

## Effects of season and sex on packed cell volume, haemoglobin and total proteins of indigenous pigeons in Zaria, Northern Nigeria

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### ABSTRACT

Blood samples were obtained from 178 indigenous pigeons, comprising 103 males and 75 females, with the aim of determining the effect of season and sex on their packed cell volume (PCV), haemoglobin (Hb) and total proteins (TP) using routine laboratory procedures. The samples were obtained during the harmattan, hot and rainy seasons. Correlation coefficients between meteorological elements and PCV, Hb as well as TP, were negative during the hot season. The highest PCV and Hb values of  $37.50 \pm 1.23$  (%) and  $129.0 \pm 03.0$  g/L, respectively, were obtained during the rainy season, while the lowest PCV and Hb values of  $29.12 \pm 0.88$  % and  $97.2 \pm 2.9$  g/L, respectively, were obtained during the hot season. The TP values of  $78.2 \pm 13.0$  g/L and  $82.5 \pm 10.0$  g/L obtained during the hot and rainy seasons, respectively, were significantly ( $P < 0.05$ ) higher than the value of  $64.5 \pm 3.3$  g/L obtained during the harmattan season. PCV and Hb values were higher ( $P < 0.01$ ) in male than in female pigeons during the three seasons. The results show seasonal and sex variations in PCV, Hb and TP values of indigenous pigeons. In conclusion, the rainy and harmattan seasons are apparently more conducive to the rearing of pigeons than the hot season in the Northern Guinea Savannah zone of Nigeria.

**Key words:** season, sex, haematology, indigenous pigeon

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## **Introduction**

The pigeon population in Nigeria is estimated to be about one million. Traditional pigeon husbandry is an important source of income for rural dwellers, particularly in the Northern Guinea Savannah zone of Nigeria, where pigeons are considered the only birds whose young are fit for human consumption by the Hausas of Northern Nigeria (IBRAHIM and ABDU, 1992). Roasted pigeon meat is highly valued by the peoples of Northern Nigeria, and they are reared for this purpose.

PCV, Hb and TP values are important haematological parameters, which are of importance in the assessment of health status and disease of birds (HAWKEY et al., 1983; HAWKEY et al., 1984), and are good indices of livestock adaptability to prevailing environmental conditions (KAUSHISH et al., 1976). The value of PCV is also a good indicator of the haemogram, and especially of the number of circulating erythrocytes and Hb (BENJAMIN, 1985).

Three distinct seasons exist in the Northern Guinea Savannah zone of Nigeria, where Zaria is located. They are the harmattan (November to February) hot (March to May) and rainy (June to October) seasons. These seasons are known to influence livestock production (AYO et al., 1998). The fact that these birds are free-ranging and semi-domesticated means that they are frequently exposed to the adverse effects of heat stress prevailing in the Northern Guinea Savannah zone of Nigeria, particularly during the hot season when the ambient temperature is very high. High environmental temperature has been identified as a factor which alters physiological parameters of birds (DONKOH, 1989; BELAY and TEETER, 1993). So far, there is no available information on the effects of meteorological elements and seasons on the physiological parameters of pigeons, reared under the traditional extensive management system in the Northern Guinea Savannah zone of Nigeria. Presently, available data on physiology of pigeons are those obtained from pigeons reared in the temperate regions of the world. Such data, which are currently used in our local environment, are often misleading because they do not reflect the possible variations in climatic, nutritional, and genetic factors known to affect physiological parameters of birds, reared in different geographical regions of the world. Therefore, as part of a comprehensive study of the physiology of indigenous pigeons

in Northern Nigeria, values of PCV, Hb and TP were determined in order to establish the effects of seasons and sex on them.

### **Materials and methods**

*Site of experiment.* The experiment was performed in Zaria (11°10'N; 07°38'E), located in the Northern Guinea Savannah zone of Nigeria, between November 1998 and October 1999. Meteorological data during the study period were collated from the Meteorological Unit, Institute for Agricultural Research, Ahmadu Bello University, Samaru – Zaria, Nigeria.

*Experimental birds.* A total of 178 indigenous pigeons, comprising 103 males and 75 females were used in the experiment. The pigeons were free-ranging, semi-domesticated and were aged from six months to two years.

*Laboratory procedures.* Blood samples were collected at random every week by exsanguination and kept in a set of Bijou test tubes containing ethylene diamine tetra acetic acid (EDTA) as an anticoagulant, at a ratio of 5 mg/ml of blood. The samples were analysed for values of PCV, Hb and TP using the routine laboratory procedures of DACIE and LEWIS (1984), with certain modifications. Samples containing EDTA were aspirated into a set of plain capillary tubes and centrifuged at 9,500 g for 15 minutes. Thereafter, the values of PCV were read directly on graphic readers, and Hb as one-third of PCV. The TP was determined using a hand refractometer. After reading PCV values on a graphic reader, micro-haematocrit capillary tubes were broken at a point immediately above the buffy coat. The ends of the tubes containing plasma were placed on the sample surface of a refractometer. Reading of the TP values was made through the objective lens of the refractometer.

