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SOME PHYSIOLOGICAL RESPONSES OF IMPORTED DORSET SHEEP AS OBSERVED IN THE SHADE

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RINGKASAN

Lima ekor biri-biri betina daripada tiap-tiap baka Dorset Horn (DH) dan Polled Dorset (PD) yang diimport dari New Zealand, dan baka tempatan (ISM) telah digunakan untuk mengkaji penyesuaian biri-biri yang diimport pada iklim tropika Malaysia. Selepas sepuluh hari di kandang, suhu rektum, kadar pernafasan dan kadar denyutan nadi telah dicatat pada pukul 8.00 pagi dan 2.00 petang. Suhu udara dan kelembapan sekitaran juga dicatatkan. Data yang dianalisis menunjukkan purata suhu rektum pagi dan petang bagi PD, DH dan ISM masing-masing adalah 39.23±0.32°C, 39.57±0.40°C, 38.94±0.25°C, 39.27±0.27°C, 38.70±0.45°C dan 39.27±0.31°C; ini adalah dalam lingkungan purata 39.0±1.5°Celsius. Suhu rektum pada pukul 2.00 petang telah meningkat dengan peningkatan suhu udara. Ini diikuti oleh peningkatan kadar pernafasan yang merupakan petanda ketegasan haba yang tinggi terutamanya pada baka eksotik. Kadar denyutan nadi telah bertambah dengan bererti ($P<0.05$) bagi PD dan berlebih lagi bagi DH dan ISM. Indeks penyesuaian Benezra pada pukul 2.00 petang didapati lebih tinggi untuk PD dan DH berbanding dengan ISM (6.70 dan 6.79 berbanding dengan 3.85) manakala angkali ketahanan haba Rhoad bagi PD, ISM dan DH masing-masing adalah 89.80, 94.00 dan 95.20. Ini menunjukkan bahawa di antara dua baka yang diimport, baka DH mempunyai keupayaan yang lebih baik untuk menyesuaikan diri pada iklim di Malaysia bila dibela di dalam kandang.

INTRODUCTION

The local sheep which is small in size and well adapted to local climate, produces low yield of mutton. Consequently, the Dorset sheep has been identified as a potential breed for crossbreeding with local sheep to improve the size of the crossbreds and increase mutton production. A plan to upgrade the local sheep by importing and distributing the Dorset sheep to smallholders throughout the country is still under consideration. Before large-scale importation can be initiated, the production capability of Dorset sheep under humid tropical condition has to be evaluated. The initial evaluation should be on its adaptability to local climate.

The physiological responses of sheep to hot environment had been studied (QUARTERMAIN, 1964; THWAITES, 1968; RATHORE, 1970). Such responses were increase in body temperature, respiration rate and pulse rate (QUARTERMAIN and BROADBENT, 1974). Similar work had also been done on cattle (RHOAD, 1936; 1944; BONSMA, 1940; SEATH dan MILLER, 1946; DOWLONG, 1956; FINDLAY, 1958; BIANCA, 1963; McDOWELL, 1972; NORDIN, *pers comm.*, 1984).

This study was initiated to establish some basic physiological characteristics of the Dorset sheep as compared with the local sheep in Malaysian climate. Future management and breeding programmes for improving the imported Dorset sheep could then be initiated to achieve its maximum potential. The objective of this study was to evaluate the physiological responses of newly imported Dorset sheep by measuring the morning and afternoon rectal temperatures, respiration rates and pulse rates in the shade. These variables were also used to determine the heat tolerance and adaptability indices for the shade condition.

MATERIALS AND METHODS

Ewes of purebred Dorset Horn (DH) and Polled Dorset (PD) (both imported from New Zealand), and indigenous sheep of Malaysia (ISM), five of each breed, were

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used in this study. All the sheep were non-pregnant, non-lactating and in good health. These animals were confined in the shed for ten days for adaptation to this environment before the variables were recorded. Cut Guinea grass *(Panicum maximum)* and water were provided *ad libitum.*

The rectal temperature was measured using a clinical thermometer. The respiration rate and the pulse rate were determined by recording the flank movements and the pulsation of the femoral artery respectively. These variables were recorded twice daily at 0800 hours and 1400 hours for three days. The environmental air temperature and relative humidity were also recorded concurrently.

