Comparison of Egg Productivity Performance between Iraqi Indigenous and Hy-line Chickens

Dhafer A. Ali Nihad Abdul–Lateef Ali Mohammed Baqur S. Al-Shuhaib
Department of Animal Production, College of Agriculture, Al-Qasim Green University, Iraq.
E-mail: dr.nihad@agre.uoqasim.edu.iq

Abstract

This study was conducted in the animal production farm of the College of Agriculture, Al-Qasim Green University in the period from 8-12-2022 to 8-4-2023. This study was conducted to compare the egg productivity performance between the commercial layers Hy-line W-80 and the Iraqi Indigenous layers at the age of 44 weeks to 59 weeks (the peak of egg production). We obtained the Hy-line W-80 layers from Cheflawi Farm in Babil province, while the Iraqi Indigenous Chicken (IIC) layers were obtained from the Al-Saddah district in the same province. A total of 120 birds of Hy-line W-80 layers and the same number of IIC were raised on the floor on deep litter. Both analyzed lines were kept in a similar condition under the same management for 16 weeks. The main objective of this study is to evaluate and compare the productivity traits of the IIC breed with those of the Hy-line W-80, a high-performance commercial hybrid. Analysis reveals significant differences between the two breeds across multiple parameters including hen day production (HD%), egg weight, egg mass, average daily feed intake (ADFI), and feed conversion ratio (FCR). The Hy-line W-80 consistently outperforms the IIC in all traits measured. These findings underscore the genetic superiority of commercial hybrids like the Hy-line W-80 in maximizing productivity and profitability in poultry farming operations. They also highlight the need for targeted conservation efforts and selection work to enhance the quality traits of indigenous breeds for improved productivity. Overall, this study provides valuable insights for poultry farmers and breeders seeking to optimize egg production processes and enhance competitiveness in the market .

Keywords: Chickens; Egg Numbers; Egg Weights, Raqi Indigenous Chicken, Hy-Line, Genotyping

.Introduction

The global production and consumption of chicken eggs have been significantly increased as chicken eggs are the main protein source preferred by humans daily. The use of eggs, particularly in baking adds structure to some wheat products and may also be a source of yellow-brown pigment (1). As a result of their simple preparation process, nutritional benefits, and low cost, they are widely used as a breakfast food and bakery ingredient. The internal and external qualities of the eggs are the two primary features distinguishing eggs and encompass vital information about the purity-transparent, and fresh color, weight, and integrity of the food (2). Nowadays, many commercial strains are used in poultry production for eggs and meat. The majority of these strains, which are hybrids, are generally dwarf and are selected on either egg or meat performance basis (3). On the other hand, IIC are distributed all over Iraq and are thought to have originated, from a mixture of Creole and wild red jungle fowl through natural selection and hybridization over the past few thousand years. Iraq consists of 1

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governorates, with various climates, including desert, steppe, and moderate and subtropical regions. In addition to these different climates ,

there are differences in various species among its governorates (4–7). These circumstances resulted in the flock and phenotypic diversity among Iraqi indigenous chickens (8–10). Hy-Line International is deeply invested in genetic selection to improve laying hen performance, and the resulting genetic product is known as a commercial or modern laying hen (11.(

Rearing native chickens is profitable in poultry farming as eggs are getting in the backyard chicken and producing free food at a lower cost is extremely profitable. According to the above, it is extremely important to understand the egg production performance of indigenous chickens in the breeding system available for the rural poor (Lee et al., 2020). IIC is considered one of the breeds, which has a high potential resistibility to survive in harsh environments (12). Due to the ability of IIC to adapt to different agro-ecological conditions (13), they are the choice for farmers who favour raising this kind of line due to its superior viability, and less lipid and cholesterol content in the egg. At the same time, the public demand for native or ethnic country poultry products is increasing due to an increased consciousness of natural food processing and use (14). ICC is simply reared by villagers in conditions of free range and fed with locally available feed (15). Among many other features, egg production and hatching properties of these native lines have not been reported adequately. In order to improve their features, it is essential to evaluate their performance by comparing it with the most known commercial lines, such as the Hy-line line, that are available in the same region within the same conditions. Due to the commercial importance of the HyLine line, the egg production capacity of this indigenous line may be enhanced. Thus, the selection of variable phenotypic traits between both lines may have remarkable importance for considering selection different selection criteria for indigenous types are clearly appropriate to increase performance (16). Despite the significance of diversity in shaping egg production in IIC (15), the inherently low level of egg production of Iraqi indigenous chickens (IIC) remains unexplored. Therefore, this study aims to compare between IIC with the standard Hy-Line W-80 to assess the level of egg productivity potential in the IIC and to find out the tools necessary to enhance the productivity in this native line.