*Statistical analysis.* All data obtained were subjected to statistical analysis using Student's t-test and correlation analysis. The data were expressed as mean  $\pm$  standard error of the mean (mean  $\pm$  SE). Values of  $P < 0.05$  were considered significant.

## Results

Meteorological data during the study period indicate that the highest ( $30.7 \pm 0.8$  °C) and the lowest ( $25.1 \pm 1.5$  °C) ambient temperatures (ATs) were obtained during the hot and harmattan seasons, respectively. The highest ( $81.4 \pm 0.5\%$ ) and lowest ( $22.1 \pm 1.5\%$ ) values of relative humidity (RH) were obtained during the rainy and harmattan seasons, respectively. The highest difference between dry-bulb (DBT) and wet-bulb temperatures (WBT) of  $11.4$  °C was obtained during the hot season (Table 1).

Table 1. Meteorological data during the study period (Mean  $\pm$  SE)\*

Season	Ambient temperature (°C)	Dry-bulb temperature (°C)	Wet-bulb temperature (°C)	Relative humidity (%)
Harmattan	$25.1 \pm 1.5$	$26.9 \pm 0.3$	$18.6 \pm 1.8$	$22.1 \pm 1.5$
Hot	$30.7 \pm 0.8$	$32.5 \pm 0.5$	$21.1 \pm 1.0$	$44.3 \pm 1.2$
Rainy	$25.8 \pm 0.2$	$25.5 \pm 0.3$	$22.7 \pm 0.6$	$81.4 \pm 0.5$

\* Data collected from the Meteorological Unit, Institute for Agricultural Research, Ahmadu Bello University, Zaria, Nigeria.

Table 2. Seasonal and sex variations in packed cell volume, haemoglobin and total proteins of the pigeon (Mean  $\pm$  SE)

Season Sex	PCV %			Haemoglobin g/L			Total proteins g/L		
	Harmattan	Hot	Rainy	Harmattan	Hot	Rainy	Harmattan	Hot	Rainy
Male	$44.80 \pm 1.04^*$ (n=36)	$32.56 \pm 1.22^*$ (n=36)	$45.01 \pm 1.02^*$ (n=31)	$149.9 \pm 3.5^*$ (n=36)	$108.5 \pm 4.1^*$ (n=36)	$152.1 \pm 21.0^*$ (n=31)	$62.9 \pm 3.3$ (n=36)	$74.9 \pm 4.2^*$ (n=36)	$78.1 \pm 11.1^*$ (n=31)
Female	$30.11 \pm 1.46^{**}$ (n=28)	$25.68 \pm 0.94^{**}$ (n=28)	$30.00 \pm 1.10^{**}$ (n=19)	$100.3 \pm 4.8^{**}$ (n=28)	$85.9 \pm 3.1^{**}$ (n=28)	$105.9 \pm 12.5^{**}$ (n=19)	$66.1 \pm 3.3^*$ (n=28)	$81.5 \pm 4.0^*$ (n=28)	$86.9 \pm 12.0^*$ (n=19)
Mean $\pm$ SEM	$37.46 \pm 0.34^a$ (n=64)	$29.12 \pm 0.88^b$ (n=64)	$37.50 \pm 1.23^a$ (n=50)	$125.1 \pm 4.8^a$ (n=64)	$97.2 \pm 2.9^b$ (n=64)	$129.0 \pm 3.0^a$ (n=50)	$64.5 \pm 3.3^a$ (n=64)	$78.2 \pm 13.0^b$ (n=64)	$82.5 \pm 10.0^b$ (n=50)

a,b = for each blood parameter, data along the same row with different superscript alphabets are significantly different (at least  $P < 0.05$ )

\*, \*\* = for each blood parameter, data along the same column with different superscript asterisks are significantly different (at least  $P < 0.05$ )

n = number of birds

Table 3. Correlation coefficients (r) between meteorological elements and packed cell volume, haemoglobin and total proteins in the pigeon

