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USING ANALYSIS OF VARIANCE TO COMPARE BIOCHEMICAL BLOOD AND PRODUCTIVE PARAMETERS OF TWO BROILER CHICKENS

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ABSTRACT: As the poultry industry has grown in recent years, it has become necessary to assess various broiler strains so as to increase production efficiency while taking physiological and productive traits such as (live body weight, body weight gain, feed intake, total protein, albumin, triglycerides, cholesterol, HDL, LDL, phosphorus, calcium, superoxide dismutase, ALT, and AST). Consequently, the purpose of the current study was to compare blood parameters and productive performance of two chickens strains (Ross and Arbo Acres) broiler strains. Two strains were fed the same commercial diet broiler ad libitum (starter and grower diet), and body weight and body weight gain were weekly recorded, Feed consumption and feed conversion ratio were calculated at the end of the experiment, also blood samples were collected randomly through venipuncture (eight samples from Ross and Arbo Acres broiler chicken). A one-way ANOVA test was applied to compare the overall ($p < 0.01$) of blood parameters across groups, the present findings indicated that Ross strain was significantly better than Arbo Acres strain .The mean weekly live body weight was highly significant in two broiler chicken ($p<0.01$). Ross (1970) had a significantly ($p<0.001$) greater mean final LBW (kg/bird) than Arbo Acres (1750). Mean total body weight gain (g/bird) was high significantly ($p<0.01$) in Ross (1926) than in Abo acres (1708). The findings demonstrated that the overall feed intake and feed conversion ratio were significantly impacted by the chicken strain. The total feed intake values were 650and 537g/bird in 14 day of age, and 2325and 2653g/bird in 28 day of age, as well as the FCR values were 1.32and 1.05in 14 day of age, and 1.32 and 1.34g feed/g gain in 28 day of age for Arbo Acres and Ross, respectively. In conclusion, the results showed that broiler chickens' physiology and productivity are significantly influenced by their strains. Ross outperformed the Arbo Acres strains of live body weight, body weight gain and feed consumption.

Keywords: Broiler chickens, Blood, analysis statistical, body weight and feed conversion.

INTRODUCTION

As the poultry industry has grown in recent years, it has become necessary to assess various broiler strains so as to increase production efficiency while taking physiological and productive traits such as (live body weight, body weight gain, feed intake, total protein, albumin, triglycerides, cholesterol, HDL, LDL, phosphorus, calcium, superoxide dismutase, ALT, and AST).Silva et al., (2007) showed that the measurement of total protein levels and their fractions yields the data required to understand the prevalence of immunological disorders, infections, dehydration, and inflammatory reactions. The liver is the primary site of serum protein synthesis. Its functions include maintaining blood volume, buffering blood pH, transporting hormones and medications, facilitating blood coagulation, catalyzing chemical reactions (enzymes), regulating metabolism (hormones), and aiding in the body's defense against foreign substances. (Melillo, 2013). Peebles *et al*., (2004) revealed that the decrease in serum cholesterol was associated with the levels of LDL, a lipoprotein linked to the transport of cholesterol, as opposed to HDL levels. Triglycerides are produced in the intestinal mucosa and in the Liver from the digestion of dietary components and the ab-sorption of fatty acids (Alonso-Alvarez 2005). Furthermore, egg production, short productive life span, absence of dietary restriction, and global distribution have everything favored the use of chickens products as a signify-cant source of animal protein (Husna et al., 2017). The decrease in body weight and body weight gain might be low feed intake, ineffective digestion, the genetic make-up of birds and environment temperature (Tona et al., 2004). The main objective of the research is to investigate whether a variation in the production and physiological traits by compare two broiler strains.

MATERIALS AND METHODS

Ethics statement

The researchers adhered to the rules set forth by the appropriate ethics committee for animal care. The Poultry Breeding Farm, Faculty of Agriculture, Ain Shams University, was the site of this experiment.

Experimental Birds

During the months of October to November of 2024, the investigation was carried out in a four-week (28-day) semi-controlled broiler chicken house. All birds were provided with commercial Starter and Grower broiler diets under an open feeding system in table (1). Water was available ad-libitum for all birds. Routine vaccination, medication, and standard management practices were followed throughout the study. All birds were initially brooded in floor for 4 weeks. The initial number of each strain (Ross and Arbo Acres) was 200 chicks one day old.

