

New Zealand Society of Animal Production online archive

This paper is from the New Zealand Society for Animal Production online archive. NZSAP holds a regular annual conference in June or July each year for the presentation of technical and applied topics in animal production. NZSAP plays an important role as a forum fostering research in all areas of animal production including production systems, nutrition, meat science, animal welfare, wool science, animal breeding and genetics.

An invitation is extended to all those involved in the field of animal production to apply for membership of the New Zealand Society of Animal Production at our website www.nzsap.org.nz

[View All Proceedings](#)

[Next Conference](#)

[Join NZSAP](#)

The New Zealand Society of Animal Production in publishing the conference proceedings is engaged in disseminating information, not rendering professional advice or services. The views expressed herein do not necessarily represent the views of the New Zealand Society of Animal Production and the New Zealand Society of Animal Production expressly disclaims any form of liability with respect to anything done or omitted to be done in reliance upon the contents of these proceedings.

This work is licensed under a [Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License](http://creativecommons.org/licenses/by-nc-nd/4.0/).



You are free to:

Share— copy and redistribute the material in any medium or format

Under the following terms:

Attribution — You must give [appropriate credit](#), provide a link to the license, and [indicate if changes were made](#). You may do so in any reasonable manner, but not in any way that suggests the licensor endorses you or your use.

NonCommercial — You may not use the material for [commercial purposes](#).

NoDerivatives — If you [remix, transform, or build upon](#) the material, you may not distribute the modified material.

<http://creativecommons.org.nz/licences/licences-explained/>

Some effects of hot conditions on Brahman or Sahiwal crossbred calves

C. W. HOLMES, T. P. HUGHES, C. T. KING, P. E. L. SAUWA and P. S. A. AUKO

Department of Animal Science
Massey University, Palmerston North

ABSTRACT

Two experiments were carried out in controlled temperature rooms, with Brahman \times Friesian (B \times), Sahiwal \times Friesian (S \times) and Friesian (F) calves aged 6 to 9 months exposed to 34°C or 17°C air temperature.

In Experiment 1, there was no difference between B \times , and F calves in energy metabolism measured at about 15°C, and heat production of calves of both breeds was increased under hot conditions. At 34°C the B \times calves had lower rectal temperatures and lower respiratory rates than F calves; at this high temperature, B \times calves ate more and grew faster than F calves only if given a highly digestible diet (72%) but not if given a diet of lower digestibility (63%).

The B \times calves also had lower rectal temperatures and respiratory rates and faster rates of sweating than F calves when exposed to a hot environment with a source of radiant heat.

When exposed to 34°C in Experiment 2, the S \times calves had lower rectal temperatures and respiratory rates than the F calves; the S \times calves also had slightly higher growth rates and feed intakes at this temperature.

INTRODUCTION

Bos indicus cattle are generally more tolerant of hot conditions and some tropical parasites and diseases than *Bos taurus* cattle; however the latter generally have the potential for higher productivity under good conditions (Frisch and Vercoe, 1978; Willis, 1976). Consequently there has been considerable interest in programmes of crossbreeding between cattle of the 2 types which attempt to breed cattle which are reasonably productive and are also reasonably tolerant of tropical conditions.

The cattle used in the present experiments resulted from 2 such crossbreeding programmes in New Zealand. In the first Brahman (beef breed) were crossed with Friesians and in the second Sahiwals (dairy breed) were crossed with Friesians.

The purpose of the experiments was to measure some physiological responses and aspects of productivity of crossbred cattle and of Friesian cattle, under hot and mild climatic conditions. Some results have been published previously (Holmes *et al.*, 1978; 1980) and further details can be obtained in King (1978), Sauwa (1978) and Auko (1980).

METHODS

Experiment 1

Eight calves of each of 2 breed types Friesian (F) and Brahman \times Friesian (B \times), 6 months old at the start of the experiments, were used. They were fed *ad libitum* either of 2 diets, 1 of which consisted mainly of concentrates while the other mainly of hay. The calves

were kept either at 17°C or 34°C for 8 weeks, during which time their food intake, growth rate, rectal temperature and respiratory rates were measured.

The energy metabolism of 10 of these cattle was then measured at 2 levels of feeding, at 15°C. Heat production was also measured at 30 to 35°C in some of these calves.

Experiment 2

Four calves of each of 2 breed types, Friesian (F) and Sahiwal \times Friesian (S \times) were used in an experiment of similar general design to Experiment 1 except that energy metabolism was not measured.

RESULTS

Experiment 1

The estimated values for metabolisable energy required for maintenance (ME_M) and for the net efficiency with which ME is utilised above maintenance (k_p) were similar for both breed types (0.43 and 0.44 MJ ME/kg^{0.75} daily and 0.51 and 0.54 respectively for B \times and F).

The rates of heat production of both breeds were increased by approximately 5% when their rectal temperatures were increased by 1 to 2°C as a result of exposure to hot conditions.

The digestibility of dietary dry matter was 70% and 58% for the 2 diets measured at 15°C. Digestibility of both diets was slightly higher, at 34°C in association with a decrease in feed intake.

The average live weights of the B \times and F cattle

TABLE 1 Some mean values and results of analyses of variances for Experiment 1.

Temperature Diet Breed	Hot				Cool				Significant effects ¹		
	Conc		Hay		Conc		Hay				
	B ×	F	B ×	F	B ×	F	B ×	F			
Rectal temperature (°C)	39.6	40.6	40.0	40.4	39.1	39.1	38.9	39.0	T**	Br*	TxBr*
Respiratory rate/min	97	101	89	100	39	53	24	40	T**	Br**	D*
Dry matter intake ² (kgDM/d)	3.70	2.52	2.82	2.95	4.73	4.45	3.76	4.16	T**	TxBr*	D**
Rate of live-weight gain (kg/d)	0.91	0.41	0.37	0.32	1.24	0.97	0.71	0.71	T**	Br*	D**

¹ T = Temperature.