Season	PCV %			Haemoglobin g/L			Total proteins g/L		
	Harmattan	Hot	Rainy	Harmattan	Hot	Rainy	Harmattan	Hot	Rainy
Ambient temperature	0.979***	-0.998**	0.878 <sup>NS</sup>	0.998***	-0.461**	0.802 <sup>NS</sup>	0.981***	-0.830 <sup>NS</sup>	0.964**
Dry-bulb temperature	0.798 <sup>NS</sup>	-0.999***	0.240 <sup>NS</sup>	0.912 <sup>NS</sup>	-0.976**	0.101 <sup>NS</sup>	0.997***	-0.863 <sup>NS</sup>	0.454 <sup>NS</sup>
Wet-bulb temperature	0.984 <sup>NS</sup>	-0.922*	0.987***	0.949**	-0.819 <sup>NS</sup>	0.995***	0.837 <sup>NS</sup>	-0.606 <sup>NS</sup>	0.925 <sup>NS</sup>
Relative humidity	0.996***	-0.977***	0.926 <sup>NS</sup>	0.962***	-0.994*	0.863 <sup>NS</sup>	0.981**	-0.738 <sup>NS</sup>	0.429 <sup>NS</sup>

NS = non-significant correlation ( $P>0.05$ ); \* =  $P<0.05$ ; \*\* =  $P<0.01$ ; \*\*\* =  $P<0.001$

PCV values of  $37.46 \pm 0.34\%$  during the harmattan season and  $37.50 \pm 1.23\%$  during the rainy season were significantly ( $P<0.001$ ) higher than the value of  $29.12 \pm 0.88\%$  obtained during the hot season. Similarly, the Hb values of  $125.1 \pm 4.8$  g/L obtained during the harmattan season, and  $12.90 \pm 0.30\%$ , obtained during the rainy season, were significantly ( $P<0.001$ ) higher than the value of  $97.2 \pm 2.9$  g/L obtained during the hot season (Table 2).

PCV values in the males were significantly ( $P<0.001$ ) higher than in their female counterparts in all seasons. Similarly, Hb values in the males were significantly ( $P<0.01$ ) higher than those of the females in all seasons. TP values of the female were higher than those of the male pigeons in all seasons (Table 2).

Correlation coefficients between meteorological elements and PCV, and Hb and TP were negative during the hot season. AT was positive and significantly correlated with PCV ( $r = 0.979$ ,  $P<0.001$ ), Hb ( $r = 0.998$ ,  $P<0.001$ ) and TP ( $r = 0.981$ ,  $P<0.001$ ) during the harmattan season. RH was positive and insignificantly correlated with PCV ( $r = 0.926$ ,  $P>0.05$ ) during the rainy season. WBT was positive and significantly correlated with PCV ( $r = 0.987$ ,  $P<0.001$ ), while DBT was positive but insignificantly correlated with PCV ( $r = 0.240$ ,  $P>0.05$ ) during the rainy season (Table 3).

### **Discussion**

The significantly lower values of PCV and Hb during the hot season than in the rainy and harmattan seasons were probably due to poor nutrition, especially protein deficiency, which is known to have negative effects on some haematological parameters. The fact that these birds were free-ranging, semi-domesticated and were reared under the traditional extensive management system, with little or no feed supplements from their owners, subjected them to the scarcity of herbage and vegetables which occurs predominantly during the hot season of the year in the Northern parts of Nigeria (ONYEYILI et al., 1991; AGAIE and UKO, 1998). This considerably reduced the amount of natural nutrients available to these birds, and may be involved in the reduction in PCV and Hb values during the hot seasons. There was no significant difference ( $P>0.05$ ) between PCV or Hb values of the harmattan and rainy seasons. Although herbage and vegetables were dried during the harmattan season, farm leftovers were abundant, especially those of cereals such as sorghum, millet, maize and rice, widely cultivated in this zone. This is due to the fact that the harmattan season, which immediately follows the rainy season, coincides with the harvesting period in Northern Guinea Savannah zone of Nigeria. The abundance of feeds and farm leftovers and, therefore, of nutrients during the harmattan and rainy seasons, for free-ranging and semi-domesticated birds, could be responsible for higher PCV and Hb values during these two seasons than in the hot season.

The fact that meteorological elements during the hot season were negatively correlated with the PCV, Hb and TP, indicates that the hot season was thermally stressful to free-ranging and semi-domesticated birds reared virtually without shelter. This result supports that reported by BIANCA (1976), and EGBUNIKE (1979), stating that AT and RH, especially their combined effects, are thermally stressful to birds. Also, a thermally stressful environment is known to alter the homeostatic mechanisms of birds (JOHN et al., 1975; JOHN and GEORGE, 1977), resulting in impairment of erythropoiesis and protein synthesis (DONKOH, 1989). It is known that high environmental temperature increases body temperature, respiration and respiratory water loss and oxygen consumption of birds. The increased oxygen intake increases the partial pressure of oxygen in the blood of birds

