Comparative analysis of haematological parameters of guinea fowl of different breeds and populations

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Abstract. Comparative analysis of haematological parameters of some breeds and populations of Guinea fowl grown in the Russian Federation was carried out. The following breeds were studied: Volga white breed, the French breed BroilerGuineaFowl ESSOR MI. LF, the Zagorsk white-breasted breed. The following coloured populations were examined: gray-mottled, blue from the CJSC “Mariyskoye” of the Mari El Republic and gray-mottled from Sergiev Posad. Contents of haemoglobin g/l, erythrocytes $10^{12}$ l, leukocytes $10^9$ and thrombocytes thousand/mcl, as well as the nuclear Arneth’s count (percentage ratio of different types of leukocytes) were determined in blood of Guinea fowls. The pseudoeosinophil / lymphocyte ratio was calculated. Standard hematological methods were used. Statistical processing of the results was carried out with the help of a single-factor analysis of variance. It was established that the clinical picture of blood of the examined Guinea fowls is characterized by uniformity of type. An exception is toms and hens of the Essor breed that had higher and lower hemoglobin level correspondingly in relation to the same haematological parameter of other groups of the examined birds. The average values of the hemoglobin level in the studied breeds and the populations of Guinea fowl ranged from 85.0 ± 4.4 g / l to 128.0 ± 6.98 g / l. Blood of the studied groups of Guinea fowls did not differ significantly in relation to all other clinical haematological parameters. The nuclear Arneth’s count of blood of Guinea fowls of all studied groups corresponds to the normal amount of mature birds of most species. First of all, it is characterized by the lymphocytic profile. The second position in the quantitative content of cells in the nuclear Arneth’s count is taken by pseudoeosinophils. The structure of the nuclear Arneth’s count of blood depends on the breed or population. The white blood cell count of the French Guinea fowls has some peculiarities. The obtained values of the clinical haematological parameters of the examined Guinea fowls make it possible to conclude that the studied groups of birds are relatively healthy.

1. Introduction
Nowadays Guinea fowls breeding is a promising and developing branch of poultry keeping. Guinea fowls have a number of significant productive advantages over other species of birds. They have valuable qualities as high reproduction rates, bones solidity, high vital capacity, tasty meat, nutritious eggs, and high adaptive capacity for unfavorable environmental factors. Many authors note the good adaptation characteristics of Guinea fowl to stressful environmental factors [1]. Meat of the birds is characterized by low fat content (0.5 - 0.7%) and high protein content (25-27%). In relation to the content and ratio of aminoacids, Guinea fowl's meat is better than meat of other bird species. The proportion of essential aminoacids in Guinea fowl's meat is 52.3%, and in chicken this proportion is...
46.8% [26]. Many researchers point out the fact that Guinea fowl is a ready source of animal protein (due to their meat and eggs) [2].

Due to certain biological advantages, the genetic potential of Guinea fowls is highly valued by various scientists and is considered as an important element in improving modern breeds of chickens and as the basic material for selective breeding [1]. Nevertheless, this potential is underestimated both in our and foreign countries [3].

One of the most important reserves for ensuring high productivity of Guinea fowls in the conditions of modern keeping technology is the increased level of natural resistance of their organism to unfavorable environmental factors. It is reflected in unusual values of cytochemical parameters of their leukocytes, in greater resistance to diseases in comparison with other species of poultry [4].

A more detailed study of the biology of this bird, in particular the basic haematological parameters, is necessary to finally understand the mechanisms of its natural resistance. Moreover, development of industrial poultry farming and selection of birds for high productivity influence the blood system. The comparative analysis of blood of Guinea fowls grown in the Russian Federation is of particular interest because the issue was not properly researched. In our opinion, such an analysis is necessary for further correction of selection programmes of Guinea fowls aimed at increasing the productive qualities of this bird preserving high taste and nutritional values of eggs and meat.

The purpose of the research is the comparative analysis of haematological parameters of some breeds and populations of Guinea fowls grown in the Russian Federation with the account of the population and gender.

