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INFLUENCE OF GENDER AND AGE ON HAEMATOLOGICAL INDICATORS OF POLBAR'S BREED CHICKENS

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The aim of the study was to determine the values of selected haematological indices of the Polbar breed of chickens by gender and age. There was a significant WBC difference in cocks and hens with age. In each of the periods, cocks were characterized by a lower than hens number of LY. LY and NE declined with increasing age. Most values showed significant (P ≤ 0.05) differences for birds at different ages. These results of the haematological indices from consolidated Polbar breed can be used for comparisons with other breeds of poultry. The study deepens and organizes the knowledge within the possibilities of using and interpreting levels of haematological indicators for monitoring health of hens. In this paper, we managed to obtain information on the level of indicators rarely determined in chickens.

Key words: blood, leucocytes, poultry, red cell index, plates

INTRODUCTION

The study of haematological indicators including blood cell count is one of the most frequently performed laboratory profiles in humans and mammals, but birds are not commonly used (Koncicki and Krasnodębska-Depta 2000; Truchliński *et al.,* 2006; Krauze and Grela 2010; Straková 2010; Krauze *et al.,* 2012). In the cited literature, there are only fragmentary data on basic laboratory finding for chicken or poultry in general (Krasnodębska-Depta and Koncicki 1999). The values of the haematological indices available in the literature often refer to the experimental systems and the impact of selected parameters on these values. Any interpretation of the results without any reference values developed for chickens is unfounded. The comparison of haematological indices expands the diagnostic capabilities, allowing for a comprehensive blood monitoring.

Values of haematological indices in poultry are variable and depend on a number of factors, such as bird species, breed, sex, age, stage of laying

(Kaczanowska *et al.,* 1986), but also the time of day, temperature, feeding and breeding technology (Koncicki and Krasnodębska-Depta 2005). No reference values for hens significantly hinders diagnosis, detection of sub-clinical symptoms in clinically healthy individuals, findings of the pathological process and degree of damage, as well as the evolution of disease and the effectiveness of treatment.

MATERIALS AND METHODS

Animals and procedures

The material for the study originated from the consolidated Polbar genetically bred chickens belonging to the University of Life Sciences in Lublin (Poland). Birds were kept on litter in standardized conditions and fed balanced feed *ad libitum*. During the rearing period, there were no clinical signs of disease or unexplained deaths.

Haematological testing

Blood for haematological analysis was collected with a hypodermic needle, each time from 100 birds (50 hens and 50 cocks) in the 8th, 12th and 18th week of age from the basilic vein (*v. basilica*) into sterile tubes coated with sodium heparin. The birds were previously fasted. Haematocrit (HCT), hemoglobin (HGB), red blood cell (RBC), red cell distribution width (RDW), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), leucocytes (WBC), number of neutrophils (NE), number of lymphocytes (LY), number of cells that machine could not correctly identify (MI), platelet count (PLT) and the following platelet parameters: mean platelet volume (MPV), platelet volume distribution width (PDW), plateletcrit (PCT) were determined. The RDW index was calculated automatically with a hematology analyser using the following formula: RDW (%) = SD x 100 %/MCV, mean SD was the average standard of deviation of MCV. The values of selected haematological indices of red blood cells were recorded on an automated hematology analyser, Abacus Junior Vet.

Statistical evaluation

The resulting figures were divided into groups according to gender and age. In such a stacked group, mean values were compared to the characteristics of the students' t-test ($P \leq 0.05$). Results were analysed using the statistical package SAS.

RESULTS

Hens showed higher values for RBC, HGB, and RDW (Table 1). MCV and MCH was higher in cocks. The level of MCHC in hens was higher than in cocks until 12 weeks of age but in the 18th week was at its lowest. There was a higher

Table 1. Haematological indices of chickens Polbar breed (n=50), Means ± SD (Standard Deviation)

