Nutritional, Genetic and Meat Quality Aspects of Once-Bred Heifer Beef Production Systems in New Zealand

A thesis presented in partial fulfilment of the
requirements for the degree of
Doctor of Philosophy
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"In the Name of Allah, Most Gracious, Most Merciful"

ERRATA

Page	Paragraph	Line	Correct	Incorrect
i	2	3	"was"	"were"
vii	1	1	"BEHAVIOUR"	"BEAHVIOUR"
7	2	6	"beef cows reared few calves and"	"beef cows and"
30	1	1	"practised"	"practiced"
33	2	7	"inseminated with"	"mated to"
36	3	1	"the daily faecal output (FO)"	"the daily (FO)"
50	Table 2.5	9	"349.5"	"449.5"
59	1	4	"4 h or 28 h"	"4 h or 24 h"
61	3	7	"sides"	"slides"
82	2	3	"does"	"dose"
83	1	16	"liveweight"	"liveweigt"
85	1	4	"anoestrous"	"anoestrus"
86	1	7	"oestrous"	"oestrus"
101	Table 4.3	9	"number of animals 13, 7, 12, 8"	"12, 8, 11, 9"
101	Table 4.3	14	"number of animals 11, 7, 10, 8"	"10, 8, 10, 8"
101	Table 4.3	22	"number of animals 13, 7, 12, 8"	"12, 8, 11, 9"
102	Table 4.4	10	"number of animals 13, 7, 12, 8"	"12, 8, 11, 9"
102	Table 4.4	15	"number of animals 11, 7, 10, 8"	"10, 8, 10, 8"
102	Table 4.4	23	"number of animals 13, 7, 12, 8"	"12, 8, 11, 9"
103	2	1	"None of the heifers"	"None of heifers"
110	2	7	"oversease"	"overseas"
111	3	4	"were"	"was"
114	2	2	"weaning heifers at"	"weaning heifers of"
114	4	2	"herbage is"	"pastures are"
121	2	8	"oestrous"	"oestrus"
134	2	14	"difference"	"differences"
142	2	3	"oestrous"	"oestrus"
143	Table 6.1	9	"oestrous"	"oestrus"
144	2	1	"basis for"	"basisfor"
150	Table 6.2	5,6	".. the gross margin would increase (e.g. by $5.74 to $47.42/SU for 3-month-old early-weaned heifers, see below)."	".. the gross margin (e.g. for 3-month-old early-weaned heifers, see below) would increase by $5.74 to $47.42/SU"
151	1	2	"$1-2/SU"	"$2-4/SU"
163	3	2	"use"	"sue"
186	2	1	"Roberts, J.S. 1986"	"*Roberts, J.S. 1986*"
195	Table All.1	14	"1.28"	"0.28"
195	Table All.1	18	"(±0.34)"	"(0.81)"
195	Table All.1	19	"(±0.35)"	"(1.05)"

ABSTRACT

Khadem, A.A. 1994: Nutritional, Genetic and Meat Quality Aspects of Once-Bred Heifer Beef Production Systems in New Zealand.

Issues related to the nutrition, management, carcass and meat quality traits, and the profitability of "Once-Bred Heifer" (OBH) beef production systems under New Zealand pastoral conditions were investigated in this research programme. Once-bred heifer beef production systems involve surplus heifers from the dairy industry which are mated to beef sire breeds at about 15 months of age and rear their calves for 3-6 months before being slaughtered at 30-32 months of age. Both the heifer dams and their progeny are thus prime meat-producing animals.

The performance of once-bred v. unbred heifers and of early-weaned (EW) heifers (heifers weaned at day 84 of lactation "L84") v. normal-weaned (NW) heifers (heifers weaned at L147) were studied in the first two trials. In the third trial, Hereford x Friesian (H x F) v. Simmental x Friesian (S x F) heifers offered a restricted herbage allowance (RHA, an allowance to maintain weight) v. normal herbage allowance (NHA, an allowance to grow at 0.6-0.7 kg/d) during mid pregnancy (from pregnancy day 114, "P114", to P214) were studied in an attempt to investigate the effects of dam genotype and prior herbage allowance on the performance of heifer dams (growth rate, reproduction and carcass and meat quality traits) and their progeny (growth rate and weaning weights). A gross margin analysis was also performed to evaluate the profitability of alternative OBH beef production systems.

Once-bred v. unbred Hereford x Friesian heifers consumed similar amounts of herbage organic matter (OM) during the period equivalent to late pregnancy of the former group (4.72 v. 5.15 kg OM/hd/d), but lactating heifers consumed more herbage OM than the comparable unbred group (11.36 v. 9.19 kg OM/hd/d, $P < 0.05$) to support the growth of their calves, as well as themselves. Unbred heifers had greater carcass weights and higher dressing-out percentages than once-bred heifers. However, the differences in other carcass and meat quality traits between the heifer groups were small, indicating that once-bred heifers are capable of producing meat comparable in

quality to that of unbred and empty heifers. Higher gross margins ($5-10/Stock Unit (SU)) were calculated for once-bred v. unbred heifers.

