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THE DOMESTICATION AND NUTRITION OF
SAMBAR DEER (Cervus unicolor);
A COMPARATIVE STUDY WITH RED DEER (Cervus elaphus)

A Thesis
Presented in Partial Fulfilment of the
Requirements for the Degree of
Doctor of Philosophy
in Animal Science at
Massey University
Palmerston North, NEW ZEALAND

Gono Semiadi

1993



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

**THE DOMESTICATION AND NUTRITION OF SAMBAR DEER (Cervus unicolor);
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(Gono Semiadi, Massey University, Palmerston North, NEW ZEALAND)

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.

LIST OF CONTENTS

	Page
ABSTRACT	i
LIST OF CONTENTS	v
LIST OF TABLES	x
LIST OF FIGURES	xiv
LIST OF PLATES	xvi
LIST OF APPENDICES	xvii
LIST OF ABBREVIATIONS	xviii
PREFACE	xx
ACKNOWLEDGEMENTS	xxi
INTRODUCTION	1
LITERATURE REVIEW	3
1. FEEDING BEHAVIOUR	3
1.1 Feeding classification & diet selection	3
1.2 Time budgeting	4
1.3 Rate of prehending biting	5
2. SEASONALITY	5
3. NUTRITION & PRODUCTION	6
3.1 Voluntary feed intake pattern	6
3.2 Growth pattern & growth rate	6
3.3 Carcass weight	8
4. REPRODUCTION	8
4.1 Hind maturity & oestrous	8
4.2 Calving time, calving interval & calving rate	10
4.3 Stag maturity	12
4.4 Antler	13
5. HORMONAL PROFILE	15
5.1 Luteinizing hormone (LH)	15
5.2 Testosterone (T)	15
5.3 Prolactin (PRL)	16
6. ARTIFICIAL REARING	16
6.1 Milk composition & milk substitute	16
6.2 Feeding rate & weaning age	18
6.3 Growth rate	19

7. CONCLUSIONS	19
CHAPTER 1. GENERAL BIOLOGY OF SAMBAR IN CAPTIVITY	20
INTRODUCTION	20
MATERIALS AND METHODS	20
Location	20
Animals	20
Observations	21
Calculation of data	21
RESULTS	22
Calving pattern & calving interval	22
Birth weight, sex ratio & mortality	22
Antler status & dimension	24
Behaviour	25
Health status	26
DISCUSSION	27
CONCLUSIONS	30
CHAPTER 2. GRAZING PATTERNS OF SAMBAR AND RED DEER IN CAPTIVITY	32
INTRODUCTION	32
MATERIALS AND METHODS	32
Experimental design	32
Animals	32
Paddock layout	33
Pasture vegetation	33
Observation techniques	33
Data collection	35
Pasture sampling & chemical analysis	35
Calculation of data & statistical analysis	36
RESULTS	36
Air temperature	36
Herbage mass, height & nutrient quality	36
Grazing observations	39
DISCUSSION	41
CONCLUSIONS	44

CHAPTER 3. DIETARY PREFERENCES OF SAMBAR AND RED DEER	45
INTRODUCTION	45
MATERIALS AND METHODS	45
Experimental design	45
Animals	45
Plant species & paddock	45
Paddock management	46
Data collection	46
Plant sampling & chemical analysis	48
Statistical analysis	48
RESULTS	48
Plant height & species purity	48
Dietary preference	50
Stem diameter	51
Nutritive value	51
Plants on offer	51
Plants selected	51
DISCUSSION	55
CONCLUSIONS	56
APPENDIX 3.1 Calculation of composition of total diet selected by sambar and red deer	58
CHAPTER 4. MILK INTAKE, GROWTH AND BEHAVIOUR OF ARTIFICIALLY REARED SAMBAR AND RED DEER CALVES	59
INTRODUCTION	59
MATERIALS AND METHODS	60
Experimental design	60
Animals	60
Red deer calves	60
Sambar calves	60
Feeding	60
Health	61
Data collection	61
Laboratory analysis	63
Statistical analysis	63
RESULTS	63
Feeding	63
Date of birth & birth body dimensions	64
Liveweight	64
Milk replacer consumption	65
Behaviour	65
Health	65
DISCUSSION	68
CONCLUSIONS	71

