EVALUATION OF PRODUCTIVE PERFORMANCE OF BROILER BREEDERS AT SOME COMMERCIAL FARMS DURING REARING PERIOD

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ABSTRACT: *Aiming to evaluate the productive performance of some commonly found in Egypt broiler breeders' strains (i.e. Arbor Acres, Hubbard, Indian River, Cobb 500 and Ross 308), the current study was carried out at some commercial farms in three different governorates (North Sinai, Ismailia and Fayoum) during the period from 2015 to 2019. Records of 99455 broiler parent females (23440, 18800, 20623, 12480 and 24112 females) from Arbor Acres, Hubbard, Indian River, Cobb 500 and Ross 308 broiler breeders, respectively, were collected and used in the present study. All studied strains reared under close house conditions according to their management guides from breeding companies. Results showed that, body weight at receiving time for different strains ranged between 32.56 g (Hubbard) to 42.42 g (Arbor Acres). Arbor acers pullets reached 2092.5 g body weight at sixteenth week of age, while the lightest weight at this age detected for Indian River pullets (1683.0 g). After photo-stimulation, reaching sexual maturity, Hubbard pullets recorded the heavier body weight as 3032.25 g comparing with 2954.48, 2919.67, 2861.75 and 2822.5 g for Ross, Cobb, Indian River and Arbor Acers broiler breeder pullets, respectively. Statistical analysis revealed highly significant (P≤0.01) differences between strains at receiving time and 24 weeks of age. Results revealed that, daily and cumulative feed consumption differed significantly (P≤0.01) at first week of age among studied strains, however, the differences in daily and cumulative feed consumption were not significant at 24 weeks of age. Current results could help to predict and evaluate the performance of breeders during production cycle.*

Key words: *broiler breeders, rearing period, commercial.*

INTRODUCTION

The management process of modern broiler breeders became very complicated and challenge due to the continuous genetic improvements for individual strain. These improvements for the most important economic traits (i.e. growth rate, feed conversion and meat yield) increased the challenge facing breeder managers, and may be have a negative effect on egg production and reproductive performance of broiler parents.

Basically, to achieve good egg production and persistency, pullets should be ideally prepared during rearing period, and producers should work for high uniformity, body confirmation and body weight profile by feed management (Yıldırım and Yalçınalp, 2018). Breeders that not reached the target body weight needed for sexual maturity will not commenced egg production (van der Klein *et al.*, 2018). There is a big challenge to control body weight in the period between starting photostimulation and the production peak (Yıldırım and Yalçınalp, 2018). Heavier hens start to lay eggs latter than standard weighed hens, this delay leads to reduction of peak production, and mortality due to heavy weight may occur.

Productive performance of parent stocks influenced by many non-genetic factors. One of these factors is body

weight during production period (it is mainly depending on body weight at rearing period), which considered one of the key factors that affect breeder's performance. When growth rate is excessive, productivity declines due to many ovulations, and conversely, if feed restriction is too severe, egg production will be decreased due to the delay of ovulation and the target will not acquire (Álvarez and Hocking, 2007). So, feed restriction is uninterrupted during the whole life period of commercial broiler breeders' stocks, specially the rearing period (in most cases, during the first two weeks of age the breeder chicks have *ad libitum* access to their food).Breeding companies utilize many of genetically varied stocks to improve the most economically important traits (i.e. body weight, egg production, egg weight and chick quality) in their breeding plans.

In Egypt, mainly due to the growth of population and gross domestic product, there is a growing demand by consumers for low-price animal protein, such needs give an opportunity to broiler chicken meat production to increase. On the other hand, Egyptian poultry association estimated 2017's poultry meat consumption in Egypt by 43% of total consumed animal protein in Egypt (FAO, 2017).Commercially, the most crosses found in Egypt are Ross, Cobb, Arbor Acres, Indian River and Hubbard from the major breeding companies.Performance of broiler breeders differed from one country to another (Yıldırım and Yalçınalp, 2018). Egypt, as one of developing countries, may have lower performance of broiler breeder flocks due to many factors including: management conditions, low feed quality, diseases and the management staff.

MATERIALS AND METHODS

Aiming to evaluate the performance of some broiler breeders' genotypes during rearing period, current study was carried out at some commercial farms in three different governorates in Egypt (North Sinai, Ismailia and Fayoum) during the period from 2015to 2019. Data of the most five commonly found in Egypt broiler breeders' strains have been studied (i.e. Arbor Acres, Hubbard, Indian River, Cobb 500 and Ross 308).

