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Haematology of the Malaysian Swamp Buffalo (*Bubalus bubalis*)

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RINGKASAN

Nilai-nilai hematologi dan kepekatan jumlah protin plasma dianalisakan dari darah vena jugula yang diperolehi daripada kerbau-kerbau sawah jantan dan betina yang sihat dan berumur dari 2 hingga 4 tahun.

Nilai purata bagi kiraan jumlah sel darah merah (RBC) ialah 8.8 × $10^6/\mu l$., kepekatan hemoglobin 13.4 g/dl. dan PCV 39.3%. Nilai purata bagi MCV ialah 49.3 μ^3, MCH 16.5 pg. dan MCHC 34.1%.

Nilai purata bagi kiraan jumlah sel darah puteh (WBC) ialah 10.7 × $10^3/\mu l$. Kiraan diferensial sel darah puteh bagi limfosit ialah 54.2%, neutrofil 35.2%, monosit 3.7%, eosinofil 6.6% dan basofil 0.3%. Nilai purata bagi jumlah kepekatan protin plasma ialah 7.4 g/dl.

Dibandingkan dengan kerbau sungai (sapi) dan lembu, kerbau sawah mempunyai kiraan jumlah sel darah merah, kepekatan hemoglobin, PCV dan kiraan jumlah sel darah puteh yang tinggi.

SUMMARY

Haematological values and total plasma protein concentration were determined from jugular vein blood samples obtained from clinically healthy 2 to 4 year old swamp buffaloes of both sexes.

The mean values for total RBC count, haemoglobin concentration and PCV were 8.8 × $10^6/\mu l$, 13.4 g/dl and 39.2% respectively. The mean values for MCV, MCH and MCHC were 49.3 μ^3, 16.5 pg and 34.1% respectively. The mean total WBC count was 10.7 × $10^3/\mu l$. The differential white cell counts for lymphocytes, neutrophils, monocytes, eosinophils and basophils were 54.2, 35.2, 3.7, 6.6 and 0.3 percent respectively. The mean total plasma protein value was 7.4 g/dl.

Compared with the river buffalo and cattle, swamp buffaloes had higher total RBC count, haemoglobin concentration, PCV and total WBC count.

INTRODUCTION

Swamp buffaloes *(Bubalus bubalis)* are regarded as an integral part of rural agriculture in Malaysia. They are important for draught purposes and meat production.

Haematological analyses are useful as aids to the diagnosis and prognosis of diseases in domestic animals. Except for the study of packed cell volume (PCV) and erythrocyte sedimentation rate (ESR) (Escudero and Resoso, 1968) in the Phillipine swamp buffalo (locally known as carabaos), no other haematological studies have been conducted in swamp buffalo. Haematological parameters have been determined for river buffaloes in Egypt (Hafez and Anwar, 1954; and Bokori, 1974) and in India (Simon and Jacob, 1961; and Rao and Rao, 1977a and 1977b). At present, haematological values for the river buffalo and cattle are used as standard values for the swamp buffalo.

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Haematological values vary according to physiological states, environmental factors and genetic differences. Therefore, results from different breeds or species in one geographical location cannot be taken as norms for related animals or species in another locality. This may lead to misintepretation and consequently error in disease diagnosis.

This study attempts to compile normal haematological values for the swamp buffalo in the hope that they may aid veterinarians in routine diagnosis of diseases in swamp buffaloes in Malaysia.

MATERIALS AND METHODS

Blood samples from 50 clinically healthy swamp buffaloes (15 males and 35 females), 2 to 4 years old, were taken at Universiti Pertanian Malaysia buffalo unit at Puchong, Petaling, Selangor, during the period from June to August 1979. The average minimum and maximum temperatures during the period of study were 21.9°C and 34.0°C respectively. The average minimum and maximum relative humidities were 67.1% and 96.2% respectively (Source: MARDI Meteorological Station, Serdang).