Br = Breed.

² Dry matter intake adjusted to a common mean initial live weight.

at the start of the experiment were 106 and 97 kg respectively.

The mean values for some measurements are given in Table 1. Dry matter intake was significantly related to the initial live weight of the animals and it was therefore adjusted by covariance to a common mean initial live weight.

Experiment 2

The digestibilities of the 2 diets was slightly higher than those given above for Experiment 1. The average initial live weights of the S × and F cattle were 118 and 159 kg respectively.

The mean values for some measurements are given in Table 2. Dry matter intake was not significantly related to live weight at the start of the experiment and the unadjusted data have been given, together with the values for digestible energy intake expressed per kg^{0.75}.

DISCUSSION

In the hot conditions of both experiments the *Bos indicus* crossbred cattle had lower values for rectal temperature and respiratory rates than the Friesian

cattle, regardless of the diet, and agrees with other findings (e.g., Kellaway and Colditz, 1975) which suggest that the B × cattle were under less 'stress' than the F cattle when exposed to 34°C. But the B × cattle ate more feed and grew faster than the F cattle only on the concentrate diet and not on the hay diet. An important question which arises is 'Why, when fed hay at 34°C, did the B × cattle fail to eat more feed and grow faster than the F cattle, despite the fact that the former cattle had lower rectal temperatures and respiratory rates. Would this result be repeated under tropical field conditions?'

The results raise doubts about the invariable validity of rectal temperature and respiratory rate as measures of animals' heat stress, when the factor of greatest importance is the animals' growth rate.

In Experiment 2 the S × cattle ate slightly more feed and grew faster than the F cattle on both diets, under the hot conditions.

In Experiment 1, after the raw data for growth rate had been adjusted to a common mean digestible energy intake, no significant treatment effects remained although the average adjusted growth at 34°C was still slightly slower than that at 17°C. In Experiment 2, feed intake accounted for 70% of the

TABLE 2 Some mean values and results of analyses of variance for Experiment 2.

Temperature Diet Breed	Hot				Cool				Significant effects	
	Conc		Hay		Conc		Hay			
	S ×	F	S ×	F	S ×	F	S ×	F		
Rectal temperature (°C)	39.6	40.1	39.7	40.2	38.7	38.7	38.7	38.7	T**	TxBr*
Respiratory rate/min	74	109	97	122	24	43	35	45	T**	Br**
Dry matter intake (kgDM/d)	4.00	4.24	3.47	3.14	4.06	5.41	4.11	4.02	T*	
Digestible energy intake (MJ/kg ^{0.75} d)	1.61	1.46	1.32	1.04	1.65	1.90	1.60	1.34	T*	
Rate of live-weight gain (kg/d)	0.71	0.57	0.12	-0.13	0.74	1.33	0.46	0.16	T**	D*

variation in growth rate, while rectal temperature accounted for only 25% of the variation.

The results of both experiments indicate that the effect of hot conditions on growth rate was due mainly to the decrease in food intake, although the associated increase in rectal temperature probably had some smaller, specific effects. These effects may have included increases in heat production (see above) and in urinary nitrogen excretion (Kellaway and Colditz, 1975).

The present results suggest that there was no difference in the rate of heat production between the 2 breed types at a common feeding level. The apparent differences between the types in their ability to tolerate hot conditions must therefore have been due to differences in their heat losses and in both experiments the *Bos indicus* cattle had faster rates of sweating than the Friesians under hot conditions, although the difference was not significant in Experiment 2.

ACKNOWLEDGEMENTS

The assistance provided by Animal Enterprises Ltd, R. D. and R. J. Wallace Ltd, and the New Zealand Ministry of Foreign Affairs is gratefully acknowledged.

REFERENCES

Auko P. S. A. 1980. Studies on some effects of hot climatic

- conditions on the performance of Friesian and Sahiwal × Friesian heifers. Master of Agricultural Science thesis, Massey University, Palmerston North.
- Frisch J. E.; Vercoe J. E. 1978. Utilising breed differences in growth of cattle in the tropics. *World animal review* **25**: 8-12.
- Holmes C. W.; Hughes T. P.; Christensen R. 1978. Energy metabolism of Brahman × Friesian and Friesian calves, and the influence of an increase in rectal temperature on their heat production. *New Zealand journal of agricultural research* **26**: 615-622.
- Holmes C. W.; King C. T.; Sauwa P. E. L. 1980. Effects of exposure to a hot environment on Friesian and Brahman × Friesian cattle, with some measurements of the effects of exposure to radiant heat. *Animal production* **30**: 1-11.
- Kellaway R. C.; Colditz P. J. 1975. The effect of heat stress on growth and nitrogen metabolism in Friesian and F, Brahman × Friesian heifers. *Australian journal of agricultural research* **26**: 615-622.
- King C. T. 1978. Some effects of hot climatic conditions on Brahman × Friesian and Friesian calves fed on high and low roughage diets. Master of Agricultural Science thesis, Massey University, Palmerston North.
- Sauwa P. E. L. 1978. The effect of a high ambient temperature on the physiological responses of Friesian and Brahman × Friesian calves fed on two rations. Master of Agricultural Science thesis, Massey University, Palmerston North.
- Willis M. B. 1976. The use of *Bos taurus* in beef breeding programmes in tropical areas; Chapter 6, pp. 332-346, *In* 'Beef production in the developing countries'. Smith A. J. ed., University of Edinburgh.