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RESEARCH ON THE DYNAMICS OF ERYTHROCYTIC SERIES IN RELATION TO AGE, IN CHICKENS

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Abstract

In this paper we would like to observe the dynamics of the red blood cell series of chickens, during their growth and development. Research has taken place on two groups made out of 10 chickens: one group (named group 1) containing an industrial hybrid (Cobb 500), and one group (named group 2) containing common breed chicken. The haematological determination has been made at the age of 14, 45 and 75 days. The results obtained showed that at 45 days, the mean corpuscular haemoglobin presented a significant difference ($p<0.05$), higher with 6.26% than the chicken in the group 2. Regarding the determination made at the age of 75 days, we have found a significant increase ($p<0.05$) between the two groups regarding: the red blood cells number (with 18.43% higher than the group 2), the haematocrit value (with 7.64% higher than the group 2), the haemoglobin concentration (with 16.6% in favour of the group 2). Regarding the mean corpuscular volume, it presented a significant increase (with 8.64% higher than the group 1). During the experiment, the concentration of mean corpuscular haemoglobin didn't present any significant changes ($p>0.05$), the results of this parameter falling within the physiological values.

Key words*: chicken, erythrocytes, haemoglobin, haematocrit.*

INTRODUCTION

Currently, the broiler is a remarkable practical accomplishment of the genetics and nutrition, this accomplishment that has been materialized thanks to the scientific and technological progress. The main goal is represented by the exploitation of the broilers, by discovering the methods or possibilities of achievement of a bigger and constant production in a short period of time, with a minimum of investment and expenditures. The consumption of chicken meat offers nutritional advantages that cannot be denied within healthy alimentation, such as: moderate caloric intake, protein content based on all the essential amino acids, a low proportionality of cholesterol and fats. (Gonciarov et al., 2015).

The nutritional value of chicken meat comes both from its protein richness and respectively from amino acids, but also from its high coefficient of digestibility of the nutritive components, in the case of protein reaching up to 96%-98%, as well as the maintenance of its physicochemical and microbiological characteristics, throughout their entire period of validity (Petcu, 2006; Petcu et al., 2015; Khawaja et al., 2016).

The chicken meat can be considered a dietary product, because it presents a high digestibility coefficient of nutritional components, has an optimal content of fat, a low quantity of connective tissue and a high quantity of muscle tissue (Savu & Petcu, 2002; Chikumba et al., 2013).

For the achievement of the desired products, the chickens need to benefit from all the necessary conditions, as well as a good overall health. In this regard, the research of erythrocytic series offers plenty of information, the erythrocytes being actively involved in the transportation and oxygen provision to the tissue level. Also, the investigation of the red series offers information about the installation of anemia, being known that this affection it's often encountered in the event that the feed it's not well balanced in amino acids and vitamins (Bălăceanu et al., 2017) or when the absorption processes on an intestinal level are affected (Pop et al., 2006).

The addressed topic has emerged following the finding that the specialized literature (Orawan et al., 2007; Kim et al., 2013; Bedánová et al.,

2016) is quite poor regarding the values of the parameters of the erythrocyte series of chickens. We mention that the papers examined by us (Alabi et al., 2015, Sugiharto et al., 2016) did not offer data regarding the erythrocyte parameters of chicken on age groups, which constituted an additional challenge for us.
The data obtained can be regarded as reference values, because we determined the erythrocyte parameters by age categories.

MATERIALS AND METHODS

This study aims to gather data regarding the erythrocyte parameter changes of chickens, during their growth and development.
The biological material had been represented by two batches of chickens as follows: the first group was made out of ten broilers (Cobb 500 hybrid) and the second group was made out of ten common chicken. The both groups benefited from the same maintenance conditions, the food being represented by concentrated feed (minced cereals) and green plants.
At the ages of 14, 45 and 75 days, in order to perform haematological determinations, blood has been collected on anticoagulant (initially from the crest by puncture or by sectioning), then from the axillary vein (by puncture) in order to achieve the haematological determinations.
The working methods used in the current study had been the following: the determination of red blood cells (RBC), the determination of the haematocrit (HCT), the determination of haemoglobin (Hb), the determination of mean corpuscular volume (MCV), the determination of mean corpuscular haemoglobin (MCH), the determination of mean corpuscular haemoglobin concentration (MCHC).
The determination of the erythrocyte number was realised by directly counting them on the microscope using the haemocytometer.
The haematocrit and haemoglobin were determined using the HemoSmart apparatus.
The determination of the mean erythrocyte volume, mean erythrocyte haemoglobin, and mean erythrocyte haemoglobin concentration were determined using the calculation formulas described in the specialized literature (Cotor et al., 2012).
Comparisons regarding the statistical relevance of the differences between the two experimental groups were made using the t test (Student).

