BRIEF COMMUNICATION: Milk production, live weight, body condition and somatic cell score during the first 150 days of lactation in Friesian, Jersey and crossbred cows milked once daily

F Lembeye[a*], N Lopez-Villalobos[a], JL Burke[a] and SR Davis[b]

Institute of Veterinary, Animal and Biomedical Sciences, Massey University, Private Bag 11222, Palmerston North 4442, New Zealand; [b]LIC, Private Bag 3016, Hamilton 3240, New Zealand
**Corresponding author. Email: F.Lembeye@massey.ac.nz*

Keywords: Milking frequency; lactation curves; gross efficiency

Introduction

Pasture-based dairy farming in New Zealand has predominately been with cows milked twice a day (TAD). However, since the last decades, milking once a day (OAD) has been adopted by some farmers in New Zealand for herd management and lifestyle benefits (Davis 2005).

A challenge for the dairy industry is to develop systems that have a low impact on the environment, and to an attempt to evaluate this goal, on July 2013 No. 1 dairy farm of Massey University changed from TAD to OAD milking with the feeding system based mainly on pasture. The long term plan for breed composition of the herd is to have 80 Friesian (F), 80 Jersey (J) and 80 F×J crossbreds.

The economic viability of OAD systems, however, remains uncertain due to decreases in milk production (Clark et al. 2006). In this sense, traits related to efficiency are critical to economical profitability (Davis 2005). A measurement of gross efficiency (GE) used in grazed dairy systems is the proportion of milk and milk solids yield per 100 kg of live weight (Prendiville et al. 2009) and could be a useful measure for cows in an OAD system.

The objective of the present study was to compare the yield of milk (MY) and milk solids (MSY), average somatic cell count (SCC), live weight (LW), body condition score (BCS) and GE of cows of three different breed groups milked OAD for the first 150 days of lactation.

Materials and methods

Records from 46 F, 40 J and 84 F×J spring calving cows lactating between July 2013 and January 2014 were used in this study. The averages breeding worth (BW) were 120.0 for F, 127.2 for J and 118.3 for FxJ cows. The other cows in the herd were autumn calving and were not considered in this comparison. Monthly herd tests of milk traits (daily MY, fat percentage and yield, protein percentage and yield and SCC; 728 records), LW (698 records) and BCS (560 records) were used. Somatic cell count was transformed to somatic cell score (SCS) calculated as $SCS=\log_2(SCC)$.

Lactation curves were modelled using a three order Legendre polynomial considering Y_t as the level of production of a trait *i* measured on day (t) of the lactation from calving, The polynomial was defined as: $Y_t = \alpha_0 \cdot P_0 + \alpha_1 \cdot P_1 + \alpha_2 \cdot P_2 + \alpha_3 \cdot P_3$; where α_i are the regression coefficients to be estimated for each trait. The Legendre polynomial's functions of P_j were calculated as:

$P_0(t) = 1, P_1(t) = x, P_2(t) = \frac{1}{2}(3x^2 - 1)$

$P_3(t) = \frac{1}{2}(5x^3 - 3x)$ where $x = -1 + 2 \cdot \frac{(t - t_{min})}{(t_{max} - t_{min})}$

(Kirkpatrick et al. 1990).

Accumulated yields of milk, fat and protein for each cow were estimated using the polynomial equation as the sum from day 1 to maximum days in milk. Gross efficiency was calculated as accumulated MSY per 100 kilograms of LW. Least-square means for each breed group were obtained from a linear model that included the fixed effect of breed group, and lactation number and days from median calving date of the herd as covariates. A mixed model for repeated measures was used to estimate the least-squares means for SCS, BCS and LW during the lactation. The model included the fixed effect of the stage of lactation (SL) (SL_1:< 30; SL_2: >30 and <60; SL_3: >60 and <90, and SL_4: >90 days in milk) and breed group, lactation number and days from median calving date as covariates, and the random effect of cow to account for repeated measures on the same cow.

