VENISON PRODUCTION FROM WEANER RED DEER STAGS GRAZING MOATA ANNUAL RYEGRASS OR PERENNIAL RYEGRASS PASTURES

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DEDICATION

This thesis is dedicated to my late mother, Zainab Acharu Ataja, and also to my elder sister, Hawawo Ataja, who passed away on September 14, 1990.

ABSTRACT

Four grazing experiments were conducted with red deer stags, three with weaner stags (start 6 months old; end 12 months old) and one with yearling stags (start 15 months old; end 21 months old). In New Zealand (NZ) the calving season for red deer is during late spring/early summer (November/December) and the calves are normally weaned in late February/early March. The price schedule for venison is highest during August to November, in response to Northern Hemisphere export market demand and is greater for carcasses of 50 kg or above. However, there is no well defined system for meat production from deer. The objective of these studies was to evaluate different systems of growing red deer stags to a slaughter liveweight (LW) of 92 kg (> 50 kg carcass weight (CW)) by one year of age or less, by the end of November. Thus an attempt was made to define a system of meat production from deer that was most profitable to NZ venison producers.

Experiment 1

The effects of two pasture dry matter (DM) allowances (medium and high; 4.5 and 6.3 kg DM/animal/day), the introduction of annual Italian ryegrass ('Grasslands Moata') direct drilled into existing perennial ryegrass/white clover pasture (PRG) at 15 kg seed/ha and active immunisation against melatonin (commencing at 6 months of age) upon voluntary food intake (VFI) and liveweight gain (LWG) of weaner red deer stags were studied during winter and spring. The Moata paddocks were direct drilled and band-sprayed with herbicide. The pastures were grazed under a rotational grazing system, with VFI estimated from pasture cuts before and after grazing.

1. During winter, Moata comprised 19% and 17% of total DM in the medium and high allowances, respectively. During spring these increased to 27% in the Moata medium allowance and 36% in the Moata high allowance.

2. During winter, the diet of animals grazing PRG pasture had predicted digestibility of OM (OMD) and ME values of 0.82 and 11.8 MJ/kg DM, respectively. These increased slightly to 0.84 and 12.0 MJ/kg DM, respectively, during spring. The diet of the Moata group had predicted OMD and ME of 0.84 and 12.0 MJ/kg DM, respectively during both winter and spring.

3. LWG and VFI during winter were approximately 100 g/day and 1.7 kg DM/day, respectively, and were not affected by either herbage allowance or the introduction of Moata. LWG increased in spring, and was higher ($P < 0.10$) for animals grazing Moata high herbage allowance (222 g/day) than those grazing pasture high (186 g/day) or Moata medium herbage allowance (176 g/day). The VFI increased in spring to about 2.2 kg DM/day and was not affected by either herbage allowance or the introduction of Moata.

4. Twenty-five percent of animals grazing the Moata high allowance and 17% of those grazing the Moata medium allowance attained the target slaughter LW (92 kg; 50 kg CW) by the end of November, but no animals grazing the pasture allowances attained the target LW by this date.

5. Fifty-six percent of stags immunised against melatonin developed detectable levels of antibody titre. Antibody titres against melatonin were slow to develop, being absent during winter and slowly increasing during spring to attain a mean level of 1:1571 ± 583 by early November. Immunisation against melatonin had no effect on the plasma concentrations of LH, testosterone and prolactin, or upon LWG.

Experiment 2

The effects of two different sward surface heights (5 and 10 cm), using set stocking grazing system; the introduction of Moata (direct drilled into PRG pasture at 20 kg seed/ha, band-sprayed with herbicide) and active immunisation against melatonin (commencing at weaning; 3 months of age) upon LWG and diet selection of weaner red deer stags were studied during winter and spring. Diet selection was determined using complete rumen emptying of rumen fistulated stags.

1. During winter, Moata comprised 46% and 33% of total DM in the 5 cm and 10 cm swards, respectively. During spring these declined to 22% in the Moata 5 cm sward and 19% in the Moata 10 cm sward. The amount of perennial ryegrass and other species in the diet was greater than that in the herbage on offer ($P < 0.001$), however, the diet contained less white clover and Moata than herbage on offer.

2. During winter, the two herbage types on offer (PRG and Moata) had similar OMD of 0.82 and ME of 11.2 MJ/kg DM. During spring these values were also similar for both herbage types, though slightly lower at 0.78 and 10.7 MJ/kg DM for the OMD and ME, respectively. In June and November the OMD and ME for the herbage ingested by both PRG and Moata groups were similar.

