

REFERENCE VALUES IN BLOOD CHEMISTRY AND HAEMATOLOGY FOR CROSSBRED CALVES IN PENINSULAR MALAYSIA

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SUMMARY: Blood samples, taken from 200 crossbred calves from 3 government farms in Peninsular Malaysia, were analysed to establish the means and reference values in blood chemistry and haematology.

The means for total erythrocytes ($7.09 \pm 1.46 \times 10^6/\mu\text{l}$), Hb ($9.97 \pm 1.68\text{g/dl}$), PCV ($30.36 \pm 5.0\%$) and calcium ($8.91 \pm 1.17\text{ mg/dl}$) for the local crossbred calves were lower than those reported for temperate breeds. Mean values for total leucocytes ($13.86 \pm 3.58 \times 10^3/\mu\text{l}$), neutrophils ($2.62 \pm 1.36 \times 10^3/\mu\text{l}$), lymphocytes ($10.07 \pm 3.16 \times 10^3/\mu\text{l}$), monocytes ($0.57 \pm 0.46 \times 10^3/\mu\text{l}$), magnesium ($2.13 \pm 0.36\text{ mg/dl}$), copper ($78.53 \pm 20.83\ \mu\text{g/dl}$), creatinine ($1.39 \pm 0.26\text{ mg/dl}$), total cholesterol ($85.91 \pm 22.18\text{ mg/dl}$), albumin ($3.39 \pm 0.51\text{g/dl}$), albumin/globulin ratio (0.89 ± 0.23), and activities of AST ($38.72 \pm 7.52\text{ U/l}$), ALT ($13.86 \pm 3.57\text{ U/l}$) and GGT ($12.85 \pm 2.67\text{ U/l}$) were similar to those reported in the literature. However, the means for eosinophils ($0.55 \pm 0.45 \times 10^3/\mu\text{l}$), Phosphorus ($8.34 \pm 1.21\text{ mg/dl}$), BUN ($16.16 \pm 3.78\text{ mg/dl}$), total protein ($7.37 \pm 0.82\text{ g/dl}$), globulin ($3.98 \pm 0.76\text{ g/dl}$), AP ($180.20 \pm 57\text{ U/l}$) and Cholinesterase ($119.50 \pm 33.50\text{ U/l}$) were found to be higher than those for temperate breeds.

Key words: reference values; blood chemistry; haematology; calves; Malaysia

INTRODUCTION

Biochemical and haematological investigation are useful ancillary aids which help the clinician in the assessment of the health status and diagnosis of metabolic and nutritional disorders of cattle which are usually subclinical in nature (Stogale, 1981; Schmid and Forstner, 1986). Reference values in blood chemistry and haematology established in one geographical area for certain breeds of animals cannot be considered as standards for related or different breeds in another locality (Payne and Leech, 1964; Greatorex, 1957; Holman, 1956). In Malaysia, the large scale cross-breeding between highly efficient temperate breeds with local breeds of cattle has resulted in an increase in crossbred calves. Although information on some biochemical and haematological parameters of local Kedah-Kelantan (KK) calves and lactating non-pregnant cattle (Mazenah and Fadzil, 1985), and crossbred lactating cattle of Malaysia (Muniandy *et al.*, 1986) have been reported, no such information on crossbred calves in Malaysia is available. Results of these studies are reported in this paper.

MATERIALS AND METHODS

Animals

Two hundred and eighty-six clinically healthy calves between six to twelve months of age were selected as the reference population from different herds belonging to government farms in Sungai Siput, Batu Arang and Kluang. The calves were crossbreds of Local Indian Dairy (LID) and temperate breeds, namely Friesian, Jersey, Hereford and Charolais.

These calves had been vaccinated against brucellosis and foot-and-mouth disease and were regularly and were regularly deticked and dewormed. They were grazed on established pastures consisting of *Brachiaria decumbens*, *Brachiaria humidicola*, *Setaria kazungula* and *Panicum maximum*. The calves were given supplement feeds with concentrates and palm kernel cake pellets and mineral supplements in the form of salt and mineral licks.