Data Collection

The live body weight was measured weekly. Live body weight (g/bird) of the two broiler strains was weighed immediately from one day of age by using a digital balance for 28 day of age of the experimental period. The overall body weight gain (g/bird) was calculated at the end of both week and expressed as body weight gain = body weight f – body weighti; where body weight f is the BW at the end of the week, and BWi indicates the BW at the start of the week. Also, through rearing, the difference between the amount of feed delivered and the amount of feed left in each feeder was recorded weekly to determine the feed intake (FI; g/bird). At the conclusion of the experiment, the total FI was determined. A hanging spring balance was used to weigh the feed while the birds were eating. At the conclusion of the study, the feed conversion ratio was determined by dividing the quantity of feed intake by the amount of body weight gain (g feed/g gain). Blood samples were collected during the autumn season in November 2024. A total of 16 peripheral blood samples (eight samples per strains) were collected at 4 weeks of age from two strains via venipuncture into heparinized Wasserman plastic tubes. Plasma samples were obtained by centrifuging the blood samples at 6000 rpm for ten minutes using a laboratory centrifuge (Hettich Zentrifugen, manufactured in Germany). The plasma samples were tightly sealed and stored in a deep freezer at -20 ºC until biochemical analysis was performed. The blood parameters analyzed included total protein, albumin, triglycerides, cholesterol, HDL, LDL, phosphorus, calcium, superoxide dismutase, ALT, and AST. Using a digital Th-ermo Hygrometer, the temperature was first kept at 35°C for the length of the experiment and then lowered by 2°C each week. The chicks were raised with constant light and roughly 60% humidity.

Blood Constituents

Plasma albumin was subtracted from total plasma protein to determine globulin. Also, triglycerides (mg/dl), plasma cholesterol, and high density lipoproteins (HDL, LDL, and HDL). The following formula was used to determine low density lipoprotein:

Total cholesterol minus the cholesterol in the supernatant equals LDL (mg/dl).

According to other researchers, the activity of the enzymes Alanine Aminotransferase (ALT) and Aspartate Aminotransferase (AST) (U/L) were evaluated calorimetrically using commercial kits acquired from Spectrum Diagnostics.

According to the methods of other studies, the activities of Superoxide dismutase (SOD) in erythrocytes were tested colorimetrically.

2.1Statistical analysis

Data were subjected to one way analysis using the General Linear Models SAS 9.4 (Statistical Analysis System, SAS Institute Inc., Cary, NC, USA,2013) to estimate the effect of the traits. ANOVA analysis indicated a level of significance (p<0.01).

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

Where:

μ= Overall mean

S_i=Strain effect

e_{ij} = Experimental error

RESULTS AND DISCUSSION

Live body weight and Body weight gain

The results presented in figure (1) indicated that no significant variances in the mean body weight between the two broiler strains in one day of age. Also, at the end of the experimental period (28 days)), the overall body weight (g/bird) was significantly (p<0.001) higher in Ross (1970) than in Arbo acres (1750).Data presented in figure (2) indicated that total body weight gain of two broiler strains were significantly (P<0.01) heavier in Ross (1926) than in Aboacres (1708). The main objective of the producers is to have high broiler weight at slaughter (Tona et al., 2004). Reductions in body weight and body weight gain will raise production costs and market age. Promoting poultry farming worldwide requires the identification of the right strains based on the production traits of broiler chickens (Kalia et al., 2017). According to the current findings, the two broiler strains studied had an overall weekly BW that was highly significant. It should be noted that growth rate is one of the most often used metrics for evaluating the performance of broiler strains. (Rezaei et al., 2004).The growth of Live body weight can be adequately described by growth curve functions (Goliomytis et al., 2003). Our results showed that Ross broiler were higher in body weight with the findings of Hossain et al. (2011). As well, notable variations in the live body weight of six commercial broiler strains—Arbor Acres, Arian, Cobb 500, Hubbard, Lohmann, and Ross—were noted.(Rahimi et al., 2006). It has to be mentioned that Body weight difference between strains may result from a variety of sources, including genetic variation. Therefore, it is thought that the higher Live body weight of Ross broiler strains may be caused by the strain impact or by the genetic makeup during the embryonic stage, which can result in differing growth potentials. The mean weekly Body weight gain for the two chicken strains varied significantly, according to the current results. The findings go counter to those of Hossain et al. (2011), who discovered that strain had no effect on the strains' Body weight gain. But in this study it became clear that body weight gain is affected by body weight in the Ross strain compared to the Arbo Acres strain. but this study is based on a comparison between a strain that has a higher genetic potential in growth than the Arbo Acres strain.

