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Study Of The Canonical Correlation Between Reproductive And Egg Production Characteristics In The Local Brown Chicken Selected For The Genetic Diversity Of The Neuropeptide Y Gene

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ABSTRACT

The results of the current study and from the estimates of the Canonical correlation coefficient indicated an important linear relationship in both directions between the first group of variables S1 (reproductive traits) and the second group of variables the S2 (productive traits) which are the independent variable matrix and the dependent variable matrix respectively in the Iraqi local brown chicken flock, that were selected to the genetic diversity of the NPY gene, which showed a highly significant canonical correlation coefficient (P <0.01) has reached 81%, as body weight was affected by age at sexual maturity due to the presence of a positive and weak correlation coefficient of 21%, as was the rate of egg production at all stages Productivity (the period before production, the period of the peak of production, the period post-peak of production) by age at sexual existence, due to the presence of a negative correlation coefficient that ranged between average and strong (-74, -45 and -51%, respectively), and these results revealed the contribution of the first pair of variables Canonical (body weight at sexual maturity, egg production before the summit) of the two matrix variants (S1 and S2), in influencing egg production in subsequent productive periods of having positive and strong correlation coefficients of 92 and 94%, respectively, and contributed Estimates of the linear correlation coefficient between the corresponding variables in the matrix in revealing the negative linear relationship, which reached the highest influential value for age at sexual maturity - 89%. Therefore, the age variable at sexual maturity and the total production variable for the number of eggs is one of the most efficient factors that focus on in the selection programs for selecting the superior parents in producing eggs in the local brown herd of Iraqi chickens.

Keywords: Canonical correlation coefficient, Canonical variables, Canonical matrices, linear correlation coefficient.

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INTRODUCTION

Estimates of the values of variance shown by the individuals of the Iraqi local brown herd with their genetic diversity are few for the reproductive and egg production traits. There are no local studies that have used canonical correlation analysis between a set of variables of egg production traits, and it was noted that the effect of the age attribute at sexual maturity is the most influencing the production rate eggs compared to the effect of the body weight and egg weight attributes on laying hens when using the canonical correlation statistical model (Akbas and Takma, 2005). Usually, the relationship between two or more traits (variables) is usually measured using correlation analysis, as canonical correlation analysis was used to estimate and evaluate the relationship between three characteristics (variables) is age at sexual maturity, food intake, and egg production traits in Isa brown chicken in two different periods (Cankaya and colleagues, 2008), and the Canonical link describes how a variable correlates or forecasts other variables, and this type of correlation shows a positive relationship between Age and body weight at sexual maturity in foreign pure chicken breeds compared to domestic chicken (Agaviezor and *et al*., 2011), and that ecclesiastical correlation analysis is a technical model for statistical analysis Multivariate E determines the correlation between two sets of variables (Ventura and colleagues, 2011) and not causality despite its weakness or simplicity, and this technique can avoid multiple linear correlations between independent or dependent variables beyond correlations more than 80% (Montgomry and Peck, 2012 While analyzing the Canonical correlation, it is possible to discover even the weak relationship between the groups of variables under study to know the minimum variance as well as reduce the variance within the group to clarify the genetic correlation and genetic diversity in poultry, especially local strains (Ogah, 2013), in addition to determining the percentage The variance between the two groups of variables (Jacob and Ganesan, 2013), and the results of using canonical correlation analysis showed that there is a high positive correlation between weight at sexual maturity and the characteristics of egg production when the quantity and quality of food intake are identical at the stage when eggs began to be produced in Isa Brown (Udeh, 2014).

