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HEMATOLOGY AND BIOCHEMISTRY PROFILE OF SILVER SABAHIA CHICKEN STRAIN

Amany Adel El-Sahn, Osama Mahmoud Aly, Afaf Ibrahim El-Turky, Yousria Kamel Afiffi, Magda Mostafa Balat, Nema Mosaad, Hanan Hassan Ghanem

Anim. Prod. Res. Inst., Minis. of Agric., Giza, Egypt

Corresponding author: Hanan Ghanem Email: hananhasen2003@yahoo.com

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ABSTRACT: The objective of this study was to record baseline data for the Sliver Sabahia chicken strain and evaluate the effect of sex on the various hemato-biochemical parameters. Total of 40 birds at 33 weeks of age (20 male and 20 female) were used. The hematological profile included hemoglobin (Hb), red blood cells (RBCs), packed cell volume (PCV), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), and white blood cells (WBCs), whereas the biochemical parameters include total protein, globulin, cholesterol, uric acid "etc." Significantly ($p \leq 0.05$) higher, RBC, PCV, and WBC values were recorded in males than females. Total protein, globulin, cholesterol, triglycerides, calcium, uric acid, alkaline phosphatase were significantly ($p<0.05$) higher in females. The rest of the parameters were not significantly different between the sexes. Interestingly, almost all investigated hematological and blood chemical parameters in these chickens were within range of the recorded reference values of healthy birds. This study concluded a significant effect of sex on various physiological characteristics of the Sliver Sabahia chicken strain. Also, this paper exclusively provided reference values of hematological and blood chemistry for this strain, which help in the breeding programs to produce the commercial egg type strain.

Key Words: Silver Sabahia, hematology, biochemistry

INTRODUCTION

The poultry industry in Egypt is considered one of the most important industries that contribute to the provision of animal protein. Therefore, Egypt started from the seventies to improve the economic traits of the local breeds and develop chicken strains with high eggs and meat production. Since 2004, those strains have been included in the breeding selection and crossing-programs in order to obtain both of the paternal grandparents (Golden Sabahia) by Ghanem *et al*. (2017) and the maternal grandparent (Silver Sabahia) by Aly *et al*. (2017) for produce a commercial egg type breed that competes with the international commercial egg type breed.

Blood plays an important role in the transportation of nutrients, metabolic waste products, and gases around the body (Zhou *et al*., 1999). It is known that hamate-biochemical parameters are an easy, economical, fast, and practical way to provide important information about the physiological state of chickens which can be used in the implementation of better management practices, feed schedules, prevention, and treatment of diseases. It could also be incorporated into breeding programs for genetic improvement (Ibrahim *et al*. 2012).

Hemato-biochemical values were correlated with a number of factors such as age, sex, and nutrition. Regarding to the sex, a study was conducted by Naveen *et al.* (2019), who found that the values of RBCs, MCV, and MCH were higher in male Rajasri chickens than those of females. Also, Bora *et al.* (2017) recorded that the value of Hb, RBCs, PCV and WBCs in mature males Kadaknath chickens were significantly higher than females. Also, the same authors stated that the serum levels of aspartate aminotransferase (AST), alanine aminotransferase (ALT), calcium (Ca) and phosphorous (P) were significantly higher in Rajasri chicken males compared with females. Contrary to this, higher level of Ca and P was observed in female Aseel chickens (Kumar and Kumbhakar, 2015). Also, Panigrahy *et al*. (2017) reported that MCV, MCH, total protein, albumin, globulin, and albumin/globulin ratio were higher in females Vanaraja chickens.

Although the normal values of blood analyses for several genotypes of chickens have been reported previously (Ritchie *et al*., 1994 and Elagib *et al*., 2012). There is no information about the blood profile for the Silver Sabahia strain. Therefore, the aim of this work was to study the hemato-biochemical values for males and females in order to have base line information about this new strain. Moreover, studying the blood profile may reflect the viability and productivity of chickens, which can be used in the selection programs for producing the parents of the commercial egg type strain.