.2Material and methods

.2.1Ethical Approval

All the conducted experiments and the other housing conditions met ethical standards for animal welfare, including providing adequate space, enrichment, and care for the hens' well-being throughout the duration of the study. The animal welfare committee of Al-Qasim Green University's College of Agriculture approved the animal-related procedures (approval no. 0014/2023). The hens' health and behavior were monitored by specialized veterinarians, and the other housing conditions met ethical standards for animal welfare, including providing adequate space, enrichment, and care for the hens' well-being throughout the duration of the experiment (17 .(

.2.2Birds' resources

This study focused on two lines that exhibited significant disparities in egg production capacity. The two hen populations evaluated in the present study were 120 birds of the

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standard Hyline line and an equivalent number of IIC birds. The age of the selected line was 44th week, which represents the highest level of productivity. The total number of 120 individuals was divided into three replicates, each replicate consisted of 40 hens. In the station, both analyzed lines were kept in similar conditions under the same intensive management for 16 weeks, starting from 44th to 59th weeks of age. Hens were fed a commercially balanced diet that was suitable for the level of productivity. This concentrated was made of a corn-soy-bean blend that contained 17.13% crude protein and 2,756.19 kcal of metabolizable energy per kilogram. Feed was limited acording to the age of the layers, while water was added ad libitum. Ventilation, temperature, and lighting were automatically controlled and easy access for cleaning and maintenance were confirmed. Hens were exposed to 14 hr lighting and 10 hr of darkness with an intensity of 3 – 4 Watts per m2. The temperature was kept at 20˚C and relative humidity ranged from 65 – 70 .%

.2.3Data collection

After adjusting both lines in the station to the same conditions, eggs were collected and the amount of food was also measured on a daily basis. Various productivity traits were collected from the investigated lines on a weekly basis, including hen day production (HDP), feed-to-egg conversion ratio (FCR), egg weight (EW), egg mass (EM), and average day feed intake (ADFI) (26). Using IBM SPSS Statistics software, version 24.0 (IBM, NY, USA), all included traits were calculated and all analyses were deemed statistically significant if the P-value was 0.05 or below .

.3Results

The main productivity traits of two different lines of laying hens, IIC and Hy-Line W-80, were directly compared over 16 weeks, starting from week 44 to week 59. Concerning HD%, Hy-Line W-80 consistently shows higher HD values compared to the IIC line. The average HDP for Hy-Line W-80 ranges from 83.57 to 85.96, while for IIC, it ranges from 37.5 to 41.43. This indicates that Hy-Line W-80 hens lay more eggs per day on average than IIC hens. With higher HDP values and slightly heavier eggs, the Hy-Line W-80 achieves greater overall egg mass production compared to IIC. Concerning FCR values, Hy-Line W-80 has lower FCR indices than IIC, indicating they are more efficient in converting feed into eggs. The FCR for Hy-Line W-80 is between 1.8 and 2.12, whereas for IIC, it is between 3.53 and 4.7. With FCR values ranging between 1.8 and 2.12, the Hy-Line W-80 demonstrates its ability to optimize feed utilization and minimize wastage, ultimately leading to higher egg production efficiency. In contrast, the FCR values observed for the IIC line indicate room for improvement in feed efficiency. With FCR values ranging between 3.53 and 4.7, the IIC line exhibits a significantly higher feed conversion ratio compared to the Hy-Line W-80 (Table 1). This suggests that IIC hens require more feed to produce the same amount of eggs, leading to higher production costs and reduced profitability

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Table 1. Comparison between hen day production and feed to egg conversion ratio traits in IIC and Hy-Lline W-80