Feed consumption and feed conversion ratio

The overall feed consumption (g/bird) and feed conversion ratio (g feed/g weight gain) of the Ross and Arbo acres broiler strains are presented in figure (3and 4). The present results indicated that broilers chickens had significant influence on the total feed intake and feed conversion ratio. Also, the total feed intake values were 650and 537g/bird in 14 day of age, and 2325and 2653g/bird in 28 day of age, as well as the Feed conversion ratio values were 1.32and 1.05in 14 day of age, and 1.32and 1.34g feed/g gain in 28 day of age for Arbo Acres and Ross, respectively. It is important to note that Feed consumption ratio is another measure used to evaluate the performance of broiler strains (Rezaei et al., 2004). Given that feed accounts for the largest percentage of all production expenditures for broiler chickens (Poltowicz & Doktor, 2012).Therefore, effective feed use is a prerequisite for achieving favorable production outcomes. The present findings, however, demonstrated that the overall Feed intake and Feed consumption ratio are not significantly impacted by broiler strain. Therefore, the efficient utilization of feeds is a must for the accomplishment of good production results. However, the variation in Feed intake and Feed consumption ratio may be explained by a variety of factors, including strain, feed quality, feed palatability, age, sex, individual body requirements, and stage of production, climate effect, mortality, and diseases. (Husna et al., 2017). Intentional genetic selection using conventional quantitative methods has resulted in a significant shift in the broiler chicken industry's productivity (Hunton, 2006). Due to early statistical limitations, geneticists were compelled to concentrate on the most economically viable, easily measurable, and highly heritable factors, such as yield, LBW, FI, and FCR (Hunton, 2006).

Blood biochemical analysis:

Blood biochemical analysis:

Blood protein profile:

Figure (5) illustrated total protein levels (TP) at 4 weeks of age for both Arbo acres and Ross. TP plasma levels for Ross were significantly higher than TP plasma levels for Arbo acres broilers. The highest TP value was for (5.02g/dl) compared to (4.25g/dl) respectively. Similarly, Similarly, Albumin (Alb.) was significantly higherRoss strain generally showed higher values for TP and Albumin compared to Arbo acres strain also, level of Albumin (Alb.) in Ross strain. Broiler strains such as Arbor Acres and Ross can significantly influence various blood parameters, reflecting changes in physiological and health statuses. Total protein (TP) and albumin (Alb) levels varied significantly across different broiler strains. The reduced protein levels in crossbreeds indicate a shift in metabolic priorities, possibly favoring rapid growth over immune function (Ali et al., 2021).

Blood lipid profile:

Lipid profile was shown by figure (5) as Triglyceride (TG) values were significantly different between Ross and Arboacres broiler strains with significantly higher values in Ross (127.93 mg/dl) than Arbo acres (100.81 mg/dl) however, the Lowest value was for Ross (117.93 mg/dl) compared to Arbo acres (130.37 mg/dl) in Cholesterol Plasma .Similarly, HDL plasma levels for Arboacres had significantly a higher value compared with Ross. On the other hand, there was significant for Ross than Arbo acres at LDL levels at 4 weeks of age. It is noteworthy that, the high levels of TG obtained for Ross strain indicated the efficient nutrient partitioning for fat storage. In contrast, the significant observed reduction of cholesterol plasma levels of Ross strain which is associated with reduced HDL plasma levels suggests poorer lipid clearance, possibly linked to metabolic trade-offs for growth. This indicates that possibly indicating improved lipid metabolism efficiency, improved lipid metabolism, which may contribute to better Meat quality with lower fat deposition (Ali et al., 2021). High density lipo-protein (HDL) plays a critical role in cardiovascular health by transporting cholesterol away from tissues (El-Tarabany and El-Bayomi, 2020). Reduced HDL levels in broiler strain could suggest that their lipid metabolism favors energy storage rather than cholesterol clearance, which might affect meat quality and overall health (Ali et al., 2021). Low density lipoprotein (LDL), often stated to as "bad cholesterol," showed significant variations, potentially leading to leaner meat production (Ahmed et al., 2023). The variations in triglyceride and cholesterol levels highlight the potential benefits of crossbreeding for improved fat metabolism and meat quality (Ahmed et al., 2023). for which strain (Oke et al., 2022).

