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Effect of crossbreeding on some productive characteristics of laying hens

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Abstract: The hybridization process is considered One of the crucial techniques in programs aimed at enhancing and refining animal breeds, as it works on increasing production and transferring and collection of a large number of desirable genes present in the resulting hybrids, thereby improving them. The generation of chickens resulting from the hybridization of breeds Generally excels in various economic aspects like growth rate, feed efficiency, age of initial egg laying, egg output, and meat production, and meat production. To improve the local chickens, which have a rich reservoir of genes and traits that have given them the ability to adapt to local environmental conditions and resistance to diseases, the production performance is still low. Therefore, this study aims to emphasize the significance of crossbreeding local chickens with high-yield breeds while preserving their unique traits. This approach holds great promise for enhancing the productivity of layer chickens.

Keywords: Crossbreeding, layer hens, local chickens, genetic variation, production traits.

أثر التضريب في بعض الصفات الإنتاجية للدجاج البياض

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المستخلص: تعتبر عملية التهجين من الطرق ألمهمة في برامج التربية وتحسين الحيوان حيث تعمل على رفع الإنتاج ونقل وتجميع عدد كبير من الموروثات المرغوبة الموجودة في الهجن الناتجة اي تحسينها وإن جيل الدجاج الذي ينتج من تهجين السلالات يكون أفضل في معظم الصفات الاقتصادية مثل معدل النمو وكفاءة التحويل الغذائي وعمر الدجاج عند أول بيضة والخصائص الإنتاجية من بيض ولحم. ولتحسين الدجاج المحلي الذي له مخزوناً غنياً بالموروثات والجينات والتي اعطتها القدرة على التأقلم مع الظروف البيئية المحلية ومقاومته للأمراض إلا ان الاداء الإنتاجي مازال منخفضاً لذا هدفت هذه الدراسة على تسليط الضوء على تضريب الدجاج المحلي مع السلالات عالية الإنتاج والاحتفاظ بصفاته لما له اهمية في تحسين الصفات الإنتاجية للدجاج البياض

الكلمات المفتاحية: التهجين، الدجاج البياض، الدجاج المحلي، التباين الوراثي، الصفات الإنتاجية.

Introduction:

The primary goal of poultry breeding is to obtain a high-quality food source with good nutritional value, represented by the production of eggs and meat, which are among the most important nutritional elements for human consumption. Therefore, genetic improvement methods in chickens have been emphasized to obtain breeds and hybrids with high feed conversion efficiency and production. In order to provide a large number of commercial layer chickens that have resulted from the crossbreeding of purebred strains specialized in egg production and suitable for breeding in different country conditions (Zieba et al., 2003).

Crossbreeding is one of the important methods followed in breeding and improvement programs, which works to genetically enhance and improve production performance. It involves transferring and collection of a large number of desirable genes in the resulting hybrids (Hanafi and Iraqi, 2001). Obtaining good and desirable traits occurs by crossbreeding individuals of and different inheritance traits. The performance of the individuals resulting from crossbreeding is generally better and higher than that of the parents or the average of the parents. This phenomenon is referred to as hybrid vigor, and it is measured by calculating the increase in trait performance in the offspring resulting from crossbreeding. This phenomenon is attributed to the genetic differences among the hybrid individuals due to the blending of genetic factors inherited from the mating parents (Qasim, 2022).

The outcomes of crossbreeding are superior in various economic traits such as growth rate, age at first laying egg, feed conversion efficiency, and production characteristics like egg and meat production (Khawaja et al., 2018). Significant improvements in production traits of crossbred chickens (local Brown feather and local black feather with Lohmann Brown) over pure lines were observed (Tawfeq and Al-Neemy, 2022). Balcha et al. (2021) noted that crossbreeding between the White Leghorn (WL) strain and the local Fayoumi (F) strain resulted in improved production traits in local chickens, with the hybrid outperforming the pure strain.