In accordance with the purpose, the following objectives were determined: to compare the amount of hemoglobin, erythrocytes, leukocytes, platelets and blood composition of the nuclear Arneth’s count of Guinea fowls of the Volga white breed and gray-mottled and blue populations with the same haematological parameters of Guinea fowls of the French breed Essor and the Zagorsk white-breasted breed and gray-mottled population from Sergiev Posad.

2. Experimental part
The research was carried out at the Department of Biology at Mari State University. Blood for analysis was taken from Guinea fowls of the Volga white breed (VW) and of blue (B) and gray-mottled populations (GM) (6 toms and 6 hens in each study group) grown in the CJSC "Mariyskoye" in the Mari El Republic, from birds of the French breed BroilerGuineaFowl ESSOR MI .LF (grown in the LTD "SamsonFerma", the village of Dvoriki in the Kaluga Region) (E) and the Zagorsk white-breasted breed (ZW) (4 toms and 4 hens) as well as from birds of gray-mottled population from Sergiev Posad (GMSP) (5 toms and 3 hens) (grown in the LTD "Genofond", Sergiev Posad). The bird's age was 25-27 weeks.

Blood sampling from Guinea fowls was made by puncturing the axillary vein. Heparin was used for stabilization. In whole blood the content of erythrocytes, 10^{12} l; leukocytes, 10^{9} l; haemoglobin, g/l; thrombocytes, thousand/mcl was determined in accordance with the common methods. Blood smears which were stained by Romanovsky were prepared to calculate the nuclear Arneth’s count; the calculation of the count was made per 100 cells. During examination of the nuclear Arneth’s count, microscopy was made with the help of CarlZeissJena LABOVAL 4 with the lens x90 (oil immersion). The obtained data were processed statistically with the help of a single-factor analysis of variance.

3. Results and discussion
During study of individual clinical haematological parameters of Guinea fowls it was established that in whole, the hemoglobin level in toms corresponded to the norm and its values ranged from 85.0 ± 4.4 g/l to 128.0 ± 6.98 g/l. The highest level of hemoglobin was found in blood of toms of the Essor breed (p=0.004688) (figure 1).

Due to other clinical haematological parameters, there was no difference between toms.
In Guinea fowls hens the similar pattern was found: significant differences were also revealed only by hemoglobin. Guinea fowls of the French breed had a significantly smaller amount of haemoglobin ($p=0.003266$) (figure 2).

Figure 1. The haemoglobin level (g/l) in blood of Guinea fowls toms, where Hereinafter – VB – birds of the Volga white breed; GM – gray-mottled birds; B – blue birds; E – birds of the French breed Essor.

Figure 2. The level of haemoglobin (g/l) in blood of Guinea fowls hens.

Due to other clinical haematological parameters, the studied groups of Guinea fowls had no significant differences. It should be noted that according to the values of the clinical data, the examined bird is relatively healthy (table 1).

**Table 1.** The average data on clinical haematological parameters of Guinea fowls.

| Breed of population | Gender | Haemoglobin, g/l | Erythrocytes, $10^{12}$/l | Leukocytes, $10^9$/l | Thrombocytes, thousand/mcl |
|---------------------|--------|------------------|---------------------------|----------------------|---------------------------|
| Volga white         | ♂      | 101.67± 3.1      | 2138416.0 ±               | 81603.0±             | 7223.33±                  |
|                     | ♀      | 109.0±1.3        | 1848062.0±                | 99753.0±             | 74132.0±                  |
| Gray-mottled        | ♂      | 109.0± 4.8       | 1604429.0±                | 70352.0±             | 74702.0±14155.6          |
|                     | ♀      | 98.0± 3.3        | 1681250.0±                | 66372.0±             | 55212.0±                  |
| Blue                | ♂      | 101.0± 4.3       | 1890667.0±                | 66020.0±             | 39980.0±                  |
|                     | ♀      | 99.0± 4.8        | 1786650.0±                | 101428.0±            | 60255.0±                  |
| French breed Essor  | ♂      | 128.0± 7.0       | 1928693.0±                | 72055.0±             | 60465.0±                  |
|                     | ♀      | 85.0± 4.4        | 1584625.0±                | 50808.0±             | 42068.0±7221.8            |

Remarks: hereinafter – ♂ - toms; ♀ - hens.