Plasma glucose and minerals

Plasma levels of phosphorous and Calcium at 4 weeks of age are presented in figure (6) its evident shown that concentration of phosphorous increased significantly for Ross (13.72 mg/dl) compared to Arboacres (11.67 mg/dl). Ross showed numerically higher plasma levels of calcium that was significant compared to Arbor Acres. Data shown by figure (6) illustrate a significant difference among broiler strains concerning the Glucose level, as glucose plasma levels showed a significant for Ross (200 mg/dl) than Arbo acres (103.88 mg/dl). The higher concentration of phosphorous for Ross strain may reflect bone mineralization. (Ali et al., 2021).

Aspartate Aminotransferase (AST), Alanine Aminotransferase (ALT) Enzymes and SOD activity

As shown in figure (7), plasma levels of AST didn't significantly differ between Ross and Arboacres. Similarly, ALT plasma levels were significantly higher for Ross compared to Arbor Acres. SOD activity of broiler strain as shown by figure (7) were significantly higher in Arbo acres than Ross. (AST) and (ALT) are critical markers of liver function. The relatively stable AST levels among broiler strain indicate that the hybrids may not suffer from severe liver stress, which is essential for maintaining metabolic homeostasis (El-Tarabany and El-Bayomi, 2020). Elevated ALT levels in broiler strains might indicate increased metabolic activity in the liver, possibly due to adaptive physiological responses (Ahmed et al., 2023). These findings suggest that although crossbreeding introduces metabolic variations, liver health remains largely stable, which is a positive indicator for overall physiological resilience. Elevated ALT levels in crossbreeds might indicate increased metabolic activity in the liver, possibly due to adaptive physiological responses (Ahmed et al., 2023). Liver health remains largely stable, which is a positive indicator for overall physiological resilience. Lower antioxidant activity in crossbreeds may indicate greater susceptibility to environmental stressors, which could impact their overall productivity (Ali et al., 2021). However, as increased metabolic activity might result in a greater production of reactive oxygen species (ROS), which calls for better antioxidant defenses, this could also be explained by variations in metabolic rates (Ahmed et al., 2023).The reduction in SOD activity in crossbreeds suggests the need for dietary antioxidants to improve stress resistance and overall well-being.

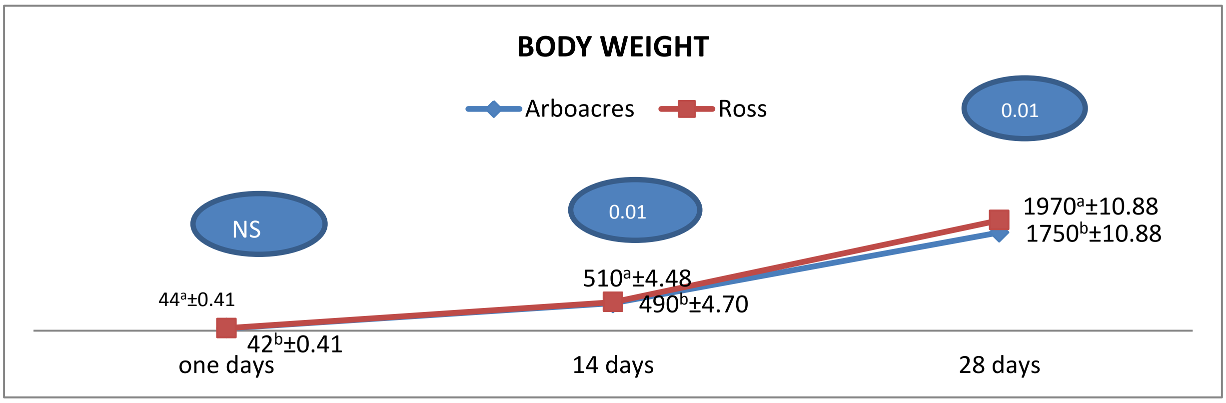
CONCLUSIONS

The current study examines how broiler strains affect Live body weight, Body weight gain, Feed intake, and Feed convertion ratio in order to increase broiler chicken productivity. The present results indicated that broiler strains chickens had a significant impact on production performance, with Ross outperforming the other strain in terms of LBW, BWG, FCR and blood parameter. It is anticipated that the current findings will support ongoing efforts to boost chicken production and be utilized for breeding soundness evaluation in order to select the best strain of chicks.