Studied Production Traits:

1- Average body weight at sexual maturity and age at sexual maturity: -

The average body weight at sexual maturity is considered one of the significant biological factors that indirectly influence egg production. It is affected by growth rate, where heavier birds tend to have delayed or slower sexual maturation (North, 1984). Tawfeq and Al-Neemy (2022) indicated in (Table 1) the presence of significant differences in body weight at sexual maturity. Crossbreeding (Lohmann Brown × Local Black) resulted in a high body weight of 1417.33 g, followed by crossbreeding (Lohmann Brown × Local Brown) and (Local Black × Lohmann Brown) with weights of 1109.03 and 1109.10 g, respectively. Crossbreeding (Local Brown × Lohmann Brown) resulted in a weight of 1094.90 g, while pure strains had lower body weights compared to the crossbred lines, with local black, Lohmann Brown, and local brown chickens gave weights of 1050.20, 1039.50, and 991.67 g, respectively. Similarly, Balcha et al. (2021) noted that crossbreeding between White Leghorn (WL) and Fayoumi resulted in a heavier sexual maturity weight than pure strains. Researcher Debes (2017) also found similar results, with White Leghorn having lower sexual maturity weight (1418.16 g) compared to Rhode Island Red (1550.76 g) and Dandarawi (1456.09 g), while reciprocal crossbreeding between (SM × LSL) resulted in a higher sexual maturity weight of (1553.22) g.

As for the age at sexual maturity, it is an important economic trait because the primary objective of breeding layer chickens is egg production. Therefore, adjusting the age at sexual maturity is crucial to enable flocks to start egg production at the appropriate age. Several researchers have pointed out that The onset of sexual maturity is affected by a range of factors, comprising both genetic and environmental elements like temperature, light, and nutrition, or other factors related to reproductive development (Uemoto et al., 2009). Tawfeq and Al-Neemy (2022) reported significant differences in age at sexual maturity, with Lohmann Brown maturing at 138 days and Local Brown at 143.67 days. Crossbreeding (Local Black × Lohmann Brown) and (Local Brown × Lohmann Brown) resulted in maturity ages of 143 and 141 days, respectively. However, sexual maturity was delayed in local black chickens and reciprocal crossbreeding (Lohmann Brown × Local Black) and (Lohmann Brown × Local Brown) with ages of 151, 149, and 150 days, respectively. Hussen et al. (2020) reported that hybrids (H × DRB) and (DRB × H) reached sexual maturity at a younger age (130.7, 137.3 days, respectively) compared to the pure breeds (DRB) and (H) (139.0, 140.4 days, respectively). Similarly, Soliman et al. (2020) found that White Leghorn reached sexual maturity at a younger age (151.40 days) compared to local chickens (182.78 days), and crossbreeding between them resulted in an intermediate maturity age (172.83 days). Debes (2017) noted that White Leghorn had an earlier sexual maturity age (149.65 days) compared to Silver Montazah (189.88 days) and Matrouh (187.41 days). Crossbreeding between (SM ×

LSL) resulted in a younger sexual maturity age (186.6 days), and crossbreeding (MT × SLS) reached sexual maturity at (185.48 days). The reason for this might be due to the negative correlation between body weight and age at sexual maturity (Bruggeman et al., 2005).

Table 1. Average body (BW)weight at sexual maturity (SM) and age at sexual maturity (ASM) in different chicken breeds (Means ± SE).