3. During winter, herbage accumulation rates in both Moata swards were similar (19 kg DM/ha/day) and higher than either in PRG 5 cm (11 kg DM/ha/day) or PRG 10 cm sward (16 kg DM/ha/day). Consequently, the Moata swards had higher average carrying capacity (14.3 animals/ha/day) than the PRG swards (11.5 animals/ha/day). During spring herbage accumulation rates increased in all swards, with that in Moata swards being similar (41 kg DM/ha/day) but slightly lower than that either in PRG 5 cm (44 kg DM/ha/day) or PRG 10 cm sward (50 kg DM/ha/day). Consequently, the Moata swards had slightly lower average carrying capacity (12.4 animals/ha/day) than the PRG swards (13.4 animals/ha/day).

4. During winter, LWG was greater in weaner stags grazing the 10 cm swards (142 g/day) than those grazing the 5 cm swards (77 g/day; $P < 0.001$), with the introduction of Moata having no effect. During spring, there was an interaction ($P < 0.001$) between sward height and the presence of Moata, with LWG being high on 10 cm swards (222 g/day) and not affected by introduction of Moata. LWG was lower in animals grazing pasture 5 cm sward (147 g/day) and was increased by the presence of Moata ($P < 0.001$), with LWG of the Moata 5 cm group being similar to that of the 10 cm groups (211 g/day). Forty-two-50% of animals grazing the 10 cm swards and 21% of those grazing the Moata 5 cm sward reached the target LW (92 kg) by the end of November, whilst no animal grazing the pasture 5 cm swards attained the target LW.

5. Seventy-three percent of stags actively immunised against melatonin developed detectable levels of antibody titre and this attained highest values (1:613 ± 256) in November. Immunisation against melatonin had no effect on the plasma concentrations of LH and testosterone, however, plasma prolactin concentration was consistently higher in immunised than non-immunised animals with the difference being significant ($P < 0.10$) in October. Active immunisation against melatonin had no effect on either LWG during winter and spring or carcass composition.

Experiment 3

Two immunisation experiments were conducted.

A. The effects of active immunisation against luteinising hormone releasing hormone (LHRH) upon LWG was examined with 10 yearling red deer stags (5 immunised + 5 non-immunised; 90-96 kg LW) during autumn. Yearling stags normally undergo a growth stasis during autumn which includes the rut. Thus, active immunisation against LHRH was examined as a potential means of increasing growth over this period.

1. Eighty percent of stags actively immunised against LHRH developed detectable levels of antibody titre (1:173 - 1:925). Immunisation against LHRH reduced plasma LH concentrations.

2. Yearling stags immunised against LHRH grew faster than the control stags (13 v -54 g/day; $P < 0.05$) during the rut season. However, immunisation had no effect upon carcass weight and slightly lowered carcass dressing-out percentage.

B. The effects of active immunisation against melatonin upon LWG was examined with 15 yearling red deer stags (8 immunised + 7 non-immunised; 90-96 kg LW) during autumn and winter.

1. Seventy-five percent of stags immunised against melatonin developed detectable levels of antibody titre (1:210 - 1:3,167). Plasma concentrations of LH and testosterone were not affected by active immunisation against melatonin. However, plasma prolactin concentration was consistently, but non-significantly, higher in immunised than non-immunised animals.

2. Active immunisation against melatonin had no effect upon either liveweight loss during the rut (-45 v -35 g/day) or the low rate of LWG (46 v 63 g/day) during winter. However, stags immunised against melatonin had lower rump fat width ($P < 0.05$) than the non-immunised stags.

Experiment 4

Studies on the effect of the introduction of Moata (direct drilled into PRG at 24 kg seed/ha, blanket-sprayed with herbicide) and active immunisation against melatonin (commencing at birth) upon VFI, rumen VFA and and ammonia concentration, diet selection and LWG of weaner red deer stags were carried out during winter and spring. Rumen fluid was taken from rumen fistulated stags (RF) and extrusa was collected from oesophageal fistulated stags (OF). VFI was estimated using chromium capsules.

1. Moata annual ryegrass (MAR) comprised an average of 82% of total DM in the direct drilled swards during winter. However, this declined to 65% during spring. Extrusa from OF animals grazing both swards contained less dead matter (Dm; 1.9% and 0.8%) during winter and spring, respectively, than the amounts present in the herbage on offer in winter (6.1%) and spring (13.6%).

2. The OMD of herbage on offer was higher for Moata than PRG during winter (0.86 v 0.80) and spring (0.80 v 0.79), but was similar for herbage ingested (extrusa) by the animals during winter and spring (0.89). ME concentration for both types of herbage on offer and also for extrusa were similar during winter and spring (11.4 and 12.5 MJ/kg DM, respectively).

3. During winter, both Moata and PRG swards supported a similar number of animals/ha/day (8.8 v 8.7). The number of animals/ha/day increased for both sward types during spring, with Moata swards having lower carrying capacity than the PRG swards (16.6 v 23.0).