CHAPTER 5. A COMPARISON OF DIGESTION, CHEWING EFFICIENCY, EATING AND RUMINATING TIME IN SAMBAR AND RED DEER	73
INTRODUCTION	73
MATERIALS AND METHODS	73
Experimental design	73
Animals	74
Diet	74
Digestion trial	75
Jaw recording	75
Experiment 1. Time spent eating and ruminating	75
Experiment 2. Efficiency of chewing during eating	77
Experiment 3. Efficiency of chewing during ruminating	77
Sample processing & chemical analysis	77
Statistical analysis	79
RESULTS	79
Voluntary feed intake & digestibility	79
Water consumption	80
Particle size	80
Eating & ruminating time	81
Eating & ruminating bouts	84
Efficiency of chewing	84
DISCUSSION	87
CONCLUSIONS	88
CHAPTER 6. A COMPARISON OF ENDOGENOUS PATTERNS OF GROWTH, VOLUNTARY FEED INTAKE AND PLASMA HORMONE CONCENTRATIONS IN SAMBAR AND RED DEER	90
INTRODUCTION	90
MATERIALS AND METHODS	91
Experimental design	91
Animals	91
Health	92
Housing	92
Feeding	92
Weighing, scrotal measurement, blood & fibre sampling	92
Hormonal assays	93
Prolactin (PRL)	93
Testosterone (T)	93
Progesterone (P)	93
Luteinizing hormone (LH)	94
Data collection & statistical analysis	94

RESULTS	95
Diet quality & voluntary feed intake	95
Liveweight change, seasonal feed intake, efficiency of feed conversion & energy requirements	95
Scrotal circumference & hard antlers	102
Fibre	102
Hormonal patterns	105
Prolactin	105
Luteinizing hormone	105
Testosterone	105
Progesterone	105
DISCUSSION	109
CONCLUSIONS	113
CHAPTER 7. HAEMATOLOGICAL VALUES IN CAPTIVE SAMBAR	115
INTRODUCTION	115
MATERIALS AND METHODS	115
Experimental design	115
Animals	115
Blood sampling	115
Statistical analysis	116
RESULTS	116
DISCUSSION	119
CONCLUSIONS	121
GENERAL DISCUSSION	122
LITERATURE CITED	126

LIST OF TABLES

		Page
Table 1	Duration of oestrous (h) and length of oestrous cycle (days) in several temperate and tropical deer	10
Table 2	Calving time in sambar and rusa living in tropical and non-tropical regions	11
Table 3	The gestation period (days) and calving interval (days) in tropical and temperate deer	12
Table 4	Antler conditions of sambar and rusa living in tropical and non-tropical regions	14
Table 5	Comparisons of milk composition (%) of several deer species and domesticated animals	18
Table 1.1	Mean calving date patterns in two groups of captive sambar under New Zealand conditions	23
Table 1.2	Antler status from captive adult (≥ 3 years of age) and young (< 3 years of age) sambar stags under New Zealand conditions, between 1990 and 1992	24
Table 1.3	Mean date of hard antler commencement (mean, SD) in captive adult (≥ 3 years of age) and young (< 3 years of age) sambar stags, and length of time (days, SD) in velvet and hard antler conditions, under New Zealand conditions (n=number of observations)	25
Table 1.4	Number of groups (mean, SD) and number of animals per group (mean, SD) formed by group B (18 sambar deer), during the period when they were accustomed to the presence of humans in their paddock	26
Table 1.5	Some comparisons of the biology of reproduction and antler growth (mean, SD) in captive adult sambar and red deer	30
Table 2.1	Annual and seasonal grazing time (h/24 h) of sambar and red deer grazing unimproved pasture in New Zealand	39
Table 2.2	Annual and seasonal grazing cycles per 24 h of sambar and red deer grazing unimproved pasture in New Zealand	41
Table 2.3	Rate of prehending biting (number/min, SE) of sambar and red deer grazing unimproved pasture in New Zealand	41
Table 2.4	Time spent grazing (h/24 h) for several domesticated animals and wild deer compared to the present study	42
Table 2.5	Rate of prehending biting (number/min) for several domesticated animals compared to the present study	43
Table 3.1	Mean number of observations for sambar and red deer grazing a range of plants over three observation times; December 1991, February 1992 and April 1992	50
Table 3.2	Mean number of observations for sambar and red deer grazing browse, legume and grass in December 1991, February 1992 and April 1992	51

