

Tropical seasonal changes impact on hematological parameters of goats

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ABSTRAK

Penelitian dilakukan untuk mengevaluasi dampak variasi musiman terhadap respon hematologi kambing di Malaysia. Lima puluh dua kambing (24 jantan dan 28 betina), berusia antara 1 sampai 2 tahun digunakan dalam penelitian ini. Kambing diberi pakan konsentrat komersial dan hijauan, akses ke garam mineral dan air *ad libitum*. Sampel darah diambil dari masing-masing kambing pada bulan Januari, Mei dan September untuk menganalisis hematologi darah selama penelitian. Hasil penelitian menunjukkan bahwa tingkat sel darah merah (RBC) pada betina Anglo-Nubian meningkat secara dramatis pada bulan Januari dan Mei sementara breed Saanen tetap tanpa keragaman. Di semua musim, konsentrasi hemoglobin (Hb) tinggi pada jantan Anglo-Nubian tidak seperti breed Saanen. Untuk Saanen betina, mean corpuscular volume (MCV) meningkat secara signifikan, sedangkan pada Saanen jantan, mean corpuscular hemoglobin (MCH) dan konsentrasi MCH (MCHC) meningkat. Konsentrasi volume sel yang dikemas (PCV) tinggi dari betina Anglo dibandingkan dengan yang lain selama bulan September. Sebagai kesimpulan, variasi dalam breed dan jenis kelamin kambing mencerminkan kemampuan yang berbeda dari perubahan tropis yang telah terbentuk selama efek musiman pada respon hematologi antara kedua breed kambing.

Kata kunci: Kambing, Hematologi, Heat stress, Perubahan musim, Iklim tropis

ABSTRACT

The study was carried out to evaluate the impact of seasonal variations on the hematological responses of goats in Malaysia. Fifty-two goats (24 bucks and 28 does), aged between 1 to 2 years old were used in the study. The goats were fed on commercial concentrate and forage, access to mineral salt and water was *ad libitum*. Blood samples were obtained from each goat in January, May and Sep-

tember to analyze hematology blood constitute during the study. The results showed that red blood cell (RBC) levels in Anglo-Nubian females rose dramatically in January and May while the Saanen breed remains without diversity. In all seasons, high hemoglobin (Hb) concentration of Anglo-Nubian males was unlike Saanen breed. For Saanen females, mean corpuscular volume (MCV) increased significantly, whereas in Saanen males, mean corpuscular hemoglobin (MCH) and MCH concentration (MCHC) were increased. High packed cell volume (PCV) concentration of Anglo females compared to others during September. In conclusion, variations in breed and sex of goats reflect the distinct ability of tropical changes that have been formed during seasonal effects on hematological responses between the two breeds of goats.

Keywords: Goats, Hematology, Heat stress, Seasonal changes, Tropical climate

INTRODUCTION

In most countries, livestock suffers different types of stress such as photoperiod, nutritional, relative humidity and temperature. Stress is a reflex reaction of the animals in a cruel environment and causes unfavorable consequences that range from discomfort to death of the animal (Attia, 2016; Saeed and Khalaf, 2014). In addition, stress is a body's reaction to stimuli that disturb homeostasis (Ribeiro *et al.*, 2018). Sever environmental conditions during climate changes could have a negative impact on the animal condition.

Heat stress is the most important climatic stress that even threatens the survival of the animals (Chavez *et al.*, 2020; Sejian *et al.*, 2013). It is an imbalance between heat gain and heat loss in which there is an inability to dissipate sufficient heat to maintain the homeothermy when the heat load of an animal is greater than its capacity to lose heat and the animal temperature is higher than the temperature ranges of the animal thermoneutral zone (Attia, 2016; Saeed and Khalaf, 2014). However, farmers and small-scale private farms in tropical and semi-tropical countries are raising goats, mostly for meat, milk, hide and subsistence during the scarcity of food and economic income (Inbaraj *et al.* 2018). Goats are subject to a complicated environmental condition in tropical climates, leading to improvements in physiological thermoregulatory responses that may decrease fertility and testicular activity, reducing reproductive efficiency due

