Braz. J. vet. Res. anim. Sci.,
São Paulo, v. 30, n. 2, p. 141-4, 1993.

EFFECT OF AGE AND STRAIN ON HAEMATOLOGICAL AND GASOMETRIC PARAMETERS IN SELECTED AND NON-SELECTED BROILER CHICKENS

EFEITO DA IDADE E LINHAGEM SOBRE PARÂMETROS HEMATOLÓGICOS E GASOMÉTRICOS DE FRANGOS DE CORTE SELECIONADOS E NÃO SELECIONADOS

Renato Luis FURLAN[1];Fernanda Marcussi TUCCI[2]; Laura Okada NAKAGHI[1]; Euclides Roberto SECATO[3]; José Roberto GUERREIRO[3]; Marcos MACARI[4]

SUMMARY

This investigation was undertaken to evaluate the effect of age and strain on haematological and gasometric parameters in selected and non-selected broiler chickens. Forty selected and 10 non-selected male broiler chickens were used. Blood samples were withdrawn at 21 and 42 days of age, and haematological parameters were determined including (red blood cell (RBC), white blood cell (WBC), hemoglobin (Hb), hematocrit (Ht), mean cell volume (MCV), mean cell hemoglobin (MCH) and mean cell hemoglobin concentration (MCHC)) and gasometric pH, partial pressure of oxgen (pO_2) and partial pressure of carbon dioxide (pCO_2) were determined. The results showed that almost all studied parameters are affected by broiler strain and age. Selected broiler shown lower red blood cell (RBC) count and higher mean cell volume (MCV) at 21 days of age, when compared to that of 42 day old animals, and an inverse relation was verified by non-selected broiler. These data suggest that selected broiler chickens could have higher sensitivity to alterations in pulmonary rheological parameters at early age, and triggering the ascite's syndrome.

UNITERMS: Selected broiler fowl; Non-selected broiler fowl; Hematology; Blood gas analysis

INTRODUCTION

Ascites has been recognized as a cause of significant mortality in young broilers; however, the etiology of this syndrome is not well defined but seems to be dependent on increased oxygen demand or inadequate oxygen availability (HERNANDEZ[4], 1987). Among the pathophysiologic alterations that must be considered include cardiovascular and pulmonary (HOERR[5], 1988). One interesting hypothesis concerning the pathophysiology of ascites is that affected broilers have an elevated pulmonary artery pressure, and ultimately, right-ventricular failure (JULIAN[6], 1990). Recently, MIRSALIMI and JULIAN[10] (1991) reported that reduced erythrocyte deformability may be one of the predisposing factors that increase resistance to blood flow and alter the rheology of blood in the microcirculation in the lung, resulting in pulmonary hypertension, heart failure, and ascites in broiler chickens. Despite several situations are known to influence the occurrence of ascites in broilers, such as rapid growth, only few experiments have dealt with haematologic changes in selected and non-selected broiler chickens. Thus, this experiment was carried out to study the comparatively haematologic and gasometric parameters by selected and non-selected broiler chickens at two different ages (21 and 42 days old) in an attempt to identify changes that could be related to the high incidence of metabolic disease (ascites) in selected broilers when compared with non-selected ones.

MATERIAL AND METHOD

Animals

Forty male broiler chickens of selected (HUBBARD, COBB, ROSS and ARBOR ACRES strains) and ten from non-selected (FC) strains, aged 1 day were obtained from commercial hatcheries and from local farmer, respectively. The birds were reared on the floor and had free access to tap water and commercial rations through the end of the experiment at day 49.

Blood samples

Venous blood was withdrawn by wing vein puncture using sterile and heparinized syringe. A blood sample of 3 ml was obtained from each bird, and 2 ml was used to haematological analysis and 1 ml for gasometric determinations. Blood samples were obtained at 21 and 42 days of age and no fasting period was established before sampling.