Sire.No	BW. SM(g	A.S.M (day)	Breed	Studied Country	Reference
1	1050.20± 1.07d	151.0± 1.53a	L.Bl	Iraq	Tawfeq and Al-Neemy 2022
	991.67±1.23f	143.67±2.03b	L.Br		
	1039.50±2.49e	138.67±0.88c	LH.Br		
	1109.10±0.57b	143.0±1.53bc	L.Bl × LH.Br		
	1094.90±0.65c	141.0±1.53bc	L.Br× LH.Br		
	1417.33±0.17a	149.0±1.15a	LH.Br × L.Bl		
	1109.03±0.63b	150.0±1.53a	LH.Br × L.Br		
2	1257.22 + 4.94c	167.00 + 0.57a	WLH	Ethiopia	Balcha et,al, 2021
	1178.36 + 2.94d	167.00 + 1.15a	Fayoumi		
	1357.22 + 4.90b	163.00 + 0.57b	WLH × Fayoumi		
	1364.89 + 1.06a	156.00 + 0.58c	Fayoum WLH×		
3	1418.16±10.23b	149.65±0.67c	LSL	Egypt	Debes, 2017
	1550.76±13.0a	189.88±0.64a	SM		
	1456.09±27.7b	187.41±0.59ab	MT		
	1553.22±44.90a	186.6±1.83b	SM×LSL		
	1479.91±39.43ab	185.48±0.9b	MT×LSL		
4	1669.16±32.64b	182.78±2.50a	AA	Egypt	Soliman et.al,2020
	1829.25±4.73 5a	151.40 ±0.86c	LL		
	1649.72±28.21 4b	180.01±2.64ab	A×L		
	563.74±35.42 b*	172.83±2.31b	L×A		

***Mean with a different letter in the same column indicate a statistical difference (P≤0.05)**

2- Egg weight produced and number of eggs per female:

egg weight is considered an important quantitative trait, as some consumers prefer eggs with higher weight and size. The average egg weight in chickens is approximately 55-60 g (Al-Fayadh and Naji, 1989). Studies conducted by conducted by Tawfeq and Al-Neemy (2022), (Table 2) revealed significant differences in average egg weight. Crossbreeding (Lohmann Brown × Local Black) resulted in the highest average weight of (45.0) g , followed by (Local Brown × Lohmann Brown), (Local Black × Lohmann Brown), and (Lohmann Brown × Local Brown), and finally Lohmann Brown with weights of (43.9, 42.4, 41.6, 41.9) g respectively, outperforming Local Black and Local Brown (40.2, 38.8) g at 6 months of age. This could be attributed to the positive correlation between body weight and egg weight (Al-Neemy, 2009). The number of eggs produced per female was higher for crossbred chickens than for local chickens.

El-Tahawy and Habashy (2021) observed significant differences in egg weight over 90 days in their study of White Leghorn, Sinai, and reciprocal crossbreeding between them. White Leghorn and the hybrid (White Leghorn × Sinai) and (Sinai × White Leghorn) outperformed local Sinai chickens, with egg weights of (56.45, 53.44, 50.71, 47.06) g , respectively. Soliman et al. (2020) found significant differences in egg weight between Egyptian local chickens, White Leghorn, and reciprocal crossbreeding between them. White Leghorn produced the heaviest eggs (57.55) g, followed by the hybrid (Local × White Leghorn) with egg weight (53.14) g , and the reciprocal crossbreeding (White Leghorn × Local) with egg weight (52.29) g , compared to the local strain (47.47) g , which had the

lowest egg weight. The number of eggs was higher for White Leghorn (59 eggs) compared to local chickens (34 eggs), and crossbreeding between the two strains resulted in a higher number of eggs. Debes (2017) noted significant differences in egg weight for Egyptian strains, Silver Montazah (SM), Matrouh (M), and Leghorn (L), and reciprocal crossbreeding among them, at 365 days of age. Egg weight improved for Leghorn and the reciprocal crossbreeding (SM × L) and (M × SLS) compared to Silver Montazah and Matrouh, with weights of (59.22, 56.23, 56.28, 53.43, 53.31) g respectively. The same pattern was observed for the number of eggs produced, where crossbreeding between (SM × L) and (M × SLS) resulted in a higher number of eggs compared to pure strains. The reason for this could be the positive correlation between body weight and egg weight (Al-Neemy, 2009).

Table 2. Average egg weight (eg.w)and number of eggs per female in different chicken breeds (Means ± SE).