Age (weeks)	Sex	HCT (l/l)	HGB (mmol/l)	RBC (10^{12}/l)	RDW (%)	MCV (fl)	MCH (pg)	MCHC (g/dl)
8	cock	0.23 ± 0.02	9.08 ± 1.21	1.86 ± 0.28	11.44 ± 0.72	97.08^{A*} ± 2.02	76.85 ± 3.69	79.32 ± 4.11
	hen	0.22 ± 0.02	9.63^{A} ± 0.72	2.06^{A*} ± 0.23	11.81 ± 1.10	92.90 ± 2.52	75.73^{A} ± 6.17	80.27^{A} ± 4.11
	mean	0.23 ± 0.02	9.38 ± 1.00	1.97 ± 0.27	11.65 ± 0.95	94.76 ± 3.09	76.22 ± 5.18	79.85 ± 4.14
12	cock	0.24 ± 0.04	9.05 ± 0.84	1.69 ± 0.45	11.09^{B} ± 0.76	94.29^{B*} ± 1.55	76.44 ± 9.65	77.07^{B} ± 7.02
	hen	0.23 ± 0.04	8.70^{B} ± 0.71	1.71^{B} ± 0.44	11.59^{B} ± 0.57	91.95 ± 4.47	74.82 ± 7.67	79.45 ± 6.80
	mean	0.24 ± 0.04	8.88 ± 0.80	1.70 ± 0.45	11.33 ± 0.72	93.15 ± 3.51	75.65 ± 8.78	78.23 ± 7.01
18	cock	0.25 ± 0.05	9.22^{*} ± 0.69	1.64 ± 0.52	11.88^{A} ± 0.64	93.00^{B} ± 6.57	77.95* ± 8.71	80.92^{A*} ± 8.26
	hen	0.24 ± 0.04	8.58^{B} ± 1.40	1.80^{B} ± 0.49	12.16^{A} ± 1.39	92.74 ± 4.87	71.80^{B} ± 7.09	76.16^{B} ± 7.42
	mean	0.26 ± 0.04	8.88 ± 1.17	1.73 ± 0.51	12.03 ± 1.11	92.86 ± 5.73	74.66 ± 8.46	76.57 ± 7.53
together	cock	0.24 ± 0.04	9.12 ± 0.89	1.71 ± 0.45	11.47 ± 0.79	94.43 ± 4.53	77.10 ± 8.31	80.92 ± 8.26
	hen	0.23 ± 0.04	8.89 ± 1.14	1.79 ± 0.47	11.94 ± 1.11	92.66 ± 4.94	74.20 ± 7.80	76.57 ± 7.53
	mean	0.24 ± 0.03	9.08 ± 0.92	1.81 ± 0.41	11.46 ± 0.83	93.79 ± 3.44	75.88 ± 7.56	78.87 ± 6.09

A:B:C - means with different superscripts within column differ significantly ($P < 0.05$),
* significant differences ($P \leq 0.05$ between cocks and hens of the same age
HCT – haematocrit, HGB – hemoglobin, RBC – red blood cell, RDW – red cell distribution width, MCV – mean corpuscular volume, MCH – mean corpuscular hemoglobin, MCHC – mean corpuscular hemoglobin concentration

WBC and LY count in hens at 8 and 12 weeks of age (Table 2). The level of NE was higher in cocks at 8 weeks of age. In the 8 week, a statistically significant difference for the studied hematological parameters between the sexes was demonstrated. WBC count decreased with the age of the birds, in both hens and cocks. Cocks were characterized by a higher level of NE and lower count of LY, as compared to hens. The number of PLT was higher in hens, but without statistical significant differences (Table 3). PLT and PDW width volume in hens and cocks decreased with age. PDW was highest at cocks at 8 weeks of age and PCT at 18 weeks in hens.

Table 2. Changes in the white blood cells count of chickens Polbar breed (n=50), Means ± SD (Standard Deviation)

Age (week)	Sex	WBC (10^9/l)	LY(10^9/l)	NE (10^9/l)	MI (10^9/l)
8	cock	34.47^{A} ± 8.44	27.55^{A} ± 7.15	6.74 ± 1.86	0.20^{A} ± 0.05
	hen	39.43^{A*} ± 6.16	33.06^{A*} ± 3.24	5.88^{A} ± 0.13	0.23 ± 0.08
	mean	37.23 ± 7.58	30.61 ± 5.97	6.26 ± 1.60	0.22 ± 0.07
12	cock	31.54 ± 5.73	26.12^{A} ± 4.90	6.29 ± 1.59	0.20^{A} ± 0.08
	hen	32.30^{B} ± 7.75	26.98^{B} ± 6.24	5.03 ± 2.30	0.19 ± 0.04
	mean	31.91 ± 6.80	26.54 ± 5.61	5.67 ± 1.90	0.19 ± 0.06
18	cock	27.38^{B} ± 5.66	22.53^{B} ± 5.02	4.19 ± 1.07	0.16^{B} ± 0.03
	hen	26.79^{C} ± 8.73	23.03^{C} ± 7.87	3.29^{B} ± 0.31	0.20 ± 0.15
	mean	27.06 ± 7.47	22.80 ± 6.70	3.71 ± 0.14	0.19 ± 0.13
together	cock	30.63 ± 6.99	25.09 ± 5.90	5.60 ± 1.50	0.19 ± 0.07
	hen	29.87 ± 8.86	25.20 ± 7.47	4.20 ± 1.80	0.20 ± 0.10
	mean	30.02 ± 7.58	28.15 ± 6.09	5.91 ± 1.66	0.20 ± 0.09