During the 10 days immediately prior to weaning, NW heifers had organic matter, dry matter and energy intakes which were slightly higher ($P < 0.10$) than those of EW heifers (weaned at L84). Weaning caused a slight weight loss in both early- and normal-weaned heifers for the first 30-45 days post-weaning, but liveweight (LW) was recovered after this period. During L84 - L147, EW heifers had a higher daily liveweight gain (LWG) than NW heifers (0.79 v. 0.51 kg/d, $P < 0.01$). Calves weaned at L84 had significantly lower daily LWG than NW calves during the period L84 - L147 (0.73 v. 1.30 kg/d, $P < 0.001$). This resulted in EW calves being 30 kg lighter ($P < 0.001$) than NW calves at the time of weaning for the latter group. Early-weaned heifers reached the target slaughter weight in March and, overall, had slightly better carcass and meat quality characteristics than those of the normal weaned group. Although similar gross margins were calculated for EW ($41.68/SU) v. NW ($42.00/SU) heifers, early weaning offers advantages to OBH beef production systems through increased flexibility of grazing management and selling times for animals.

From P114 until P214, NHA heifers had significantly ($P < 0.001$) higher growth rates (0.72 ± 0.03 kg/d) than the RHA group (0.16 ± 0.02 kg/d). This resulted in a higher LW in NHA heifers at P214 ($P < 0.001$) and P270 ($P < 0.01$) than the RHA heifers. Gestation length, calving score, LW loss at calving and calf birth weight were not affected by dam genotype (Hereford x Friesian v. Simmental x Friesian) or prior herbage allowance. Meat quality traits were not affected by dam genotype, but it was concluded that the use of Simmental x dairy heifers in a OBH beef production system increases carcass weights of heifer dams in comparison to those of heifers derived from traditional British beef x dairy animals. However, gross margins were similar for H x F and S x F heifer groups indicating that little incentive would exist for dairy farmers to use sires of the large European breeds (e.g. Simmental) rather than Hereford sires which are commonly used to mate first-calving heifers in the dairy industry.

The results are discussed in the context of the development of once-bred heifer beef production systems in New Zealand.

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LIST OF ABBREVIATIONS

AFFCO	Auckland Farmers' Freezing Company
L, P, K, G & T	Carcass grades with 1-3, 4-7, 8-12, 13-18 and 19-24 millimeters of subcutaneous fat thickness over the fourth quarter of the eye muscle at the twelfth rib, respectively, based on the New Zealand export beef classification system.
AI	Artificial Insemination
AS	Angus-Sired
CS	Charolais-Sired
Cr_2O_3	Chromic Oxide
CIDR	Controlled Internal Drug Releasing Device
CRC	Controlled Release Capsule
CSH	Compressed Sward Height
cm	centimeter(s)
c.	circa (approximately)
d or D	day(s)
L50	day 50 of Lactation
P260	day 260 of Pregnancy
°C	degree(s) Celsius
DO%	dressing-out percentage(s)
DM	Dry Matter
DMI	Dry Matter Intake
DOMD	Digestible organic matter in dry matter herbage
EW	Early-Weaned
FO	Faecal Output
g	gram(s)
hd	head
ha	hectare(s)
H x F	Hereford x Friesian
H	Height
h	hour(s)
HFRO	Hill Farming Research Organisation
IY	Initial yield
I	Intake
kg	Kilogram(s)
LS	Limousin-Sired
Ltd	Limited
LW	Live Weight
LWG	Live Weight Gain
LD	*longissimus dorsi* muscle
MAF	Ministry of Agriculture & Fisheries
ME	Metabolisable Energy
MJ	Megajoules

µm	micrometer(s)
mW	micro Wave length
mg	milligram(s)
ml	milliliter(s)
mm	millimeter(s)
mM	millimolar
m	minute(s)
N.R.C.	National Research Council
nm	nanometer
NZ	New Zealand
NHA	Normal Herbage Allowance
NW	Normal-Weaned
OBH	Once-Bred Heifer(s)
OM	Organic Matter
OMI	Organic Matter Intake
OMD	Organic Matter Digestibility
PF	Peak Force
%	percentage
KCl	Potassium Chloride
R630	Reflectance at a wavelength of 630 nanometer
WL	wave length
RHA	Restricted Herbage Allowance
S x F	Simmental x Friesian
cm^2	square centimeter(s)
m^2	square meter(s)
SSH	Sward Surface Height
TDN	Total Digestible Nutrients
L^*, a^* & b^*	the brightness, redness and yellowness, respectively, of meat colour measured by Minolta Chroma Meter II, Minolta Camera Co., Meter Division, Ramsey, NJ, U.S.A.
v.	versus
WB	Warner-Bratzler
WHC	Water Holding Capacity (expressed juice)
W	Width
Statistical terms	
r	correlation coefficient
PSE	Pooled Standard Error of the Mean
SE	Standard Error
SEM	Standard Error of the Mean