Results and discussion

The accumulated MY was significantly greater for F followed by F×J and J cows; however, there was no difference in MSY among breeds. The results expressed relatively to J, indicate that F and F×J cows had 31.0 and 12.9% more accumulated MY from calving to mid lactation (Table 1). These findings are consistent with Heins et al. (2008), who reported similar accumulated fat and protein yields at 147 days in F and F×J cows despite higher MY by F cows during the same period in a TAD system (MY: 4,644 and 4,338 kg; MSY: 302 and 309 kg, in F and F×J, respectively).

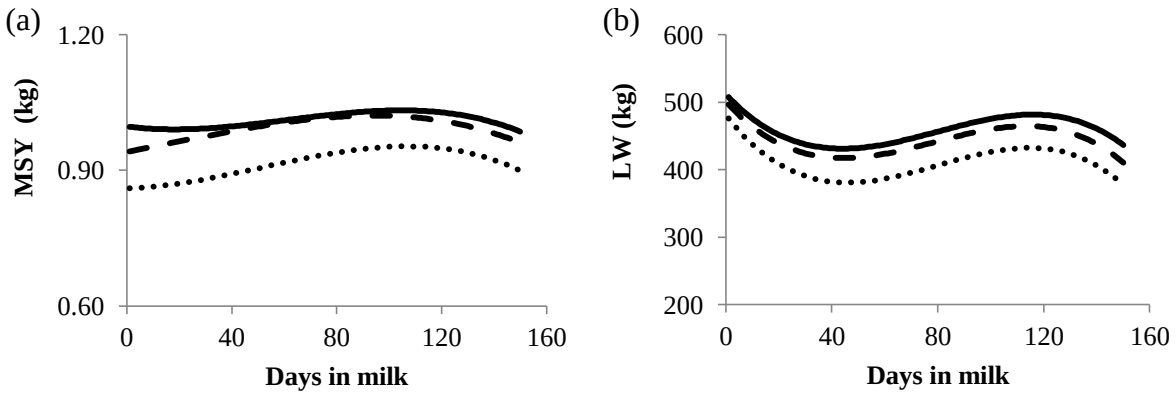
There is no clear evidence of a superior breed to be used for OAD milking in New Zealand, but there is evidence of a large variation in MSY between cows when they are changed from TAD to OAD (Stelwagen et al. 2013). In a four-year experiment, Clark et al. (2006) observed that J cows lost the least MS

Table 1 Means and standard errors of days in milk (DIM), somatic cell score (SCS), live weight (LW), body condition score (BCS), accumulate milk yield (MY), fat yield (FY), protein yield (PY) and milk solids yield (MSY), and gross efficiency (MSY/100 kg of LW) of Friesian, Jersey and Friesian×Jersey crossbred cows during first 150 days of lactation under once a day milking at Massey University No. 1 dairy farm.

	Friesian	Jersey	Crossbred
DIM (days)	123.4±2.0	123.5±1.9	121.8±1.3
MY (kg/cow)	2455±68[a]	1874±64[c]	2115±44[b]
FY (kg/cow)	108.4±3.2	106.8±3.0	109.8±2.1
PY (kg/cow)	87.7±2.6[a]	77.7±2.4[b]	81.8±1.7[a]
MSY (kg)	194.5±5.5	183.1±5.2	190.6±3.6
SCS	6.06±0.07	6.14±0.07	6.09±0.05
LW (kg)	504±6[a]	437±7[b]	483±4[c]
kg MSY/100 kg of LW	38.5±1.16[a]	41.9±1.09[b]	39.5±0.75[a]
BCS	4.27±0.07[a]	4.06±0.07[b]	4.42±0.05[c]

[a, b, c] Means with different superscripts in the same row are significantly different (P<0.05). BCS on a 1-to-10 scale

Figure 1 Predicted milk solids (MSY) (a) and live weight (LW) (b) from calving to 150 d of lactation of Friesian (——), Jersey (·····) and Friesian×Jersey crossbred (– –) cows under once a day milk at Massey University No. 1 dairy farm.



production by OAD milking than F cows in a pasture-based dairy system. They also found a greater variability between F cows milked OAD compared to F cows milked TAD and J cows milked either OAD or TAD.