A:B:C – means with different superscripts within column differ significantly ($P<0.05$),
* – significant differences $P\leq0.05$ between cocks and hens of the same age
WBC – leucocytes, NE – neutrophils, LY – lymphocytes, MI – cells that machine could not correctly identify

DISCUSSION

The hematology of Polbar breed, both hens and cocks showed significant differences between the groups within the studied blood parameters. In the available literature no reference values were found for chicken (Gallus gallus), which definitely makes it difficult to interpret the results. HCT in cocks and hens increased with age similar as in Bedáňová *et al*. (2007) study. Simarks *et al*. (2004), Koncicki and Krasnodębska-Depta (2005), Krzymowski (2005), Mazurkiewicz *et al*. (2005), and

Table 3. System of cells associated with blood clotting of chickens Polbar breed (n=50), Means ± SD (Standard Deviation)

Age (week)	Sex	PLT (10^9/l)	PCT (%)	MPV (fl)	PDW (%)
8	cock	20.50^{C} ± 11.47	0.0109^{B} ± 0.0029	6.99^{A} ± 0.34	33.55^{A} ± 1.43
	hen	21.82^{C} ± 13.01	0.0128^{B} ± 0.0045	9.62^{A} ± 0.43	32.73^{A} ± 1.96
	mean	21.06 ± 12.36	0.0120 ± 0.0039	6.95 ± 0.39	33.09 ± 1.77
12	cock	28.10^{B} ± 14.91	0.0108^{B} ± 0.0027	6.40^{B} ± 0.34	32.21^{A} ± 2.08
	hen	28.80^{B} ± 16.06	0.0100^{C} ± 0.0017	6.74^{A} ± 0.15	32.24^{A} ± 0.49
	mean	28.00 ± 15.70	0.0102 ± 0.0020	6.57 ± 0.31	32.22 ± 1.53
18	cock	32.80^{A} ± 17.96	0.0150^{A} ± 0.0096	5.15^{C} ± 0.62	27.39^{B} ± 3.17
	hen	33.00^{A} ± 18.03	0.0219^{A} ± 0.0109	5.40^{B} ± 0.59	28.76^{B} ± 2.64
	mean	32.80 ± 18.05	0.0194 ± 0.0109	5.28 ± 0.62	28.12 ± 2.98
together	cock	27.25 ± 16.73	0.0121 ± 0.0062	6.06 ± 0.88	30.69 ± 3.58
	hen	27.70 ± 17.26	0.0118 ± 0.0038	5.84 ± 0.88	29.77 ± 3.14
	mean	27.48 ± 17.10	0.0119 ± 0.0050	6.72 ± 0.39	35.57 ± 1.68

A:B:C - means with different superscripts within column differ significantly ($P<0.05$)
PLT - platelet count, PCT – plateletcrit, MPV – mean platelet volume, PDV – platelet volume distribution width

Blahová (2007) obtained different values for this parameter in cocks compared to hens, which is also confirmed by our study. Mazurkiewicz (2005) found that the HCT increases with age and is dependent on the genetic line. Krasnodębska-Depta and Koncicki (1999) recorded for laying hens a lower hemoglobin value for cockerels at 10 weeks, while higher values were between 11 and 15 weeks of age. Lower values of the HGB reported in this study were by Kontecka *et al*. (1997), Polonis and Dmoch (2007) and Witkowska *et al*. (2007). Bhatti *et al*. (1989) reported HGB values higher than those obtained in the present study. Our findings are in complete agreement with those reported by Král and Suchỳ (2000) for the Rhode Island Red cockerels at 10 weeks of age and Krasnodębska-Depta and Koncicki (1999) and Koncicki and Krasnodębska-Depta (2005) for laying hens. Kaczanowska *et al*. (1986) found that the number of RBC increases until the birds reach sexual maturity, and then were maintained at a constant level characteristic for their sex, while researchers have reported higher values for mature erythrocytes in cocks than hens. Similar correlations were observed by Aengwanich and Tanomtong (2007) on Gallus gallus. Along with changes in the level of HGB and RBC, resulting from age and physiological condition of the birds, there are corresponding variations of red cell indices (Kaczanowska *et al.,* 1986). The studied birds were characterized by