The relative ratio of white blood cells makes it possible to identify the processes occurring in the birds’ organism and to assess the leukocytic status of blood. The nuclear Arneth’s count was analyzed to study the leucocytic blood composition of Guinea fowls. The data is presented in the table 2.
It was established that the nuclear Arneth’s count of all studied groups of Guinea fowls corresponds to the formulas described by other authors: the predominant cells in the structure of this formula are lymphocytes, and the second group of cells in relation to the number is pseudoeosinophils which is shown in a number of works \[6, 7\].

A single-factor analysis of variance revealed that during comparison of the nuclear Arneth’s count of Guinea fowl toms from the gene pool of the CJSC "Mariyskoye" and blood of Guinea fowls of the breed Essor, there were significant differences in the content of basophils (\(p = 0.038803\)). The amount of basophils in birds of the Essor breed was minimal but corresponded to the limits of the physiological norm.

**Table 2. The nuclear Arneth’s count of Guinea fowls blood, %.

| Breed of population | Gender | Lympho-cytes | Monocytes | Eosonophils | Pseudoeosinophils | Basophils | Pseudoeosinophils/Lympho-cytes (Ps/L) |
|---------------------|--------|--------------|-----------|-------------|------------------|-----------|--------------------------------------|
| Volga white         | ♂      | 60.57± 9.55  | 4.25± 0.47| 3.34± 0.54  | 30.01± 10.05     | 1.42± 0.81| 0.31±0.078                           |
|                     | ♀      | 59.75± 5.74  | 3.53± 0.48| 4.98± 1.13  | 28.6± 6.52       | 3.13± 0.83| 0.39±0.10                           |
| Gray-mottled        | ♂      | 62.96± 3.14  | 4.04± 0.87| 4.7± 0.44   | 26.85± 3.74      | 1.41± 0.20| 0.45±0.09                           |
|                     | ♀      | 65.11± 5.11  | 3.17± 1.06| 3.17± 0.52  | 26.34± 5.37      | 2.18± 0.64| 0.46±0.15                           |
| Blue                | ♂      | 60.93± 3.69  | 3.21± 0.74| 9.94± 5.60  | 27.98± 3.32      | 3.53± 0.42| 0.46±0.07                           |
|                     | ♀      | 56.33± 5.92  | 4.00± 0.70| 4.76± 0.93  | 30.31± 7.55      | 3.29± 0.86| 0.72±0.61                           |
| French breed Essor  | ♂      | 71.55± 0.75  | 1.41± 0.60| 4.79± 0.70  | 21.05± 0.46      | 1.20± 0.27| 0.29±0.01                           |
|                     | ♀      | 72.13± 1.12  | 1.69± 0.48| 3.63± 0.63  | 22.32± 1.29      | 0.23± 0.20| 0.31±0.02                           |
| Zagorsk white-      | ♂      | 79.27± 2.04  | 1.62± 0.74| 3.40± 0.90  | 15.01± 2.49      | 0.71± 0.24| 0.19±0.04                           |
| breasted            | ♀      | 80.35± 1.42  | 1.25± 0.48| 2.44± 0.63  | 14.74± 1.32      | 1.21± 0.46| 0.19±0.02                           |
| Gray-mottled from   | ♂      | 82.46± 2.27  | 0.98± 0.56| 1.32± 0.34  | 15.82± 2.41      | 2.64± 0.32| 0.19±0.32                           |
| Sergiev Posad       | ♀      | 81.7± 0.95   | 2.29± 0.68| 1.73± 0.18  | 12.34± 1.13      | 1.94± 0.55| 0.15± 0.02                           |

Remarks: hereinafter – Ps/L – index of percent reference of pseudoeosinophils and lymphocytes.

During comparison of the nuclear Arneth’s count of Guinea fowls toms from the CJSC "Mariyskoye" and the nuclear Arneth’s count of Guinea fowls toms from Sergiev Posad, differences in the content of monocytes (\(p = 0.032059\)) and basophils (\(p = 0.021293\)) were found. It was shown that in toms of the Zagorsk white-breasted breed and gray-mottled Guinea fowls from Sergiev Posad the nuclear Arneth’s count contained the minimal amount of monocytes in comparison with the birds from the CJSC "Mariyskoye" (figure 3).