Several recent studies have shown that there is an important correlation coefficient between reproductive characteristics such as age at sexual maturity, body weight at sexual maturity, and weight of the first egg in domestic chicken (2010, Udeh), as well as the characteristic rate of egg production in multiple stages of production is one of the most quantitative and economic characteristics Interest by the breeder to assess the correlation between them and the reproductive traits (average age and body weight at sexual maturity) in the herd and as an accurate indication of the viability of the productive herd (2014, Udeh), Canonical correlation analysis was used to estimate the relationship between the egg production trait and reproductive traits, which was very convincing Especially the age when laying the first egg and the early production of eggs and showed great importance in determining the effect of the variables and the strength of their Canonical attachment

(Hidalgo and colleagues, 2015), and although studies that used Canonical correlation analysis in poultry are few, they indicated that the selection of herd members by ages Less when laying the first egg leads to an increase in the number of eggs production as well as a decrease in the rate of their weights (Ribeiro and et al, 2016). Eggs produced for a period of ten weeks in quail bird (Takma et al., 2017), Khokhar and Rajarathinam (2018) have indicated a high negative correlation coefficient between the total egg number and age at sexual maturity and a positive correlation coefficient with average body weight at pre-production age (12 and 16 weeks) in a laying hens flock.The aim of the current study is to use Canonical correlation analysis to determine the type and value of the relationship and accurately between age at sexual maturity and body weight at sexual maturity (group of first variables) and egg production rates in three production periods to improve the selection performance of the selection of members of the local brown Iraqi hens, and to assess the genetic diversity by dependence On phenotypic properties.

MATERIALS AND METHODS:

Blood samples collected from the Wing vein of 102 individuals from the local brown flock of the third generation. After DNA extraction, the PCR-REFLP technique was used and the Neuropeptide Y gene amplification showed the DNA product transport bands throw acrylamide gel showing multiple manifestations (TT, TC and CC) for the NPY gene, and that these bands are of varying partial sizes (differentiated in the number of base pairs), they represent the genotypes of the members of the experimental herd, who were tightly selected 50% for the highest age at sexual maturity.Canonical correlation analysis technique was used to study the relationship (the best linear correlation) between two groups of independent and dependent variables (S_1 and S_2), as the first group represented the S_1 (independent variables) age at sexual maturity and weight at sexual maturity, while the second group included (dependent variables) S_2, egg number production before the productive peak, egg number production at the production peak, egg number production after the production peak, and various genotypes of the NPY gene for the experimental herd, and implemented the CCA technique using the Statistical Analysis Program (SPSS) Statistical Package Society Science), and the Wilks (1938) test was used to determine the level of significance between one variable and another variable in the second group, and the analysis of canonical correlation included a better study of linear relationship between the two sets of variables that show the correlation coefficient to the maximum extent, despite the absence of correlations between pairs The variables that make up it are as follows:

-Descriptive Statistics
-Correlation Bivariate Arrays
-Canonical Correlation
• Correlation Coefficients, Eigenvalue Correlation
• Calculated and tabulated F values
• Wilks test
-Measuring the simple linear relationship between independent and other dependent variables

Canonical Loadings, linear relationship of the variables (X and Y) can be described in the constituent groups S_1 and S_2 according to the following mathematical model:

$S_1 = ai_1 X_1 + ai_2 X_2 + \ldots\ldots + ai\ p\ XP$

$S_2 = bi_1 Y_1 + bi_2 Y_2 + \ldots\ldots + biqYq$

Since a and b: the correlation coefficient of the group of variables S_1 and S_2 respectively, and X, Y are the independent and dependent variables respectively.

RESULTS AND DISCUSSION:

Canonical correlation analysis was use to evaluate the relationships between reproductive traits (age and body weight at sexual maturity) and production traits (number of eggs before the productive summit and the number of eggs at the height of production and the number of eggs post-peak) in the local Iraqi brown chicken. Table 1 showed descriptive analysis data of independent and dependent variables in the two groups of variables, revealing the age and body weight at sexual maturity and egg production rates throughout the production period of the experimental individuals selected from the local brown Iraqi chicken.