Table 3.3	Mean total nitrogen content (%DM) and organic matter digestibility (%DM) of plants on offer, over three observation times in December 1991, February 1992 and April 1992.	52
Table 3.4	Condensed tannin concentrations and its fractions (% DM) in plants on offer and plants selected by sambar and red deer, during December 1992	53
Table 3.5	Nutritive value of plant species selected by sambar and red deer in December 1992	54
Table 3.6	Comparison of total diet selected by sambar and red deer	56
Table 4.1	Milk feeding regime during artificial rearing for both sambar and red deer calves	61
Table 4.2	The descriptions of the behaviour observed during artificial rearing of sambar and red deer calves	62
Table 4.3	The nutritive value of milk powder and pasture grazed during the period of artificial rearing for both sambar and red deer calves, from two to 70 days of age	63
Table 4.4	Mean calving date and birth body dimensions (mean, SE) of sambar (n=8) and red deer calves (n=8) that were artificially reared in 1991	64
Table 4.5	Liveweight gain (g/day) for both sambar and red deer calves from two to 70 days of age	65
Table 4.6	Mean age at which sambar and red deer calves commenced selected activities during artificial rearing. Unless otherwise stated, age was measured from the date of birth of individual animals (mean, SE)	67
Table 4.7	Comparative birth weight (kg) and the proportion (%) of calve birth weight to dam liveweight in temperate and tropical deer	69
Table 5.1	Mean age (days, SE) and liveweight (kg, SE) of sambar and red deer used in the digestion trial, during both summer and winter	74
Table 5.2	Chemical composition (g/kgDM) of chaffed lucerne hay fed to sambar and red deer during the digestibility trials conducted during summer and winter	79
Table 5.3	Voluntary feed intake and apparent digestibilities of sambar (n= 4) and red deer (n=5) fed chaffed lucerne hay <u>ad libitum</u> during summer and winter	80
Table 5.4	Water consumption (ml/day) in sambar (n=4) and red deer (n=3) fed chaffed lucerne hay <u>ad libitum</u> during summer and winter	81
Table 5.5	Distribution of particle size (%DM), retained in sieved, of feed on offer and faeces in sambar and red deer fed chaffed lucerne hay <u>ad libitum</u> during summer and winter (Sambar n=4; Red deer n=5).	82
Table 5.6	(Exp.1) Time (min) spent eating and ruminating by sambar (S) and red deer (R) fed chaffed lucerne hay <u>ad libitum</u> during summer (S n=3; R n=4) and winter (S n=3; R n=3)	83

Table 5.7	(Exp.1) Number of eating and ruminating bouts in sambar (S) and red deer (R) fed chaffed lucerne hay <u>ad libitum</u> during summer (S n=3; R n=4) and winter (S n=3; R n=3)	85
Table 5.8	(Exp. 2 & 3) Chewing efficiency during eating and chewing during ruminating in sambar (R) and red deer (S) fed chaffed lucerne hay <u>ad libitum</u> during summer (S n=3; R n=4) and winter (S n=3; R n=3)	86
Table 6.1	Mean age (days, SE) and liveweight (kg, SE) of sambar and red deer when they were placed in individual indoor pens	91
Table 6.2	Seasonal patterns of voluntary feed intake, liveweight gain and feed conversion efficiency (mean, SE) in young sambar and red deer, fed indoors on a pelleted diet <u>ad libitum</u> , under New Zealand conditions. At the start of summer'92, sambar were six months of age and red deer were 12 months of age	98
Table 6.3	Voluntary feed intake, liveweight gain and feed conversion efficiency (mean, SE) in young sambar and red deer, fed indoors on a pelleted diet <u>ad libitum</u> , over corresponding 12-month periods (sambar: Nov'91-Nov'92; red deer: Jul'91-Jul'92)	99
Table 6.4	Age, liveweight gain, voluntary feed intake and feed conversion efficiency in young sambar and red deer growing to target liveweights (stags 100 kg; hinds 80 kg), fed indoors on a pelleted diet <u>ad libitum</u> (mean, SE)	100
Table 6.5	Regression equations of liveweight gain (g) per day per $\text{kgW}^{0.75}$ on MEI (MJ) per day per $\text{kgW}^{0.75}$ for young sambar and red deer between similar ages (sambar: 8-20 months, autumn'92-summer'93; red deer: 9-21 months, spring'91-winter'92)	100
Table 6.6	Maximum voluntary feed intake and liveweight attained in young sambar and red deer, in the period following their initial period of slow growth (sambar, spring; red deer, winter), when fed indoors on a pelleted diet <u>ad libitum</u> (mean, SE)	110
Table 6.7	A comparison of estimated metabolisable energy requirements for maintenance (MER) and gain in young sambar and red deer	111
Table 6.8	A comparison of voluntary feed intake, liveweight gain, feed conversion efficiency and fasting metabolism between Brahman (Bos indicus) and Shorthorn x Hereford (Bos taurus) cattle fed chaffed lucerne hay	111
Table 6.9	Mean age and liveweight when sambar and red deer first showed peak values in plasma testosterone and progesterone concentrations and the age when stags had their first hard antler (mean, SE; n= number of animals)	113
Table 7.1	A comparison of red blood cell values (mean, range) from unsedated sambar, kept indoors, during May and September 1992	117
Table 7.2	A comparison of white blood cell values (mean, range) from unsedated sambar, kept indoors, during May and September 1992	118

