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*Corresponding author
Hurea Saber Abdulrazaq
hurea.abdulrazaq@su.edu.krd

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Genetic Association Between A Parents And Its Grandparents In Performance Traits Of Broiler Chickens

Hurea Saber Abdulrazaq[1]
1Department of Animal Resource ,College of Agriculture, Salahadden University-Erbil,Erbil,Kurdistan Region, Iraq.

ABSTRACT

This study aims to estimate the heredity and genetic correlations of some productive performance traits that geneticists are interested in, well as to investigate the genetic relationship between parents and grandparents of broiler chickens. Blood samples were collected from in tubes containing EDTA anticoagulant. From 240 Ross-308 birds, which were transferred directly laboratory to conduct the process of extracting DNA from blood samples. As for polymorphism, it was highest in OPA-9, where it was recorded as 13, and the percentage of polymorphism was 39.39 for the same primer. Coefficient of genetic similarity was between 0.81 - 1.00. , these characteristics were taken to compare between parents and grandparents at the age of 30 weeks in order to identify the characteristics studied when they are at the best productive age for comparison between them. It was found that there were significant differences between parents and grandparents in Egg/bird/week, Hatching, egg production, hatching all eggs (%), Chicks/Hen, where the parents recorded the highest significant difference in all of these characteristics, which was (5.90 , 5.70, 87.1 , 87.1 , 5.10). respectively. Grandparents recorded a significant superiority in body weight and egg weight, which were (4064.33 and 58.5), respectively.

1.Introduction

The development of molecular genetics technology provides new possibilities in selecting genes for the development of farm animals. PCR played a major role in eukaryotic genomics research to develop DNA marker applications ((Marle-Köster & Nel, 2003). By detecting genetic variation, genetic markers provide useful information at various levels including population structure, levels of gene flow, evolutionary markers (Féral, 2002). PCR is one of the most useful and cost-effective measures of genetic diversity and is a useful biomarker (Bagley et al., 2001). It relies on this technology to distinguish important genetic resources in poultry and other farm animals ((Abdulrazaq, 2023); (Nahashon et al., 2010), (Abdulrazaq et al., 2020), (Alcaraz & García-Berthou, 2007). In a study conducted by (Omer & Darogha, 2024), polymerase chain reaction was used to detect bacteria, as it is considered to have multiple uses.

Eggs are produced from chickens, but not everyone has information about the ancestors of these chickens. Most chickens around the world come from large poultry companies, and many are commercial hybrid breeds. In recent decades, poultry farming sectors have been intensively strengthened, and this increase has led to the retention of larger numbers of pure genetic lines and thus increased availability to choose from (Korver et al., 2024). This study aims to estimate the heredity and genetic correlations of some productive performance traits that genetic improvement scientists are interested in, as well as to knowing the parents and grandparents of broiler chickens and the genetic relationship between them, which relates to international companies specializing in the production of broiler chickens.

2. MATERIALS AND METHOD

2.1. Sample collection

Samples were collected from the wing vein in the arm near the elbow joint in tubes containing EDTA anticoagulant. 3 mm of blood was collected from 240 Ross-308 birds obtained from VANO GROUP, where one hundred and twenty Ross parents and one hundred twenty Ross grandparents. It was transferred directly to the laboratory to conduct the process of extracting DNA from blood samples.

2.2. DNA extraction

DNA extraction was performed using the Promega USA kit (Han et al., 1990). In the DNA analysis laboratory at the university's medical research center. The concentration and purity of DNA were measured using the Nano Drop® spectrometer, and the purity of the DNA samples was between 1.8 and 1.9. Samples were diluted to 30 ng/µL, for use in RAPD PCR.