Sire.No	eg.w	Egg N./f	Breed	Studied Country	Reference
1	40.4±1.58c	±0.58d0.19	L.Bl	Iraq	Tawfeq and Al-Neemy 2022
	38.8±1.12d	c69±0.0.22	L.Br		
	41.9±1.36b	3b7.1±0.52	LH.Br		
	42.4±1.48b	±0.61cd0.02	LH.Br×L.Bl		
	43.9±1.73a	a5.11±0.03	LH.Br× L.Br		
	45.0±0.38a	±0.40a9.28	L.Bl×LH.Br		
	41.6±1.44bc	a9±0.60.28	L.Br×LH.Br		
2	59.56b± 0.41	.....	BL	Iraq	(Abdulla et.al,2016)
	62.30 a± 1.16	.....	BLB		
	62.29a± 0.50	.....	W		
	58.40 b± 0.61	.....	ISA		
3	59.22A±0.73	176.30C±2.49	LSL	Egypt	(Debes, 2017)
	53.43B±0.11	155.94D±1.8	SM		
	53.31B±0.11	155.94D±1.8	MT		
	56.23A±0.39	198.46B±2.3	LSL×SM		
	56.28A±0.31	210.48A±2.9	LSL×MT		
4	57.45 ± 1.00bc	75.58 ±12.28 c	BL	Iraq	(Omer et.al,2016)
	56.58 ±0.74 c	84.50±10.04b	BLB		
	60.00 ±0.62 b	108.75 ±15.60 a	W		
	66.25±0.75 a	102.75±17.06 a	ISA		
5	47.47c ±0.63	33.94c ±1.91	AlexandriaAA	Egypt	(Soliman et.al,2020)
	57.55a±0.40 51	59.00a±0.78	Lohmann LL		
	53.14b±0.64	46.37b±2.20	L×A		
	52.29b±0.88	42.28b±2.30	A×L		
6	56.45 ± 0.55	.....	Lohmann Brown (LH)	Egypt	(El-Tahawy and Habashy,2021)
	47.06 ± 0.51	.....	Sinai (Si)		
	53.44 ± 0.64	.....	Si×LH		
	50.71 ± 0.70	.....	LH×Si		

***Mean with a different letter in the same column indicate a statistical difference (P≤0.05).**

Also, Omer et al. (2016) observed in their study of 4 lines (Local Black, Black with Brown Neck, Local White Feather, ISA Brown) at 75 weeks of age that ISA Brown chickens gave the highest weight compared to the other lines. Regarding the number of eggs,

the Local White Feather and ISA Brown strains gave the highest number of eggs, while the Black with Brown Neck had a lower number of eggs, with the Local Black strain having the lowest number of eggs, reaching (108.75, 102.75, 84.50, 75.58) respectively. Similarly, Abdulla et al. (2016) noted in their study of local Black and Black with Brown Neck layers, Local White Feather, and ISA Brown chickens that the egg weight produced by Black with Brown Neck and White Feather chickens was higher than that of local Black and ISA Brown, with weights of (62.30, 62.29, 59.56, 58.40) g respectively.

3- Average egg mass (grams/bird):

The outcome of the average egg weight and the number of eggs produced is represented by the egg mass, and the number of produced eggs can be increased through direct selection processes, thereby increasing egg mass (Diyab, 1988). Through research conducted on chickens (Local Black - BL and Black with Brown Neck - BLB), (Table 3) indicated the superiority of Black with Brown Neck chickens. Hermiz et al. (2019) noted that the daily egg mass reached (34.67) g compared to Black Feathered chickens, which had an egg mass of (24.64) g . However, both Mohammed and Hani (2019) did not observe significant differences in daily egg mass between Black Feathered and White Feathered local chickens. On the other hand, Soliman et al. (2020) observed significant differences in egg mass between the Egyptian local strain (A), White Leghorn strain (L), their crossbreeding (A×L), and reciprocal crossbreeding (L×A). The White Leghorn strain outperformed the crossbreeding (A×L) and reciprocal crossbreeding (L×A) in total egg mass (3394.8, 2452.7, 2231) g, respectively, while the local strain gave the lowest egg mass of (1630.7) g. Furthermore, Tawfeq and Al-Neemy (2022) stated that the total egg mass was higher when crossbreeding local breeds (Brown and Black Feathered) and Brown Leghorn chickens. The egg mass for crossbreeding (Brown × Brown Leghorn) and (Brown Leghorn × Black Feathered) was higher than other treatments, reaching (1318.3, 1302.2) g respectively. Black local chickens gave the lowest value of (767.6) g.