Table (1): Composition and quantitative evaluation calculated of the starter diets and grower diets according (Brazilian feed stuffs, 2017).

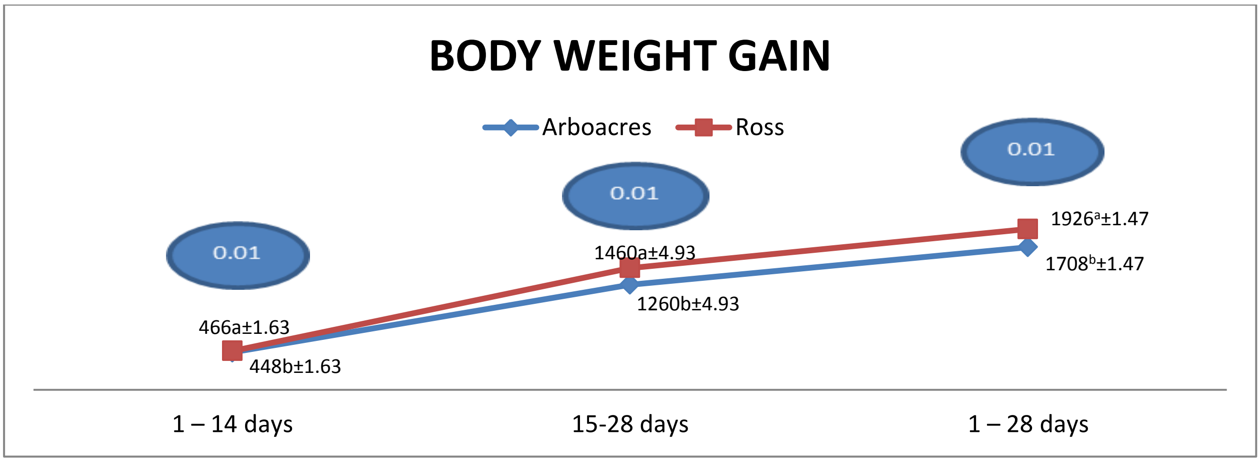
Ingredients (%)	**Starter 1: 14 days**	**Grower 15: 28 days**
Yellow corn	52.96	55.96
Soybean meal (46)	33.00	32.10
Corn gluten meal (60)	7.00	5.00
Soybean oil	2.40	2.80
Monocalcium phosphate	0.96	2.18
Limestone	2.50	0.88
HCL- Lysine	0.28	0.21
D-L Methionine	0.30	0.27
Salt	0.30	0.30
Premix*	0.30	0.30
Total	100.00	100.00
Price LE/(ton)***	2100	2000
Calculated composition**		
Metabolizable energy (Kcal/kg)	3017.48	3050.29
Crude protein (%)	23.07	21.57
Crude fiber (%)	2.53	2.53
Calcium (%)	0.97	0.87
Available phosphors (%)	0.49	0.44
Lysine (%)	1.40	1.29
Methionine (%)	0.666	0.61
Methionine + cysteine (%)	1.09	0.99

Figure (1): Least-square means and standard error means for body weight of broilers strains