a lower average volume of RBC, compared to Simarks *et al*. (2004) results. In the presented study the average WBC count for Polbar was higher compared to laying hens (Koncicki and Krasnodębska-Depta 2005) and *Gallus gallus* (Aengwanich and Tanomtong 2007). Heavy lines of laying hens has a lower number of WBC in comparison to the light lines (Mazurkiewicz 2005). According to Krzymowski (2005) and Gromysz-Kałkowska *et al*. (2000), the number of WBC was lower in cocks than hens. This relationship was also confirmed in our study at 8 and 12 weeks of age. Mazurkiewicz (2005) reports that there are no differences in the values of the WBC count between cocks and hens up to 12 weeks of age, only between 14-18 weeks of age, where cocks have a lower value. Krasnodębska-Depta and Koncicki (1999) reported that with increasing age the amount of LY decreases and this is confirmed by our results. However, different results were obtained, by Gromysz-Kałkowska *et al*. (2000). The presented results of WBC are similar to those presented by Krasnodębska-Depta and Koncicki (1999) and lower than reported by Kontecka *et al*. (1997). There has been an increase in PLT trends with the age of the birds, irrespective of sex. These data correlate with the results by Chuanqing *et al*. (2002) and Krzymowski and Przała (2005). Similar values of PLT have also been reported by Witkowska *et al.,* (2007) for chickens in the control group at 6 weeks of age. In the presented work lower values of PLT were obtained as compared to those reported by Dmoch and Polonis (2007) and Sokół *et al*. (2009). Similarly, the mean PCT, MPV and PDW values differed significantly at 8, 12 and 18 weeks of age in cocks and hens. During the rearing of chickens the PLT and PCT showed an increasing trend. Unlike MCV, PDW was decreased. In studies by Dan *et al*. (2011), for the parameters MCV and PDW, which displayed an upward trend with the age of the birds. Blood cells associated with blood clotting in Polbar breed chickens, cocks and hens, revealed many significant differences between these groups. The range of blood parameters is similar as previously reported by Gryzińska *et al*. (2008a, 2008b). The values of hematological indices available in the literature usually refer to experimental systems and to the impact of the input parameters to these values. Any interpretation of results without reference values developed for the hens is unfounded. The results of the indicators associated with cells of blood clotting consolidated in the Polbar breed can be used for comparison to other poultry breeds. Comparison of hematological indices extends diagnostic capabilities, which allows for a comprehensive monitoring of the poultry stock. The values presented in this paper may serve as a guide to the state of health in the monitored birds.

