EFFECT OF DIFFERENCES IN LIVE WEIGHT ON FEED REQUIREMENTS OF PREGNANT NON-LACTATING GRAZING DAIRY COWS

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EFFECT OF DIFFERENCES IN LIVE WEIGHT ON FEED REQUIREMENTS OF PREGNANT NON-LACTATING COWS.

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ABSTRACT

The effect of differences in live weight (LW) on feed requirements of pregnant non-lactating cows was assessed during a 41-day grazing experiment. Thirty eight dry pregnant Friesian and Jersey cows (28 Friesian cows differing in live weight and 10 Jerseys) at similar stages of pregnancy (range 190 to 230 days pregnant) and averaging 5.8 years of age were used. The cows were grouped according to their initial LW in three size-groups, i.e. Big Friesians (BF; n=14, LW = 526 kg), Small Friesians (SF; n=14, LW = 415 kg) and Jerseys (J; n=10, LW = 362 kg). Within each size-group the cows were randomly allocated to one of two levels of daily herbage dry matter (DM) allowance (HA), calculated to meet either maintenance and pregnancy (i.e. HA of 7.7 to 11.0 kg DM/cow/day), or the gain of 1 kg of maternal live weight above maintenance and pregnancy (i.e. HA of 17.1 to 22.5 kg DM/cow/day).

The cows provided individual records of their daily liveweight gain (LWG, kg/cow), total liveweight gain (ΔLW) and total condition score change (ΔCS) achieved during the 41-day experimental period. Group average herbage dry matter intake (DMI) and herbage DM allowance were calculated for each treatment group from herbage mass (HM) assessed by cutting-washing-drying and weighing, and by means of two calibration equations, one for each level of feeding, relating HM to the average of 30 plate meter readings (PMR) taken every day before and after grazing. These two calibration equations were:

(1) for the *ad libitum* level of feeding:
HM (kg DM/ha) = 764.0 (*s.e.* 212.0) + 158.0 (*s.e.* 12.7) * PMR
(r = 0.98; CV = 24%; r.s.d. = 548 kg DM), and

(2) for the maintenance fed cows:
HM (kg DM/ha) = 171.0 (*s.e.* 3.5) * PMR
(r = 0.98; CV = 21.6%; r.s.d. = 442 kg DM).

The energy content of the herbage (MJ ME/kg DM) apparently grazed by the cows and their metabolizable energy intake (MEI) were calculated from the *in vitro* digestibility analyses of pasture samples plucked randomly from each of the grazing areas. Least squares means were calculated for group average herbage dry matter intake (DMI), herbage DM allowance (HA), metabolizable energy intake (MEI), and for the variables derived from the animals' performance (ΔLW, LWG, ΔCS) and differences between levels of feeding and size-groups were tested for significance using analysis of variance.

Differences in average live weight between the three size-groups were highly significant ($P<0.001$) throughout the experimental period (i.e. BF = 552 kg; SF = 442 kg; J = 377 kg). Heavier cows had: (1) significantly higher daily herbage DM allowances (BF, 16.7; SF, 14.4; J, 12.4 kg/cow/day); (2) higher daily DMI (BF, 10.2; SF, 8.6; J, 7.5 kg/cow/day); (3) higher MEI (BF, 117; SF, 100; J, 87 MJ/cow/day), and (4) lower stocking densities (BF, 240; SF, 262; J, 305 cows/ha/24 hours). However, when HA, DMI and MEI where expressed on a metabolic weight basis, none of these variables were significantly different between the three size-groups.

From the least squares means of LWG, ΔCS, DMI and MEI calculated for each treatment group, feed requirements for zero ΔCS or maintenance (i.e. ME_m) and feed requirements for ΔCS were calculated by means of linear regression analyses. The ME_m calculated pooling the three size-groups was 0.648 MJ ME/$LW^{0.75}$/day for zero ΔCS; and an average intake of 167 kg DM or 1986 MJ ME/cow above maintenance was required for the gain of one condition score unit/cow during the 41 days of experimental period, which was equivalent to a total liveweight change of 52.7 kg/cow. From these estimates it was calculated that cows heavier by 100 kg required an extra intake for maintenance of 10.5 MJ ME/cow/day or about 0.95 kg herbage dry matter intake/cow/day. The results of the present experiment were used to assess the effect of farming large-size cattle on the productive efficiency of pasture-based dairy systems.

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□	Group of Big Friesian cows fed at maintenance.
■	Group of Big Friesian cows fed *ad libitum*.
◊	Group of Small Friesian cows fed at maintenance.
♦	Group of Small Friesian cows fed *ad libitum*.
✲	Group of Jersey cows fed at maintenance.
★	Group of Jersey cows fed *ad libitum*.
>	Greater than.
*	Significant at $P<0.05$.
**	Significant at $P<0.01$.
***	Significant at $P<0.001$.
α	Constant term of simple or multiple regression equations.
4% FCM	4% Fat corrected milk yield (kg).
b	Linear regression coefficient.
BF	Big Friesian cows.
B_i	Partial regression coefficient.
BI	Breeding index.
ΔCS	Total condition score change (CS units/cow/41 days experiment).
ΔLW	Total liveweight change (kg/cow/41 days experiment).
C.V.	Coefficient of variation (%).
CF	Correction factor for the recovery rate of the indigestible marker.
CP	Crude protein (%).
Cr_2O_3	Chromium oxide.
CRC	Controlled release chromium capsule.
CSG	Condition score gain (CS units/cow/day).
D	Herbage digestibility (%).