Breeding system and management:

All studied farms were closed houses (with controlled environment) and the system applied for rearing period was floor breeding system on deep litter (wood shavings). Broiler breeder chicks received and maintained at 32.2 - 33°C for the first week, then a gradual decrease was practiced by approximately 2.8°C/week till reaching the standard temperature (21°C) at 5 weeks of age.

Experimental broiler breeder strains and numbers:

Data presented in Table (1) showed the location, house area, number of houses and number of birds for all studied farms and strains. Records of total number of 99455 broiler parent females were collected and used in the present study.

The studied traits:

Body weight at different ages (BW$_x$):

Body weight at the day of receiving birds (BW$_R$) and at 6, 10, 16, and 24weeks of age (BW$_6$, BW$_{10}$, BW$_{16}$, and BW$_{24}$) have been recorded for current study. These weights were taken at morning before feeding, randomly and individually by using number of birds representing about 3% of the total number of birds in the house (every farm included 3 or 4 houses). The average values of body weight of the sampled birds were used in data analysis.

2

Table (1): Number of birds distributed on farms, strains, houses number, house space and location.

Location	Farm	Strain	N. of Houses	House space (m²)	Number of birds	
					Females	Males
Ismailia	1	Arbor Acres	4	1200	23440	3154
	2	Hubbard	4	920	18800	2560
North Sinai	3	Indian River	4	960	20623	3075
	4	Cobb 500	3	840	12480	2000
Fayoum	5	Ross 308	4	1200	24112	3980
Total	5	----	19	19640 m²	99455	14769

Daily and cumulative feed consumption (g/bird) on weekly basis:

Daily (FC$_x$) and cumulative (CFC$_x$) feed consumption by bird during rearing period were recorded on weekly basis (g/bird). Birds freely accessed water, and received a typical restricted amount of feed according to management guides to control their growth and maintain the target weights as possible.

$Daily\ feed\ consumption\ (g/bird)$
$$= \left(\frac{Total\ feed\ consumed\ (g)}{Total\ number\ of\ birds}\right)/number\ of\ days$$

$Cumulative\ feed\ consumption\ (g)$
$= (Daily\ feed\ consumption\ (g) \times 7)$
$+ Previous\ cumulative\ feed\ consumption\ (g)$

Stocking density on weekly basis (StD):

Actual stocking densities have been recorded on weekly basis for all houses in the investigated farms (birds/m²). Due to sexing errors and culling processes and mortality, actual stocking densities changes from farm to farm and from time (age) to time (age).

$Stocking\ density\ (bird/m^2)$
$$= \frac{Total\ number\ of\ birds}{Total\ avilable\ area\ (m^2)}$$

Statistical analysis: -

Data were computerized and variance analyzed according the following model (one-way) by software program SPSS-IBM v. 21.0 (2012) using General Linear Models (GLM). Significant differences among means were detected by Duncan test procedure implemented in the SPSS software (2012).

Model:

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

Where:

Y_{ij} = the value of the trait (observation)

μ = the general mean of the trait

S_i = the fixed effect of ith strain on studied trait (i = Arbor Acres, Hubbard, Indian River, Cobb and Ross).

e_{ij} = residual effect.

RESULTS AND DISCUSSION
Effect of strains on body weight at different ages:

Data presented in Table (2) showed body weight at different ages for

3

investigated commercial breeder strains. Body weight at receiving time (first day in the farm) for different strains ranged between 32.56 g (Hubbard) to 42.42 g (Arbor Acres). Many researchers recorded higher values (except for Arbor Acres chicks) of body weight at receiving day of broiler breeder chicks that detected in recent study, they recorded 40.0 and 44.42 g for Arbor Acres; 40.7 and 40.33g for Hubbard; and 42.0 g for Indian River chicks (Hameed *et al.*, 2005 and Hameed *et al.*, 2012). It is known that chick weight significantly correlated to egg weight that is hatching from, additionally, differences between the sources, environments and incubation management condition also may affect chick weight. So, the slight differentiation in body weight at receiving time could be attributed to above mentioned factors.