The coefficient of heat tolerance (CHT) (RHOAD, 1944) of the sheep was calculated using the following equation:

$$CHT = 100 - [18 (BT - NT)]$$

where BT = Mean body temperature recorded,
NT = Normal body temperature of sheep (39°C),
18 = Thermoneutral temperature of sheep,
100 = Perfect efficiency in maintaining body temperature at 39.0°C;

and the index of adaptability (IA) was calculated by adapting the equation proposed by BENEZRA (1954).

$$IA = BT/NT + RR/NR$$

where BT = Mean body temperature recorded,
NT = Normal body temperature of sheep (39°C),
RR = Respiration rate recorded,
NR = Normal respiration rate of sheep (23).

RESULTS AND DISCUSSION

The mean environmental air temperature and relative humidity under the shade for the three-day study period are shown in *Table 1.* Both the mean morning (21.87°C) and afternoon (30.23°C) temperatures were significantly higher than thermoneutral temperature (18°C) of sheep (CHRISTOPHERSON, 1976). The high temperature possibly imposed the heat stress. The relative humidity recorded was 98.20% in the morning and 66.97% in the afternoon with an overall mean of 82.59 per cent.

Table 1. The mean environmental air temperature and relative humidity during the 3-day study period

Time (h)	Environ. air temp. (°C)	Relative humidity (%)
0800	21.87±0.18	98.20±0
1400	30.23±0.48	66.97±2.68

The results of the variables recorded are shown in *Table 2* and the ANOVA is shown in *Table 3.* It was observed that the rectal temperature of the three breed groups was within the normal range (GRELL, 1972). The mean morning rectal temperatures of PD and DH were respectively 0.53°C and 0.24°C higher than that of ISM. In the afternoon, the mean rectal temperature of PD was 0.30°C higher than that of ISM and DH which had similar temperature. It was observed that at any time of the day, the rectal temperature of ISM was lower than both the Dorset breeds. The higher rectal temperature of the exotic breeds, to some extent, reflected the degree of ability of these animals to withstand the environment in the shade since this was indicated by the increase in respiration rate in both breeds *(Table 2).* The morning respiration rates of 58.80, 86.80 and 38.73 breaths/min increased significantly ($P<0.01$) to 130.73, 137.20 and 58.07 breaths/min in the afternoon for DH, PD and ISM respectively. There was an increase of 122.33% in the respiration rate of DH, 58.06% in PD and 49.94% in ISM. Respiration was shallow possibly to permit maximum vapourization of water. Respiration rates do effect a significant amount of cooling through evaporation (PATHMASINGHAM, MURUGAIYAH

Table 2. Mean rectal temperature, respiration rate and pulse rate of Dorset Horn, Polled Dorset and indigenous sheep of Malaysia in the shade

Breed	Rectal temp. (°C)	Respiration rate (No./min)	Pulse rate (No./min)
Morning			
DH	38.94 ± 0.25b	58.80 ± 17.47b	74.93 ± 12.73a
PD	39.23 ± 0.32a	86.80 ± 17.16a	71.00 ± 5.32a
ISM	38.70 ± 0.45b	38.73 ± 12.30c	73.60 ± 4.61a
Afternoon			
DH	39.27 ± 0.27a	130.73 ± 6.56a	85.53 ± 4.29a
PD	39.57 ± 0.40a	137.20 ± 12.40a	83.67 ± 4.56a
ISM	39.27 ± 0.31a	58.07 ± 15.66b	83.53 ± 5.49a
Increment			
DH	0.33 ± 0.28b	72.33 ± 4.20a	9.33 ± 1.75b
PD	0.34 ± 0.12b	44.60 ± 6.12b	12.80 ± 1.71a
ISM	0.64 ± 0.14a	26.67 ± 19.28c	9.93 ± 3.13b

DH = Dorset Horn
PD = Polled Dorset
ISM = Indigenous sheep of Malaysia
Means (mean + S.D.) with same subscripts in same column are statistically not different ($P<0.05$).

Table 3. ANOVA of physiological variables of sheep

Source	d.f.	Respiration rate		Body temperature		Pulse rate	
		MS	F	MS	F	MS	F
Time	1	51 744.04	146.60**	4.27	23.85**	2 570.68	27.40**
Breed	2	27 530.10	78.00**	1.21	6.73**	99.70	1.06N.S.
Time x breed	2	3 963.88	112.29**	0.24	1.31N.S.	25.75	0.27N.S.
Error (A)	24	352.96		0.18		93.83	
Day	2	455.24	2.21N.S.	0.07	0.76N.S.	131.70	3.13N.S.
Error (B)	58	205.64		0.09		42.06	
Total	89	1 528.54		16.49		87.37	

*Significant at $P<0.05$.
**Significant at $P<0.01$.

and MOHD. NASIR, 1980). In the desert sun and an ambient temperature of 40°C, breathing frequency of 450 breaths/min (in lambs) had been reported (GRELL, 1972). Adult sheep, however, do not reach such a high frequency when panting (350 breaths/min in Merinos).