to the high ambient temperature heating of the testes (Salles *et al.*, 2020]). Regarding, quantitative and morphological changes in blood cells are associated with heat stress such as variations in hematocrit values, mean erythrocytes count and hemoglobin (Ribeiro *et al.*, 2018; Ribeiro *et al.*, 2016). Poor nutrition, which occurs in animals under long-term heat stress, reduces the number of erythrocytes and hemoglobin levels, resulting in a decrease of red blood cells in the bloodstream (Ribeiro *et al.*, 2018).

Researchers pointed out an increase in blood total protein concentration when the animals are subjected to heat stress (Ribeiro *et al.*, 2016). There have been not many studies of the influences of seasonal on blood parameters in tropical areas. Hence, this study was conducted to evaluate the effect of seasonal variations under tropical environments on hematological variables of goats.

MATERIALS AND METHODS

Experimental Site and Animals

Malaysia's climate is characterized by four seasons, including two monsoon seasons and two intermonsoon seasons. The season of the southwest monsoon is from May to August, while the season of the northeast monsoon is from November to February (Suhaila *et al.*, 2010). This experiment was conducted in Al-Hilmi Agro farm Perak, Malaysia. A total of 52 adult goats were used, consisting of 24 bucks and 28 does. The age of the studied goats ranged from 1–3 years

Table 1. Seasonal Variables During Experimental Period

Month	Temperature °C			Humidity (%)	Rainfall (mm)
	Mean	Min	Max		
January	25.8	22.1	29.5	79	199.9
February	26.1	22.1	30.2	75	146.4
March	26.5	22.4	30.9	72	170.4
April	26.9	22.8	31.3	76	177.3
May	27	22.9	31.3	73	203
June	26.7	22.6	31	68	177.3
July	26.5	22.4	30.6	70	180.2
August	26.4	22.4	30.6	63	200.6
September	26.2	22.3	30.4	64	249.4
Average	26.5	22.4	30.6	71.1	189.4

old at the onset of the experiment. Two breeds were assigned for this study as followed; Saanen ($n = 27$) and Anglo-Nubian ($n = 25$). The experimental animals were apparently healthy, while pregnant and apparently sick animals were excluded. The goats were placed in their respective cages and fed on commercial concentrate and green fodder (4 kg/goat/day) and had access to mineral salt and water *ad libitum*. Amid the research period, climate temperature was 29 °C–35 °C for the duration of the day, and 19 °C–26 °C for the duration of the night. Besides, the humidity was between 65 and 85% Table 1.

Blood Sampling

Along with the study period, the blood was collected three times during the months of January, May and September. A total of 148 blood samples were collected from goats of different breeds. The blood was harvested through jugular veins with a syringe with an 18G needle accord-

ing to (Muayad *et al.*, 2019). The blood samples of 3.5 ml were collected into a plastic tube containing EDTA for hematological studies.

Hematology Analysis

Hematological tests included total red blood cell (RBC) count, hemoglobin (Hb), packed cell volume (PCV), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), MCH concentration (MCHC), RBC distribution width (RDW), total white blood cell (WBC), polymorphs (Polys), lymphocytes (Lymphs), monocytes (Monos), eosinophils (Eos), and platelet count (PLT) were determined immediately after collection via machine analyzer (CELL- DYN 3700 Abbott, USA).

Statistical Analysis

One-way ANOVA and t-test (Levene's Test for Equality of Variances) were performed with SPSS and the importance utilized was at

P<0.001. The analysis determined the significant differences based on the blood constituents, which were influenced by the month, breed and gender of the goats in Malaysia.