At six weeks of age Ross breeders' chicks showed the highest body weight among all studied strains (1142.23 g) while the lowest (741.67g) recorded for Indian River breeders' chick. Reaching the tenth week of age the same trend as in the sixth week have been observed and the highest body weight assigned to Ross breeders' chicks 1357 g comparing with 1278.75 g for Arbor acers, 1254.33 g for Cobb, 1230.25 g for Hubbard and the lowest weight recorded by Indian River breeders' chicks as 1093.75 g. Reviewing breeder performance targets for all strains under investigation, we found that Cobb 500 breeders were the heaviest at 6 and 10 weeks of age, however, Arbor Acres breeders were the lightest birds. Arbor acers pullets reached 2092.5 g body weight at sixteenth week of age, while the lightest weight at this age detected for Indian River chicks (1683.0 g). After photo-stimulation and reaching sexual maturity, Hubbard pullets recorded the heavier body weight as 3032.25 g comparing with 2954.48,

2919.67, 2861.75 and 2822.5 g for Ross, Cobb, Indian River and Arbor Acers broiler breeder pullets, respectively.

Statistical analysis revealed highly significant (P≤0.01) differences between strains at receiving time and at 6, 10, 16 and 24 weeks of age as presented in Table (2). Although, observed values of body weight at 6, 10 and 16 weeks of age were higher that the corresponding values targeted by breeding companies (management guides for studies strains), breederssucceeded in the 24th week of age to keep the body weight of pullets around the target, slightly higher. The same trend was reported by Djermanovic and Mitrovic (2018). Lower values of BW_{24} that the detected means in the recent research have been reported previously for Hubbard (Zuidhof *et al.*, 2007), Cobb 500 (Renema *et al.*, 2001; Djermanovic and Mitrovic, 2018) and Ross 308 (Djermanovic and Mitrovic, 2018) broiler breeders' pullets. Regarding statistical differences observed in all studied ages in current study, Djermanovic and Mitrovic (2018) reported that genotype didn't affected body weight of laying hen significantly. This could be attributed to the different management conditions and strains under investigation by different researchers.

Effect of strains on daily and cumulative feed consumption of broiler breeders:

Due to the high genetic potential for broiler breeder genotypes, the pullets must be subjected to feed restriction to control their body weight, and successfully entered laying phase. It has been reported that commercial broiler breeders should be subjected to restricted control of the amount of feed supplied to them (Tolkamp *et al.*, 2005).

Table (2): Means of body weights (g) at different ages as affected by strains in the current study.

Strain	BW$_R$	BW$_6$	BW$_{10}$	BW$_{16}$	BW$_{24}$
Arbor Acres	42.425 ±0.54[a]	871.25 ±20.16[b]	1278.75 ±13.15[ab]	2092.5 ±70.89[a]	2822.5 ±48.45[b]
Hubbard	32.56 ±1.10[c]	755.00 ±12.91[c]	1230.25 ±40.52[b]	1696.67 ±90.74[b]	3032.25 ±15.11[a]
Indian River	33.83 ±0.29[c]	741.67 ±9.71[c]	1093.75 ±76.83[c]	1683.00 ±40.21[b]	2861.75 ±69.62[b]
Cobb 500	40.35 ±0.92[b]	762.33 ±84.89[c]	1254.33 ±76.59[ab]	1725.33 ±5.77[b]	2919.67 ±43.32[ab]
Ross 308	40.50 ±0.71[b]	1142.23 ±3.72[a]	1357.38 ±37.06[a]	1958.48 ±65.96[a]	2954.48 ±92.15[a]
Overall	37.90 ±4.36	849.63 ±151.81	1242.29 ±101.81	1844.55 ±181.49	2918.05 ±93.74
Strain Effect	**	**	**	**	**

[a, b, c] = values having the same superscript in each column are not differed significantly at $P \leq 0.05$; BW$_{R, 6, 10, 16 \text{ and } 24}$ = body weight at receiving day, 6 weeks of age, 10 weeks of age, 16 weeks of age and at 24 weeks of age, respectively; ** = the effect of the studied factor is highly significant ($P \leq 0.01$).

Means of daily feed consumption for studied strains presented in Table (3). Average values of daily feed consumption for all strains were 32.78, 43.13, 54.11, 75.32 and 123.58 g at one day, 6, 10, 16 and 24 weeks of age, respectively. Results revealed that, daily feed consumption differed significantly (P≤0.01) until six weeks of age among studied strains, however, the differences in daily feed consumption were not significant at 10, 16 and 24 weeks of age (Table, 3). Unfortunately, we did not find any paper in available resources dealing with daily feed consumption of current studied broiler breeder strains, however, the amount of daily feed practiced and fully agreed with recommended daily intake by breeding companies, except at 24th week of age, daily feed intake overall average (123.58 g/day) for studied strains was lower than the recommended by its breeding companies with a range of 129 – 131 g/day/bird). This is very known practice that may be applied to control the higher body weights observed in previous ages of the bird's life, and regressed again to the optimal body weight that recommended by breeding companies.