Blood and Faecal Sample Collection

The samplings were carried out throughout the year over a period of 24 months from August 1986 to August 1988. Blood samples were collected as described earlier (Muniandy *et al.* 1986). Variations in the biochemical and haematological values due to seasonal differences were not considered in this study.

Biochemical and Haematological Parameters

Various biochemical parameters determined included determinations of enzyme activities of alkaline phosphatase (AP), alanine aminotransferase (ALT), aspartate aminotransferase (AST), cholinesterase, gamma-glutamyl transferase (GGT) and concentrations of albumin, total protein, blood urea nitrogen (BUN), copper, creatinine, calcium, phosphorus, magnesium and total cholesterol on the non-haemolysed serum samples using diagnostic combination kits of Boehringer Mannheim* as described earlier (Muniandy *et al.*, 1986). All determinations were made using Vitatron & FPS photometer. Packed cell volume (PCV), haemoglobin (Hb) and differential leucocyte counts were determined as described earlier (Muniandy *et al.*, 1986). Erythrocytes and total leucocytes were enumerated using a Coulter Counter† which had previously been calibrated for cattle blood.

Parasitological Examinations

Faecal egg counts, examination for liver fluke eggs, microfilaria and blood protozoa were determined as described earlier (Muniandy *et al.*, 1986).

Statistical Analysis

Data were analysed statistically using the SPSS/PC (Statistical Package for Social Sciences) programme on an IBM compatible personal computer (Licence No. 42283, DVS, Databank Project).

RESULTS AND DISCUSSION

The mean and 95% confidence intervals for each biochemical and haematological parameter for the crossbred calves are presented in Tables 1 and 2. The data were based on

*Vital Scientific, Dieren, The Netherlands.

†Model ZF, Coulter Counter Electronic Ltd., England.

TABLE 1.
Blood Chemistry Values of 200 Crossbred Calves

Blood parameters	Mean \pm S.D.	95% Confidence interval
Calcium (mg/dl)	8.91 \pm 1.17	6.57 - 11.25
Phosphorus (mg/dl)	8.34 \pm 1.21	5.92 - 10.76
Calcium/Phosphorus ratio	1.07 \pm 0.22	0.63 - 1.51
Magnesium (mg/dl)	2.13 \pm 0.36	1.41 - 2.85
Copper (μ g/dl)	78.53 \pm 20.83	36.87 - 120.19
Blood Urea Nitrogen (mg/dl)	16.16 \pm 3.78	8.6 - 23.72
Creatinine (mg/dl)	1.39 \pm 0.26	0.87 - 1.91
Total cholesterol (mg/dl)	85.91 \pm 22.18	41.55 - 130.27
Total protein (g/dl)	7.37 \pm 0.82	5.73 - 9.01
Albumin (g/dl)	3.39 \pm 0.51	2.37 - 4.41
Globulin (g/dl)	3.98 \pm 0.76	2.46 - 5.50
Albumin/Globulin ratio	0.89 \pm 0.23	0.43 - 1.35
Alkaline phosphatase (U/l)	180.20 \pm 57.00	66.2 - 294.2
Aspartate aminotransferase (U/l)	38.72 \pm 7.52	23.68 - 53.76
Alanine Aminotransferase (U/l)	13.86 \pm 3.57	6.72 - 21.0
Cholinestrace (U/l)	119.50 \pm 33.50	52.5 - 186.5
Gamma-glutamyl transferase (U/l)	12.85 \pm 2.67	7.51 - 18.19