MATERIALS AND METHODS

Experimental birds, housing, and feeding

This study was conducted at El-Sabahia Poultry Research Station, Alexandria, Animal Production Research Institute, Agriculture Research Center. Two hundred and thirty laying hens and thirty cocks of Silver Sabahia (SS) strain which contributes 7/8 (87.5%) blood of Lohman Selected Leghorn (LSL) commercial strain and 1/8 (12.5%) blood of four local Egyptian strains (Matrouh, Baheij, Silver Montazah, and Golden Montazah) using breeding-selection and crossing-programs (Aly *et al*., 2017) was used in this study.

The chickens were brooded on the floor and grown in the opening house up to 16 weeks of age, then were transferred to individual cages. Natural photoperiod was used in grower period and increased to 16 hours in layer period. Feeding system, starter diet was (23% crude protein and 2916 kcal) from 0 to 2 weeks of age, (20% crude protein and 2966 kcal) from 3 to 8 weeks of age, grower diet (15% crude protein and 2715 kcal) from 9 to 17 weeks of age, (17% crude protein and 2711 kcal) from 18 to 20 weeks of age and layer diet (18% crude protein and 2850 kcal) from 21 to 33 weeks of age. Feed and water were supplied *ad libtium* .

Blood sampling and analysis

In 7 July 2020 , approximately 3 ml blood samples were taken from 20 hens and 20 cocks from the wing vein in heparinized polystyrene tubes (at 33 weeks of age), A portion of the fresh blood was used to count the white blood cells (WBCs), red blood cells (RBCs), measure hemoglobin (Hb), packed cell volume (PCV), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), and mean corpuscular hemoglobin concentration (MCHC). After sampling, blood plasma was separated by centrifugation at 3000 rpm for 15 min and was stored at -20^{o}C until the time of analysis. Plasma total protein, albumin, globulin, cholesterol, triglycerides, total uric acid, urea, ceratinine, calcium (Ca), phosphorus (P), sodium (Na), potassium (K), magnesium (Mg), chloride (CI) aspartate aminotransferase (AST), alanine aminotransferase (ALT) and alkaline phosphatase (ALP) were determined spectrophotometrically using available commercial kits.

Statistical analysis

Data of all studied traits were analyzed using fixed models SAS, 2004 using the following model

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

Where: Y_{ij}: an observation, μ: overall, S_i: effect of sex, e_{ij}: the residual effect. Significant differences among mean were tested using Duncan's Multiple Range Test (Duncan, 1955).

RESULTS AND DISCUSSION

The comparison in the hematological profile between males and females Silver Sabahia strain (SS) was presented in Table1. A significantly ($P<0.05$) higher Hb, RBCs, PCV and WBCs values were recorded in males than females. Other hematological parameters didn't show any significant difference between both sexes. These findings were in agreement with the report of Panigrahy *et al.* (2017) who reported that the RBC counts were higher in males than females in Vanaraja chicken. Abdi-Hachesoo *et al.* (2011) found that PCV values in cocks (48.80 ± 4.31%) were higher than hens (32.60 ± 2.32%) for Ross chickens. The higher level of Hb and PCV reported in SS males is due to effect of androgens (Sturkie, 1965 and Bora *et al.*, 2017). According to Adedibu *et al.* (2014), PCV values may be useful markers for predicting spermatozoa maturation in testes, sexual maturity and the onset of semen production. Also, higher PCV values are usually due to a higher weight gain as well as a reduction in heat load (El-Safty *et al.*, 2006). Selection of SS males with significantly high PCV would therefore, lead to a boost in growth and productive life. Within erythrocyte indices, Naveen *et al*. (2019) found that MCV and MCH values in males were significantly higher than that in females. But Bora *et al.* (2017) have reported that