RESULTS AND DISCUSSIONS

The results obtained will be presented below in the form of tables and figures, for each moment of our determinations.
Regarding the values of the erythrocyte parameters of the 14-day-old chickens, from the two experimental groups, the results are presented in Table 1.

Table 1. The average values of the erythrocyte parameters in the case of the two experimental groups, at the age of 14 days

Group number	Erythrocyte parameters					
	Direct erythrocyte constants			Indirect erythrocyte constants		
	RBC *(millions/ mm^3 of blood)*	HTC *(%)*	Hb *(g/dl)*	MCV *(fl)*	MCH *(pg Hb/E)*	MCHC *(g Hb/dl E)*
Group 1	2.38	38.16	9.13	170.75	35.87	24.62
Group 2	2.44	37.53	9.06	168.62	35.87	24.87

Regarding the average number of erythrocytes (RBC), the difference between the two experimental groups at the age of 14 days was 2.52% in favour of group 2, this difference not being statistically significant.
Regarding the mean haematocrit value (HTC), the difference between the two experimental groups was 1.68% in favor of group 1, this difference not being statistically significant.
Regarding the mean haemoglobin value (Hb), the difference between the two experimental groups was 0.77% in favour of group 1, this difference not being statistically significant.
Regarding the mean value of MCV, the difference between the two experimental groups was 1.19% in favour of group 1, this difference not being statistically significant.
Regarding the mean value of MCH, there is no difference, the average value being the same for both of the experimental groups.
Regarding the mean value of MCHC, the difference between the two experimental groups was 1.02% in favour of group 2, this difference not being statistically significant.
In Table 2 we present the average values of all haematological parameters determined in the

case of both experimental groups, at the age of 45 days.

Table 2. The average values of the erythrocyte parameters in the case of the two experimental groups, at the age of 45 days

Group number	Erythrocyte parameters					
	Direct erythrocyte constants			Indirect erythrocyte constants		
	RBC (millions/ mm^3 of blood)	HCT (%)	Hb (g/dl)	MCV (fl)	MCH (pg Hb/E)	MCHC (g Hb/ dl E)
Group 1	2.46	36.75	8.7	166.12	33.75	24.62
Group 2	2.62	38.58	9.21*	164.62	35.87*	23.87

*P<0.05

Regarding the average value of the total number of erythrocytes (RBC) in the case of the two experimental groups, at the age of 45 days, the difference was 6.5% in favour of group 2, this difference not being statistically significant. However, there is an increase in this difference compared to the value obtained after the first determination.

Regarding the average value of the haematocrit (HTC) in the case of the two experimental groups, at the age of 45 days, the difference was 4.98% in favour of group 2, this difference not being statistically significant.

Regarding the average value of the haemoglobin (Hb) in the case of the two experimental groups, at the age of 45 days, the difference was 5.86% in favor of group 2, this difference being statistically significant (P<0.05).

Regarding the mean value of MCV in the case of the two experimental groups, at the age of 45 days, the difference was 0.91% in favour of group 1, this difference not being statistically significant.

Regarding the average value of MCH in the case of the two experimental groups, at the age of 45 days, the difference was 6.28% in favour of group 2, this difference being statistically significant (P<0.05).

Regarding the average value of MCHC in the case of the two experimental groups, at the age of 45 days, the difference was 3.14% in favour of group 1, this difference not being statistically significant.

In Table 3 we present the average values of all the haematological parameters determined in the case of both experimental groups, at the age of 75 days.