4- Egg Production (HDP) %:

Through studies conducted on laying hens, a comparison of egg production among four breeds - the local black, black with brown neck, local white-feathered, and ISA Brown chickens - was observed by Omer et al. (2016), as shown in Table 3. The results indicated that the breed with brown neck had the highest egg production at 50% of production, reaching 50.95%. It was followed by the local black breed 46.83%, the white-feathered breed 45.58%, and finally, the ISA Brown breed 43.65%. Hermiz et al. (2019) noted that the black-feathered breed with brown neck outperformed in egg production, achieving 58.27%, compared to the black-feathered breed which had an egg production 42.33%. Moreover, hybridization significantly improved egg production invigor local chickens when crossbred with foreign chickens. Tawfeq and Al-Neemy (2022) indicated that the crossbreeding of local brown with brown Lohmann and brown Lohmann with local black resulted in higher egg production percentages (50%, 48.2%, and 46.7%, respectively) compared to other combinations, while the local black breed had the lowest production 31.7%. The improvement in egg production can be attributed to hybrid vigor enhancing economic traits.

Table 3. Average egg mass and egg production percentage (HDP)in different chicken breeds (Means ± SE).

Sire.No	egg mass(g)	:% (HDP)	Breed	Studied Country	Resources
1	.....	46.83 ± 5.47	BL	Iraq	(Omer et.al,2016)
2	.....	50.95 ± 5.46	BLB		
2	.....	45.58 ± 5.24	W		
2	.....	43.65 ±5.27	ISA		
3	24.64 ± 1.06 b	42.33 ± 1.80 b	Black (BL)	Iraq	et.al Hermiz) (2019.
	34.67 ± 1.06 a	58.27 ± 1.80 a	Black brown neck (BBN		
	22.61 ± 0.59 a	.....	Local White (L1)	Iraq	Hani و Mohammed) (2019.
	22.57 ± 0.56 a	.....	Local Black (L2)		
4	1630.67c ±100.26	.....	AlexandriaAA	Egypt	(Soliman et.al,2020)
	3394.82a±47.35	.....	Lohmann LL		
	2452.69b±117.47	.....	L×A		
	2231.51b±137.35	.....	A×L		

Sire.No	egg mass(g)	:% (HDP)	Breed	Studied Country	Resources
5	767.6±14.18 c	31.7±0.87 d	L.Bl	Iraq	Tawfeq and Al-Nuaimi 2022
	853.1±12.56 c	15.1±7.36 c	L.Br		
	1044.3±14.25 b	89.2±7.14 b	LH.Br		
	848.0±19.52 c	±0.963.33 ed	LH.Br×L.Bl		
	1318.3±11.69 a	91.1±050. a	LH.Br× L.Br		
	1302.2±17.94 a	64±0.2.48 a	L.Bl×LH.Br		
	1164.1±12.39 b	46.7±1.15 a	L.Br×LH.Br		

***Mean with a different letter in the same column indicate a statistical difference (P≤0.05).**

5- Fertility Rate (%):