Data in Table (4) showed the cumulative feed consumption for all broiler breeder strains under investigation. Significant differences between strains were detected by statistical analysis until 16 weeks of age, however, there were no significant differences between studied strains in cumulative feed consumption at 24 weeks of age. The grand mean values of cumulative feed consumption during the rearing period across all strains investigated were 187.73, 1227.63, 2334.68, 5084.95 and 10749.79 g after 1, 6, 10, 16 and 24 weeks of age, respectively. Higher values of cumulated

feed intake during rearing period (i.e. 0 – 24 weeks of age) have been recorded by Hameed *et al.*, 2012 (13.85 kg – Arbor Acres; 14.12 kg - Hubbard) than those detected (range of 10.33 – 11.32 kg) in our research. Results are fully agreed with those found by England *et al.* (2014) and van Emous *et al.* (2015) for Ross 308 breeder pullets. van der Klein *et al.*, 2018 found that during the rearing phase, cumulative feed intake was lower for hens on the standard BW treatment compared to hens on the high BW treatment.

Actual stocking densities for different studied strains:

Actual stocking densities at different ages for studied strains have been recorded in Table (5). For the first, sixth, tenth, sixteenth and twenty-fourth weeks of age, stocking densities averaged in general 27.58, 14.00, 5.62, 5.64 and 5.38 bird/m². Stocking density differed significantly between strains (Table, 5). It was applied also according to recommendations of management guides of studied strains. Since, wrong stocking density could be one of the factors leading to lower performance of egg production (Hellwig and Ranson, 2005), because of the competence for restricted amount of feed – if stocking density settled as higher number of birds/m² – or over feeding when density of birds kept lower, in addition to hygienic problems. Stocking density should be continually monitored and adjusted.

Results obtained in the current study could help evaluating and assessing performance of investigated broiler breeder strains, since the production performance mainly affected by the performance of breeder hens during the rearing period as discussed above.

Table (3): Means of daily feed consumption by bird (g/bird) on weekly basis as affected by strains.

Strain	FC_1	FC_6	FC_{10}	FC_{16}	FC_{24}
Arbor Acres	37.33 ±5.69[a]	34.25 ±2.63[c]	52.75 ±5.38	74.25 ±4.92	125.00 ±0.00
Hubbard	35.00 ±1.73[a]	45.67 ±0.58[ab]	52.00 ±0.00	68.75 ±5.32	122.75 ±0.50
Indian River	26.00 ±0.00[b]	45.00 ±0.00[b]	50.00 ±0.00	67.00 ±0.00	129.00 ±0.00
Cobb	---	48.00 ±0.00[a]	53.00 ±0.00	72.00 ±0.00	113.00 ±1.73
Ross	---	47.00 ±0.00[ab]	62.50 ±17.00	93.75 ±47.50	125.50 ±1.91
Overall	32.78 ±5.97	43.13 ±5.78	54.11 ±8.60	75.32 ±22.08	123.58 ±5.25
Strain Effect	**	**	NS	NS	NS

[a, b, c] = values having the same superscript in each column are not differed significantly at $P \leq 0.05$; $FC_{1, 6, 10, 16 \text{ and } 24}$ = daily feed consumption per pullet at 1 week, 6 weeks, 10 weeks, 16 weeks and at 24 weeks of age, respectively; ** = the effect of the studied factor is highly significant ($P \leq 0.01$); NS = non-significant effects.

Table (4): Cumulated feed consumption on weekly basis as affected by strains.

Strain	CFC_1	CFC_6	CFC_{10}	CFC_{16}	CFC_{24}
Arbor Acres	261.33 ±39.80[a]	1032.50 ±513.33[c]	2262.75 ±405.65[c]	4971.75 ±374.89[b]	10748.50 ±449.98
Hubbard	245.00 ±12.12[a]	1747.67 ±20.21[a]	2703.75 ±859.99[a]	5278.00 ±706.99[a]	10872.75 ±477.14
Indian River	182.00 ±0.00[b]	1554.00 ±0.00[ab]	2436.00 ±938.00[b]	4893.00 ±938.00[ab]	10367.00 ±938.00
Cobb	---	1087.33 ±650.67[abc]	2515.33 ±650.67[b]	5056.33 ±650.67[a]	10336.67 ±598.13
Ross	---	781.67 ±676.98[bc]	1800.75 ±962.63[d]	5218.50 ±1013.98[a]	11320.75 ±1828.56
Total	187.73 ±100.07	1227.63 ±547.33	2334.68 ±775.44	5084.95 ±703.70	10749.79 ±975.79
Strain Effect	**	**	**	*	NS

[a, b, c, d] = values having the same superscript in each column are not differed significantly at $P \leq 0.05$; $FC_{1, 6, 10, 16 \text{ and } 24}$ = daily feed consumption per pullet at 1 week, 6 weeks, 10 weeks, 16 weeks and at 24 weeks of age, respectively; *, ** = the effect of the studied factor is significant ($P \leq 0.05$), highly significant ($P \leq 0.01$); NS = non-significant effects.