In the nuclear Arneth’s count of the Zagorsk white-breasted toms the number of basophils was minimal in comparison with the nuclear Arneth’s count of toms of other studied birds (table 2). During comparison of the nuclear Arneth’s count of the French breed toms and toms of the Zagorsk Guinea fowls, the following differences were revealed: in the nuclear Arneth’s count of Guinea fowls of the breed Essor the number of lymphocytes was minimal in comparison with the birds from Sergiev Posad (\(p=0.005900\)) (figure 4).
Figure 3. The percentage of monocytes in the nuclear Arneth’s count of Guinea fowls toms, where _Hereinafter_: 3B – Zagorsk white-breasted birds; 3C – gray-mottled birds from Sergiev Posad.

On the contrary, due to the content of eosinophils, haematological parameters of the French Guinea fowl toms were greater in comparison with the Guinea fowls from Sergiev Posad (p = 0.037022). At the same time, the content of basophils in toms of the gray-mottled Guinea fowls from Sergiev Posad was higher than in Guinea fowl of the breed Essor and Zagorsk white-breasted breed (p=0.003462) (figure 5).

During analysis of the nuclear Arneth’s count of hens in all studied groups of Guinea fowls it was established that the nuclear Arneth’s count of Guinea fowls from the CJSC "Mariyskoe" did not differ significantly from the same parameter of Guinea fowls of the Essor breed. However, during comparison of the nuclear Arneth’s count of Guinea fowls hens from the CJSC "Mariyskoye" and the nuclear Arneth’s count of hens of the Zagorsk white-breasted and the gray-mottled population from Sergiev Posad, significant differences in the content of lymphocytes and eosinophils were revealed.

The results showed that in the nuclear Arneth’s count of birds from Sergiev Posad, the number of lymphocytes was higher than in the birds of the Volga white breed and coloured populations from the CJSC "Mariyskoe" (p = 0.003593). On the contrary, the content of eosinophils in the nuclear Arneth’s count of birds from Sergiev Posad was lower in comparison with the same haematological parameter of Guinea fowls from the CJSC "Mariyskoe" (p=0.003001).

During comparison of the nuclear Arneth’s count of hens of the Essor breed from Sergiev Posad (Zagorsk white-breasted and gray-mottled), significant differences in the content of lymphocytes and pseudoeosinophils were found.

As it can be seen from the Figure 6, Guinea fowls of the Essor breed had the minimal number of lymphocytes (p=0.000331).
The content of pseudoeosinophils in Guinea fowls of the Essor breed was maximum (p=0.000531) (table 2).

The certain differences in the structure of the nuclear Arneth's count in the compared groups of Guinea fowls may be explained by other keeping conditions of the poultry. Probably, it is necessary to consider the characteristics of the breed which can be caused by selective breeding. It is confirmed by the data from the research works in which it is indicated that the haematological parameters of animals and, in particular, of birds can depend on various factors (age, gender, breed, conditions of the poultry reproduction) [8; 9].

During research it was noted that Guinea fowls of the French breed differed from birds of other compared groups in a number of parameters (clinical, structure of the nuclear Arneth's count, Ps/L index). It should be considered that these Guinea fowls are broilers. They are characterized by a higher rate of growth, and therefore should have a number of genetic and physiological peculiarities.

4. Conclusion

The study revealed a tendency that birds with high lymphocyte content in the structure of the nuclear Arneth's count had a relative decrease in the proportion of monocytes and basophils, but in a greater degree of pseudoeosinophils proportion. It led to a significant reduction in the relative value of the Ps/L parameter. It is necessary to carry out comprehensive studies of the dynamics of the Ps/L ratio in relation to gender and age with the account of the bird activity connected with oviposition. Haematological parameters of Guinea fowls of the French breed are characterized by certain peculiarities. The research lays emphasis on the need to establish the basic haematological parameters of commercial poultry under the changing conditions of modern agricultural production of meat and eggs.

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