Table 3. The average values of the erythrocyte parameters in the case of the two experimental groups, at the age of 75 days

Group number	Erythrocyte parameters					
	Direct erythrocyte constants			Indirect erythrocyte constants		
	RBC (millions/ mm^3 of blood)	HCT (%)	Hb (g/dl)	MCV (fl)	MCH (pg Hb/E)	MC HC (g Hb/ dl E)
Group 1	2.17	35.73	8.18	174.5*	33.16	22.5
Group 2	2.57*	38.46*	9.53*	160.62	34.75	24.5

*P<0.05

Regarding the average value of the total number of erythrocytes (RBC) in the case of the two experimental groups, at the age of 75 days, the difference was 18.43% in favor of group 2, this difference being statistically significant (P<0.05).

This difference can be attributed to the diet (Akinleye et al., 2008), because during the growing season the broilers preferred to feed almost exclusively on concentrated feed (ground cereals), that are poorer in vitamins, compared to the green plants the common breed chickens (which also ate green fodder), benefited from. The low value of the average number of red blood cells in the case of chickens from group 1 (very close to the physiological minimum), makes us to assert that these chickens suffered from anemia, most likely deficiency type (the main deficiency being the folic acid present in the leaves and probably, the iron deficiency). We mention that these results were also communicated by other authors (Ghiță et al., 2021).

Regarding the average value of the haematocrit (HCT) in the case of the two experimental groups, at the age of 75 days, the difference was 7.64% in favour of group 2, this difference being statistically significant (P<0.05). We mention that we expected to notice this difference, because the erythrocytes being in smaller numbers in the blood of the chicks from group 1, it was logical that the volume occupied by them to be smaller.

Regarding the average value of haemoglobin (Hb) in the case of the two experimental groups, at the age of 75 days, the difference was 16.5% in favor of group 2, this difference being statistically significant (P<0.05).

This finding, as well as the fact that in the case of group 1, the average value of haemoglobin is slightly lower than the physiological minimum, justifies us to say that the chickens in group 1 suffered from anemia.

The values obtained by us fall within the limits communicated by other authors (Orawan et al., 2007).

Regarding the average value of VEM in the case of the two experimental groups, at the age of 75 days, the difference was 8.64%, this time in favour of group 1, this difference being statistically significant ($P<0.05$).

This finding, as well as the fact that in the case of group 1, the average values of erythrocytes, haematocrit and haemoglobin are lower than in the case of group 2, justifies us to affirm that the chickens in group 1 suffered from macrocytic anemia (anemia with high MCV).

This type of anemia is characteristic of deficiency anemia, installed when the body is vitiated by nutrients that influence mitosis in the hematogenous bone marrow (folic acid, cobalt, vitamin B_{12}, vitamin E, etc.) (Zagrai et al., 2020).

Regarding the average value of MCH in the case of the two experimental groups, at the age of 75 days, the difference was 4.79% in favour of group 2, this difference being statistically insignificant. This observation is logical, which means that even if there are fewer erythrocytes, they contain haemoglobin in physiological concentrations, the anemia being eminently due to the low number of erythrocytes, so in this situation, we discuss a normochromic anemia (Cotor et al., 2021).

Regarding the average value of MCHC in the case of the two experimental groups, at the age of 75 days, the difference was 8.89%, in favour of group 2, this difference being statistically insignificant.

This observation is logical, which means that even if the erythrocytes are less, they contain haemoglobin in physiological concentrations, the anemia being eminently due to the low number of erythrocytes, so in this situation we discuss a normochromic anemia.

In Figures 1, 2, 3, 4, 5 and 6 we present in dynamics the changes of the erythrocyte parameters studied for both experimental groups in the 3 moments (the age of 14, 45 and 75 days).