Fertility is among the essential traits for a breeding flock, contributing to increased fertilized egg numbers and hatchings in the flock. It is influenced by various factors including genetic, environment, temperature, nutrition, egg size, season, male-to-female ratio, and egg storage duration. Exceeding optimal body weight through selection can help maintain fertility rates *(North and Bell, 1990)*. A study by Amin (2014), as shown in(Table 4)revealed significant differences in fertility percentages across three breeds (Saso S, Mandarah M, Italian I) and their crossbreeds. Italian, Saso, I×S, and the reciprocal crosses (I×M) and (S×I) exhibited higher fertility rates (73.6%, 72.9%, 71.6%, 72.5%, and 72.5%, respectively). In contrast, Mandarah, M×S, S×M, and M×I showed lower fertility rates (63.5%, 69.7%, 70.6%, and 70.6%, respectively). Ibrahim et al. (2018) measured fertility rates in five white egg layer breeds and observed higher fertility rates for Dominant Red (DR), Dominant Sussex (DS), and Koekoek (KK) compared to Lohmann Brown (LB) and Lohmann Dual (LD) breeds (83.3%, 83.3%, 84.4%, 70.0%, and 30.5%, respectively). Furthermore, Abdullah (2022) noticed significant differences in fertility between Kurdish local chickens (K) and Super Harco commercial dual-purpose chickens (H), and their crossbreeds (H×K) and (K×H). Furthermore, (K) and the hybrids (K×H) and (H×K) exhibited higher fertility.

Table 4. Average Fertility Percentage in Different Chicken Breeds (Means ± SE).

S.No	(%)Fertility rat	Breed	Studied Country	Resources
1	63.5±7.90	Mandarah (MM)	Egypt	(Amin ,2014)
	72.5±9.90	Saso (SS)		
	73.6±10.8	Italian (II)		
	71.6±9.80	S×I		
	69.7±7.50	S×M		
	70.6±11.1	I×M		
	72.5±9.40	I×S		
	70.6±8.80	M×S		
	72.5±10.1	M×I		
2	83.3a	DR	Ethiopia	(Ibrahim et al.,2018)
	83.3a	DS		
	84.4a	KK		
	70.0b	LB		
	30.0c	LD		
3	75.40b ± 1.94	HH	Iraq	(Abdullah,2022)

S.No	(%)Fertility rat	Breed	Studied Country	Resources
	92.38a ± 0.95	KK		
	86.54 a± 0.96	HK		
	87.89a ± 4.68	KH		
4	72.0 d ± 1.15	L.Bl	Iraq	Qasim, 2022
	84.0 bc± 2.31	L.Br		
	82.1 c± 1.73	LH.Br		
	84.0 bc ± 1.15	L.Bl × LH.Br		
	96.0 a± 0.58	L.Br× LH.Br		
	88.5 b± 2.03	LH.Br × L.Bl		
	88.0 b± 2.18	LH.Br × L.Br		

***Mean with a different letter in the same column indicate a statistical difference (P≤0.05)**

rates compared to (H), with percentages of (92.38, 86.54, 87.89, 75.40) % respectively. Additionally, (Qasim, 2022) pointed out a significant improvement in fertility rates through crossbreeding. The hybrid (♀ Local Brown × ♂ Brown Lohmann) showed the highest fertility rate of 96.0%, surpassing the other hybrids. Purebred hybrids, on the other hand, demonstrated lower fertility rates, with (Local Black) 72.0% and (Brown Lohmann) 82.1%, respectively. The observed variation in live body weight between the crossbred and purebred hybrids might contribute to the negative impact on fertility rates, as a negative correlation between fertility and body weight has been reported (Siegel and Dunnington, 1985).

