Voluntary feed intake, growth and efficiency of feed conversion in growing sambar (*Cervus unicolor*) and red deer (*Cervus elaphus*)

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ABSTRACT

Hand-reared sambar and red deer (3 hinds and 5 stags/species) were confined indoors in individual pens and fed a pelleted diet *ad libitum*, to study seasonal effects upon voluntary feed intake (VFI) and body growth. Mean age at the start of the experiment was 5 months for sambar and 7 months for red deer. Red deer of both sexes showed maximum VFI and liveweight gain (LWG)in summer and minimum values in winter. Sambar of both sexes also showed seasonal cycles in VFI and LWG, but with maximum values in autumn and minimum values in spring, and with the amplitude of the cycles being much less than for red deer. Over a complete 12 month period (7-19 months of age), total LWG was similar in sambar and red deer, but total VFI was lower for sambar ($p<0.01$) and efficiency of food conversion (kgDM/kgLWG) more efficient for sambar than for red deer ($p<0.05$). When energy requirements were calculated, the amount of metabolisable energy (ME) required for both maintenance and gain were lower for sambar than for red deer.

Keywords: sambar deer; red deer; voluntary feed intake; body growth; feed conversion; metabolisable energy.

INTRODUCTION

Studies with tropical deer have been conducted mainly with rusa (*Cervus timorensis*) and chital deer (*Axis axis*) in Australia (van Mourik 1988; Chapple 1989; Mylrea 1992). Sambar (*Cervus unicolor*) are known as the largest of the tropical deer, and were first introduced to New Zealand (NZ) from Sri Lanka in 1875 (King 1990). Currently sambar are running wild in the Manawatu, Whakatane and Rotorua areas and are available for recreational hunting. The body conformation of sambar deer suggests a "meaty-type" animal, with large muscles around the rump and hind leg areas.

Sambar in NZ calve throughout the year, with a mean calving date of 8 May (SD 70 days), and can be satisfactorily hand reared (Semiadi *et al.*, 1993). The present experiment was designed to compare seasonal patterns of voluntary feed intake (VFI), growth, and feed conversion efficiency in hand reared sambar and red deer.

MATERIALS AND METHODS

Animals & feeding

The study was carried out at the AgResearch Flock House Agricultural Centre, Bulls. Apart from one red hind, all animals (5 stags and 3 hinds/species) were hand-reared (Semiadi *et al.*, 1993). Animals were individually penned, fed a pelleted diet *ad libitum*, and liveweight gain and VFI monitored. During the study, one sambar stag died due to a neck injury and one sambar hind and one sambar stag died from malignant catarrhal fever (MCF). No replacements were made.

Because of different calving times (Semiadi *et al.*, 1994), the red deer were placed in individual pens on 7 July 1991, at a mean age of 7 months, and sambar were penned from 23 September 1991 to 2 January 1992, at a mean age of 5 months. Due to behavioural problems, one red stag and one red hind were replaced in September 1991. Mean age and liveweight of sambar and red deer at commencement of the experiment are shown in Table 1. Data collection was started after a two week period of adjustment to the diet and surroundings, and lasted for 16 months. Velvet spikes were removed when they reached 15 cm in length in red stags and 7 cm in sambar stags.

TABLE 1: Mean age (SE) and liveweight (SE) of sambar and red deer when they were placed in individual indoor pens.

	Sambar stag	Red stag	Sambar hind[1]	Red hind
Age (days)	160 (55.4)	219 (18.6)	128 (25.5)	232 (27.9)
Liveweight (kg)	49.5 (7.70)	51.2 (2.09)	36.6 (2.85)	44.6 (5.62)
n	3	5	2	3

[1] where n=2, range (±) is given

All animals were fed the pelleted diet (2.9 % N, 12 MJ ME/kgDM), once daily, at 0800-0900 h, at a rate of 120% of the previous day's consumption. Feed intake and feed refusal were recorded weekly. Samples of feed on offer and feed refusals were collected daily, pooled weekly and a representative sample taken for dry matter analysis. Quality of feed on offer (total N & energy) was monitored for each 2-tonne batch.

Data collection & statistical analyses

Data from dead animals were excluded. Body growth was monitored every two weeks. VFI, liveweight gain (LWG) and feed conversion efficiency (FCE: kgDMI/kgLWG) for the two deer species were compared at similar ages, over a 12 month

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period, using a 2 x 2 factorial model, with deer species and sex as the factors. To estimate energy requirements, regression equations were calculated of liveweight gain (g) per day per kg metabolic weight on calculated ME intake (MJ) per day per kg metabolic weight, as described by Fennessy *et al.*, (1981), using values for each animal calculated over four consecutive three-month periods in each regression.