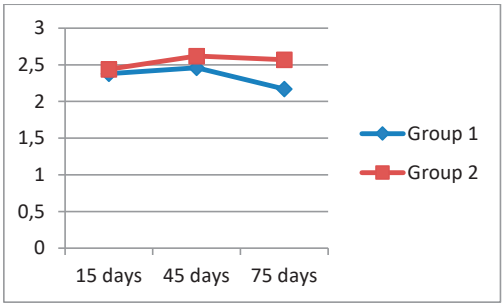

Figure 1. RBC dynamics in the case of the two experimental groups

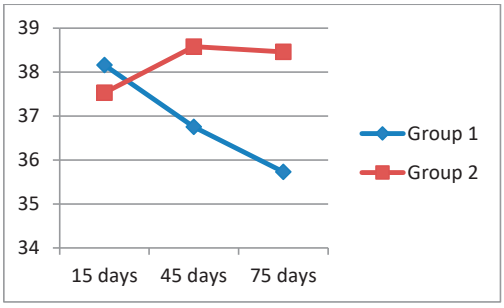

Figure 2. HCT dynamics in the case of the two experimental groups

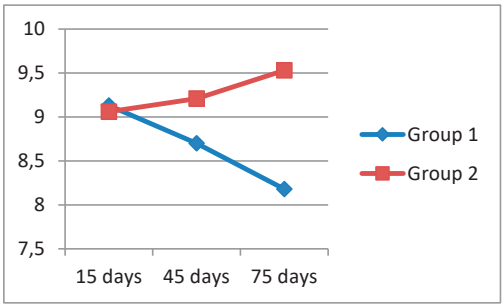

Figure 3. Hb dynamics in the case of the two experimental groups

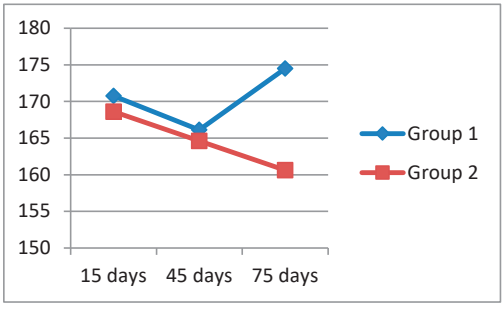

Figure 4. MCV dynamics in the case of the two experimental groups

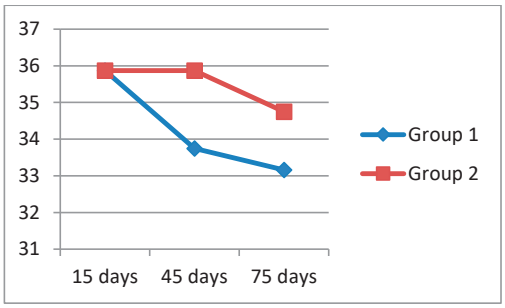

Figure 5. MCH dynamics in the case of the two experimental groups

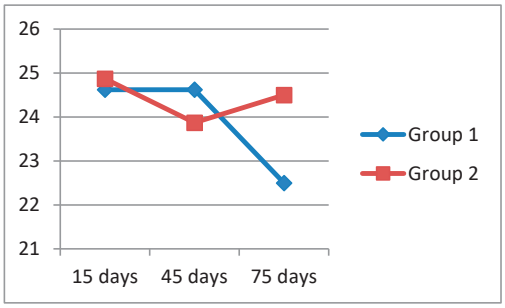

Figure 6. MCHC dynamics in the case of the two experimental groups

CONCLUSIONS

The number of erythrocytes of the chickens in the two experimental groups was within the physiological limits throughout the experiment except for the age of 75 days when a significantly higher difference of 18.43% was found in favour of group 2.

The value of haematocrit showed a significant difference only at the age of 75 days, the difference being 7.64% higher in favour of group 2.

Haemoglobin values showed significant differences both at the age of 45 days (higher by 5.86% in favour of group 2) and at the age of 75 days (higher by 16.6% in favour of group 2).

The mean corpuscular volume showed a significant difference only at the age of 75 days (being 8.64% higher in favour of group 1).

The mean corpuscular haemoglobin showed a significant difference only in the case of 45-day-old chicks (the difference being 6.26% higher in favour of the chicks in group 2).

The mean corpuscular haemoglobin concentration did not show significant differences throughout the experiment, the values of this parameter falling within the physiological limits.