The overall Benezra's index of adaptability (BIA) of ISM *(Table 4)* (3.26±0.91) was significantly lower than that of imported DH and PD breeds indicating a greater degree of adaptation. This was supported by a low value of respiration rate (48.4 breaths/min). In comparison, the mean BIA values of PD and DH (5.80 and 5.13 respectively)

Table 4. The coefficient of heat tolerance and index of adaptability of Dorset Horn, Polled Dorset and indigenous sheep of Malaysia

Breed	Coefficient of heat tolerance	Index of adaptability
Morning		
DH	101.08 ± 4.50a	3.55 ± 0.76b
PD	95.92 ± 5.83b	4.80 ± 0.68a
ISM	105.52 ± 7.80a	2.67 ± 0.53c
Afternoon		
DH	95.20 ± 4.79a	6.70 ± 0.29a
PD	89.80 ± 7.22b	6.79 ± 0.87a
ISM	94.00 ± 5.07a	3.85 ± 0.83b

Values with same subscripts in same column are statistically not different ($P<0.05$).

were high and, therefore, the respiration rates were also high. The result using BIA to predict the adaptability is consistent with the result calculated using the Rhoad's CHT *(Table 4)*. In Rhoad's method, the final rectal temperature as opposed to incremental rise in rectal temperature, and respiration rate are the critical variables for measuring the heat tolerance ability of an animal (McDOWELL, LEE, FOHRAM and ANDERSON, 1953; BIANCA, 1963). The Rhoad's CHT for PD was significantly lower than that of ISM (95.92±5.83 *vs* 105.52±7.80 in the morning and 89.80±7.22 *vs* 94.00±5.07 in the afternoon) indicating that the former breed had a lower ability to withstand heat. Similar observations were made on cattle by NORDIN (*pers comm.*, 1984).

The study also showed that environmental air temperature and humidity have positive effect on the rectal temperature and respiration rate. The correlation of environmental air temperature (21.87°C – 30.23°C) and humidity with the rectal temperature was highest in PD (0.72) followed by ISM (0.65) and DH (0.42). ALIM and AHMAD (1959), BHATNAGAR and CHAUDARY (1960), MULLICK (1960), MISRA, SENGUPTA and ROY (1963) and ALIM and FATTAH (1966) had also observed that body temperature was closely correlated with air temperature. The correlation coefficients of environmental air temperature and humidity with respiration rate in the three breed groups studied were found to be highly significant ($P<0.01$) and ranged from 0.62 to 0.93.

CONCLUSION

From the study, it was observed that the imported animals showed signs of heat load even though they were kept in the shade. Under this condition, there were indications that Dorset Horn breed of sheep was more adaptable than Polled Dorset. Further research could be conducted to study the response of the animals to the hot sunny environment and the effects of such environment on its growth and reproduction.

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ABSTRACT

Ewes of purebred Dorset Horn (DH) and Polled Dorset (PD) (both imported from New Zealand), and indigenous sheep of Malaysia (ISM), five of each breed, were used to study the adaptation of the imported Dorset breeds to the Malaysian tropical climate. After ten days of initial adjustment in the shade, rectal temperature, respiration rate and pulse rate were recorded at 0800 hours and 1400 hours daily for three days. Environmental air temperature and relative humidity were also recorded. The results showed that the morning and afternoon rectal temperatures of PD, DH and ISM were 39.23±0.32°C and 39.57±0.40°C, 38.94±0.25°C and 39.27±0.27°C, and 38.70±0.45°C and 39.27±0.31°C which were within the normal range of 39.0±1.5° Celsius. The rectal temperature increased with the increase in environmental air temperature in the afternoon. This was followed by an increase in respiration rate which was a sign of high heat load, particularly in exotic breeds. The pulse rate of PD increased significantly ($P<0.05$) and the increase was highly significant ($P<0.01$) in DH and ISM sheep. In the afternoon, the values of Benezra's index of adaptability (BIA) were higher in both imported breeds as compared with that of ISM (6.70 and 6.79 *vs* 3.85) while the Rhoad's coefficients of heat tolerance (RCHT) for PD (89.80) and ISM (94.00) were lower than that of DH (95.20) which indicated that PD had lower capability than DH in adapting to local environment even under the shade.

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