These animals were raised under same management conditions. They were maintained on a rotational grazing system of established pure pastures, consisting of guinea grass *(Panicum maximum)*, star grass *(Cynodon plectostachyus)* and setaria grass *(Setaria splendida)*. The stocking rate was equivalent to one animal per acre. No supplementary concentrate feeding was provided but all animals had access to water and mineral supplement in the form of a salt lick. They were vaccinated against haemorrhagic septicaemia, dewormed twice a year and weighed monthly. The animals showed normal positive growth and performance.

Blood samples were collected around 8 a.m. from the jugular vein using evacuated blood collecting tubes (Venojet, Termo corporation, Tokyo, Japan) containing EDTA as anti-coagulant and analysed the same day.

Total red blood cell (RBC) and total white blood cell (WBC) counts were determined using a coulter counter (Model ZF, Coulter Electronics Limited, England) which had been previously standardized for cattle and buffalo blood.

Haemoglobin concentrations were determined by the cyamethemoglobin method using a haemoglobinometer (modal HGBRT, Coulter Electronics Ltd., England).

Packed cell volumes (PCV) were determined by the microhaematocrit method; mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) were calculated from PCV, haemoglobin concentrations and total RBC counts; and differential white blood cell counts were performed on Wright's-Leishman stained blood films (Schalm *et al.*, 1975). Total plasma protein concentrations were estimated using a refractometer (model 208, Bellington and Stanley Ltd., England).

RESULTS AND DISCUSSION

Table 1 presents the results for red blood cell (RBC) parameters and total plasma protein concentration and Table 2 presents the results for white blood cell (WBC) parameters. Histograms were constructed for total WBC count (Fig. 1), haemoglobin concentration (Fig. 2),

TABLE 1
Red blood cell parameters and total plasma protein concentration of swamp buffalo

	Mean ± S.D.
RBC ($\times 10^6/\mu l$)	8.8 ± 2.4
Haemoglobin (g/dl)	13.4 ± 1.9
PCV (%)	39.2 ± 4.9
MCV (μ^3)	49.3 ± 13.9
MCH (pg)	16.5 ± 4.7
MCHC (%)	34.1 ± 2.1
Total plasma protein (g/dl)	7.40 ± 0.46

TABLE 2
Total and differential white blood cell counts of swamp buffalo

	Mean ± S.D.
WBC ($\times 10^3\mu/l$)	10.7 ± 3.1
Lymphocyte (%)	54.2 ± 8.70
Neutrophils (%)	35.2 ± 9.91
Monocytes (%)	3.7 ± 2.11
Eosinophils (%)	6.6 ± 2.68
Basophils (%)	0.3 ± 0.45

PCV *(Fig. 3)* and total WBC count *(Fig. 4)*. In Table 3, results obtained for the swamp buffaloes are compared with normal haematological values reported for the river buffalo and cattle.

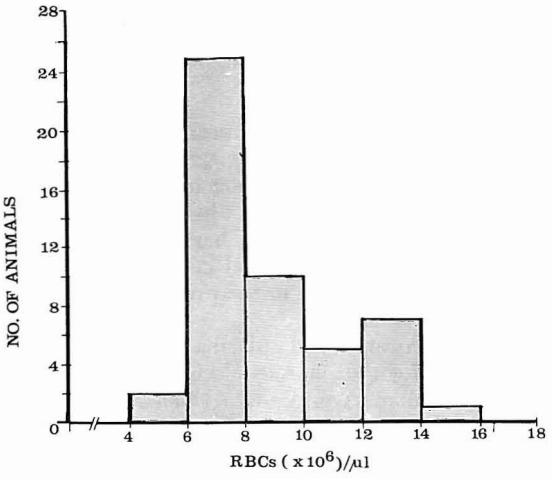

Fig. 1 Histogram for total red blood cell (RBC) count in swamp buffalo.