d	days.
DCP	Digestible crude protein (%).
DE	Digestible energy (MJ/kg DM).
DM	Dry matter (%).
DMD	Dry matter digestibility (%).
DMI	Dry matter intake (kg/cow/day).
DOMD	Digestible organic matter expressed as a proportion of the DM.
e	Base of the natural logarithm.
EB	Energy balance.
EEI	Estimated energy intake (MJ/day).
ENE	Estimated net energy intake (Mcal/day).
EV_g	Energy value of the gain (MJ/kg).
FCS	Final condition score (CS units/cow).
FEI	Feed energy intake (MJ/day).
FHP	Fasting heat production (MJ/day).
FLW	Final live weight (kg/cow).
FM	Fasting metabolism (MJ/cow/day).
FO	Faecal output.
FPCM	Fat and protein corrected milk yield (kg).
FU_m	Feed units for maintenance.
FW	Fasted live weight (kg).
g	Grams.
GE	Gross energy.
GBF	Big Friesians fed *ad libitum*.
GFE	Gross feed efficiency (%).
GJer	Jersey cows fed ad libitum.
GSF	Small Friesians fed *ad libitum*.
h^2	Heritability (%).

ha	hectare.
HA	Herbage allowance (kg DM/cow/day).
HM	Herbage mass (kg DM/ha).
$HM^{f,e}$	Herbage mass measured in exclosure areas (kg DM/ha).
hr	Hour.
I	Intake.
ICS	Initial condition score (CS units/cow).
ILW	Initial live weight (kg/cow).
J	Jersey cows.
kg	kilogram.
k_g	Efficiency of utilization of ME for growth and fattening (%).
$k_{g(l)}$	Efficiency of utilization of ME for body tissue deposition when the cow is lactating (%).
k_l	Efficiency of utilization of ME for milk and tissue energy deposition (%).
km	Kilometre.
k_m	Efficiency of utilization of ME for maintenance (%).
k_p	Efficiency of utilization of ME for pregnancy (%).
k_{p1}	Efficiency of utilization of ME for the synthesis of uterine tissue and uterine contents (%).
k_{p2}	Efficiency of utilization of ME for oxidation due to pregnancy (%).
k_{p3}	Efficiency of utilization of ME for foetal maintenance and increased maternal fasting metabolism due to pregnancy (%).
LW	Live weight.
$LW^{0.75}$	Metabolic weight.
LWG	Liveweight gain (kg/cow/day).
M/D	Energy concentration of the pasture (MJ ME/kg DM).
MBF	Big Friesian cows fed at maintenance.
Mcal.	Megacalories.
ME	Metabolizable energy (MJ/kg DM).
MEA	Metabolizable energy allowance (MJ).
ME_g	Metabolizable energy intake for liveweight gain (MJ/day).

MEI	Metabolizable energy intake (MJ/cow/day).
MEI	Metabolizable energy intake (MJ).
ME_m	Metabolizable energy for maintenance (MJ/$LW^{0.75}$/day).
ME_p	Metabolizable energy for pregnancy (MJ/day).
ME_Y	Metabolizable energy used for milk yield.
MF	Milkfat (kg).
MJ	Megajoules.
MJer	Jersey cows fed at maintenance.
MLWG	Maternal liveweight gain (kg/cow/day).
MSF	Small Friesian cows fed at maintenance.
N	Nitrogen (%).
NE_g	Net energy of the gain made (MJ/kg liveweight gain).
NE_p	Net energy for pregnancy (MJ/day).
N_{p1}	Net energy stored in uterus and the uterine contents (MJ/day).
N_{p2}	Net energy lost as 'Heat increment of gestation' (MJ/day).
N_{p3}	Net energy for foetal maintenance and the increased maternal fasting metabolism due to pregnancy (MJ/day).
OMD	Organic matter digestibility (%).
P	Protein content of the organic matter (g/kg).
PHM	Pre-grazing herbage mass (kg DM/ha).
q	Metabolizability [i.e. (DE/ME)*100].
qL	Metabolizability determined at any level of feeding.
qm	Metabolizability determined at a maintenance level of feeding.
r	Repeatability (%).
r	Correlation coefficient.
r.s.d.	Residual standard deviation.
r^2	Coefficient of determination.
RHM	Post-grazing or residual herbage mass (kg DM/ha).
RR	Recovery rate of the indigestible marker in faeces (%).

S.D.	Standard Deviation.
s.e.	Standard error.
SF	Small Friesian cows.
t	Day of gestation.
t	tonne.
TDN	Total digestible nutrients (%).
TEG	Tissue energy gain (MJ/day).
TEL	Tissue energy loss (MJ/day).
W_0	The amount of component of tissues of pregnancy at day zero of gestation.
W_t	The amount of component of tissues of pregnancy at day t of gestation.
Y_E	Energy deposited as milk (MJ/day).
$Y_{E(C)}$	Energy deposited as milk, adjusted by positive (TEG) or negative (TEL) tissue energy change.

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