THE DOMESTICATION AND NUTRITION OF

SAMBAR DEER (Cervus unicolor);

A COMPARATIVE STUDY WITH RED DEER (Cervus elaphus)

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Gono Semiadi

1993

"NICK": Sambar s ag (2.5 years of age, 210 kg liveweight).

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ABSTRACT

A comparison between sambar and red deer in grazing behaviour, dietary preference, digestive efficiency and changes with time in voluntary feed intake (VFI) and plasma hormone concentrations was conducted at the Flock House Agricultural Centre, New Zealand Pastoral Agricultural Institute, Bulls, New Zealand. The general biology of sambar under field conditions was also studied, and systems developed for the artificial rearing of sambar calves.

1. Two groups of semi-domesticated sambar comprising eight stags and 23 hinds were documented in terms of behaviour, calving pattern, birth weight, hard antler and health status for a 3-year period (1989-1992).

Sambar had a wide spread of calving, from January to November, with mean calving date being 8 May (SD 71.3 days). The hinds calved annually with the calving interval being 329 days (SD 29.7 days). Birth weight of stag and hind sambar calves were similar, being 8.1 kg (SD 1.37 kg) and 7.8 kg (SD 1.72 kg), respectively. The male:female ratio was 1.6:1.0, with mortality of stag calves being 41% and hind calves 6%.

Sambar stags were reasonably well synchronized in hard antler and were in hard antler from May to November. Hard antler in adult stags was carried for 231 days (SD 40 days) and cast annually, while younger stags carried their hard antler for 205 days (SD 107.8 days). Mean antler casting date in adult stags was 7 December (SD 35.4 days) and in young stags was 21 January (SD 45.2 days). During the rut, the dominant sambar stag demonstrated a high degree of tolerance toward the presence of rival stags near the harem. Although sambar are very cautious and nervous animals, they can be quietened under farming conditions by regular daily visits and hand feeding with maize or hay. Malignant catarrhal fever (MCF) was the main health problem in sambar and they appeared resistant to internal parasite problems if set stocked and kept out of contact with red deer.

2. Grazing behaviour was recorded in sambar and red deer for continuous 24 h periods, at 2-monthly intervals, over 12 months. Scan sampling was used with observations made every 12 min. Both groups of deer were grazed separately on adjoining areas of the same pasture for the duration of the study.

Sambar grazed mostly during the night (0100-0500 h), late afternoon and evening (1700-2100 h), whereas red deer grazed mostly during early morning (0500-0700 h), afternoon and early evening (1500-2000 h). Total grazing time was not altered by season and month and was similar for both sambar and red deer (9.1 v 9.4 h/24h). However, sambar spent more time grazing during the night (6.2 v 4.9 h)/24h; $p<0.01$) and less time grazing during the day (2.9 v 4.5 h/24h; $p<0.01$) than red deer. Rate of prehending biting was greater for sambar than for red deer (64.5 v 47.7 bites/min; $p<0.001$). It is suggested that longer night grazing by sambar may have evolved to reduce thermoregulatory stress in tropical environments and as a defensive strategy against attack by predators.

3. Dietary preferences of sambar and red deer were determined by field observations on three occasions, at 2-monthly intervals, by offering the animals access to two legumes, three grasses and two browse species. The animals were allowed to graze freely until 300 observations had been recorded. Nutritive quality of plants on offer and of the diet selected, plant height, plant species purity, plant preference and stem diameter selected were also recorded.

Willow was the first preference of sambar followed by high endophyte perennial ryegrass. Red clover was the first preference by red deer followed by lotus. Sambar selected both willow leaves and stems below 36 mm diameter, whilst red deer selected leaves only. Sambar selected plant components higher in lignin and condensed tannin, but lower in OMD and total N than red deer.

4. Ten sambar and nine red deer calves were taken from their dams within 24 h of birth and artificially reared with ewe milk replacer until weaning at 70 days of age. Body dimensions at birth (weight, height, girth circumference and length), liveweight gain, milk consumption and behavioural aspects during artificial rearing were recorded.

Sambar calves had lower overall milk consumption than red deer calves (312 v 359 gDM/day: $p<0.05$), and showed an earlier peak in milk consumption, a faster rate of decline in milk consumption and earlier self-weaning. Birth weight as a proportion of dam liveweight was lower for sambar than for red deer, but liveweight gains to weaning (347 v 330 g/day) and weaning weights (30.0 v 30.4 kg) were similar. The age at which calves commenced a range of activities, including eating forage and ruminating, were similar for both species. However, "jumping" activities commenced five days later in sambar than in red deer ($p<0.01$). Following milk feeding, sambar calves were less active than red deer calves. This study demonstrated that sambar calves can be successfully artificially reared using ewe milk replacer, but extra precautions are needed to avoid scouring and abomasal bloat, which were more prevalent in sambar than in red deer.

5. Artificially reared sambar and red deer were confined in metabolism cages and fed chaffed lucerne hay ad libitum for the period of four weeks during summer and winter. Measurements were

made of VFI, water intake, apparent digestibility, faeces particle size distribution, eating and ruminating time and the rate of chewing during eating and ruminating. Red deer reduced VFI (kg DM/d) markedly from summer to winter (1898 v 1345 gDM, respectively), while that of sambar increased slightly over this time (1244 v 1404 gDM, respectively). Digestive efficiency was similar in sambar and red deer during both summer and winter (58.1% DMD) and the critical particle size for leaving the rumen was less than one mm sieve size for both deer species. Time spent eating/gDMI was greater for sambar than for red deer during summer (0.28 v 0.16 min/gDMI; $p<0.01$), but there was no difference during winter (0.14 v 0.16 min/gDMI). Relative to red deer, sambar consistently spent more time ruminating/gDMI and spent a greater proportion of total ruminating time as daytime ruminating, and had more daytime ruminating bouts. Sambar had less number of chews/bolus ruminated but more rumination boli/h than red deer. Differences between sambar and red deer were more pronounced in ruminating than in eating behaviour, which may be a mechanism to improve the breakdown of low quality tropical forages.