Table -1- Descriptive analysis of data of independent and dependent variables in Iraqi brown local chicken

Trait	Sample	Minimum	Maximum	Mean	Stander deviation
Age at maturity/d	50	148	193	156.92	8.437
Body weight at maturity/ g	50	1120	2042	1601.48	217.547
Egg number pre-peak/ egg	49	0	32	20.69	7.537
Egg number at peak/ egg	50	13	179	136.82	29.213
Egg number at post peak/ egg	50	4	87	47.80	17.956
Genotype	50	1	3	1.76	0.716

Age at sexual maturity ranged between 148-193 days and the average age at sexual maturity was 156.92 days, while the body weight at sexual maturity ranged between 1120-2042 g and the mean body weight at sexual maturity is 1601.48 grams, while the production of eggs before the peak of production ranged between 0- 32 eggs at the top, Production 13–179 eggs, and in the period after the peak of production, it reached 4–87 eggs, at a rate of 20.69, 136.82, and 47.8 eggs for the three consecutive periods and the highest standard deviation was 217.547 body weight at sexual maturity, while the lowest standard deviation was 7.537 for the number of eggs before the production peak Shown by the above table.

Table 2 showed Pearson's correlation coefficient, probability value, and sample size for experimental traits. The correlation coefficient for sexual age was positive and weak (0.212) with body weight at sexual and strong

negative (- 0.742) with the number of eggs in the period per-peak, and weak negative (- 0.261, - 0.208, - 0.084) with the number of eggs at the productive peak and the number of eggs at post peak and genotype respectively, and the correlation coefficient for body weight at sexual maturity is negative (- 0.454, - 0.519) and highly significant (P <0.01) With the number of eggs pre-peak and the number of eggs post-peak respectively, and significant weak negative (P <0.05, -0.351) with the number of eggs at the productive top and a negative low (-0.063) with genotype, while the correlation coefficient for the number of eggs per-peak Productivity is positive, medium (0.455), and highly significant (P <0.01), with the number of eggs at the height of productivity and significantly weak (P <0.05, 0.33) with the number of eggs post-peak, and weak positive (0.51) with genotype,

Table -2- Matrix of correlation coefficients for reproduction and production traits in local Iraqi brown chickens

Traits	Age at maturity	Weight at maturity	Egg number pre-peak/ egg	Egg number at peak/ egg	Egg number at post-peak/ egg	Genotype
Age at maturity	1	.212	-.742**	-.261	-.208	-.084
Weight at maturity	.212	1	-.454**	-.351*	-.519**	-.063
Egg number pre-peak/ egg	-.742**	-.454**	1	.455**	.330*	.051
Egg number at peak/ egg	-.261	-.351*	.455**	1	.563**	.034
Egg number at post peak/ egg	-.208	-.519**	.330*	.563**	1	.115
Genotype	-.084	-.063	.051	.034	.115	1

** correlation is significant at the 0.01 level (2- tailed).
*correlation is significant at the 0.05 level (2- tailed).

The correlation coefficient for the number of eggs at the productive peak was positive, mean and highly significant (P <0.01, 0.563) with the number of eggs at post peak, and poorly (0.34) with the genotypic, while the correlation coefficient for the number of eggs at post peak was positive and weak (0.115) with genotype (Lehman, 2005).