RESULTS

The data of hematology had collected in January is shown in Table 2 appeared a significant increase (P<0.001) in RBC and PCV for Anglo females and Hb for males, while data refers to significant increasing (P<0.001) in

MCV for Saanen females whereas, MCH and MCHC were increased in males of Saanen. A significant decrease (P<0.001) in Polys level for Saanen males compared with females. A significant increase (P<0.001) in lymphocytes and PLTs for Saanen males, while there are no significant differences in WBC, Monocytes, Eos between Saanen and Anglo males and females.

In May, the blood parameters results referred to an increase (P<0.001) in RBC, PCV for Anglo females and MCH and MCHC concentration for Saanen males. While there is a low de-

Table 2. Seasonal Changes on Hematological Parameters of Goats during January

Parameters	Saanen		Anglo		SEM	P ⁺
	Male	Female	Male	Female		
RBC (10 ⁶ /μL)	3.24 ^b	3.84 ^b	3.88 ^b	4.61 ^a	0.37	*
Hb (g/dL)	10.34 ^b	10.25 ^b	10.66 ^a	9.10 ^b	0.61	*
PCV (%)	29.45 ^b	40.57 ^b	37.58 ^b	50.06 ^a	4.16	*
MCV (fL)	92.10 ^b	115.14 ^a	97.72 ^b	105.62 ^b	9.87	*
MCH (pg)	32.12 ^a	28.85 ^b	27.16 ^b	19.87 ^b	3.14	*
MCHC (g/dL)	36.47 ^a	25.85 ^b	26.16 ^b	19.56 ^b	3.46	*
RDW (%)	22.80	21.10	22.29	21.27	2.71	NS
WBC (cells/μl)	13930	18300	14016	13650	2942	NS
Polys	32.70 ^b	56.78 ^a	60.72 ^a	58.68 ^a	8.07	*
Lymphs (%)	57.50 ^a	42.00 ^b	35.02 ^b	38.81 ^b	9.01	*
Monos (cells/μl)	1.20	1.71	0.55	1.68	0.85	NS
Eos (cells/μl)	1.75	1.07	2.33	0.62	1.00	NS
PLTs (10 ³ /μL)	809000 ^a	555428 ^b	685833 ^b	593125 ^b	67524	*

^{a,b,c} Means in the same row with different superscripts differ significantly at P<0.001. NS: not significant.

crease ($P < 0.001$) in Hb and RDW for Anglo females and in MCV for Saanen males. However, a significant increase ($P < 0.001$) in Anglo males and females in the level of Polys compared with Saanen. A significant increase ($P < 0.001$) in lymphocytes and PLT for Saanen males compared with others (Table 3).

Data during September shows a significant increase ($P < 0.001$) in Saanen females and Anglo males in Hb. A significant difference ($P < 0.001$) in Anglo females PCV concentration compared with others (table 4). The mean value of polys

level was higher in Anglo breed females compared with males in the same breed or Saanen breed. However, interestingly the levels of lymphs, Eos and PLTs were influenced significantly by seasonal changes in Saanen males.

DISCUSSION

The current study revealed that RBC level in Anglo females was increased significantly in January and May compared with males and breed of Saanen, this maybe indicates elevated heat load for goats, which culminated in the physio-