Table 7.3	Haematological values from mixed age semi-domesticated adult sambar stags sedated using a mixture of 10% Xylazine and Fentaz in September 1992 (n=4)	119
Table 7.4	Comparisons of haematological values in sambar under different sampling conditions	120

LIST OF FIGURES

		Page
Figure 1	(A) Voluntary feed intake and (B) growth patterns of young red stags fed indoors on a pelleted diet <u>ad libitum</u> , under southern hemisphere conditions (Suttie <u>et al.</u> 1989)	7
Figure 2	Growth pattern of rusa and red deer grazing pasture, under sub-tropical environments (Southern hemisphere). Rusa were about two months of age in May and red deer were about three months of age in January, resulting an age differences of four months between both species (Suttie <u>et al.</u> 1992)	9
Figure 3	A comparison of the hormonal profiles (testosterone, prolactin) in (A) rusa stag under sub-tropical environments (Southern hemisphere, Winter= Jun-Aug), and (B) red stag under temperate environments (Northern hemisphere, Winter= Oct-Dec) (Suttie & Kay 1985; van Mourik & Stelmasiak 1990)	17
Figure 1.1	Monthly calving distribution in captive sambar under New Zealand conditions, from 1989-1992	23
Figure 2.1	Layout of the paddock being grazed by sambar (S) and red deer (R) during grazing behaviour observations (DW= drinking water through, PT= pine trees; OR= observation room)	34
Figure 2.2	Mean herbage height (cm) and standing herbage mass (kgDM/ha) of pasture grazed by sambar (●) and red deer (○) during the study. Vertical bars represent SE (S= summer solstice; W= winter solstice)	37
Figure 2.3	Mean total nitrogen content (%DM) and organic matter digestibility (%DM) of pasture grazed by sambar (●) and red deer (○) during the study. Vertical bars represent SE (S= summer solstice; W= winter solstice)	38
Figure 2.4	The percentage of sambar (■) and red deer (□) observed to be grazing at hourly intervals, over a 24 h period. Data presented are the means of observations made at bimonthly intervals, over a 12-month period. Vertical bars represent SE	40
Figure 3.1	(A) Mean herbage height (cm, willow= height*10) and (B) plant purity (%) of plants on offer, prior the introduction of animals during December 1991, February 1992 and April 1992 (1= red clover, 2= lotus, 3= willow, 4= lupin, 5= prairie grass, 6= Yorkshire fog, 7= low endophyte perennial ryegrass, 8= medium endophyte perennial ryegrass, 9= high endophyte perennial ryegrass)	49
Figure 4.1	Mean daily milk consumption of sambar (●) and red deer calves (○) during artificial rearing. Vertical bars represent SE	66
Figure 5.1	Traces of jaw activity during summer from the same animal in each species. (A) Ruminating patterns in red deer (upper) and sambar (lower). (B) Eating patterns in red deer (upper) and sambar (lower). (C) Idling patterns in red deer (upper) and sambar (lower)	78

Figure 6.1	Voluntary feed intake (kgDM/day) of young sambar (●) and red deer (○) fed indoors on a pelleted diet <u>ad libitum</u> . Vertical bars represent SE (range, for sambar hinds) (S=summer solstice; W= winter solstice)	96
Figure 6.2	Liveweight changes (kg) of young sambar (●) and red deer (○) fed indoors on a pelleted diet <u>ad libitum</u> . Vertical bars represent SE (range, for sambar hinds) (S=summer solstice, W=winter solstice)	97
Figure 6.3	Relationship between metabolisable energy intake and liveweight gain for sambar and red deer (S= sambar; R= red deer)	101
Figure 6.4	Scrotal circumference (mm) pattern of young sambar (●) and red stags (○) fed indoors on a pelleted diet <u>ad libitum</u> . Vertical bars SE (S= summer solstice, W= winter solstice)	103
Figure 6.5	Fibre length of primary fibres and secondary fibres in young sambar (●) and red deer (○) fed indoors on a pelleted diet <u>ad libitum</u> . In red deer, moulting of secondary fibres commenced in early September and concluded in early November. Vertical bars represent SE for stags and range for hinds.	104
Figure 6.6	Plasma prolactin profile of young sambar (●) and red deer (○) fed indoors on a pelleted diet <u>ad libitum</u> . Vertical bars represent SE for stags and range for hinds (S= summer solstice, W= winter solstice)	106
Figure 6.7	Plasma luteinizing hormone profile of young sambar (●) and red deer (○) fed indoors on a pelleted diet <u>ad libitum</u> . Vertical bars represent SE for stags and range for hinds (S= summer solstice, W= winter solstice).	107
Figure 6.8	(A) Plasma testosterone profile of young sambar (●) and red stags (○), and (B) Plasma progesterone profile of young sambar (●) and red hinds (○) fed indoors on a pelleted diet <u>ad libitum</u> . Vertical bars represent SE for stags and range for hinds (S= summer solstice, W= winter solstice)	108