The Canonical correlation study is the most appropriate to assess the relationship between groups (matrix) of variables (Sherry and Henson, 2005), as the results of the current study were similar to what indicated by the results of Akbas and Takma (2005) that there was a correlation and moral coefficient between the characteristics within the two matrix of variables, and contributed the method of determining correlations with high precision and optimal between a set of productive traits (variables) in Chinese domestic chicken is the Jinghai yellow strain to determine which of these traits is more contributing (Yang and et al, 2006), and that the effect of age at sexual maturity is higher than the effect of body weight on sexual maturity on the number of eggs production for three of the egg production periods in the flock of broiler parents (Ross- 308), the results of this study were also consistent with the results of the study applied to adult birds of the Isa Brown breed in assessing the canonical correlation of reproductive traits (body weight at maturity, Sexual) which is most contributing to the effect on egg production for multiple production periods (Cankaya, 2008), having studied physiological characteristics (liver enzymes, protein, albumin, blood sugar level, insulin and stress hormones) in quail in matrix variables to reveal the effect of their blood levels on others in inhibition and release (Ajakaiye and colleagues, 2010), and Udeh (2010) in his study results on local Nigerian chicken lines striking with foreign lines, indicated that all groups of first generation individuals showed a significant correlation between average weight Body and weight of the first egg at sexual maturity, correlation between age, weight of the first egg and body weight at sexual maturity, and the selection for these traits gives positive indications, and as the analysis of canonical correlation showed a significant positive correlation between age and weight at sexual maturity, the weight of the first egg showed a strong correlation with the number of eggs Product in subsequent productive periods compared to age and weight at sexual maturity, and the use of the weight of the first egg as an selection function was used to select the laying hens strains for the number of eggs produced (Udeh, 2014), and the reproductive traits and productive traits in laying quail were studied using a canonical correlation analysis to describe the correlation between these two groups reported that it is moderate as well as the strong correlation between age at sexual maturity and the productive period bsefore the summit (Ribeiro, 2016), while Khokhar (2018) used canonical correlation analysis to Estimation of the correlation coefficient at late age at sexual maturity with body weight, egg weight and production, and if it was negative with the number of eggs in different productive periods, while canonical correlation analysis was used to reveal the strength of the relationship between the external and internal qualitative characteristics of Spanish domestic chicken eggs (Utrerana) and comparison with the Likhorn strain of chickens then characterizes productive ability and employs it within the selection program strategy (Ariza and colleagues, 2019).

Table-3- Canonical correlation coefficient between the two sets of variables (reproduction and production characteristics) in Iraqi brown local chickens

Sets Variable	correlation coefficient	Square correlation coefficient	Wilks Test	F Test	Degree of freedom	Probability of freedom	Significant
1	.810	1.912	.283	9.453	8.000	86.000	.000
2	.419	.213	.824	3.122	3.000	44.000	.035

Table 3 showed the coefficient of the canonical correlation between the first group of variables S1 (age at sexual maturity, body weight at sexual maturity), and the second group of variables S2 (egg production before the summit, egg production at the top, egg production after the summit), and that the coefficient canonical correlation has occurred between the variable pairs of these two groups, and the correlation coefficient for the first pair in the two groups (the two matrices) showed that the variables are strong and positive (81%) and highly significant (P <0.01), and the second canonical correlation coefficient has reached (44%) for the second pair among the canonical variables, the F test contributed to the detection of the statistically significant and highly significant statistical between the pairs of variables of the two matrices under study, which is an indication of the influence of egg production rates in the three different productive stages and in a significant way, age at sexual maturity and body weight at sexual maturity, which are identical results. The results obtained by Akbas and Takama (2005) are similar to those of Cankaya and et al (2008), when studying on laying hens, and that the canonical correlation coefficient was able to measure the correlation coefficient between the various variable lines (Kim and colleagues, 2017).

It was clear from the above table that the values of the variance of the percentage of the first pair of dependent matrix variables (Wilks test) was 0.283, and with a highly significant statistical function (P <0.01), while the variance of the percentage of the pair of the second variables showed the significance at the level of P <0.05, and the same these results were obtained when studying the index selection for quail birds (Hidalgo and colleagues, 2015), and they also coincided with the results that indicated the emergence of a medium and highly significant correlation coefficient between the reproductive and productive characteristics of quail and for the first pair (age at sexual maturity and egg production) thereof. A strong correlation coefficient (Riberio and colleagues, 2016), and was consistent with the study of canonical correlation analysis for egg production in quail (Takama and colleagues, 2017), and in broiler chicks revealed the correlation coefficient between chemical properties and stress oxidation not based on the origin of the contrast between these variables but rather shows Among the groups comprising the variables in canonical bivariate variables (Keskin et al., 2018).

In Table 4 the amount of the change in the standard deviation values for the independent groups in the independent groups and the dependent variables in the second group (Covariant sets) is shown, when the values of the standard deviation change one value from the standard value which equals one and the average value equals zero (sd) = 1, M = 0), change in the standard deviation by one will be accompanied by a change in the values of the standard deviation of - 0.786, -0.664 for the coefficient of the first and second canonical correlation for the first independent variable, age at sexual maturity in the independent group, as well as for the second and for the second group variables canonical, which will increase the accuracy of the correlation coefficient reading as a function to illustrate the variable affecting reproductive and productive performance.