Haematologic analysis

Blood venous samples were obtained with syringes containing anticoagulant (heparin) and haematologic parameters were measured. Haemoglobin (Hb) was determined by the cyanmethaemoglobin method. Red blood cells (RBC) was recorded using an electronic particle counter (CELL CC 510), and white blood cells (WBC) determined by using a

1 - DVM - Faculty of Agrarian and Veterinary Sciences - UNESP - Campus of Jaboticabal, São Paulo, Brazil
2 - Graduate Student - Faculty of Agrarian and Veterinary Sciences - UNESP - Campus of Jaboticabal, São Paulo, Brazil
3 - Technician - Faculty of Agrarian and Veterinary Sciences - UNESP - Campus of Jaboticabal, São Paulo, Brazil
4 - Associate Professor - Faculty of Agrarian and Veterinary Sciences - UNESP - Campus of Jaboticabal, São Paulo, Brazil

Neubawer's chamber and the dilution solution used was according to NATT and HERRICK[12] (1952) recomendation. The haematocrit (Hct) was measured by the microhaematocrit method. The following indices were calculated (CAMPBELL; CAMPBELL[3], 1986): mean cell volume (MCV), mean cell hemoglobin (MCH), mean cell hemoglobin concentration (MCHC).

Gasometric analysis

Venous blood was injected in a Corning 175 automatic pH/blood Gas Analyser System, which was adjusted to each broiler cloacal temperature (measured before sampling), and pH, pCO_2 (mmHg) and pO_2 (mmHg) were determined.

Statistical analysis

The data were submitted to analysis of variance (ANOVA) using SAS (SAS INSTITUTE[13], 1985), and means compared by Tukey-Kramer method when the F value showed significance at P<0.05.

RESULTS

Tab. 1 and 2 show the results obtained for haematologic and gasometric parameters, respectively. It is also shown the F values (ANOVA) as well as the differences between means (Tukey-Kramer method) for strains and ages. Tab. 1 shows that strain and age influenced significantly the haematologic parameters, and interaction between these variables was also statistically significant. Red blood cell (RBC) was significantly (P<0.05) higher for non-selected broilers when compared to that of selected ones, and among selected strains, Cobb showed the lower RBC value. The effect of age on RBC number revealed that 42 day old animals had higher RBC value (P<0.05) than 21 day old birds. The statistical analysis of hematocrit data showed that there was no difference among strains, but a significant effect of age (P<0.05) with 21 day old broiler having lower hematocrit values than 42 day old birds. Total haemoblobin did not differ statistically among strains or ages. An effect of strain (P<0.05) was observed on mean cell volume (MCV) showing that Hubbard (selected) and non-selected strain differ statistically (P<0.05) from other strains. However, opposite to RBC data MCV was significantly (P<0.05) lower for older than younger broilers. MCH and MCHC were influenced by strains, but not by the age, and was not observed a consistent difference between selected and non-selected broiler strains for these parameters.

Tab. 2 shows the venous blood gasometric parameters. It was verified an effect of strain on pH values which seems to be not related to animal selection. Age has influenced significantly the pH (P<0.05), being lower values observed for younger (21 days old) broilers. Venous pO_2 and pCO_2 were not affected by age, but a significant (P<0.05) effect of strain was verified.

DISCUSSION AND CONCLUSION

The results of this experiment show that haematologic and gasometric parameters are affected by the broiler strain and age. The age has influenced especially RBC, hematocrit, WBC, MCV and pH. The effect of animal selection was observed specifically on RBC and MCV, since the values observed for selected and non-selected strains showed a statistically significant (P<0.05) difference. The data revealed that selected strains had significantly lower RBC count and higher MCV at early ages when compared with non-selected birds. MIRSALIMI and JULIAN[10] (1991) reported that MCV from broiler chicken is bigger than leghorns at least up to 14 days of age. The author's data also showed that for broiler chicken

TABLE 1
Haematological data from selected and non-selected broilers, Jaboticabal-SP, 1991.