RESULTS

Figure 1 shows the pattern of VFI of sambar and red deer of both sexes. Sambar tended to consume less feed than red deer, with the latter showing a more pronounced seasonal fluctuation. Peak VFI in sambar occurred in autumn and was lowest in spring. In contrast, VFI in red deer peaked in summer and was lowest in winter. A drop in VFI in both sexes of red deer coincided with the breeding season in autumn.

FIGURE 1: Voluntary feed intake (kgDM/day) of young sambar (●) and red deer (○) fed indoors on a pelleted diet *ad libitum*. Vertical bars represent SE (range for sambar hinds). S= summer solstice; W= winter solstice.

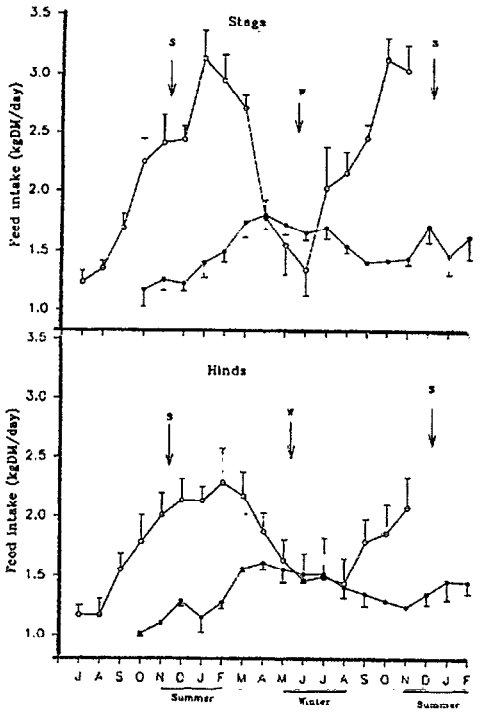
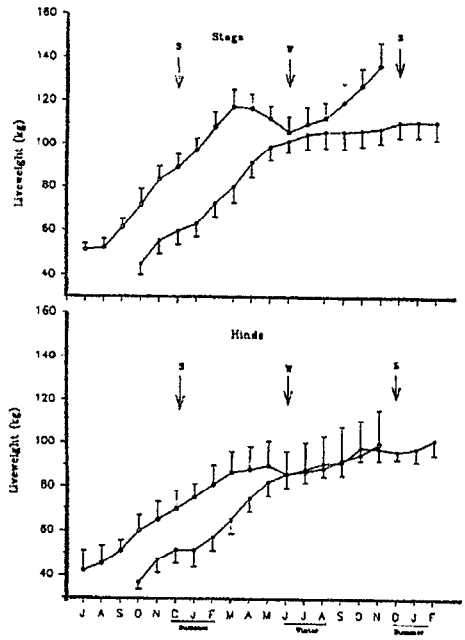


Figure 2 shows the changes in liveweight of sambar and red deer of both sexes. In general, sambar showed increased growth during their first summer and autumn. Sambar hinds showed a continuous but slow body growth throughout the winter and their second spring, but sambar stags showed a slow growth over winter and static growth during their second spring. On the other hand, red deer showed a high growth rate in spring/summer and slow growth over winter. During the autumn breeding season, red hinds lost 4.4% of liveweight compared to 6.8% in red stags.

Over a complete 12 month period, no interaction between species and sex or effects of sex on VFI, FCE and LWG were found (Table 2). However, sambar had significantly lower VFI ($p<0.01$) and more efficient FCE ($p<0.05$)

FIGURE 2: Liveweight changes (kg) of young sambar (●) and red deer (○) fed indoors on a pelleted diet *ad libitum*. Vertical bars represent SE (range, for sambar hinds). S= summer solstice; W= winter solstice.



than red deer, with growth being similar for sambar and red deer.

TABLE 2: Voluntary feed intake, liveweight gain and feed conversion efficiency (mean, SE) in sambar and red deer, fed indoors on a pelleted diet *ad libitum*, over corresponding 12 month periods (sambar Nov'91-Nov'92; red deer: Jul'91-Jul'92).