2.3. RAPD-PCR analyses

Fifteen of the primers gave results to find complementary sites on genomic DNA and are listed in (Table 1). DNA analysis and amplified begins after preparing the reaction solution, which contains: DNA 30 ng, primer 10 µM, 1x PCR buffer GoTaq® Green Master Mix, 1x, MgCl2 3 mM, Each: (dATP, dCTP, dGTP dTTP) (400µM), The final volume is 25 µl. The first stage: the double-stranded DNA is denatured at a temperature of 95 degrees Celsius for 5 minutes. This is followed by 40 cycles at 95°C for one minute (short denaturation), 42°C for one minute (primer annealing), and 72°C for two minutes (DNA elongation). The complementary stage at a temperature of 72 for 5 minutes. The Gene Ruler™ 100 bp DNA Ladder marker 100 – 1500 bp. In all samples, 2 µl of Blue/Orange Loading dye obtained from the American company Promega was added to 10 µl of the reaction product. Electrophoresis was performed by applying 100 V of electrical energy. The duration of electrophoresis is 90 minutes. The electrophoresis product was tested on 2% agarose gel in 1XTBE buffer obtained from the same American company Promega. Then the stage of dyeing with ethidium bromide begins, and then the result is photographed by shining ultraviolet light inside a special device called a darkroom.

2.3. Production characteristics

Productive characteristics were measured for both parents and grandparents: body weight, feed intake per bird per day, number of eggs per bird per week, feed conversion factor, number of eggs hatched per bird per week, percentage of weekly egg production, percentage of eggs hatched, number of chicks per chicken per week. Egg weight. The measuring devices were used,

including a scale with a capacity and sensitivity of ± 10 kg for the weight of the chicken, and a digital scale with a sensitivity of 0.1 gm for the weight of the eggs. The following equations were used as follows: % for egg production = number of eggs/number of birds x 100; feed conversion ratio = feed intake / egg mass (egg mass = average egg weight * Number of eggs in a certain period).

2.5. Statistical analysis

Calculate the genetic similarity (F) between parents and grandparents, using the law (Nei & Li, 1979): F = 2 x Nxy / (Nx + Ny). Data were recorded and statistically analyzed with a score of (1) or absence of (0). The polymorphism of each primer was calculated by applying the following formula: polymorphism = (Np / Nt) × 100 (Bowditch et al., 1993).

As for the production characteristics, they were analyzed statistically using the SAS program (Institute, 2012).

3. RESULTS AND DISCUSSION

In the current study, the RAPD technique was used to evaluate the genetic relationship between parents and grandparents. The (Table 1) shows the fifteen primers that gave results. As for (Figure 1), it shows the bands obtained from electrophoresis.

It is clear from (Table 2) the number of band for each of the parents and grandparents, as well as the polymorphism of the band and the percentage of polymorphism for them. Whereas grandparents outperformed parents in the number of bands, polymorphisms, and polymorphism percentage, which were 184, 11, and 6, respectively. When comparing groups, the group that records the highest percentage of polymorphisms is characterized by increased genetic similarity compared to the other group. This is consistent with what was found by (Abdulrazaq, 2022) when comparing five groups of birds, where the highest percentage of polymorphisms was 10.1 for the E group compared to the W groups. ,N,S,C were 7.4, 7.9, 9.8, 8.2 respectively.

The (Table 3) shows the total number of bands, polymorphisms, percentage of polymorphisms, unique and monomorphisms, in addition to the molecular weight of each primer. The primer, OPA-19, recorded the highest number of total bands, 38, while OPA-16 recorded the lowest one, 11. As for polymorphism, it was highest in OPA-9, where it was recorded as 13, and the percentage of polymorphism was 39.39 for the same primer. The lowest polymorphism and percentage of polymorphism was for the OPA-19 primer, where it was recorded as 1 and 2.63, respectively. As for the mono band and monomorphic band, the highest were in OPA-19, where they were 18 and 37, respectively, while the lowest were 5 and 10, respectively, for OPA-16 and OPU-01. As for the molecular weight, it was highest in OPA-18, which was 150-1500, and lowest in OPA-01, which was 300-1000. The total number of bands was 361, and this agrees with what was found by (Abdulrazaq & Ameen, 2023) In a study comparing three types of local birds: chicken, guinea fowl, and quail, in which 12 primers were used and a total number of bands was obtained of 340. The total polymorphism percentage in the current study for all primers was 18.84, and this agrees with what was found by (Singh & Sharma, 2002) when using 12 primers, and this represents the high similarity between the genotypes. The molecular weight of all primers in the current study was 100-1500bp, and this agrees with (Fadhil & Ahmed, 2016).