4. During winter, animals grazing the Moata swards had greater VFI (1615 v 1185 g DM/day; $P < 0.001$) and LWG (165 v 140 g/day; $P < 0.05$) than those grazing the PRG swards. During spring, both the Moata and the PRG groups had similar VFI (1718 v 1762 g DM/day; $P > 0.10$), calculated from individual rectal faecal samples, and similar LWG (235 v 226 g DM/day; $P < 0.10$). Analysis of group faecal samples showed greater VFI, with the Moata group being similar to the PRG group (2570 v 2318 g DM/day; $P > 0.10$). Sixty percent of animals grazing Moata swards and 40% of those grazing PRG swards attained the slaughter LW of 92 kg by 12 months of age. The Moata group had greater carcass dressing-out percent than the PRG group (53.8 v 52.6; $P < 0.05$).

5. There was no significant difference ($P > 0.10$) in the concentration of total VFA in the rumen fluid of animals grazing Moata swards (94.7 m mol/l) and those grazing PRG (89.2 m mol/l). Acetate/propionate ratio for both groups were similar (3.56 v 3.70). However, ammonia concentration was lower in the Moata group (133.8 mg N/l) than the PRG group (188.0 mg N/l).

6. Seventy-five percent of stags immunised against melatonin developed detectable levels of antibody titre. Commencing active immunisation against melatonin at birth resulted in the development of high mean antibody titres (1:15,215 ± 5,551) for animals immunised using Freund's adjuvant and (1:1,941 ± 423) for those immunised using DEAE-dextran adjuvant. Active immunisation against melatonin had no effect on the plasma concentrations of LH and testosterone. Plasma prolactin levels were consistently higher in the immunised animals than the non-immunised animals. The DEAE-dextran group had greater plasma prolactin levels than the control group in mid May and early November ($P < 0.05$; 0.10, respectively). Active immunisation against melatonin had no effect on carcass composition. However, the Freund's immunised group had heavier testes than the control group ($P < 0.10$).

Conclusions

Grazing deer on pasture at 5 cm sward surface height as is normally practised with sheep reduced their growth rate, hence no stags grazing PRG 5 cm swards attained slaughter LW of 92 kg by 12 months of age. However, grazing weaner stags on ryegrass, especially Moata at 10 cm sward surface height (high DM allowance) can provide a means of finishing a high proportion of weaner stags in their first year. To further enhance the success rate of early venison production programmes, there is a need for further studies in the development of alternative pasture types for summer and autumn grazing for deer, e.g. red clover, chicory and lucerne. Increased weaning liveweights from grazing these pastures would result in heavier stags as starting material for the early venison production programmes in winter.

Peak antibody titre against melatonin is slow to raise in the deer. With commencing active immunisation against melatonin at birth, antibody titre peaked about 11 months later. Therefore, the timing of immunisation programmes and the choice of appropriate adjuvants to generate early optimum immune responses and sustained antibody titres over a long period of time, needs further study.

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ARH-291	Anti-melatonin vaccine (5-methoxy-tryptamine hemisuccinamide: Human serum albumin conjugate)
CW	Carcass weight
c.v.	coefficient of variation
CRD	Controlled release device
Cr	Chromium
Cr_2O_3	Chromium sesquioxide
C.S.I.R.O.	Commonwealth Scientific and Industrial Research Organisation
cv	Cultivar
d	day
DEAE-dextran	Diethylaminoethyl dextran
DLWG (LWG)	Daily liveweight gain
Dm	Dead matter
DM	Dry matter
DMI	Dry matter intake
DOMD	Digestible organic matter digestibility
DSP	Deer slaughter premises

E	Expected plasma prolactin concentration
FCA	Freund's complete adjuvant
FIA	Freund's incomplete adjuvant
FO	Faecal output
G	Guage
GH	Growth hormone
GHRH	Growth hormone releasing hormone
GIB	New Zealand Game Industry Board
GLM	General linear models procedure
GR	Tissue depth over the 12th rib, 16 cm from the mid line
ha	Hectare
HCl	Hydrochloric acid
HSA	Human Serum Albumin
IGF-1	Insulin-like growth factor-1
i.m.	Intramuscular
IR	Internal recovery rate
i.v.	Intravenous
$kg^{0.75}$ ($LW^{0.75}$)	Metabolic liveweight

L	litre
LH	Luteinizing hormone
LHRH	Luteinizing hormone releasing hormone
LSM	Least squares means
LW	Liveweight
LWG	Daily liveweight gain
MAR	Moata annual ryegrass
M/D	Nutritive value
ME	Metabolisable energy
MEI	Metabolisable energy intake
MJ	Megajoule
MR	Maintenance requirements
N	Nitrogen
Na	Sodium
NaCl	Sodium chloride
NH_3	Ammonia
NHPP	National Hormone and Pituitary Programme
NIADDK	National Institute of Arthritis, Diabetes, Digestive and Kidney Diseases