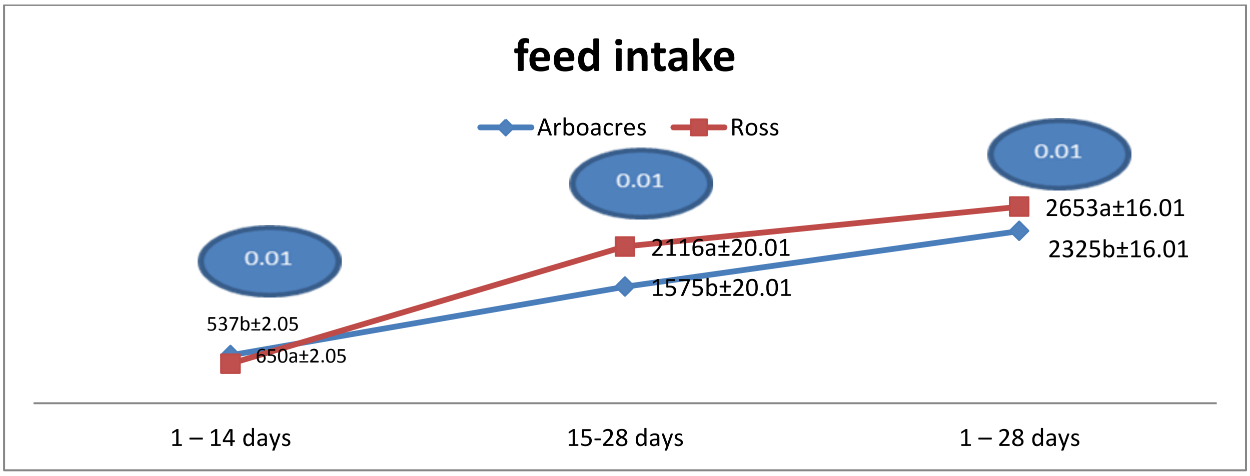
a, b * Significant at P < 0.01; SD = standard error; NS = not significant;

Figure (2): Least-square means and SD for body weight gain of broilers strains



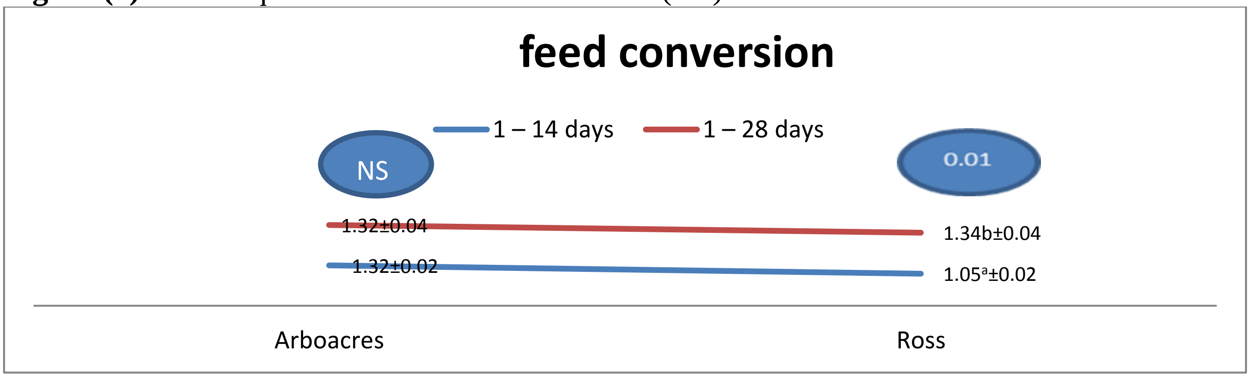
a, b * Significant at P < 0.01; SD = standard error; NS = not significant;

Figure (3): Least-square means and standard error means (SD) for feed intake of broilers strains



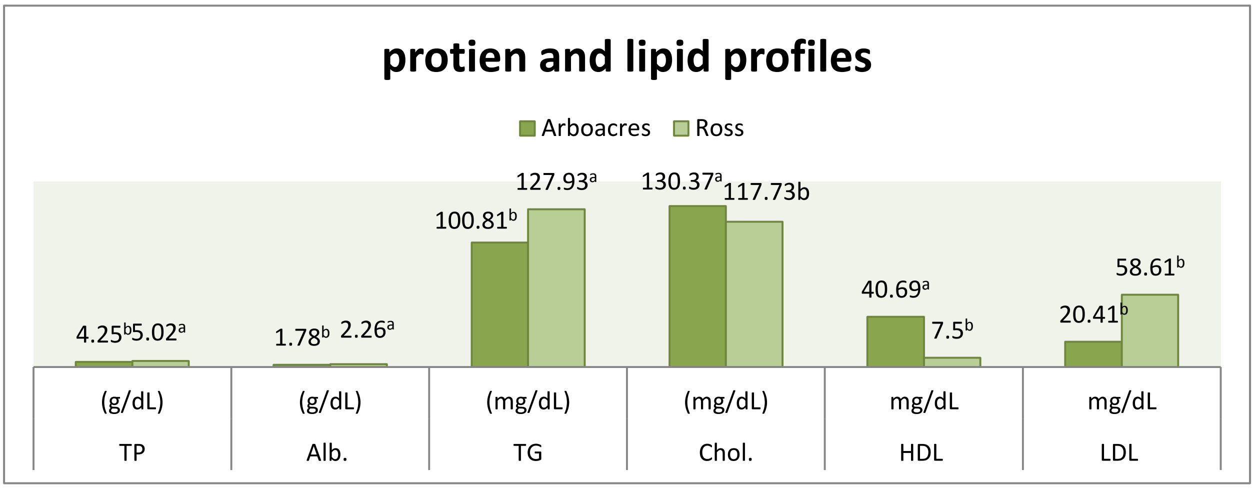
a, b * Significant at P < 0.01; SD = standard error; NS = not significant;