	Parameters						
	RBC (10^3 cell/MM³)	Ht (%)	Hb (g/100 ML)	WBC (cell/MM³)	MCV (fl)[1]	MCH (pg/cell)	MCHC (%)
F values							
Strain (S)	9.83**[2]	1.95	1.48	11.97**	9.32**	5.55**	3.41**
Age (A)	26.26**	5.21*	2.90	7.03*	9.89**	0.29	0.44
S x A	8.51**	1.00	1.33	7.64**	7.56**	6.58**	2.16
C.V. (%)	10.74	10.44	17.97	25.02	8.77	16.83	18.16
Mean strain values selected							
Arbor acres	2.104[b(3)]	30	10.70	6.560[b]	142[ab]	50[ab]	36[ab]
Cobb	1.836[c]	27	11.30	11.720[a]	149[a]	61[a]	41[ab]
Hubbard	2.183[b]	28	12.20	6.880[b]	132[bc]	58[a]	44[a]
Ross	2.190[ab]	30	10.90	9.330[ab]	146[ab]	52[ab]	40[ab]
Non-selected							
FC	2.486[a]	30	10.30	11.860[a]	120[c]	44[b]	34[b]
Means by age							
21 days	1.998[b]	28[b]	10.60	8.400[b]	143[a]	54	38
42 days	2.335[a]	30[a]	11.60	10.140[a]	132[b]	53	38

(1) Fentoliters
(2) ** P<0.01 and * P<0.05
(3) In each column number with different superscript means P<0.05 (Tukey-Kramer method)

TABLE 2
Blood gasometric parameters from selected and non-selected broilers. Jaboticabal-SP, 1991.

	Parameters		
	pH	pO_2 (mmHg)	pCO_2 (mmHg)
F. values			
Strain (S)	5.04**(1)	6.26**	20.89**
Age (A)	18.18**	0.58	1.20
S x A	12.28**	9.99**	7.92**
C.V. (%)	0.57	13.23	10.36
Mean strain values selected			
Arbor acres	7.44$^{a(2)}$	43.10^{ab}	48.70^{b}
Cobb	7.41^{ab}	37.40^{c}	57.10^{ab}
Hubbard	7.37^{b}	50.50^{a}	50.70^{ab}
Ross	7.45^{b}	42.50^{bc}	59.60^{a}
Non-selected			
FC	7.45^{ab}	46.80^{ab}	34.00^{c}
Mean by age			
21 days	7.44^{b}	43.90	51.30
42 days	7.49^{a}	44.30	48.70

(1) ** P<0.01 and * P<0.05
(2) In each column number with different superscript means P<0.05 (Tukey-Kramer method)

MCV decreased from 143 to 122 fentoliters (fl) from 7 to 35 days of age, respectively; however, it was not referred whether MCV was statistically influenced by age. On the other hand, MCV seems not to be affected by age in leghorn hens. Electron microscope studies of avian lung (AKESTER[1], 1974) revealed that erythrocytes have to deform when passing through lung cappilaries. However, many factors, such as pH, osmolarity, iron deficiency and others, seems to affect erythrocytes deformability (LEBLOND; COULOMBE[9], 1979; MOHANDAS et al.[11], 1980; YIP et al.[16], 1983; KOUTSOURIS et al.[8], 1985).

The high incidence of ascites in selected broilers is reported to be at high altitudes, which was related due to air oxygen rarefaction. Nowadays other variables are being investigated, such as changes in red blood cell count and mean cell volume (MCV). WITZEL et al.[15] (1990) reported an increase in MCV at high altitude which seems to change the pulmonary rheological parameters in growing broilers inducing pathophysiological alterations. In birds, the lung is a fixed organ in the rib cage which contracts and expands very little compared to mammals. The cappilaries being smaller in diameter than that of the red blood cell can dilate very little to allow more blood flow. Thus in selected broilers any alterations in blood composition (physical, physicochemical or chemical) may change resistence to blood flow. We can speculate that any stimuli increasing the demand for oxygen during growth by selected broilers, such as atmospheric hypoxia, inadequate housing environment, respiratory disease, rapid growth rates, high energy rations, toxins (ANDERSON et al.[2], 1986; JULIAN et al.[7], 1986; HOERR[5], 1988; WIDEMAN[14], 1988) associated with increased MCV and low RBC count at early age (21 days), can induce changes in pulmonary rheological parameters (increased resistence with the onset of pulmonary hypertension, right ventricular failure) and can trigger the ascite's syndrome.