there was no significant difference in MCV, MCH and MCHC values between the sexes of Aseel chickens. Albokhadaim (2012) reported that the MCHC values are sex independent. In our study, the higher level of WBCs in males may be due to the sexual hormone effect (Abdi-Hachesoo *et al*.,2013) or inherent sex difference. RBCs count for SS chickens was similar to the reference range (male=2.90-4.10×10^6 /mm^3; female =1.58-3.82×10^6 /mm^3) which was reported by Mitruka and Rawnstey (1977). Also, El-Sheikh *et al*. (2016) found that the RBCs count was 3.1×10^6/mm^3 for Gimmizah cocks. While, El-Saadany *et al*. (2017) reported that RBCs count for Bandarah laying hens was 2.15 ×10^6 / mm^3. These values were close to those reported in the present study. The value of Hb concentration obtained for female SS strain was near to the normal range of Bandarah laying hens (10.00±0.24 g/dl) (Abou-Shehema *et al*., 2016). Moreover, Hb concentration in males in the experimental study was lower than local Egyptian strains (18.32 and 18.61g% for El-Salam and Dokki-4, respectively) reported by (Taha *et al*., 2019). However, the concentration of Hb and PCV in Silver Sabahia males were within the range of previously reported data for healthy birds (Fowler, 1986) (Hb=10-20 g/dl; PCV=37-53%). Also, PCV for SS females was within the reference range of normal chickens (24.9-40.7 %) which was mentioned by Mitruka and Rawnstey (1977). WBCs values were near to the reference for Sina laying hens at 34wk. (17.22× 10^3/ mm^3) which was indicated by Rizk *et al*. (2017). Also, the WBC values for Silver Sabahia strain were fall within the range values for normal chicken mentioned by Mitruka and Rawnstey (1977). In addition, the remain recorded data of hematological parameters were near to the findings of Jain (1993).

The data in Table 2 indicated that, the values of plasma total protein (6.00 g/dl) and globulin (4.03 g/dl) in Silver Sabahia females, respectively were significantly higher ($p \leq 0.05$) than those of males, (4.87 g/dl) and (3.02 g/dl), respectively. No significant differences ($p \leq 0.05$) were observed between the two sexes in the plasma albumin and A/G ratio.

Hassan *et al*. (2016) reported that the concentration of plasma total protein was different between the local Egyptian strains (5.37 and 6.03g/dl for Silver Montazah and Matrouh, respectively) at 38 wks of age. These values were close to those reported in the present study. Moreover, A/G of Silver Sabahia chickens was near to the normal range of chickens (0.43-0.71) (Sturkie, 1976).

It is generally accepted that the level of plasma proteins is lower in adult cocks than in adult hens. This result is confirmed by Schmidt *et al. (*2007 and 2008), who reported that the increase of total protein in the blood of females could be related to the egg production. Simaraks *et al*. (2004) found a considerable increase in plasma total protein concentration occurs just prior to egg laying, which could be attributed to an estrogen- induced increase in globulin. Also, Ritchie *et al*. (1994) explained that the proteins are the yolk precursors (vitellogenin and lipoproteins), which are synthesized in the liver and transported via the plasma to the ovary where they are incorporated in the oocytes.

The females, compared to the males, show significantly ($P<0.05$) higher levels of cholesterol and triglycerides within the Sliver Sabahia chicken strain (Table 3).

The egg cholesterol is synthesized in liver, transported in blood and is then incorporated in the egg yolk. Our results are confirmed into the results of Saeki (1971), who observed that males had significantly lower plasma cholesterol levels than that of laying hens. Also, Shanmugam *et al*. (2017) found that higher level of cholesterol in females compared with males is due to that females started egg production. The cholesterol values of SS hens were within range of reference (130.70 -138.80 mg/dl) (Khawaja *et al*., 2013). Also, cholesterol values of males were close to the values reported in male's Saudi chickens (82.80 mg/dl) by Albokhadaim *et al*. (2012). The low level of plasma cholesterol in SS males has great benefits because their meat protects humans from atherosclerosis. This previous result has been supported by (Ademola *et al*., 2009).