TABLE 2.
Reference Haematological Values of 200 Crossbred Calves

Haematological parameters	Mean S.D.	95% Confidence interval
Erythrocytes ($\times 10^6/\mu$ l)	7.09 \pm 1.46	4.17 - 10.01
Haemoglobin (g/dl)	9.97 \pm 1.68	6.61 - 13.33
Packed Cell Volume (%)	30.36 \pm 5.00	20.36 - 40.36
MCV (fl)	43.51 \pm 4.52	34.47 - 52.55
MCHC(%)	32.85 \pm 1.95	28.95 - 36.75
Total leucocytes ($\times 10^3/\mu$ l)	13.86 \pm 3.56	6.74 - 20.98
Neutrophils ($\times 10^3/\mu$ l)	2.62 \pm 1.36	0.35 - 7.27 *
Lymphocytes ($\times 10^3/\mu$ l)	10.07 \pm 3.16	3.75 - 16.39
Monocytes ($\times 10^3/\mu$ l)	0.57 \pm 0.46	0 - 2.76*
Eosinophils ($\times 10^3/\mu$ l)	0.55 \pm 0.45	0 - 2.30*
Basophils ($\times 10^3/\mu$ l)	0.01 \pm 0.04	0 - 0.20 *

*Minimum to maximum values (not 95% confidence interval)

200 whole blood and serum samples collected from the predetermined reference population. Although samples were taken from 286 animals, all data corresponding to animals that were positive for helminth egg and *Anaplasma marginale* were not included in the statistical analysis.

The term "reference value" is used in this paper in place of 'normal values' for reasons well discussed by Mainland (1971) and Sunderman (1975). Reference values reported in our study

refer to the 95% confidence limits. The mean reference values reported in this paper is calculated from the pooled data of the three farms sampled throughout the year. This was done to ensure the values thus obtained is representative of the true situation for the calves in the various farms in the country under different nutrition and management conditions.

The mean for erythrocyte count, haemoglobin content and PVC were lower than the values given by Greatorex (1954), Holman (1956), Gartner *et al.*, (1966), Mazenah and Fadzil, (1985) and Jain (1986).

The mean values for total leucocyte, neutrophil, lymphocyte and monocyte counts obtained in this investigation agreed closely with the figures reported for cattle of same age group in Queensland, Australia (Granzien, 1968). The mean value for eosinophils count was slightly higher than the value ($0.34 \times 10/\mu\text{l}$) given by Granzien (1968). However, the mean value for total leucocyte counts was lower than that of calves in Malaysia (Mazenah and Fadzil, 1985), but it was higher than those reported for calves of temperate breeds (Greatorex, 1954; Holman; 1956; Jain, 1986).

Variation in haematological parameters due to environmental conditions (Holman, 1955), breed (Greatorex, 1957) and nutrition or grazing conditions (Grazien, 1968) have been shown to exist. Some of these factors may be responsible for the differences observed between the results of this study and published data.

A slightly lower mean value and a wider reference range for calcium concentration was found in the present study than other temperate breeds (Vagher *et al.*, 1973; Lumsden *et al.*, 1980; Bouda and Jagos, 1984) and KK calves (Mazenah and Fadzil, 1985). The mean for serum inorganic phosphorus concentration in the present study is higher than that of local KK calves (Mazenah and Fadzil, 1985) but quite similar to the temperate breeds (Vagher *et al.*, 1978; Lumsden *et al.*, 1980). The variations in the concentrations of serum calcium and phosphorus could be due to the difference in rearing systems, physiological, nutritional and environmental factors (Rowland *et al.*, 1974; Kitchenham *et al.*, 1975).

The mean reference value for magnesium and copper is similar to that of the temperate crossbreds (Ruppanner *et al.*, 1978, Bouda and Jagos, 1984) and Holstein-Friesien calves (Lumsden *et al.*, 1980).

A much higher mean and wider range for BUN concentrations is found in the present study as compared to others (Vagher *et al.*, 1973; Bouda and Jagos, 1984, Mazenah and Fadzil, 1985). Urea is quantitatively one of the main degradation products of protein metabolism and is a sensitive indicator of dietary intake of digestible crude protein. The high concentrations of BUN noted in the present study reflect the supplementation of high protein to the calves in these government farms (Manston *et al.*, 1975). The mean creatinine value for KK calves is much higher than the local crossbred calves.