LIST OF PLATES

		Page
Plate 3.1	(A) Experimental paddock (area B, replicate 1) during December 1991. From left to the right, lotus, medium endophyte perennial ryegrass, red clover, low endophyte perennial ryegrass and lupin. (B) Experimental paddock (area B, replicate 2) during December 1991. From left to the right, high endophyte perennial ryegrass, willow, low endophyte perennial ryegrass and Yorkshire fog.	47
Plate 5.1	Recording of jaw movements for chewing efficiency during summer. (A) Jaw harness attached to a sambar stag, and (B) position of animal during recording	76

LIST OF APPENDICES

		Page
Appendix 3.1	Calculation of composition of total diet selected by sambar and red deer	58

LIST OF ABBREVIATIONS

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).**

ACKNOWLEDGMENTS

This study would not have been possible without the collaboration and support of numerous people and institutions. I wish to express my sincere gratitude to Professor T N Barry, my chief supervisor, and also to Dr P D Muir, my second supervisor at New Zealand Pastoral Agricultural Institute, for their valuable guidance in the planning and writing of this thesis, constructive criticism, helpfulness in many ways and most importantly, encouragement throughout my four years of study with the Department of Animal Science, Massey University.

I would like to thank Dr W M Kain, Chief Executive Officer, AgResearch (formerly Area Manager, MAF Tech. North Central, Palmerston North) for his vision in initiating the sambar research programme at Flock House. Thanks are also due to Dr A G Gilligham, Science Manager, Flock House for his support and encouragement.

I also wish to thank my other supervisors Dr P R Wilson, Dr R W Purchas and Professor J Hodgson for their contribution towards the success of my programme, Dr N da Silva and Dr B Fletcher of New Zealand Pastoral Agricultural Institute and Dr Ian Gordon for their statistical advice, Dr C J Veltman for her input during the grazing behaviour study, Dr K Stafford and Dr C W Reid for their assistance in setting up the jaw recorder. My sincere thanks to Lawrence and Patt Rowe and Clive Jermy for allowing me to use their sambar.

I am grateful to Kam Burke for her technical skill during blood sampling, Peter Burke for deer management, Louise Gosling for assistance with the indoor animals, and H B Dick and Heidi van Schilfgaarde, for computing and graphic assistance. I wish to thank Professor K Lapwood for making available the testosterone assay facility, Dr G.W Asher and his staff for running the progesterone and luteinizing hormone assays, Ms M Scott for running the prolactin assay, Ms R W Watson and D Hamilton for running the nutrition analysis, and "Willy" Stiefel and Erick Sorensen for pasture management. Furthermore, I would like to express my appreciation to Mr R J Thomas of the Department of English, Massey University for his helpful suggestions in English expression.

I am grateful to the Indonesian government for awarding me a stipend scholarship during the study, the New Zealand government (c/ Ministry of Foreign Affairs and Trade) for awarding me a fees scholarship, New Zealand Pastoral Agricultural Institute for providing me with three year funding toward this study, The New Zealand Society for Animal Production and the Postgraduate Animal Science Department Scholarship for financial assistance, Anchor Milk Ltd for the donation of milk powder, and New Zealand Pastoral Agricultural Institute for the donations of seeds and plants.

I wish to acknowledge the warm hands of friendship extended to my family and me by the families of Tom and Annette Barry, John and Jenny Niezen, Peter and Kam Burke and the staff of Flock House Agricultural Centre, who all made our stay in New Zealand much easier and more enjoyable.

Finally, my love, thanks and appreciation to my dear wife, Erlina Jas, and to our son Garpepi Hanief Aotearoa and daughter Garnisa Arsyi Aotearoa, my parents, brothers and sisters in Indonesia, for their support and prayer.