Figure (4): Least-square means and standard error (SD) for feed conversion of broilers strains



a, b * Significant at P < 0.01; SD = standard error; NS = not significant;

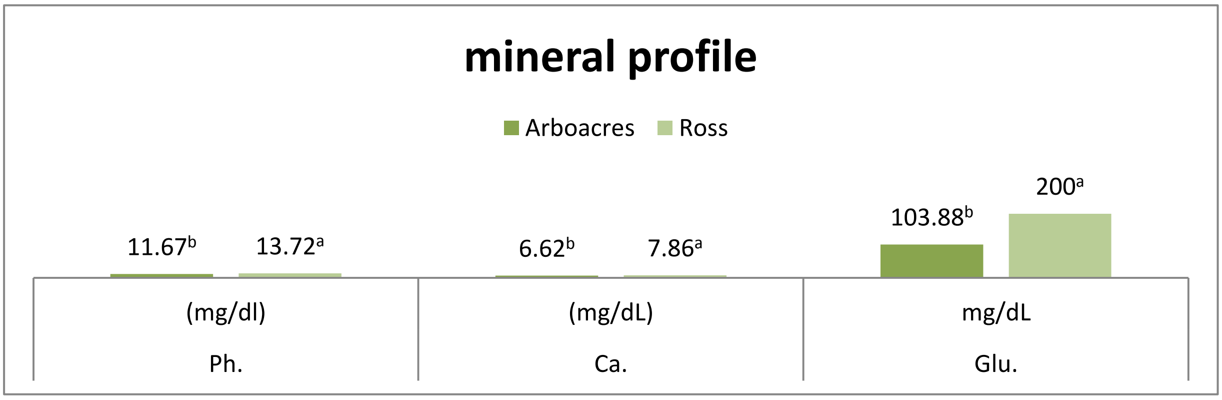
Figure (5): Least-square means and SD for protein and lipid profiles of broilers strains



	TP (g/dL)	Alb. (g/dL)	TG (mg/dL)	Chol. (mg/dL)	HDL mg/dL	LDL mg/dL
SEM	0.25	0.27	0.35	0.23	0.78	0.33
***P* value**	*	*	*	*	*	*

a, b * Significant at P < 0.01; SD = standard error; NS = not significant;. TP= Total protein, Alb=Albumen, TG= Triglycerides.

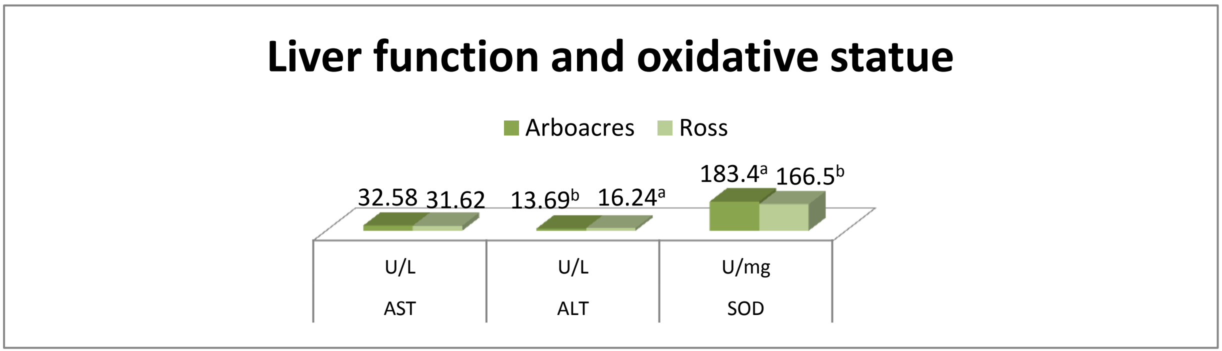
Figure (6): Least-square means and SD for mineral profile of broilers strains