There is no general agreement on the effect of sex on haematological parameters in domestic animals. Initial statistical analysis using student's t-test in this experiment showed there is no significant difference between sexes. The sample of male animals was small because the male

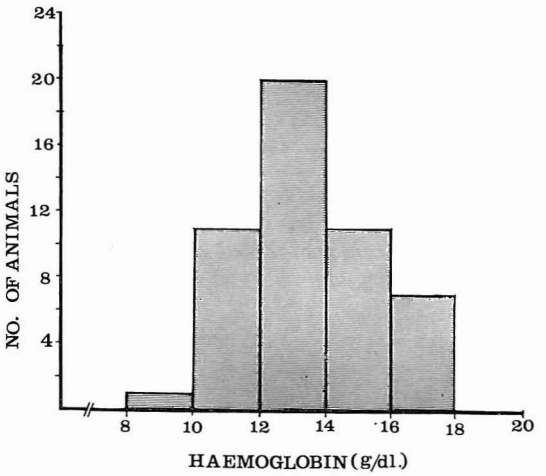

Fig. 2 Histogram for haemoglobin concentration in swamp buffalo.

TABLE 3
Comparisons between blood parameters of swamp buffaloes, river buffaloes and cattle

	Swamp buffaloes	River* buffaloes	Cattle†
RBC parameters			
RBC ($\times 10^6/\mu l$)	8.8	6.64	7.0
Hb (g/dl)	13.4	12.0	11.0
PCV (%)	39.3	35.7	35.0
MCV (μ^3)	49.3	44.6	52.0
MCH (pg)	16.5	16.9	14.0
MCHC (%)	34.1	34.1	32.7
Total plasma protein (g/dl)	7.40	7.45	7.40
WBC parameters			
WBC ($\times 10^3/\mu l$)	10.7	9.11	8.0
Lymphocytes (%)	54.2	56.7	58.0
Neutrophils (%)	35.2	33.7	28.5
Monocytes (%)	3.7	4.2	4.0
Eosinophils (%)	6.6	4.6	9.0
Basophils (%)	0.3	0.97	0.5

*Compiled from the results obtained by Kehar and Murty (1951), Hafez and Anwar (1954), Simon and Jacob (1961), Bokori (1974), and Rao and Rao (1977a and 1977b).
†Schalm, *et. al.* (1975).

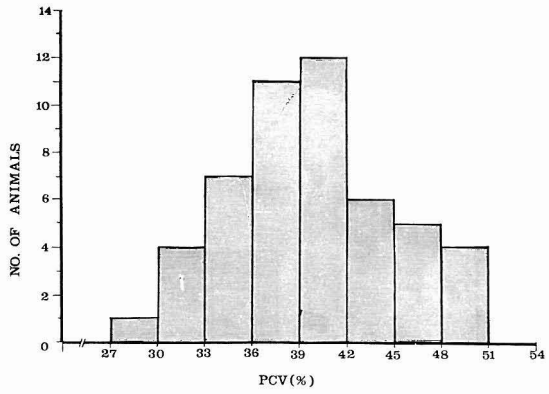

Fig. 3 Histogram for packed cell volume (PCV) in swamp buffalo.

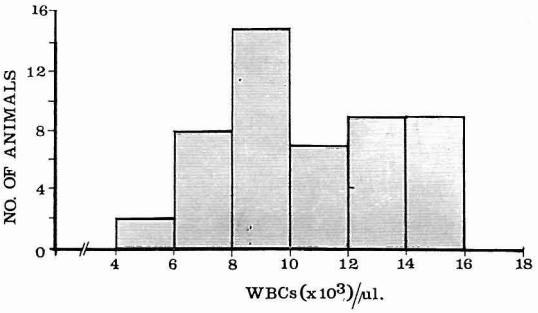

Fig. 4 Histogram for total white blood cell (WBC) count in swamp buffalo.

calves were sold before reaching two years of age. Therefore, no definite conclusion can be drawn as to sex differences in this study.

RBC parameters

The mean RBC count of 8.8 $\times$ $10^6/\mu$l is higher than the values obtained in some studies (Hafez and Anwar, 1954; Bokori, 1974; and Rao and Rao, 1977a) but lower than those obtained by other studies (Simon and Jacob, 1961; and Rao and Rao, 1977b) for the river buffalo.