The mean and reference value of total cholesterol for the local crossbred calves is similar to that Holstein-Friesien (Lumsden *et al.*, 1980), Jersey and Danish Red calves (Sinha *et al.*, 1981).

While the means for serum total protein and globulin concentrations in the present study are higher, the means for albumin and albumin/globulin ratio are much closer to those reported (Vagher *et al.*, 1973; Ruppanner *et al.*, 1978; Lumsden *et al.*, 1980). The higher value for total protein found in the present study could be due to the rise in globulin fraction. Kitchenham *et al.* (1975) have shown that, for calves, rearing systems can influence changes in the concentration of globulin with age.

The mean activities for serum AST and ALT found in the present study were closer, but that for AP activity was higher than those reported (Lumsden *et al.*, 1980; Mazenah and Fadzil, 1985). The activities of cholinesterase, an enzyme useful in the diagnosis of intoxications and synthesizing activity of the liver, are much higher than that reported by Muller (1974).

The mean GGT activities found in the present study similar to that of temperate breeds reported in France (Braun et al., 1978) GGT determinations in serum has been useful in diagnosis of hepatobiliary disease, cholestasis, hepatitis and obstructive jaundice and is found to be a sensitive indicator of liver cell damage in fascioliasis (Anderson *et al.*, 1978).

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RINGKASAN

NILAI-NILAI RUJUKAN BAGI KIMIA DARAH DAN HEMATOLOGI DALAM ANAK LEMBU KACUKAN DI SEMENANJUNG MALAYSIA

Sampel-sampel darah yang diambil dari 200 anak lembu kacukan dari tiga ladang kerajaan di Semenanjung Malaysia, telah dianalisiskan untuk menetapkan nilai-nilai purata dan rujukan bagi kimia darah dan hematologi. Nilai-nilai purata bagi jumlah eritrosit ($7.09 \pm 1.46 \times 10^6/\mu\text{l}$), Hb ($9.97 \pm 1.68 \text{ g/dl}$), PCV ($30.36 \pm 5.0\%$) dan kalsium ($8.91 \pm 1.17 \text{ mg/dl}$) adalah didapati lebih rendah dari yang dilaporkan bagi baka kacukan temperat. Nilai-nilai purata bagi jumlah leukosit ($13.86 \pm 3.56 \times 10^3/\mu\text{l}$), neutrofil ($2.62 \pm 1.36 \times 10^3/\mu\text{l}$), limosit ($10.07 \pm 3.16 \times 10^3/\mu\text{l}$), monosit ($0.57 \pm 0.46 \times 10^3/\mu\text{l}$), magnesium ($2.13 \pm 0.36 \text{ mg/dl}$), kuprum ($78.53 \pm 20.83 \text{ ug/dl}$), kreatinin ($1.39 \pm 0.26 \text{ mg/dl}$), jumlah kolestrol ($85.91 \pm 22.18 \text{ mg/dl}$), albumin ($3.39 \pm 0.51 \text{ g/dl}$), nisbah albumin/globulin (0.89 ± 0.23), dan aktiviti-aktiviti enzim AST ($38.72 \pm 7.52 \text{ U/l}$), ALT ($13.86 \pm 3.57 \text{ U/l}$) dan GGT ($12.85 \pm 2.67 \text{ U/l}$) adalah didapati sama dengan baka kacukan temperat yang dilaporkan. Tetapi nilai-nilai purata bagi esoinofil ($0.55 \pm 0.45 \times 10^3/\mu\text{l}$), fosforus ($8.34 \pm 1.21 \text{ mg/dl}$), BUN ($16.16 \pm 3.78 \text{ mg/dl}$), jumlah protein ($7.37 \pm 0.82 \text{ g/dl}$), globulin ($3.98 \pm 0.76 \text{ g/dl}$), AP ($180.20 \pm 57 \text{ U/l}$) dan kolinesterase ($119.50 \pm 33.50 \text{ U/l}$) adalah lebih tinggi daripada yang terdapat bagi baka kacukan temperat.