	Ph. (mg/dl)	Ca.(mg/dL)	Glu.mg/dL
SEM	0.06	0.32	0.46
***P* value**	*	*	*

a, b * Significant at P < 0.01; SD = standard error; NS = not significant;. Ph= Phosphorus, Ca=Calcium, Glu=Glucose,

Figure (7): Least-square means and standard error means for liver function and oxidative status of broilers strains



	AST U/L	ALT U/L	SOD U/mg
SEM	0.09	0.02	0.53
P value	NS	*	*

a, b * Significant at P < 0.01; SD = standard error of the means; NS = not significant;. AST=Aspartate Aminotransferase, ALT=Alanine Aminotransferase, SOD=Superoxide Dismutase

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الملخص العربي

استخدام تحليل التباين لمقارنة مكونات الدم الكيميائية والصفات الإنتاجية لاثنين من دجاج التسمين

حبيبة حسن رزق
قسم إنتاج الدواجن، كلية الزراعة، جامعة عين شمس، القاهرة 11566، مصر

مع تزايد صناعة الدواجن في السنوات الأخيرة، أصبح من الضروري تقييم سلالات دجاج التسمين المختلفة بهدف زيادة كفاءة الإنتاج مع أخذ الصفات الفسيولوجية والإنتاجية مثل (وزن الجسم الحي، وزيادة وزن الجسم، وكمية العلف المستهلكة، والبروتين الكلي، والألبومين، والدهون الثلاثية، والكوليسترول، وHDL، وLDL، والفوسفور، والكالسيوم، وفائق أكسيد ديسميوتاز(المضاد للاكسدة)، وALT، و AST) وبالتالي، كان الغرض من الدراسة الحالية هو مقارنة معايير الدم والأداء الإنتاجي لسلالتين من دجاج التسمين الروس والاربواكرز تم تغذية السلالتين على نفس العليقة التجارية لدجاج التسمين حسب الرغبة (علف البادئ وعلف النمو)، وتم تسجيل وزن الجسم وزيادة وزن الجسم أسبوعيًا، وتم حساب استهلاك العلف ونسبة تحويل الأعلاف في نهاية التجربة، كما تم جمع عينات الدم بشكل عشوائي من خلال بزل الوريد (ثماني عينات من دجاج التسمين الروس والاربواكرز تم تطبيق اختبار ANOVA أحادي الاتجاه لمقارنة إجمالي (p < 0.01لمعلمات الدم عبر المجموعات، وأشارت النتائج الحالية إلى أن سلالة روس كانت أفضل بكثير من سلالة الاربواكرز وكان متوسط وزن الجسم الحي الأسبوعي ذا دلالة إحصائية عالية في دجاجتين من دجاج التسمين (p < 0.01.)وكان لدى روس (1970) متوسط وزن بطني نهائي (كجم / طائر) أكبر بكثير (p < 0.001) من الاربواكرز (1750)وكان متوسط زيادة وزن الجسم الكلي (جم / طائر) مرتفعًا بشكل ملحوظ (p < 0.01) في روس (1926) مقارنة بـ للاربواكرز (1708) وأظهرت النتائج أن إجمالي تناول العلف ونسبة تحويل الأعلاف تأثرت بشكل كبير بسلالة الدجاج. بلغت قيم استهلاك العلف الكلية 650 و537 غ/طائر في عمر 14 يومًا، و2325 و2653 غ/طائر في عمر 28 يومًا، كما بلغت قيم معامل التحويل الغذائي 1.32 و1.05 في عمر 14 يومًا، و1.32 و1.34 غ علف/غ زيادة في عمر 28 يومًا لسلالتي أربوآكرز وروس على التوالي. وفي الختام، أظهرت النتائج أن فسيولوجيا وإنتاجية دجاج اللاحم تتأثران بشكل كبير بسلالاتهما. وقد تفوقت سلالة روس على سلالات أربوآكرز في وزن الجسم الحي، وزيادة وزن الجسم، واستهلاك العلف.

الكلمات الافتتاحية: دجاج التسمين، الدم، تحليل إحصائي، وزن الجسم، استهلاك العلف ومعامل التحويل الغذائي.