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BRIEF COMMUNICATION: Efficiency of crude protein utilization and milk urea nitrogen content in Friesian, Jersey and crossbred cows milked once daily

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Introduction

For the last two decades, the New Zealand dairy industry has intensified its milk production through the inclusion of feed supplements and the increasing use of nitrogen (N) fertilizer (Di & Cameron 2000). Increasing N losses from these systems, mainly from urine (Li et al. 2012), can negatively impact the environment. Cow N utilization efficiency can play a role in mitigating this negative effect (Woodward et al. 2011).

Milking cows once a day (OAD) throughout the entire season has been adopted by Massey University Dairy 1 Farm since July 2013 with a mixed breed herd of Holstein-Friesian (F), Jersey (J) and F×J crossbred cows. This publication describes the content of urea in milk (MUN) and provides estimates of the efficiency with which protein in feed offered is converted into milk protein during the first 160 days of lactation, in all breeds.

Materials and methods

Dairy 1 Farm is located in Palmerston North with a herd of 66 F, 138 F×J and 54 J milked every day at 6.30 a.m. Cows started calving in July 2016 and had access to fresh ryegrass (*Lolium perenne*)/white clover (*Trifolium repens*) pastures every day and only in August cows received 3.5 kg of pasture silage per animal. In December cows had daily access for three hours to a mixed-herb crop comprising chicory (*Cichorium intybus*), red clover (*Trifolium pratense*) and plantain (*Plantago lanceolata*).

Pasture cover measurements were recorded pre- and post-grazing with three sets of 50 rising plate meter measurements following a 'W' pattern across the grazing area. Pasture and supplementary feed offered within 18-24 hours prior to each monthly herd-testing date was sampled and analysed to estimate the content of metabolisable energy (ME) and crude protein (CP) using near infrared reflectance spectroscopy analysis at the Nutrition Laboratory of Massey University.

Daily live weight (LW) records were collected by an automatic walkover system, and monthly herd-test for daily milk yield (MY), fat and protein percentages and somatic cell counts (SCC) were collected for each cow using the routine herd-testing service. Body condition score (BCS) (scale 1 to 10) was assessed in synchrony with each herd test. Additionally, milk samples from each cow were taken in September and December for determination of MUN content using the service provided by MilkTestNZ (Hamilton, NZ).

Lactation curves for MY, fat (FY), protein (PY) and milksolids (MSY; FY+PY) yields, somatic cell score (SCS calculated as $SCS=\log_2(SCC)$) and LW were modelled using random regression models with Legendre polynomials of 3rd order, with the MIXED procedure of the Statistical Analysis System version 9.4 (SAS Institute Inc., Cary, NC, USA). Predicted daily values of LW, MY, FY and PY for each day and cow were obtained from the polynomial function for each cow. These predicted daily values allowed calculation of estimations of DM intake (DMI) based on the total ME requirements for maintenance, production and LW change (AFRC 1993) divided by the ME content of the feed consumed. Crude protein intake (CPI) was calculated from total DMI and the CP content of the feed offered. Efficiency of crude protein utilization was calculated as $ECPU=(PY/CPI)\times100$.

Least-squares means for the variables studied were obtained with a linear model that included the effects of breed, lactation number, interaction between breed and lactation number, and deviation from median calving date as a covariate.

Results and discussion

Accumulated milk yield from calving in July to 21 Dec 2016 was greater for F followed by F×J and J cows ($P<0.05$) (Table 1). There were no significant differences among breeds for FY, SCS or BCS. Protein yield was 14% lower in J than in the other breeds. Friesian cows were 34 kg heavier than F×J, and 107 kg heavier than J ($P<0.05$). These results are consistent with those of Lembeye et al. (2014) using the same cows in previous seasons.

The averages contents of ME and CP of the diet offered to the cows during this period were 11.5 MJ/kg DM and 18.4% of the DM, respectively. The ECPU was 26.5%, which is numerically greater than those of Pacheco et al. (2007) for cows milked twice a day in New Zealand conditions. However, the diets reported by Pacheco et al. 2007 were grass-only and with a greater content of CP in the DM (21-25%), which may explain the higher value of ECPU observed in this study. Although no significant differences in ECPU were found among the three breeds,

Table 1 Means and standard errors of days in milk (DIM), accumulated yields of milk (MY), fat (FY), protein (PY) and milksolids (MSY), somatic cell score (SCS), live weight (LW), body condition score (BCS), metabolizable energy intake (MEI), DM intake (DMI), crude protein intake (CPI), efficiency of crude protein utilization (ECPU) and milk urea nitrogen (MUN) in Friesian (F), crossbred (F×J) and Jersey (J) cows during the first 160 days of lactation under once a day milking at Massey University Dairy 1.

	Breed		
	F	F×J	J
n	66	138	54
DIM (days)	134.9 ± 0.2	134.5 ± 0.1	135.0 ± 0.2
MY (kg)	2,647 ± 49[a]	2,490 ± 37[b]	1,993 ± 58[c]
FY (kg)	123.0 ± 2.0	122.7 ± 1.5	117.9 ± 2.4
PY (kg)	99.1 ± 1.7[a]	96.1 ± 1.3[a]	84.1 ± 2.0[b]
MSY (kg)	222.4 ± 3.5[a]	219.0 ± 2.7[a]	202.3 ± 4.2[b]
SCS[d]	5.55 ± 0.17	5.33 ± 0.13	5.05 ± 0.20
LW (kg)	514 ± 5[a]	480 ± 4[b]	407 ± 6[c]
BCS	4.64 ± 0.04	4.65 ± 0.03	4.74 ± 0.05
DMI (kg/day)	15.5 ± 0.1[a]	15.0 ±0.1[b]	3.3 ± 0.2[c]
CPI (kg/day)	2.83 ± 0.03[a]	2.74 ± 0.02[b]	2.44 ± 0.03[c]
ECPU (%)	26.2 ± 0.2	26.5 ± 0.2	26.0 ± 0.3
MUN (mg/dL milk)	23.5 ± 0.55[a]	22.4 ± 0.43[ab]	21.3 ± 0.65[b]

[a, b, c] Means with different superscripts in the same row are significantly different (P<0.05). [d]SCS is calculated as the log base 2 of SCC, where SCC is somatic cell count per millimiter. BCS on a 1-10 scale.

ECPU was significant when considering lactation effect. The lowest ECPU was in first-lactation cows with these animals performing 3.2% less efficiently than multiparous cows (P<0.05). Possibly, first-lactation cows have different maintenance requirements and partition more nutrients towards growth rather than to milk production (Clark et al. 2006). The DMI and CPI were also both lower (P<0.05) for first-lactation cows.

The MUN levels averaged 22.3 mg/dL with significant differences (P<0.05) between breeds; F cows had higher MUN levels than J cows, but F×J had MUN level in between F and J. Additionally, CPI was also lowest in J cows (P<0.05).

This study reports new ECPU figures for cows milked OAD. Given that first-lactation cows have lower ECPU, a stabilised full-lactation OAD herd might have lower N losses due to a decrease in replacement rate.

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