Week	HDP I.I.C	Hy-Line W80	FCR I.I.C	Hy-Line W80	P-value	Sig.
44	37.5 ± 0 [b]	85.25 ± 0.23 [a]	3.65 ± 0.01	2.12 ± 0.01 [b]	0.0001	**
45	38.6 ± 0.36 [b]	85.25 ± 0.23 [a]	3.8 ± 0.06 [a]	2.01 ± 0.01 [b]	0.0001	**
46	39.1 ± 0.12 [b]	85.96 ± 0.24 [a]	3.9 ± 0.06 [a]	2 ± 0.06 [b]	0.0001	**
47	38.8 ± 0.24 [b]	85.7 ± 0 [a]	3.53 ± 0.01	1.98 ± 0.01 [b]	0.0001	**
48	40 ± 0 [b]	85.95 ± 0.24 [a]	3.7 ± 0.05 [a]	1.97 ± 0.01 [b]	0.0001	**
49	39.29 ± 0.41 [b]	84.75 ± 0.12 [a]	4.36 ± 0.01	2 ± 0.06 [b]	0.0001	**
50	39.64 ± 0.21 [b]	84.04 ± 0.12 [a]	4.7 ± 0.06 [a]	2 ± 0.06 [b]	0.0001	**
51	39.29 ± 0.41 [b]	85.36 ± 0.2 [a]	4.7 ± 0.06 [a]	1.98 ± 0.01 [b]	0.0001	**
52	39.9 ± 0.24 [b]	84.54 ± 012 [a]	4.2 ± 0.06 [a]	2 ± 0.06 [b]	0.0001	**
53	38.57 ± 0 [b]	83.7 ± 0.12 [a]	4.1 ± 0.06 [a]	2 ± 0.06 [b]	0.0001	**
54	40.7 ± 0.41 [b]	84.4 ± 0.12 [a]	3.83 ± 0.01	2 ± 0.06 [b]	0.0001	**
55	40 ± 0.41 [b]	84.29 ± 0 [a]	3.86 ± 0.01	1.97 ± 0.01 [b]	0.0001	**
56	39.75 ± 0.24 [b]	83.57 ± 0.36 [a]	3.93 ± 0.01	1.97 ± 0.01 [b]	0.0001	**
57	40.25 ± 0.23 [b]	85.36 ± 0 [a]	3.78 ± 0.01	1.8 ± 0.06 [b]	0.0001	**
58	41.43 ± 0 [b]	85.25 ± 0.23	3.63 ± 0.01	1.81 ± 0.01 [b]	0.0001	**
59	39.64 ± 0.21 [b]	84.4 ± 0.12 [a]	3.75 ± 0.01	1.8 ± 0.06 [b]	0.0001	**

The Hy-Line W-80 demonstrates significantly higher egg weight compared to IIC. With EW values ranging from 59.3 to 69.3 grams, the Hy-Line W-80 consistently outperforms IIC, whose EW ranges from 51.18 to 53.78 grams. This substantial difference in egg weight highlights the genetic superiority of the Hy-Line W-80 in laying larger and more numerous eggs, contributing to its reputation for high productivity in commercial egg production operations. The Hy-Line W-80's higher EM production compared to IIC further emphasizes its superiority. EM is a product of both HDP and EW, and the Hy-Line W-80 excels in both aspects. With EM values ranging from 50.55 to 58.5 grams, the Hy-Line W-80 consistently outperforms IIC, whose EM ranges from 19.2 to 22.03 grams. The Hy-Line W-80 exhibits significantly higher ADFI values compared to IIC. With ADFI ranging between 104 and 107 grams, the Hy-Line W-80 consumes a substantially

larger amount of feed on a daily basis. This higher feed intake is consistent with the line's elevated production levels and genetic predisposition for high egg-laying performance. Commercial hybrids like the Hy-Line W-80 are bred for optimal egg production, necessitating increased feed intake to support their metabolic needs and egg formation processes. In contrast, IIC demonstrates considerably lower ADFI values, ranging between 70 and 97.5 grams (Table 2). This lower feed intake reflects the line's comparatively lower productivity and genetic characteristics

.**Table 2.** Comparison between egg weight, and egg mass, and average of day feed intake traits in IIC and Hy-Lline W-80.