Triglycerides of SS laying hens in the experimental study was lower than that of the Mamourah laying hens (605.30 mg/dl) (Abd El-Galil *et al*., 2017).However, it was higher than Bandarah laying hens (177.00 mg/dl) which was reported by Abou-Shehema *et al*. (2016). Triglycerides of SS males was higher than adult Saudi chicken males (68.3 mg/dl) (Albokhadaim *et al*.,2012), while it was lower than those of Golden Montazah and Gimmizah strains (272.8 and 275.80 mg/dl) respectively, which reported by El-Sheikh *et al*. (2016). According to the results of Krasnodębska-Depta and Koncicki (2000), both cholesterol and triglycerides are genetically dependent and this may be one of the reasons for their great variability.

Plasma uric acid was significantly increased for females of Silver Sabhia strain compared with that of males, while plasma urea and creatinine did not display any statistical change in relation to sex (Table 4).

Among numerous factors that can influence the level of plasma uric acid in chickens, sex seems to be one of the most important factors (Sturkie,1965). Our results are in agreement with Ritchie *et al*. (1994) and Elagib *et al*. (2012), who documented hyperuricemia during ovulatory activity. Also, the uric acid values (5.41-7.41 mg/dl) for Silver Sabahia strain were within the normal range (1.9-12.5 mg/dl) recorded by Clinical Diagnostic Division (1990).

Creatinine, the biomarker of protein metabolism, derived from phosphocreatinine muscle is normally low in birds and its high level is associated with high level of activity (Harr, 2002). Creatinine values of Silver Sabahia chickens were higher than the normal range of avian (26.52-44.20 µmol/ L), Harrison and Harrison (1986), while they were lower than the normal range of the chickens (0.90-1.85mg/dl) Mitruka and Rawnstey (1977). Our results are in agreement with Albokhadaim *et al*. (2012), who found that sex did not influence creatinine level.

Chickens do not produce urea in large quantities because of the low arginase activity in liver enzyme that responsible for the production of urea (Donsbough *et al*.,2006). Dutta *et al.* (2013) found that the values of urea significantly different among the chicken breeds in which was the highest in Rhode Island Red chickens (16.2 mg/100) and the lowest in indigenous chickens (1.7 mg/100mL). The reason for such variations might be due to the differences in renal functions associated with metabolic activities in different genotypes of the chicken breeds.

Data in Table 5 demonstrated that, the investigated metallic elements, Na (148.22mEq/l), K (3.56mEq/l), Cl (119.58 mEq/l), P (5.54mg/dl) and Mg (2.58mg/dl) which the males were not significantly ($p \geq 0.05$) differed than that of females (147.89mEq/l), (4.06mEq/l),(122,68mEq/l), (6.08mg/dl) and (2.37mg/dl), respectively. Plasma Ca levels in Silver Sabahia chickens were significantly higher in females compared with males.

Plasma sodium, potassium and chloride levels in Silver Sabahia chickens did not differ significantly between males and females. These agreed with the work of Ibrahim *et al.* (2012), who found no differences between the two sexes. All Na and K values were within the values of Clinical Diagnostic Division (1990). Besides, CL levels of Silver Sabahia chickens were similar to the range cited by Mitruka and Rawnsley (1977) (116-140mEq/l).

Our results are in harmony with those of Albokhadaim *et al*. (2012), who found the normal range of Mg levels in Saudi chickens (2.70-3.20 mg/dl) and were not significantly affected by sexes. Also, the present data was supported by Bora *et al*. (2017), who reported that there was no significant difference in P between the sexes of Kadaknath chickens. But Sturkie (1965) indicated that P may be decreased when the hen is depositing shell on the egg. In addition, the level of P was near to the reference range of birds (0.646-1.937mmol/l) Harrison and Harrison (1986).

In this study, the plasma Ca levels in laying hens were significantly higher than males and these results were similar to the report by Kunjara-thitiyapung and Rueno-suphaphichat (1987) and Ritchie et al. (1994), who found that ovulating hens have significantly higher calcium levels than males. The Ca concentration in Silver Sabahia chickens was within the range of previously reported data for chickens (Sturkie 1965, Mitruka and Rawnstey 1977 and Elagib *et al*., 2012).