6. Eight artificially reared deer (5 stags, 3 hinds) from each deer species were randomly allocated to individual indoor pens for a 16-month period. Three sambar later died as a result of a neck injury (n=1) and MCF (n=2). All animals were fed a pelleted diet ad libitum (12 MJME/kgDM; 2.9% N), and the two deer species were compared for rate of body growth, VFI and blood plasma levels of prolactin (PRL), progesterone (P), testosterone (T) and luteinizing hormone (LH). During the rut, scrotal circumference of stags in both species was also measured.

Compared to red deer, both sexes of sambar showed a weak seasonal pattern of VFI and body growth. Peak VFI in sambar occurred in autumn and lowest in spring, whereas red deer had peak VFI in summer and lowest VFI in winter. Growth rate followed the same pattern. Sambar appeared to be more efficient in converting feed to liveweight gain than red deer. Estimated requirements of ME for both maintenance and gain (above maintenance) in sambar tended to be lower than for red deer, with this being true for both sexes. While sambar did not develop secondary fibres during winter, the primary fibres were coarser and sparser than those of red deer.

Plasma PRL concentrations were seasonal in both species, with highest values in summer and lowest values in winter. Relative to red deer, sambar tended to have higher plasma PRL concentrations in autumn, and sambar stags tended to have lower plasma PRL concentrations in summer.

Sambar stags showed elevated levels of plasma T concentrations over a longer period (autumn-spring), but the magnitude was not as high as for red deer. Red stags showed peak plasma LH concentrations during summer and peak plasma T concentrations in autumn, with low values in winter and spring. Spike release of plasma P was detected in red hinds in autumn and sambar hinds in spring, when they were aged respectively 17 and 14 months, and weighed 95.5 and 90.0 kg. It was concluded that sambar have endogenous cycles of VFI, growth and hormone secretion but they were

of reduced amplitude and with different seasonality to those of red deer.

7. Nine artificially reared sambar (5 stags, 4 hinds) were blood sampled without being sedated, on two occasions, May and September 1992, and four adult sambar stags were sedated and blood sampled in September 1992. Blood samples were submitted for haematological analysis, to define normal haematology parameters for sambar.

Haemoglobin (Hb), packed cell volume (PCV) and plasma protein concentrations of unsedated sambar were slightly higher in stags than in hinds, with no variation between age groups. White blood cell fraction from unsedated sambar varied with age and sex. Differences between unsedated and sedated animals were in Hb, neutrophil, eosinophil and lymphocyte fractions.

8. Areas requiring further research in sambar are the onset of puberty in sambar hinds, duration of breeding season, response to photoperiod change, and the basis of an apparently improved feed conversion efficiency. The production of sambar and red hybrids may also be of potential significance to the NZ deer industry for advanced calving and more efficient venison production.

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BW	body weight
C	Celsius
cm	centimetre
CT	condensed tannin
diam.	diameter
DM	dry matter
DW	drinking water through
E	East
Exp.	Experiment
FCE	feed conversion efficiency
Fig.	Figure
g	gram
g/dl	gram/decilitre
gDM	gram dry matter
g/head/day	gram/head/day
h	hour(s)
ha	hectare
Hb	haemoglobin
kg	kilogram
kgDM	kilogram dry matter
kg/h/day	kilogram/head/day
KJ	kilojoule
l/l	litre/litre
lat	latitude
long	longitude
LH	luteinizing hormone
LHRH	luteinizing hormone releasing hormone
m	metre
MCF	Malignant catarrhal fever
min	minute(s)

mm	millimetre
ml	millilitre
ME	metabolisable energy
MEMJ	metabolisable energy megajoule
N	North, total nitrogen
n	number of sample
NZ	New Zealand
NDF	neutral detergent fibre
OM	organic matter
OMD	organic matter digestibility
OR	observation room
p	page, probability
PCV	packed cell volume
PD	Pere David's deer
pg	picogram
PRL	prolactin hormone
PT	pine trees
P	progesterone hormone
R	red deer
RBC	red blood cell
ROB	rate of prehending biting
S	South, sambar
SD	standard deviation
SE	standard error
sec	second(s)
SEM	standard error of mean
sp	species
T	testosterone hormone
ug	microgram
USA	United States of America
VFI	voluntary feed intake
v	versus
WBC	white blood cell

PREFACE

During the period of writing this thesis, four chapters have been send for publication in several journals. There are :

1. Chapter 1.
   Semiadi G, P.D Muir and T.N Barry. 1993. General biology of sambar deer in captivity. **New Zealand Journal of Agricultural Research (submitted).**

2. Chapter 2.
   Semiadi G, P.D Muir, T.N Barry, C.J Veltman and J Hodgson. 1993. Grazing pattern of sambar deer and red deer in captivity. **New Zealand Journal of Agricultural Research** 36:253-260.

3. Chapter 4.
   Semiadi G, T.N Barry and P.D Muir. 1993. Growth, milk intake and behaviour of artificially reared sambar deer and red deer fawns. **Journal of Agricultural Science, Cambridge** 121: 273-281.

4. Chapter 5.
   Semiadi G, T.N Barry, J Hodgson and P.D Muir. 1993. A comparison of digestive and chewing efficiency and time spent eating and ruminating in sambar deer and red deer. **Journal of Agricultural Science, Cambridge (submitted).**

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