Table (5): Stocking density (bird/m²) on weekly basis for different studied strains.

Strain	StD_1	StD_6	StD_{10}	StD_{16}	StD_{24}
Arbor Acres	25.00 ±0.00[c]	15.00 ±0.00[c]	5.60 ±0.00	5.86 ±0.00	5.17 ±0.01[b]
Hubbard	26.50 ±1.00[b]	11.50 ±1.00[d]	5.40 ±0.69	5.49 ±0.74	5.34 ±0.00[ab]
Indian River	30.00 ±0.00[a]	16.50 ±1.00[b]	5.90 ±0.26	5.78 ±0.68	5.63 ±0.19[a]
Cobb	30.00 ±0.00[a]	18.00 ±0.00[a]	5.52 ±0.53	5.39 ±0.41	5.24 ±0.48[b]
Ross	27.00 ±0.00[b]	10.00 ±0.00[e]	5.66 ±0.90	5.61 ±0.93	5.49 ±0.05[ab]
Overall	27.58 ±2.06	14.00 ±3.09	5.62 ±0.54	5.64 ±0.60	5.38 ±0.25
Strain Effect	**	**	NS	NS	*

[a, b, c, d, e] = values having the same superscript in each column are not differed significantly at P ≤ 0.05; $FC_{1, 6, 10, 16\text{ and }24}$ = daily feed consumption per pullet at 1 week, 6 weeks, 10 weeks, 16 weeks and at 24 weeks of age, respectively; *, ** = the effect of the studied factor is significant (P≤0.05), highly significant (P≤0.01); NS = non-significant effects.

9

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تقييم الأداء الإنتاجى لأمهات هجن إنتاج اللحم في بعض المزارع التجارية خلال فترة الرعاية

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الملخص العربى

أجريت الدراسة بهدف تقييم الأداء الإنتاجى لبعض أمهات هجن إنتاج اللحم الشائع انتشارها في مصر (أربور إيكرز، هبرد، إنديان ريفر، كوب 500 و روص 308) في بعض المزارع التجارية في ثلاث محافظات هي شمال سيناء والإسماعيلية والفيوم خلال الفترة من 2015 وحتى 2019. تم جمع واستخدام بيانات عدد 99455 أم من أمهات هجن إنتاج اللحم (23440، 18800، 20623، 12480 و 24112 أم) لسلالات آربور ايكرز، هبرد، إنديان ريفر، كوب 500 و روص 308 على الترتيب. تم رعاية جميع السلالات تحت الدراسة في عنابر مغلقة طبقاً لما جاء في أدلة رعاية هذه السلالات التي تصدرها الشركة الأم. وأظهرت النتائج ما يلى: تراوح وزن الاستقبال في السلالات تحت الدراسة بين 32.56 جم (هبرد) و 42.42 جم (أربور إيكرز). بلغ متوسط أوزان بدارى أربور إيكرز عند عمر 16 أسبوع 2092.5 جم وكان أخف وزن لسلالة إنديان ريفر (1683.0 جم). بعد الحث الضوئى وحتى النضج الجنسى سجلت أوزان سلالة هبرد أثقل وزن (3032.25 جم) مقارنة بـ 2954.48، 2861.75، 2919.67 و 2822.5 جم لبدارى سلالات روص، كوب، إنديان ريفر و أربور إيكرز على التوالي. أظهرت نتائج التحليل الإحصائى فروقاً عالية المعنوية (P≤0.01) بين السلالات تحت الدراسة في وزن الاستقبال وكذلك وزن الجسم عند عمر 24 أسبوع. كانت هناك اختلافات معنوية في كمية الغذاء اليومى المستهلك وكذلك استهلاك الغذاء التراكمى في الأسبوع الأول من العمر، بينما لم تكن تلك الاختلافات معنوية عند عمر 24 أسبوع. من الممكن أن تساعد نتائج الدراسة الحالية في التنبؤ بـ وتقييم أداء أمهات هجن إنتاج اللحم خلال فترة الإنتاج.