Plasma enzymes values in both sexes of Silver Sabahia chicken are presented in Table 6. There were no significant differences in AST and ALT activities among the two sexes. However, it was observed that total ALP differed significantly between the two sexes, while females had the highest value (355.2u/l) compared to males (295.00 u/l).

The difference in AST and ALT levels between males and females of SS chickens was insignificant. Reports of the present study are consistent with Shanmathy *et al*. (2020), who reported no significant ($p>0.05$) differences were observed in AST and ALT enzyme concentration between males and females. In contrast, a significant increase in the concentration of AST was found during the laying period in hens (Hrabčáková *et al*., 2014). However, this phenomenon was not in accordance with our data because the AST enzyme level between sexes was not significant. This may be due to the fact that hens are still in the phase of starting laying. Data in the present study is similar to North and bell (1990) and Gyenis *et al*. (2006), who reviewed that during the egg shell formation there is an increase in activity of ALP in the blood of laying hens due to the calcification process.

The AST level of SS chickens was lower than that of broilers (male=386.7 u/l; female 398.0 u/l) as reported by (Livingston *et al.*, 2020), but higher than the Silver Montazah strain (20.22u/l) (Alderey**,** 2020). Also, levels of ALT of

the experimental chickens were higher than the range of adult local Saudi chickens (male=3.4 IU/L; female=5.5 IU/L) (Albokhadaim *et al*., 2012) but lower than the Silver Montazah chickens (26.76u/l) (Alderey**,** 2020).The serum ALP of this study was within the range reported by Khawaja *et al*. (2013) (108-1100u/l).There are many methods used by different labs to detect liver enzymes activity, and differences in their results have been found despite expressed using u/l (Harr, 2002 and Albokhadaim *et al*., 2012).

CONCLUSION

Data of the present study carried out on the Silver Sabahia strain indicate that most of the hamate-biochemical analyzed parameters are sex–dependent and have normal values for healthy growth similar to those mentioned in the references. These results are an important step in the characterization of the Silver Sabahia strain for the first time. Also, this data will help in the breeding programs to produce the commercial egg type strain.

Table (1): Means and standard error of hematological parameters in Silver Sabahia strain at 33 weeks of age

Trait	Males	Females	Significant
Hb g/dl	13.35±0.20	10.76±0.35	*
RBC 10^6 /mm3	3.19± 0.11	2.55±0.08	*
PCV %	40.65±0.73	34.08±1.11	*
MCV fl	128.09 ±1.73	133.93 ±2.7	NS
MCH pg	41.55±1.73	42.25±0.88	NS
MCHC g/dl	33.04±1.01	31.56±0.45	NS
WBC 10^3/ mm3	18.03±0.27	14.86±0.04	*

Hb: hemoglobin concentration, RBC: red blood cell, PCV: packed cell volume, MCV: mean corpuscular volume, MCH: mean corpuscle hemoglobin, MCHC: mean corpuscle hemoglobin concentration, WBC: white blood cell

*Means within each main factor in each row are significantly different at $p \leq 0.05$, NS non significant.

Table (2): Means and standard error of total protein, albumin (A), globulin (G) and A/G in Silver Sabahia strain at 33 weeks of age

Trait	Males	Females	Significant
Total protein	4.87±0.12	6.00±0.46	*
Albumin (A) g/dl	1.86±0.06	1.96±0.11	NS
Globulin (G) g/dl	3.02±0.13	4.03±0.46	*
A/G	0.61±0.06	0.49±0.05	NS

*Means within each main factor in each row are significantly different at p≤0.05, NS non-significant.

Table (3): Means and standard error of cholesterol and triglycerides in Silver Sabahia strain at 33 weeks of age

Trait	Males	Females	Significant
Cholesterol mg/dl	78.2± 4.90	132.8±18.44	*
Triglycerides mg/dl	122.2±23.45	356.0±69.21	*

*Means within each main factor in each row are significantly different at p≤0.05.