The mean haemoglobin value of 13.4 g/dl is higher than the value for river buffalo (Hafez and Anwar, 1954; Simon and Jacob, 1961; Bokori, 1974; and Rao and Rao, 1977b).

The PCV (31.95%) for the Phillipine swamp buffalo (Escudero, 1968) is lower than in this study (39.2%). This could be partly explained on the basis that in this study the micro-haematocrit method was used, which is much more reliable than the Wintrobe haematocrit method used in the former study. The PCV in the present study is also higher than the values for the river buffalo (Simon and Jacob, 1961; Bokori, 1974; and Rao and Rao, 1977b) except for a value of 44.3% reported by Hafez and Anwar (1954).

The MCV and MCH mean values of 49.3 μ^3 and 16.5 pg are higher but the mean MCHC value of 34.1% is lower than in the river buffalo (Rao and Rao, 1977b). These differences are due to the higher PCVs, haemoglobin concentrations and total red blood cell counts obtained for the swamp buffalo in the present study.

The mean total plasma protein concentration of 7.4 g/dl. agrees closely with the values for the Indian river buffalo (Kehar and Murty, 1951). Total plasma protein value is useful in the assessment of haemoconcentration. Therefore, since the value in this study is within normal range for the river buffalo, the higher values for total RBC count, haemoglobin concentration and PCV in swamp buffalo could not be attributed to haemoconcentration.

From the histograms the highest frequency for total RBC count falls within the cell 6–8 $\times$ $10^6/\mu$l. *(Fig. 1)*, for haemoglobin concentration within the cell 12–14 g/dl. *(Fig. 2)* and PCV within the cell 39–42% *(Fig. 3)*.

WBC parameters

The mean total WBC count of 10.7 $\times$ $10^3/\mu$l. obtained for the swamp buffalo is higher than the values for the river buffalo (Hafez and Anwar, 1954; Bokori, 1974; Rao and Rao, 1977a, 1977b) except for one report (Simon and Jacob, 1961).

Considering the wide variability in the differential count of blood samples in any haematological study, the values for lymphocytes (54.2%), neutrophils (35.2%), monocytes (3.7%), eosinophils (6.6%) and basophils (0.3%) in the present study do not deviate greatly from the values reported for the river buffalo (Hafez and Anwar, 1954; Simon and Jacob, 1961; Bokori, 1974; and Rao and Rao, 1977a and 1977b).

The highest frequency for total WBC count falls within the cell 8–10 $\times$ $10^3/\mu$l. *(Fig. 4)*.

Comparing the haematological values for the swamp buffalo with the river buffalo (Table 3) it can be seen that the RBC parameters, except for MCH and MCHC, and total WBC count is higher for the swamp buffalo than that for the river buffalo. The differential counts in both

the swamp and the river buffalo are essentially similar.

In river buffaloes in India temperature and relative humidity were negatively correlated with haemoglobin content, with PCV and, to a lesser extent, with total RBC and total WBC counts (Raghavan and Mullick, 1962). This does not seem to be true for the Malaysian swamp buffalo as they are exposed to higher ambient temperatures and higher relative humidity than in India. Probably genetic and physiological variations may have contributed to higher total RBC count, haemoglobin concentration, PCV and total WBC count.

The total RBC count, haemoglobin concentration, PCV and total WBC count are higher in swamp buffalo than in cattle (Table 3). The other parameters do not vary greatly between the two species.

Total plasma protein values for the swamp buffalo, the river buffalo and cattle are in close agreement.

CONCLUSION

Differences exist in the haematology of the swamp buffalo, the river buffalo and cattle. The values for total RBC count, haemoglobin concentration, PCV and total WBC count are higher in swamp buffalo than in the river buffalo or cattle. The other haematological parameters and total plasma protein concentration show very little variation between these animals.

In view of these findings, veterinarians have to take into consideration these differences in their intepretation of haematological data for disease diagnosis in swamp buffaloes.

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