RESUMO

Objetivou-se investigar o efeito de idade e linhagem sobre parâmetros hematológicos e gasométricos de frangos selecionados e não selecionados. Foram utilizados somente frangos machos, sendo 40 selecionados e 10 não-selecionados. Amostras de sangue foram colhidas aos 21 e 42 dias de idade e determinados os parâmetros hematológicos (eritrócito, leucócito, hemoglobina, hematócrito, volume globular médio, hemoglobina globular média e concentração de hemoglobina no eritrócito), e os parâmetros gasométricos (pH, pressão parcial de oxigênio e pressão parcial de dióxido de carbono). Os resultados mostraram que os parâmetros hematológicos e gasométricos são afetados pela idade e linhagem do frango. As aves selecionadas apresentaram um número de eritrócito menor e um volume globular médio maior aos 21 dias de idade quando comparados aos animais de 42 dias de idade, e uma relação inversa foi verificada nos frangos não selecionados. Estes dados sugerem que quando jovens os frangos selecionados podem ser mais sensíveis às alterações nos parâmetros pulmonares e desenvolver a síndrome da Ascite.

UNITERMOS: Frango de corte selecionado; Frango de corte não-selecionado; Hematologia; Gasometria

REFERENCES

01-AKESTER, A.R. Deformability of red blood cells in avian lung cappilaries. **J. Anat.**, v.117, p.657-8, 1974.

02-ANDERSON, L.S.; GLEESON, M.; HAIGH, A.L.; MOLONG, V. Respiratory responses of domestic fowl to low level carbon dioxide exposure. **Res. vet. Scl.**, v.40, p.99-104, 1986.

03-CAMPBELL, J.M.; CAMPBELL, J.B. **Matemática de laboratório:** aplicações médicas e biológicas. 3.ed. São Paulo, Roca, 1986.

04-HERNANDEZ, A. Hypoxic ascites in broilers: a revision of several studies done in Colombia. **Avian Dis.**, v.31, p.658-61, 1987.

05-HOERR, F.J. Pathogenesis of ascites. **Poultry Dig.**, v.47, p.8-12, 1988.

06-JULIAN, R.J. Pulmonary hypertension: a cause of right heart failure ascites in meat-type chickens. **Feedstuffs**, v.62, n.5, p.19-20, 22, 28, 1990.

07-JULIAN, R.J.; FRIARS, G.W.; FRENCH, H.; QUINTON, M. The relationship of right ventricular hypertrophy, right ventricular failure and ascites to weight gain in broiler and rooster chickens. **Avian Dis.**, v.31, p.130-5, 1986.

08-KOUTSOURIS, D.; DELATOUR, E.; HANSS, M. Physicochemical factors of erythrocyte deformability. **Biorheology**, v.22, p.119-32, 1985.

09-LeBLOND, P.F.; COULOMBE, L. The measurement of erythrocyte deformability using micropore membranes. **J. Lab. clin. Med.**, v.94, p.133-4, 1979.

10-MIRSALIMI, S.M.; JULIAN, R.J. Reduced erythrocyte deformability as a possible contributing factor to pulmonary hypertension and ascites in broiler chickens. **Avian Dis.**, v.35, p.374-9, 1991.

11-MOHANDAS, N.; CLARK, M.; SHOHET, S.B. Analysis of factors regulating erythrocyte deformability. **J. clin. Invest.**, v.66, p.563-73, 1980.

12-NATT, M.P.; HERRICK, C.A. A new blood diluent for counting

the erytrocytes and leucocytes of the chicken. **Poultry Sci.**, v.31, p.735-8, 1952.

13-SAS INSTITUTE. **SAS user's guide statistics.** 5.ed. Cary, SAS Institute, p.795-800, 1985.

14-WIDEMAN, R.F. Ascites in poultry. **Montsanto Nutrit. Update.**, v.6, n.2, p.1-7, 1988.

15-WITZEL, D.A.; HUFF, W.E.; KUBENA, L.F.; HARVEY, R.B.; ELISSALDE, M.H. Ascites in growing broilers: a research model. **Poultry Sci.**, v.69, p.741-5, 1990.

16-YIP, R.; MOHANDAS, N.; CLARK, M.R.; STEPHEN, S.J.; SHOHET, B.; DALLAMAN, P.R. Red cell membrane stiffness in iron deficiency. **Blood**, v.62, p.99-106, 1983.

Recebido para publicação em 06/10/92
Aprovado para publicação em 05/02/93