Table -4 - Standard deviation values for standard Canonical correlation coefficients for variables S_1 and S_2

Canonical variables	S_1		S_2			
	Age at maturity/ day	Weight at maturity	Egg number pre-peak/ egg	Egg number at peak / egg	Egg number at post-peak / egg	Genotype
1	-.786	-.461	.946	-.115	.248	.037
2	-.664	.920	.563	-.132	-.966	-.073

When Sd= 1, M=0

It was clear from the above table that the two variables characteristic of body weight at sexual maturity and the number of eggs produced before the peak of production. Their contributions are important because they have strong correlation coefficients (0.920%, 0.946%) as canonical variables in the group of canonical variables S1 and S2 respectively, and can adopted as selection function in the selection of individuals who ripen at early age and the best in their productive performance in the local Iraqi brown chicken flock.Carnerio et al. (2002) studied the genetic diversity of broiler parents' strains using the technique of canonical correlation analysis for multivariate groups (age at first egg laying, body weight at sexual maturity, number of eggs, and average egg weight), as well as their adoption in the study of laying hens (Barbosa) and et al, 2005), and the use of canonical analysis of the groups (matrices) of variables (productive performance, individual sex) contributed to lowering the costs of implementing selectoral programs in flocks of laying hens (Rosario and colleagues, 2005), and broiler breeds (Rosario and colleagues, 2008), The results of Table (4) were similar to the results of evaluating the relationship between some characteristics of the meat in the broiler breeds, in which it indicated that the change in the standard deviation of the original variables by one

value leads to a change in the standard deviation of the canonical variables and by a percentage in which the degree of influence of the canonical variable contributes (Bayyurt et al., 2018) as well as the influence of the original variables (Keskin et al., 2018).

Table -5 - Correlation coefficient values for the simple linear relationship of the S_1 and S_2 independent variables

Set Variables	S_1		S_2			
	Age at maturity/ day	Weight at maturity	Egg number pre- peak / egg	Egg number at peak/ egg	Egg number post peak / egg	Genotype
1	- .894	- .646	.977	.454	.499	.109
2	- .448	.764	.180	- .418	- .862	- .142

Table (5) showed the values of the simple linear correlation coefficient between the independent variables and the corresponding dependent variables in the set of other variables, and that half of these values for the correlation coefficient between the variables under the current study were negative, as the highest correlation coefficient value for age at sexual maturity was (0.894)) and the correlation coefficient value for the number of eggs at post peak in the first and second variables group (S1 and S2), respectively. The determination of linear correlation coefficient values between the corresponding variables to study linear relationships and the detection of the highest correlation values between their groups (Mendes and Akkartal, 2007), are consistent with the results indicated by Takma and et al (2017), to the greater effect of body weight at sexual maturity compared to the time of hatching and the number and weight of eggs on reproductive and productive traits as independent and dependent variables within the Canonical groups of white quail strains.

Table (6) Contrast ratio between the s1 and S2 independent variables in Iraqi brown local chicken

Canonical Variables	Within S_1	S_1 with S_2	Within S_2	S_2 with S_1
1	.608	.399	.356	.234
2	.392	.069	.243	.043

Above table showed the higher and moderate effect of the first pair of Canonical variables of the first group (reproductive traits) in the canonical variables (productive traits) of the second group of variables and in both directions, and it was found that the canonical correlation coefficient was used to describe the correlation between two sets of variables (reproductive and productive traits) That reproductive traits and egg production were moderately correlated (34%) in quail parents flock (Ribeiro and colleagues, 2016), and as studies of researchers indicated, there was a significant correlation coefficient between the first pair of variables (age at first egg laying, and body weight ratio) It has an effect on egg production rates in laying hens strains (Takma and colleagues, 2017), which are identical to the results obtained from the commercial broiler flock in India (Khokhar and Rejarathinam, 2018).

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