The Coefficient of genetic similarity is shown in (Table 4), where when using the fifteen primers, the Coefficient of genetic similarity ranged between 0.74 - 1.00 in the parent, while in the grandparent it ranged between 0.73 - 1.00, and the ratio of the parent/grandparent Coefficient of genetic similarity was between 0.81 - 1.00. This indicates the great similarity between parent and grandparent, and this is due to the fact that they are of the same variety, because the Coefficient of genetic similarity in the same variety is very high, and this is what was confirmed by (Baweja et al., 2016), where in his study it ranged between 0.92 - 1.00. The Coefficient of genetic similarity between different species is small, and this was confirmed by the study (Nahashon et al., 2010), which ranged between 0.46 - 1.0 between chickens and guinea fowl. The same thing was confirmed by (Abdulrazaq & Ameen, 2023),

which ranged between 1.0 - 0.5 when Compare three types of birds.

The productive characteristics that are concerned with those working in improving poultry, as well as the poultry breeder, are presented in (Table 5), and based on them, we can evaluate the bird, especially the parents, as we must take these characteristics as a means to fully evaluate the production performance. They include body weight (g), feed(g)/bird/ day, egg/ bird/ week, hatching/ egg/ bird/ week , egg production/ hen/ weeks %, hatching all eggs (%), chicks / week / hen - housed, egg weight (g), feed conversion ratio (FCR). In the current study, these characteristics were taken to compare between parents and grandparents at the age of 30 weeks in order to identify the characteristics studied when they are at the best productive age for comparison between them. It was found that there were significant differences between parents and grandparents in egg/bird/week, hatching, egg production, hatching all eggs (%), chicks/hen, where the parents recorded the highest significant difference in all of these characteristics, which was (5.90 , 5.70, 87.1 , 87.1 , 5.10). respectively. Grandparents recorded a significant superiority in body weight and egg weight, which were (4064.33, 58.5), respectively. The reason for the increase in egg weight is due to the decrease in the number of eggs produced, which leads to an increase in the weight of the eggs, as well as an increase in body weight because there is a direct relationship between the body weight of the bird and the weight of the eggs produced from it. Heavier birds had greater body weight and greater egg weight (Raziq et al., 2024).

Poultry breeding programs want to improve the genetic performance of birds through hybridization and selection schedules. These studies on poultry farming go through two stages. The first is selection studies to improve performance at the pure line level. At this stage, all genetic parameter estimates, breeding value estimates, and molecular genetic methods are performed. This provides the highest level of homogeneity in terms of the effects of added genes across all processes (Narin & İnanöz, 2016); (Quinton & Smallbone, 2006). Current studies are related to this stage. Breeding companies have worked on selection studies to improve their layer lines to achieve some performance (Thiruvenkadan et al., 2010). The second stage of poultry farming is the process of crossing lines that were developed by selecting and comparing hybrid groups.

Table 1. sequences of the primers used GC content

Primer Name	Sequence 5' to 3'	%GC content
OPA-17	GACCGCTTGT	60%
OPQ-01	GGGACGATGG	70%
OPA-18	AGGTGACCGT	60%
OPA-14	TCTGTGCTGG	60%
OPU-01	ACGGACGTCA	60%
OPA-20	GTTGCGATCC	60%
OPQ-15	GGACGCTTCA	60%
OPQ-10	GGCTAACCGA	60%
OPA-19	CAAACGTCGG	60%
OPA-16	AGCCAGCGAA	60%
OPA-06	GGTCCCTGAC	70%
OPA-11	CAATCGCCGT	60%
OPA-13	CAGCACCCAC	70%
OPA-01	CAGGCCCTTC	70%
OPA-09	GGGTAACGCC	70%

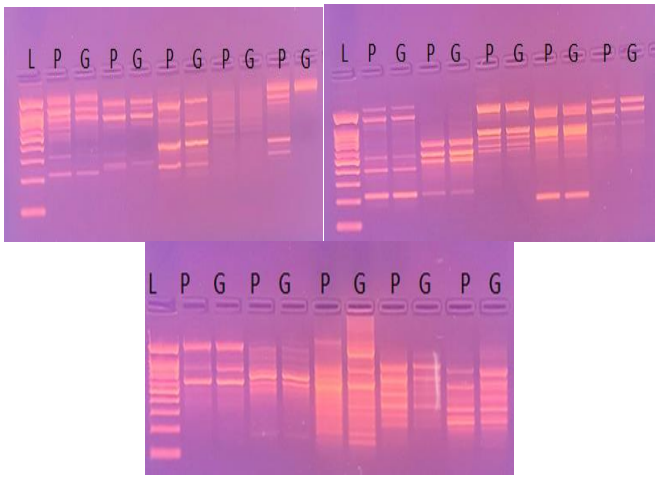

Figure 1. Electrophoretic pattern of genomic DNA amplification in parent and grandparent chicken using OPA-17; OPQ-01; OPA-18; OPA-14; OPU-01; OPA-20; OPQ-15; OPQ-10; OPA-19; OPA-16; OPA-06; OPA-11; OPA-13; OPA-01; OPA-09 primer.