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REFERENCES

1. *Aengwanich W, Tanomtong A,* 2007, Blood cell characteristics and hemalogical values of free ranging red jungle fowl (*Gallus gallus*) in Northestern, *Thailand J Biol Scien,* 7, 689-92.
2. *Bedáňová I, Voslářová E, Večerek V, Pištěková V, Chloupek P,* 2007, Haematological profile of broiler chickens under acute stress due to shackling, *Acta Vet Brno,* 76, 129-35.
3. *Blahová J, Dobšíková R, Straková E, Suchý P,* 2007, Effect of low environmental temperature on performance and blood system in broiler chickens (*Gallus domesticus*), *Acta Vet Brno,* 76, 17-23.
4. *Bhatti BM, Qureshi MS, Bajwa TM,* 1989, Haematology and clinical chemistry values in broiler chickens affected with hydropericardium syndrome prevalent in Pakistan, *Vet Arch*, 59, 107-11.
5. *Chuanqing X, Yanjun Z, Grgersen H,* 2002, Dynamic model and simulation of the platelets' role in blood coagulation, *Acta Mech*, 18, 422-8.
6. *Dan Z, HongGuang Q, ZhongHua N,* 2011, Determination of physiological and biochemical indicators of brown-egg dwarf layers at different ages*, Anim Husb Feed Sci*, 3, 16-9.
7. *Dmoch M, Polonis A,* 2007, Influence of biopleks-Cu on hematological and biochemical indeces and content of mineral components in blood of chicken broilers, *Acta Sci Pol*, 6, 11-8.
8. *Gromysz-Kałkowska K, Bieńko M, Kanoniuk D, Szubartowska E, Wójcik K,* 2000, Morphology and respiratory function of the blood of aluminum intoxicated broiler chickens. II. White blood cell system, *Zool Pol*, 45, 141-55.
9. *Gryzińska M, Niespodziewański M, Widomski P*, 2008a, Influence of age on morphometric characteristics of the male reproductive tract of Polbar breed chickens, *Med Wet*, 64, 344-7.
10. *Gryzińska M, Niespodziewański M, Widomski P,* 2008b, Influence of age on morphometric features of the female reproductive tract of polbar hens*, Med Wet,* 64, 489-92.
11. *Kaczanowska E, Gromisz-Kałkowska K, Szubartowska E,* 1986, Review of the studies on the hematology of the domestic fowl, *Prz Zool*, 3, 277-92.
12. *Koncicki A, Krasnodębska-Depta A,* 2005, Use the results of hematological and biochemical tests in the diagnosis of poultry diseases, *Mag Wet*, 5, 20-3.
13. *Kontecka H, Witkiewicz K, Sobczak J,* 1997, Effect of vitamin C addition to feed on production and haematological indices in laying hens, *Zesz Nauk PTZ*, 32, 139-45.
14. *Král I, Suchỳ P,* 2000, Haematological studies in adolescent breeding cocks, *Acta Vet Brno,* 69, 189-94.
15. *Krasnodębska-Depta A, Koncicki A,* 1999, Physiological values of haematological indices in chickens, *Pol J Vet Sci*, 2, 165-70.
16. *Krasnodębska-Depta A, Koncicki A,* 2000, Physiological values of selected serum biochemical indices in broiler chickens, *Med Wet*, 56, 456-60.
17. *Krauze M, Grela ER*, 2010, Effects of an alfalfa concentrate in turkey diets on performance and some blood parameters, *Arch Geflügel*, 74, 226-32.
18. *Krauze M, Merska M, Gryzińska M, Strachecka A,* 2012, Effect of garlic (*Allium sativum*) on selected indices of blood metabolic profile and rearing efficiency turkey hens, *Ann UMCS*, Sec EE 3, 48-59.
19. *Krzymowski T, Przała J,* 2005, Animal Physiology, Selected aspects of the physiology of birds, PWRiL Warszawa, 701- 4.
20. *Simarks S, Chinrasri O, Aengwanich S,* 2004, Haematological, electrolyte and serum biochemical values of the Thai indigenous chickens (*Gallus domesticus*) in northeastern Thailand, Songklanakarin*, J Sci Technol,* 26, 426-30.
21. *Sokół R, Michalczyk M, Spodniewska A, Barski D,* 2009, The influence of administering effective microorganisms to hens on chosen haematological and biochemical blood indexes, *Pol J VeT Sci*, 12, 519-22.
22. *Straková E, Suchý P, Kábelová P, Vitula F, Herzig I*, 2010, Values of selected haematological indicators in six species of feathered game, *Acta Vet Brno*, 79, 3-8.

23. *Truchliński J, Krauze M, Cendrowska-Pinkosz M, Modzelewska-Banachiewicz B,* 2006, Influence of garlic, synthetic 1,2,4-triasole derivative and herbal preparation Echinovit C on selected indices of turkey-hens non-specific immunity, *Pol J Vet Sci*, 9, 51-5.
24. *Witkowska D, Szarek J, Iwańczuk-Czernik K, Sowińska J, Mituniewicz T, Wójcik A* et al., 2007, Effect of disinfecting litter on rearing performance and results of blood indices and internal organs of broiler chickens, *Med Wet*, 63, 1115-9.

UTICAJ POLA I UZRASTA NA HEMATOLOŠJKE PARAMETRE KOD PILIĆA SOJA POLBAR

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SADRŽAJ

Cilj ovih ispitivanja je bio da se odrede vrednosti odabranih hematoloških parametara pilića soja Polbar u zavisnosti od pola i uzrasta. Dokazane su značajne razlike u broju leukocita između petlića i kokica u zavisnosti od uzrasta. U svim posmatranim intervalima, petlići su imali manji broj limfocita od kokica a broj limfocita i neutrofilnih granulocita se smanjivao sa uzrastom. Većina posmatranih parametara je bila značajno različita ($p \leq 0,05$) kod ptica različitog uzrasta. Dobijeni rezultati mogu da posluže za poređenje između ovog i drugih sojeva pilića kao i za monitoring zdravstvenog stanja jata kokica.