	Sambar stag (n=3)	Red stag (n=4)	Sambar hind (n=2)[1]	Red hind (n=2)[1]
Initial age (days)	198 (64.0)	201 (2.5)	169 (39.0)	204 (2.5)
VFI (kgDM/day)	1.63 (0.072)	2.21 (0.131)	1.42 (0.081)	1.82 (0.293)
LWG (g/day)	138 (24.5)	159 (17.8)	139 (1.3)	126 (33.2)
FCE (kgDMI/ kgLWG)	12.2 (2.21)	13.9 (1.09)	10.3 (0.70)	15.0 (1.66)

[1] where n=2, range (±) is given

For both sexes of both deer species, LWG (g) per day per $kgW^{0.75}$ was strongly related to ME intake (MJ; MEI) per day per $kgW^{0.75}$ (Table 3). The regression slopes were higher for sambar than for red deer ($p<0.05$), in both sexes. Maintenance energy requirement (MER), calculated as MEI corresponding to zero LWG, was consistently lower for sambar than for red deer, as was ME required for each kg of LWG above maintenance.

DISCUSSION

The present study demonstrated decreased seasonal fluctuations in VFI and liveweight changes in sambar compared to red deer. In general, the cycles in sambar were of much lower amplitude than observed for red deer, with

TABLE 3: Regression equations of liveweight gain (g) per day per $kgW^{0.75}$ on MEI (MJ) per day per $kgW^{0.75}$ for sambar and red deer between similar ages (sambar: 8-20 months, autumn'92-summer'93; red deer: 9-21 months, spring'91-winter'92).

	Sambar deer	Red deer
Stag	LWG= 37.71 MEI-20.14	LWG= 26.45 MEI-16.75
	SE 5.09 3.20	SE 3.43 3.08
	R^2= 0.85 n=12	R^2= 0.78 n=20
	p<O.001	p<O.001
	MER[a)]=0.53 MJME/$kg^{0.75}$/day	MER= 0.63 MJME/$kg^{0.75}$/day
	MEg[b)]= 26.5 MJ/kgLWG	MEg=37.8 MJ/kgLWG
Hind	LWG= 40.09 MEI-20.80	LWG= 21.63 MEI-13.56
	SE 4.70 2.90	SE 3.76 3.37
	R^2 = 0.92 n=8	R^2= 0.78 n=12
	p<O.001	p<O.001
	MER= 0.52 MJME/$kg^{0.75}$/day	MER= 0.62 MJME/$kg^{0.75}$/day
	MEg= 24.9 MJ/kgLWG	MEg= 46.2 MJ/kgLWG

[a)]MER= metabolisable energy for maintenance

[b)]MEg= metabolisable energy for gain, above maintenance

maximum and minimum VFI occurring in autumn and spring, compared to summer and winter for red deer. However, maximum VFI occurred closely related to the mean calving time in both deer species (Semiadi 1993). A comparative study of growth in young rusa and red deer under a sub-tropical environment indicated a similar pattern to the present study, with rusa continuing to grow until 17 months of age, whereas red deer slowed in growth after 15 months of age (Suttie *et al.*, 1992). The overall pattern of VFI and liveweight changes in the present red deer were similar to the findings of Suttie *et al.*, (1989), although a greater VFI occurred in the red hinds in the present study.

The more efficient feed conversion in sambar than red deer may be due to the lower energy requirements of sambar. The maintenance requirements for ME in red deer in the present study were slightly higher than those calculated by Fennessy *et al.*, (1981), perhaps due to slight overestimation of OMD values from laboratory analyses. However, the pattern clearly showed a lower ME requirement for the tropical compared to the temperate deer. A similar study with bovine animals also showed a lower maintenance heat production and FCE in tropical bovine (*Bos indicus*) compared to temperate bovine (*Bos taurus*) (Vercoe 1970). Whether the lower ME requirement for indoor sambar remains the same as for outdoor animals needs to be studied further, particularly during winter. This point is of particular interest because sambar do not develop secondary fibres, as do red deer (Semiadi 1993).

Lower ME requirements for both maintenance and growth in tropical-type animals may be an adaptive strategy to counter high environmental temperatures. For tropical animals, as ambient temperatures are warm enough to keep the body temperature at a normal physiological level, it is unnecessary for the animals to have a high level of energy production. On the other hand, higher levels of heat production are needed to counter the lower ambient temperatures experienced by red deer in the temperate zone.

It was concluded that sambar have reduced seasonality in VFI and liveweight change and a lower energy requirement for both maintenance and growth than red deer.

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