The three breed groups studied here had similar average of SCS. The values presented for SCS in Table 1 are equivalent to a SCC of approximately 65,000 to 70,000 cells/ml, substantially lower than the national average SCC (LIC and Dairy NZ 2013).

In this study, F and F×J cows were, 66 and 46 kg heavier, respectively than J cows. This difference between breeds is lower than the observed using the national average LW data. The average LW for F, F×J and J breeds in season 2012-2013 were, respectively: 468, 434 and 376 kg (LIC and Dairy NZ 2013). Despite the low number of cows studied, we hypothesise that cows milked OAD have similar dry matter intake (DMI) to cows milked TAD allowing greater daily liveweight gain, resulting in heavier cows.

Estimation of GE for the first 150 days of lactation in this study showed J cows had a significantly higher output of MSY per 100 kg of LW compared with F and FxJ (Table 1). Prendiville et al. (2009) found J cows that were milked TAD had a greater GE compared to both F and F×J cows. In that experiment, however, daily MSY/100 kg of LW was calculated instead of accumulated MSY.

Predicted daily MSY and LW of the three breed groups are shown in Fig. 1. The three breed groups had similar shaped curves for LW, while for MSY the curve of F cows was flatter than the other breeds (Fig.

1a). Caution is required in interpreting the results because the Legendre polynomials usually show a border effect that biases the beginning and the end of lactation (Macciotta et al. 2005). The lowest LW was observed around day 40 of lactation, several weeks prior to the peak of MSY (Fig. 1b), indicating that when cows have the highest energy requirements they are gaining weight. This latter fact might reflect that cows milked OAD do not decrease DMI even when nutritional requirements are lower (Stelwagen et al. 2013).

The data indicate that when cows were milked OAD for the first 150 days of lactation, F cows produced more MY than F×J and J cows, but this superiority was not translated into an increased MSY. Jersey cows had a greater GE compared with F and F×J cows. The higher GE of J cow was due to the lower LW but similar MSY compared to F and F×J cows. Further research is required to evaluate total lactation MSY, lactation persistency, feed efficiency, fertility and stocking rate to provide insight on the choice of the best breed for in OAD systems.

Acknowledgements

The principal author acknowledges the support from Programa Formación de Capital Humano Avanzado, Becas Chile, CONICYT doctoral scholarship and the staff at No. 1 Massey dairy farm for the assistance.

References

Clark DA, Phyn CVC, Tong MJ, Collis SJ, Dalley DE 2006. A systems comparison of once-versus twice daily milking of pastured dairy cows. Journal of Dairy Science 89: 1854-1862.

LIC, DairyNZ 2013. New Zealand Dairy Statistics 2012-2013, LIC and DairyNZ, Hamilton, New Zealand.

Davis SR 2005: Lactational traits of importance in dairy cows and applications for emerging biotechnologies. New Zealand Veterinary Journal 53: 400-405.

Heins BJ, Hansen LB, Seykora AJ, Hazel AR, Johnson DG, Linn JG 2008. Crossbreds of Jersey × Holstein compared with pure Holsteins for body weight, body condition score, dry matter intake, and feed efficiency during the first one hundred fifty days of first lactation. Journal of Dairy Science 91: 3716–3722.

Kirkpatrick M, Lofsvold D, Bulmer M 1990. Analysis of inheritance, selection, and evolution of growth trajectories. Genetics 124: 979-993.

Macciotta NPP, Vicario D, Cappio-Borlino A 2005. Detection of different shapes of lactation curve for milk yield in dairy cattle by empirical mathematical models. Journal of Dairy Science 88: 1166-1177.

Prendiville R, Pierce KM, Buckley F 2009: An evaluation of production efficiencies among lactating Holstein-Friesian, Jersey, and Jersey x Holstein-Friesian cows at pasture. Journal of Dairy Science 92: 6176-6185.

Stelwagen K, Phyn CVV, Davis SR, Guinard-Flament J, Pomiès D, Roche JR, Kay JK 2013: Invited review: Reduced milking frequency: Milk production and management implications. Journal of Dairy Science 96: 1–13. .