REFERENCES

Alabi, O., Ngambi, J., Mbajiorgu, F., Norris, D., & Mabelebele, M. (2015). Growth and haematological response of indigenous Venda chickens aged 8 to 13 weeks to varying dietary lysine to energy ratios. *J Anim Physiol Anim Nutr*., 99(3), 436-41.

Akinleye, S., & Afolabi, K. (2008). The performance, haematology and carcass traits of broilers as affected by diets supplemented with or without biomin a natural growth promoter. *World Journal of Agricultural Sciences,* 4(4), 467-470.

Bedánová, I., Voslárová, E., Vecerek, V., Pistěková, V., & Chloupek, P. (2016). Effects of reduction in floor space during crating on haematological indices in broilers. *Berl Munch Tierarztl Wochenschr.,* 119(1-2), 17-21.

Bălăceanu, R., Stoica, L., Ghiță, M., Ognean, L., Negoiță, I., & Dojană, N. (2017). The effect of different fibre and starch dietary levels on haematology of post-weaning rabbits. *Agro Life Scientific Journal*., Volume 6(2), 22-26.

Chikumba, N., Swatson, H., & Chimonyo, M. (2013). Haematological and serum biochemical responses of chickens to hydric stress. *Animal*., 7(9), 1517-22.

Cotor, G., Zagrai, G., Gâjâilă, G., Ghiță, M., Ionescu, A., Damian, A., Zagrai (Măierean), A., Dragosloveanu, S., & Cotor D. (2021). The evolution of some blood parameters in hypovolemia conditions in rabbits. Polish Journal of Veterinary Sciences 24 (4), 589–594.

Cotor, G., & Ghiță, M. (2012). *Theoretical and practical notions of animal biology*. Bucharest, RO: Printech Publishing House.

Gonciarov, M., Neagu, I., Ghimpeteanu, O.M., & Petcu, C.D. (2015). General principles and regulations on obtaining products from genetically modified organism, *Journal of Biotechnology*, 208, S72.

Ghiță, M., Petcu, C.D., Cotor, G., Zagrai, G., Andrei, C., & Mihai (Oprea), O.D. (2021). Research on the effect of a dietary supplement on growth and erythrogram in pigeons. *Scientific Papers. Series D. Animal Science*. LXIV(1), 142-147.

Khawaja, T., Khan, S., Parveen, A., & Iqbal, J. (2016). Growth performance, meat composition and haematological parameters of first generation of newly evolved hybridized pure chicken and their crossbred parents. *Vet. Arhiv*., 86, 135-148.

Kim, M., Parvin, R., & Mushtaq, M. (2013). Growth performance and hematological traits of broiler chickens reared under assorted monochromatic light sources. *Poultry Science*., 92(6), 1461–1466.

Orawan, C., & Aengwanich, W. (2007). Blood cell characteristics, hematological values and average daily gained weight of Thai indigenous crossbred and broiler chickens. *Pak J Biol Sci*., 10(2), 302-9.

Petcu, C.D. (2006), *HACCP-Food safety guarantor*. Bucharest, RO: Idea Design Publishing House.

Petcu, C.D., Șulea, C., & Dumitrache, M. (2014), Audit of Producers/Users of Compressed Air and other Industrial Gases used in the Food Industry, *Quality-Access to Success*, 15(130).

Pop, A., Bianu, E., Ghiță, M., & Constantin, N. (2006). Evaluation of magnesium oxide intestinal absoption in laying hens. *Bulletin of the University of agricultural sciences and veterinary medicine*, Cluj-Napoca, 63, 136-140.

Savu, C., & Petcu, C.D. (2002). *Hygiene and control of products of animal origin*. Bucharest, RO: Semne Publishing House

Sugiharto, S., Yudiarti, T., & Isroli, I. (2016). Performances and haematological profile of broilers fed fermented dried cassava (Manihot esculenta Crantz). *Trop Anim Health Prod*., 48(7), 1337-1341.

Zagrai (Maierean), A., Damian, A., Ghiță, M., Zagrai, G., Dumitrescu, I., Vasilescu, C., Păun, L., & Cotor, G. (2020). Research regarding the effect of vitamin E on some hematological parameters in toxic stress conditions in rats. *Bulletin of University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca Veterinary Medicine*, 77(1), 21-24.