Table 3. Seasonal Changes on Hematological Parameters of Goats during May

Parameters	Saanen		Anglo-Nubian		SEM	P
	Male	Female	Male	Female		
RBC ($10^6/\mu\text{L}$)	3.25 ^b	3.78 ^b	4.00 ^b	4.61 ^a	0.33	*
Hb (g/dL)	10.35 ^a	10.16 ^a	10.90 ^a	8.82 ^b	0.45	*
PCV (%)	29.89 ^b	41.40 ^b	43.75 ^b	50.32 ^a	4.43	*
MCV (fL)	92.89 ^b	112.80 ^a	108.00 ^a	110.28 ^a	7.46	*
MCH (pg)	32.63 ^a	27.80 ^b	27.00 ^b	19.96 ^b	4.04	*
MCHC (g/dL)	35.92 ^a	26.40 ^b	27.00 ^b	19.64 ^b	2.85	*
RDW (%)	22.36 ^a	22.50 ^a	25.75 ^a	20.40 ^b	2.08	*
WBC (cells/ μl)	13958	17260	14700	14450	2671	NS
Polys	32.15 ^b	55.50 ^b	70.60 ^a	60.96 ^a	5.90	*
Lymphs (%)	61.10 ^a	42.80 ^b	27.75 ^b	35.53 ^b	7.11	*
Monos (cells/ μl)	1.15	1.40	1.50	2.57	0.82	NS
Eos (cells/ μl)	2.26	1.10	2.00	0.60	0.93	NS
PLTs ($10^3/\mu\text{L}$)	811052 ^a	552000 ^b	655000 ^b	659642 ^b	52404	*

^{a,b,c} Means in the same row with different superscripts differ significantly at $P < 0.001$. NS: not significant.

logical requirement of the hemoglobin and RBC in order to cope with oxygen circulation while panting. This explanation is consistent with the result found by (Okoruwa, 2014; Sanusi *et al.*, 2011). On the other hand, these results disagree with (Addass *et al.*, 2010; Schalm *et al.*, 1975 who reported that males have higher RBC values than females. Tibbo *et al.* (2005) showed there not significant differences in all blood parameters during seasons and between genders. This increase may be a result of breed genetic differences (Essien *et al.*, 2011). Our study results observed that Hb concentrations vibrate among seasons in breeds and both males and females, but still highly significant Hb concentration of Anglo males in all seasons. This increased in Hb concentration may be due to the difference in breeds (Essien *et al.*, 2011). Gender has been effecting because males have a higher Hb concentration compared with females.

However, PCV results of this study agree with (Muayad *et al.*, 2018; Saeed *et al.*, 2019) but disagreed with that of (Njidda *et al.*, 2013), who claimed that bucks having higher PCV values than does is a likelihood of inherent sex differences between male and female (Addass *et al.*, 2010). An increase in PCV values might be attributed to the increase in environmental temperature (Habibu *et al.*, 2018). The MCV values determined in the present study agree with (Muayad *et al.*, 2018). But conflict with those of the described goats by other researchers, the trend was higher than that reported in other studies (Addass *et al.*, 2010). As mentioned in the literature review, during heat stress decrease in MCV may be due to a rise in body temperature, resulting in an increase in the amount of erythrocyte membrane vesicles created and shed from the erythrocytes, resulting in a decrease in the size of the parent erythrocytes (Habibu *et al.*, 2017). MCH and MCHC are a useful index of the capacity of bone marrow to produce RBCs (Barger, 2003). In this study, results agree with (Muayad *et al.*, 2018). These differences may be due to the nutritional variation, strain, and sex of goats.

In this study, lymphs significantly high in Saanen males for all seasons. Lymphs are the key elements in the production of immunity. Sex and breed significantly influence lymphocyte count. In the present study, the lymphocyte percentage was higher than the findings by many researchers (Bari *et al.*, 2018), but it agrees with (Muayad *et al.*, 2018) who show a highly signifi-

cant increase in males Katjang. The PLT counts are an important parameter because their count in the goat blood cannot be established easily and because of the change showed during the experimental period in adults. These results agree with Bari *et al.* (2018) who show that PLTs higher in males compared to females.

CONCLUSION

In healthy goats, hematological parameters display many differences with respect to breed and sex. The variations developed in the seasonal impact on hematological responses between the two breeds of goats indicate the distinct potential for tropical adaptation. These modifications, however, were of differing magnitude among the breeds. The findings obtained in the current research improve our knowledge of Saanen and Anglo-Nubian goats' hematology and can act as reference values that may enable future studies to better monitor the health status of animals.

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