يولية ثم اكتوبر بينما كانت معتدلة خلال اشهر ابريل و اغسطس و سبتمبر و كانت منخفضة فى معدلاتها بقية الشهور.

٨ –انخفض ارتفاع البياض فى اول الموسم (يناير و فبراير) و نهاية الموسم (سبتمبر و اكتوبر) بينما ارتفع بقية الشهور خاصة خلال شهر ابريل.

٩ – ارتفع وزن قشرة البيضة و نسبتها و سمك القشرة فى اول الموسم (يناير و فبراير) بينما انخفضت خلال باقى الشهور حتى نهاية الموسم النتاجى. و كانت النتائج الماخوذة عن عدد الثغور فى القشرة عكس ذلك تماما.