6- **Heterosis (Hybrid Vigor):** This refers to the enhanced traits of the first-generation offspring resulting from the mating of purebred parents that are not closely related, exceeding the average traits of the mated parents. This phenomenon is attributed to the genetic differences in hybrid individuals due to the combination of genetic factors from the mated parents. (Mekky et al., 2008) pointed out in (Table 5) that there is an impact of hybrid vigor in the crossbreeds produced from the Sinai, Faiyum, Rhode Island, and White Leghorn breeds. Hybrid vigor was positively related to egg weight, egg production, and the number of produced eggs. Concerning egg weight, the hybrid vigor was positive in (Faiyum × Sinai), (Sinai × Rhode Island), (Sinai × Faiyum), and (Rhode Island × Sinai), with percentages of (3.01, 4.31, 5.84, 4.58)% respectively. On the other hand, the remaining hybrids showed negative hybrid vigor. Additionally, the hybrid vigor between (Faiyum × White Leghorn) and (Sinai × White Leghorn), as well as (White Leghorn × Sinai), in egg production displayed positive hybrid vigor percentages of (5.48, 3.69, 5.81) % respectively. Moreover, a significant and high positive hybrid vigor was noted in the number of produced eggs for the hybrids (Faiyum × Sinai) and (Sinai × Faiyum) with percentages of (12.49, 18.12) % respectively. (El-Tahawy and Habashy, 2021) observed positive hybrid vigor for the number of produced eggs over 90 days when crossbreeding (Brown Lohmann × Sinai), with a percentage of (0.62) %. As for the average production trait over 90 days, hybrid vigor showed a negative percentage of (2.90) % and they mentioned that crossbreeding between local chicken breeds led to rapid growth offspring and increased the number of produced eggs. Moreover, (Qasim, 2022) indicated positive hybrid vigor percentages for the trait of the number of produced eggs in four hybrids (♀ Local Brown × ♂ Brown Lohmann), (♀ Brown Lohmann × ♂ Local Black), and (♀ Brown Lohmann x ♂ Local Brown), with percentages of (24.4, 13.02, 17.2) % respectively. This could be attributed to the maternal effect of the Local Black, as the total egg production average was significantly lower for sires (Local Black) compared to Brown Lohmann sires. Regarding egg weight, hybrid vigor was positively in favor of crossbreeding (♀ Local Brown × ♂ Brown Lohmann) over the average of the parents with a percentage of (4.01), followed by crossbreeding (♀ Brown Lohmann × ♂ Local Black) with positive hybrid vigor of (0.45). However, hybrid vigor was negative in the remaining crossbreeding combinations.

Table 5. Hybrid Vigor Percentage in Different Chicken Breeds:

Sire.No	Egg production	Egg weight	egg number	Breed	Studied Country	Resources
1	2.70	3.01	12.49	S×F	Egypt	(Mekky et al,2008)
	5.48	-5.14	4.71	WL×F		
	-4.55	-2.14	-9.12	RIR×F		
	3.69	-1.10	5.81	WL×S		

Sire.No	Egg production	Egg weight	egg number	Breed	Studied Country	Resources
	-1.58	4.31	3.22	RIR×S		
	-1.70	0.43	6.68	RIR×WL		
	4.41	5.84	18.12	F×S		
	-1.22	-3.82	-3.15	F×WL		
	-9.82	-2.18	-15.60	F×RIR		
	5.81	-4.69	-5.10	S×WL		
	-12.27	4.58	-14.05	S×RIR		
	4.55	-1.93	1.72	WL×RIR		
2	-2.90	.....	0.62	Si×LH	Egypt	El-Tahawy and Habashy,2021
3	.....	-2.39	11.6	LH.Br×L.Bl	Iraq	Qasim , 2022
	.....	4.01	24.4	LH.Br× L.Br		
	.....	0.45	13.02	L.Bl×LH.Br		
	.....	-0.15	17.2	L.Br×LH.Br		

Conclusion :

Through the research conducted on the comparative production performance between different local and foreign chicken breeds, along with crossbreeding between them, significant improvement in the local chicken's performance is observed when crossbreeding with foreign chicken breeds. This improvement is noticeable in most production traits and is attributed to hybrid vigor. This phenomenon is attributed to the genetic differences in the hybrid individuals resulting from the combination of inherited genetic factors from the parent breeds.

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