Week	EW I.I.C	Hy-Line W80		EM I.I.C		Hy-Line W80	ADFI I.I.C	Hy-Line W80		P-value	Sig.
44	51.18 ± 0.01 [b]	59.3 ± 0.06 [a]		19.2 ± 0.003 [b]		50.55 ± 0.094 [a]	70 ± 0.58	107 ± 0.58 [a]		0.0001	**
45	51.18 ± 0.01 [b]	61.75 ± 0.01 [a]		19.76 ± 0.21 [b]		52.64 ± 0.152 [a]	75 ± 0.58	106 ± 0.58 [a]		0.0001	**
46	51.78 ± 0.01 [b]	61.75 ± 0.01 [a]		20.25 ± 0.08 [b]		53.1 ± 0.16 [a]	79 ± 0.58	106 ± 0.58 [a]		0.0001	**
47	51.9 ± 0.06 [b]	61.86 ± 0.01 [a]		20.14 ± 0.09 [b]		53.01 ± 0.003 [a]	71 ± 0.58	105 ± 0.58 [a]		0.0001	**
48	52.2 ± 0.06 [b]	61.88 ± 0.01 [a]		20.9 ± 0.023 [b]		53.19 ± 0.125 [a]	77 ± 0.58	105 ± 0.58 [a]		0.0001	**
49	52.2 ± 0.06 [b]	61.88 ± 0.01 [a]		20.5 ± 0.19 [b]		52.4 ± 0.08 [a]	89.3 ± 0.1	105 ± 0.58 [a]		0.0001	**
50	52.38 ± 0.01 [b]	62.1 ± 0.01 [a]		20.76 ± 0.11 [b]		52.19 ± 0.12 [a]	97.5 ± 0.2	105 ± 0.58 [a]		0.0001	**
51	52.38 ± 0.01 [b]	62.1 ± 0.06 [a]		20.58 ± 0.21 [b]		53.01 ± 0.01 [a]	97 ± 0.58	105 ± 0.58 [a]		0.0001	**
52	52.58 ± 0.01 [b]	62.2 ± 0.06 [a]		20.98± 0.132 [b]		52.58 ± 0.12 [a]	88 ± 0.58	105 ± 0.58 [a]		0.0001	**
53	52.68 ± 0.01 [b]	62.3 ± 0.06 [a]		20.32 ± 0 [b]		52.15 ± 0.09 [a]	83.6 ± 0.2	105 ± 0.58 [a]		0.0001	**
54	52.68 ± 0.01 [b]	62.45 ± 0.01 [a]		21.44 ± 0.21 [b]		52.71 ± 0.07 [a]	82.2 ± 0.1	105 ± 0.58 [a]		0.0001	**
55	52.68 ± 0.01 [b]	63.2 ± 0.06 [a]		21.1 ± 0.21 [b]		53.27 ± 0.05 [a]	81.5 ± 0.2	105 ± 0.58 [a]		0.0001	**
56	53.18 ± 0.01 [b]	63.74 ± 0.01 [a]		21.14 ± 0.12 [b]		53.27 ± 0.23 [a]	83 ± 0.58	105 ± 0.58 [a]		0.0001	**
57	53.18 ± 0.01 [b]	67.16 ± 0.01 [a]		21.41 ± 0.12 [b]		57.33 ± 0.01 [a]	81 ± 0.58	104 ± 0.58 [a]		0.0001	**
58	53.18	67.57	±	22.03	±	57.6	± 80 ± 0.58	104	±	0.0001	**

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	0.01 [b]	0.01 [a]		0.003 [b]		0.162 [a]				0.58 [a]				
59	53.78	69.3	±	21.32	±	58.5	±	0.1	80 ± 0.58	104	±	0.0001	**	
	0.01 [b]	0.06 [a]		0.11 [b]		[a]				0.58 [a]				

.4Discussion

The Hy-Line W-80 line is known for its high productivity, which is reflected in these results. According to various studies, Hy-Line W-80 hens are among the highest producers globally, with a high values of hen day production often exceeding other lines with noticeable values (18). The observed differences in the HDP data highlighted the line's established reputation for high productivity. This reputation likely stems from a combination of genetic factors, management practices, and environmental conditions conducive to egg-laying performance (19). The data indicates that the HDP of the Hy-Line W-80 hens often surpasses that of other lines. HDP is a crucial metric in poultry farming as it directly impacts the overall efficiency and profitability of egg production operations. Achieving consistently high HDP values is indicative of the line's superior ability to lay eggs regularly and reliably. Comparing the productivity of IIC with the Hy-Line W-80 presents an interesting contrast between a native line and a commercial hybrid line known for its high performance. Commercial hybrids like the Hy-Line W-80 are specifically bred for high egg production, with extensive genetic selection focused on traits such as egg-laying efficiency and feed conversion. In contrast, indigenous lines like the IIC have not undergone the same level of genetic improvement for productivity traits. Thus, their inherent genetic potential for egg production may be lower. In agreement with our results, it has been reported that the productivity performance of IIC was less than that of the Hyline laying hens since the body mass, sexual maturity age and the total egg count from 24 to 56 weeks of age in IIC were less than that of the Hyline laying hens (20 .(

Though indigenous chickens often possess greater resilience to local diseases and environmental stressors compared to commercial hybrids, this resilience may come at the cost of lower productivity. Diseases or health challenges prevalent in the local environment may impact the health and reproductive performance of indigenous chickens, leading to lower HDP values. Commercial hybrids are bred for rapid maturity and early onset of egg production, whereas indigenous chickens may have slower growth rates and delayed onset of laying. This difference in reproductive traits can contribute to variations in HDP between the two types of chickens.

