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BRIEF COMMUNICATION

Seasonal and lactational influences on milk composition in New Zealand

M.J. AULDIST, B.J. WALSH AND N.A. THOMSON

Dairying Research Corporation Ltd., Private Bag 3123, Hamilton, New Zealand.

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In New Zealand, seasonal calving has created marked variations in the volume and composition of milk supplied to processors across the season. As a consequence, there are also seasonal variations in the manufacturing properties of the milk (Kefford *et al.* 1995). In particular, milk from later in the season can have manufacturing properties which are different from those of early and mid-season milk. Milk from this time typically has elevated concentrations of blood proteins, low casein:whey ratios and an altered mineral balance (Lucey, 1996). The 2 major factors attributed to causing this phenomenon are the stage of lactation (SOL) of the cows, and seasonal influences which affect both pasture and cows. In a seasonally-calving dairy system, the precise contributions of these factors to the reported changes in milk composition are difficult to define because of the confounding influences of other factors. The aim of the investigation presented here was to separate the respective effects of season and SOL on milk composition.

One of 4 groups of 20 Friesian cows calved during a 6 week period beginning in each of January, April, July and October. At each sampling occasion there were therefore herds in early (EL), mid (ML) and late lactation (LL), for which average days-in-milk were approximately 30, 120 and 210 respectively. Groups were managed as separate herds and each herd was offered a pasture allowance such that intake met metabolisable energy (ME) requirements necessary for the particular SOL and level of production (ARC, 1984). When insufficient pasture was available (the June sampling only) all herds were supplemented with pasture silage as a similar proportion of their diet (DM basis).

On 4 occasions during the year (September, December, March and June), milk samples were collected from each cow and analysed for a range of N fractions using macro-Kjeldahl techniques (Barbano *et al.* 1991). Bovine serum albumin (BSA) and immunoglobulin G (IgG) were tested for using commercially available radial immunodiffusion kits according to the manufacturers instructions (The Binding Site Ltd., UK). Somatic cell counts (SCC) were measured using an automated cell counter (Fossomatic 215; Foss Electric, Denmark). Data were analysed in SAS using the REML method of the mixed model procedure. Cow was specified as a random effect, and stage and period were specified as fixed effects. Cows with SCC exceeding 400,000 cells/ml were excluded from the analysis.

Preliminary results show a distinct effect of SOL for most milk composition parameters reported here (Table 1). In some instances (eg. protein, casein, whey) there was a marked increase in the concentration as lactation progressed. This probably was due largely to the concentrating effect of decreasing milk volumes. For BSA and IgG, which originate from the blood, the effect of SOL was small and inconsistent, though statistically significant. Concentrations of BSA have been used previously as an index the permeability of the mammary epithelia (Stelwagen *et al.* 1994), and in healthy animals could be used to indicate the approach of involution. In this study, there was no obvious increase in BSA or IgG in LL milk compared to the EL or ML milk. This suggests that the notable absence of any significant effect of SOL on casein:whey ratios may be explained by the cows not being late enough into lactation to exhibit this previously reported phenomenon.

Season of the year also had an effect on most milk components (Table 1). Overall, total protein, whey protein and IgG concentrations increased as the season progressed from spring through to winter. Conversely, casein:whey ratios decreased irrespective of SOL. The effects of season on casein concentrations were not significant, and for the remaining parameters reported here, effects were small and indistinct. These changes are likely to be nutritionally mediated; a reduction in the availability of pasture has previously been reported to increase concentrations of whey proteins (Gray and Mackenzie, 1987). Such a restriction would also lead to a reduction in amino acid availability for casein synthesis. Despite this, preliminary analyses of DM, energy and protein intake data in the context of requirements across the season (not presented) has revealed no obvious connection with milk composition.

In the case of total protein and casein, there were interactions between the effects of SOL and season (Table 1). The concentrations of these components in milk from cows in EL decreased as the season progressed for spring through to winter, whereas concentrations in ML and LL milk increased or were stable. This implies an increasing difficulty for cows in EL to satisfy their nutritional requirements for milk production as the season progressed.

TABLE 1: Yield and composition of milk from cows in early (EL), mid (ML) and late (LL) lactation, sampled in September (spring), December (summer), March (autumn) and June (winter). Data are means for all cows in each herd.

Sampling	Stage	Yield (kg/day)	Protein (g/kg)	Casein (g/kg)	Whey (g/kg)	NPN[a] (g/kg)	Urea (mM)	BSA (mg/l)	IgG (mg/l)	Casein :whey
September	EL	18.5	29.7	25.3	4.46	0.342	6.45	164	469	5.78
	ML	14.3	30.7	26.0	4.68	0.341	6.13	213	474	5.64
	LL	11.7	33.0	27.6	5.39	0.384	7.48	233	602	5.19
December	EL	20.4	29.9	25.3	4.61	0.292	4.57	236	667	5.60
	ML	17.4	32.7	27.8	4.85	0.260	4.11	239	534	5.86
	LL	13.6	33.7	28.6	5.08	0.313	5.15	264	608	5.74
March	EL	19.6	28.9	24.1	4.73	0.356	6.85	207	708	5.18
	ML	14.8	32.7	27.2	5.43	0.364	6.89	226	669	5.11
	LL	12.8	34.0	28.6	5.40	0.347	6.57	224	698	5.36
June	EL	19.0	28.7	23.8	4.85	0.352	7.31	209	709	4.99
	ML	12.3	33.6	27.8	5.75	0.343	6.49	269	757	4.97
	LL	8.9	34.9	28.6	6.26	0.349	7.16	256	901	4.63
SED Across herds		0.98	0.92	0.80	0.279	0.0117	0.369	18.1	58.6	0.291
SED Within herds		0.75	0.80	0.70	0.237	0.0113	0.342	14.2	52.4	0.256
Significance	Stage	**	**	**	**	**	**	**	**	NS
	Season	**	*	NS	**	**	**	**	**	**
	Int.	*	*	*	NS	**	*	NS	NS	NS

[a] Non-protein N; NS P>0.05; *P<0.05; **P<0.01.

In conclusion, these results suggest that spreading calving throughout the year could be useful in lessening seasonal variations in the composition milk supplied to factories, by reducing the peak to trough ratio in the concentrations of some milk components. This may result in a more even distribution of product yield across the season. It appears unlikely, however, that variations in the casein:whey ratio of milk, and hence some of the manufacturing properties of milk, could be altered by altering the time of calving on its own.

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