(BRACKENBURY et al., 1981a; BRACKENBURY et al., 1981b), decreases erythropoiesis and, consequently, reduces the number of circulating erythrocytes; i. e., the PCV and Hb values in birds (DONKOH, 1989). This mechanism could be responsible for low values of PCV and Hb in these birds during the hot season

The negative relationship between blood parameters and WBT and DBT during the hot season supports the finding of EGBUNIKE (1979) in chickens who showed that these meteorological elements, especially WBT, tend to increase heat stress by reducing the rate of heat loss through evaporation. The fact that the mean AT of  $30.7 \pm 0.8$  °C recorded during the hot season (Table 1) was considerably higher than the thermoneutral zone of 12-22 °C established for birds (BIANCA, 1976; HILLMAN et al., 1985) further confirms the fact that these birds, whose mechanism of heat dissipation is predominantly through panting (NECKER, 1977), were heat stressed during the hot season. This poor heat loss mechanism could be involved in weakening the body resistance of the birds to diseases, and a predisposition to vaccination failure during the hot season.

During the cooler period of the harmattan and rainy seasons, meteorological elements, AT and RH were positively correlated with PCV, Hb and TP (Table 3). The high values of PCV, Hb and TP obtained during the two seasons support the results of HUSTON (1965), and AWOTWI and ABOAGYE (1995) in chickens stating that cold weather associated with low environmental temperature enhances erythropoiesis. This is because low environmental temperatures, characterized by high metabolic rate, high oxygen demand by the body, and low partial pressure of oxygen in the blood (hypoxaemia) are known to stimulate erythropoiesis (KORTE et al., 1999).

The significantly ( $P < 0.01$ ) higher values of PCV and Hb in male than in female pigeons is consistent with previous findings in birds, that matured males generally have higher PCV and Hb values than females. This rise in blood parameters has been attributed to the hormone androgen, which stimulates erythropoiesis and increases the number of circulating erythrocytes and, consequently, PCV and Hb in birds (BALASH et al., 1973; STURKIE, 1986).

The non-significant ( $P>0.05$ ) increase in TP in the female compared to the male may be linked with the physiological status of the female birds, known to have increased circulating plasma lipid and phosphoprotein, particularly during the laying periods (STURKIE, 1986).

In conclusion, the rainy and harmattan seasons are apparently less stressful to the indigenous pigeon, and therefore the two seasons are more conducive to the rearing of pigeons than the hot season in the Northern Guinea Savannah zone of Nigeria.

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**OLADELE, S. B., S. OGUNDIPC, J. O. AYO, K. A. N. ESIEVO: Utjecaj godišnjeg doba i spola na ukupan broj stanica, hemoglobin i ukupne proteine u krvi autohtonih golubova u Zariji, sjeverna Nigerija. Vet. arhiv 71, 277-286, 2001.**

**SAŽETAK**

Istraživanje je provedeno na 178 autohtonih golubova, a među njima 103 mušjaka i 75 ženki, kako bi se odredio utjecaj godišnjeg doba i spola na ukupan broj stanica, količinu hemoglobina i ukupnih bjelančevina. Golubovima je vadena krv u doba harmatana, kao i tijekom sušnog i kišnog razdoblja. Istraživanjem je potvrđen negativni korelacijski koeficijent između meteoroloških uvjeta i ukupnog broja stanica u krvi, hemoglobina i ukupnih bjelančevina tijekom sušnog razdoblja. Najveći broj stanica ( $37 \pm 1,23\%$ ) te vrijednosti hemoglobina ( $129,0 \pm 3,0$  g/L) je dokazan u kišnom razdoblju. Najmanji broj stanica ( $29,12 \pm 0,88\%$ ) kao i vrijednosti hemoglobina ( $97,2 \pm 2,9$  g/L) utvrđen je u tijeku sušnog razdoblja. Vrijednosti ukupnih bjelančevina ( $78,2 \pm 13,0$  g/L) u tijeku sušna razdoblja te  $82,5 \pm 10,0$  g/L tijekom kišnog razdoblja bile su značajno različite ( $P < 0,05$ ) u odnosu na vrijednost ( $64,5 \pm 3,3$  g/L) utvrđenu u tijeku razdoblja harmatana. Ukupan broj stanica i količina hemoglobina bili su veći ( $P < 0,01$ ) u mušjaka tijekom svih razdoblja. Analizom dobivenih rezultata može se zaključiti da je kišno razdoblje kao i razdoblje harmatana mnogo pogodnije za uzgoja golubova nego sušno razdoblje na području sjeverne gvinejske savanske zone Nigerije.

**Ključne riječi:** godišnje doba, spol, hematologija, autohtoni golubovi

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