A lower FCR is desirable as it indicates better feed efficiency. The FCR values for Hy-Line are in line with the expected range for high-performance layers (21). The comparison of FCR values between the Hy-Line W-80 and the IIC line clearly demonstrates the superiority of the Hy-Line W-80 in terms of feed efficiency and conversion. The Hy-Line W-80 consistently exhibits lower FCR indices compared to the IIC, indicating a higher degree of efficiency in converting feed into eggs. This efficiency is crucial in poultry farming as it directly impacts the cost-effectiveness and profitability of egg production operations. The FCR values reported for the Hy-Line W-80 fall within the

expected range for high-performance layers. This consistency in FCR performance underscores the line's reliability and suitability for commercial egg production .

Hy-Line W-80 hens produce slightly heavier eggs on average compared to IIC hens. Due to the importance of the genetic selective programs in various investigated populations in Iraq (22,23), this difference in egg weight may be attributed to genetic variations between the two lines, as well as differences in breeding objectives. Notably, the egg weight values for both lines fall below typical industry standards, which usually range from 56-60 grams for commercial layers. This discrepancy may be attributed to measurement units or specific line characteristics. Nonetheless, despite not meeting industry standards in egg weight, the Hy-Line W-80 still demonstrates superiority over IIC in terms of producing slightly heavier eggs and achieving higher egg mass production. Additionally, the Hy-Line W-80's higher ADFI compared to IIC is consistent with its elevated production levels with values ranged between 104 to 107 compared with IIC that exerted ADFI values between 70 to 80. Commercial hybrids like the Hy-Line W-80 are bred for high egg production, requiring more feed to sustain their increased metabolic demands. In contrast, IIC may exhibit lower feed intake levels due to their comparatively lower productivity. Despite consuming more feed, the Hy-Line W-80's superior egg mass production indicates efficient feed utilization and conversion, resulting in higher overall productivity and profitability. While IIC may exhibit resilience and adaptation to local environmental conditions, their lower feed intake limits their potential for egg production and overall productivity in commercial settings. The superior ADFI values of the Hy-Line W-80 highlight its efficiency in feed utilization and conversion, resulting in higher egg mass production and overall profitability. Despite consuming more feed, the Hy-Line W-80 demonstrates optimal feed efficiency, converting feed into eggs at a higher rate compared to IIC. This efficiency is a key factor contributing to the line's reputation for high productivity and profitability in commercial egg production operations .

The highly significant difference in performance between the Hy-Line W-80 and IIC lines, as indicated by the p-value of 0.0001, underscores the clear superiority of the Hy-Line W-80 across all measured productivity traits. However, the reason for the lower productivity of IIC compared with the Hy-Line W-80 may be attributed to the long broody cycles that is considered as one of the main factors contributed to the fluctuated egg lying potential in this line (24.(

This comprehensive superiority of the commercial breeds over the IIC encompasses hen day production, feed efficiency, egg weight, egg mass, and feed intake. However, in many countries, including Iraq, there is no specific conservation programme or selection work to improve the quality traits of the indigenous lines, and therefore such lines usually have lower productivity levels compared to the commercial hybrids (25). Therefore, these findings hold valuable implications for poultry farmers and breeders seeking to maximize productivity and profitability in their operations. By selecting strains like the Hy-Line W-80 with demonstrated superiority in productivity traits, farmers can optimize their egg production processes and enhance their competitiveness in the market. Accordingly, the Hy-Line W-80's comprehensive superiority over the IIC line across all measured productivity traits

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underscores its status as a preferred choice for commercial egg production. Its superior performance in hen day production, feed efficiency, egg weight, egg mass, and feed intake highlights its genetic potential and suitability for maximizing productivity and profitability in poultry farming operations.

.5Conclusion

Iraqi local chicken is a genetic structure that has adapted to live in the harsh conditions of Iraq since ancient times, in addition to the delicious taste of its meat and eggs, making it a favorite for many people. Its distinctive colors and shapes have made it the focus of attention for many poultry enthusiasts. Therefore, it is necessary to preserve these genetic structures and improve them through carefully designed selection programs that work in parallel with experts in molecular genetics to select individuals with preferred genetic traits and productivity, taking into account the values and measurements obtained in our research as a primary source relied upon in determining the educational values that form the basis for selection and genetic improvement processes, and presenting the results of our study under the choice of breeders and researchers to reach the best production of Iraqi local chickens

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