Table (4): Means and standard error of uric acid, urea and creatinine in Silver Sabahia strain at 33 weeks of age

Trait	Males	Females	Significant
Uric acid mg/dl	5.41±0.27	7.41±0.52	*
Urea mg/dl	18.46±3.25	17.30±2.01	NS
Creatinine mg/dl	0.78±0.07	0.78±0.06	NS

*Means within each main factor in each row are significantly different at p≤0.05, NS non-significant.

Table (5): Means and standard error of metallic elements in Silver Sabahia strain at 33 weeks of age

Trait	Males	Females	Significant
Sodium mEq/l	148.22±0.33	147.89±1.28	NS
Potassium mEq/l	3.56±0.18	4.06±0.23	NS
Chloride mEq/l	119.58±0.67	122.68±1.59	NS
Calcium mg/dl	12.21±0.47	14.15±0.64	*
Phosphorus mg/dl	5.54±0.38	6.08±0.58	NS
Magnesium mg/dl	2.58±0.33	2.37±0.28	NS

*Means within each main factor in each row are significantly different at p≤0.05, NS non-significant.

Table (6): Means and standard error of alanine transaminase, aspirate transaminase, alkaline phosphatase in Silver Sabahia strain at 33 weeks of age

Trait	Males	Females	Significant
AST u/l	259.0±33.92	229.0±23.37	NS
ALT u/l	19.80.44±4.28	21.45±3.66	NS
ALP u/l	295.00±10.96	355.20±15.98	*

AST: aspartate aminotransferase, ALT: alanine aminotransferase, ALP alkaline phosphatase
*Means within each main factor in each row are significantly different at p≤0.05, NS non-significant.

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الملخص العربى

مرجع فى علم الدم و الصفات الكيموحيويه لسلاله الصبحيه الفضى

امانى عادل الصحن، اسامه محمود على، عفاف ابراهيم التركى، يسريه كمال عفيفى، ماجده مصطفى بلاط، نعمه مسعد ، حنان حسن غانم
معهد بحوث الانتاج الحيوانى، مركز البحوث الزراعيه، وزاره الزراعه

الهدف من هذه الدراسه هو عمل قاعده بيانات اساسيه لدراسه صفات الدم الهيماتولوجيه و البيوكميائيه الخاصه بسلالها لدجاج الصبحيه الفضى و تأثير الجنس على هذه صفات.
تم استخدام عدد ٤٠ طائر (٢٠ذكر و ٢٠ انثى) عند عمر ٣٣ اسبوع فى هذه التجربه. تم تقدير الصفات الدم الهيماتولوجيه Hb, RBC, PCV, MCV, MCH,MCHC, WBC و كذلك الصفات البيوكيمائيه البروتين الكلى، الجلوبيولين و الكوليستيرول و حمض اليوريك و....الخ.
وجد اختلافات معنويه عاليه(٠.٠٥) بين الجنسين لكلا من RBC, PCV, WBC و كذلك البروتين الكلى و الجلوبيولين و الكوليستيرول و الدهون الثلاثيه و الكالسيوم و حمض اليوريك و الالكالين فوسفاتيز، بينما لم تظهر اختلافات معنويه بين الجنسين فى باقى الصفات المدروسه.
من الملاحظ ان اغلب الصفات الهيماتولوجيه و البيوكيمائيه لهذه السلاله كانت ضمن القيم المقدرة للطيور السليمه فى مختلف المراجع.
اوضحت هذه الدراسه انه يوجد اختلافات معنويه بين الجنسين للصفات الفسيولوجيه المدروسه لسلاله الصبحيه الفضى، كذلك تعتبر هذه الورقه البحثيه من اوائل المراجع التى توضح القيم الهيماتولوجيه و البيوكيمائيه لهذه السلاله و التى عن طريقها يمكن استخدامها فى برامج التربيه لانتاج سلاله دجاج بيض تجارى.