Table 2. Number of bands for parent and grandparent

ROSS	T N B	P B	% P
parent	178	10	5.6
grandparents	184	11	6.0
sum	362	21	5.8

(TNB) total number of bands, (PB) polymorphisms of band, (%P) percentage of polymorphisms.

Table 3. Number of bands, % Polymorphism, Size (bp)

Primer Name	T N B	P B	M B	Mm B	% P	Size (bp)
OPA-17	23	7	8	16	30.43	250 - 1500
OPQ-01	16	2	8	14	12.50	300 - 1500
OPA-18	23	7	8	16	30.43	150 - 1500
OPA-14	35	1	15	34	2.86	300 - 1500
OPU-01	16	6	5	10	37.50	350 - 1500
OPA-20	20	2	9	18	10.00	220 - 1200
OPQ-15	28	4	12	24	14.29	220 - 1000
OPQ-10	32	2	15	30	6.25	300 - 1500
OPA-19	38	1	18	37	2.63	100 - 1200
OPA-16	11	1	5	10	9.09	300 - 1500
OPA-06	16	2	7	14	12.50	400 - 1500
OPA-11	17	1	8	16	5.88	200 - 1500
OPA-13	31	11	10	20	35.48	200-1500
OPA-01	22	8	7	14	36.36	300-1000
OPA-09	33	13	10	20	39.39	100-1000
sum	361	68	145	293	18.84	100-1500

Table 4. Coefficient of genetic similarity (F) for parent and grandparent

Primer Name	parent	grandparents	parent/grandparents
OPA-17	0.88	0.76	0.82
OPQ-01	0.90	0.90	0.90
OPA-18	0.88	0.76	0.82
OPA-14	0.94	1.00	0.97
OPU-01	1.00	0.73	0.86
OPA-20	1.00	0.84	0.92
OPQ-15	0.84	0.94	0.89
OPQ-10	1.00	0.89	0.94
OPA-19	0.95	1.00	0.97
OPA-16	1.00	0.83	0.92
OPA-06	0.81	1.00	0.90
OPA-11	1.00	0.89	0.94
OPA-13	0.74	0.95	0.85
OPA-01	0.88	0.74	0.81
OPA-09	0.74	1.00	0.87

Table 5. Production parameters between parents and Grandparents

production parameters	Parents	Grandparents
Body weight (g)	3431.67 ± 0.577 b	4064.33 ± 3.785 a
feed(g)/bird/ day	147.33 ± 0.57 a	147.06 ± 0.20 a
Egg/ bird/ week	5.90 ± 0.14 a	4.20 ± 0.05 b
Hatching/ egg/ bird/ week	5.70 ± 0.05 a	3.63 ± 0.12 b
Egg production/ hen/ weeks %	87.1 ± 0.05 a	60.20 ± 0.05 b
Hatching all eggs (%)	87.1 ± 0.15 a	78.1 ± 0.21 b
Chicks / week /Hen-Housed	5.10 ± 0.21 a	3.0 ± 0.16 b
Egg weight (g)	58 ± 0.25 b	58.5 ± 0.25 a
Feed conversion ratio (FCR)	2.54 ± 0.23 a	2.51 ± 0.27 a

a, b means in rows different significantly at P≤0.05.

4. CONCLUTION

We conclude from the current study that the RAPD technique can evaluate the genetic relationship between parents and grandparents and the genetic similarity coefficient between them to improve performance at the pure line level. On the other hand, it is possible through these productive qualities: They include body weight (g), feed(g)/bird/ day, egg/ bird/ week, hatching/ egg/ bird/ week , egg production/ hen/ weeks %, hatching all eggs (%), chicks / week / hen - housed, egg weight (g), feed conversion ratio (FCR). Develop, select and compare the studied groups in the future.

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