THE EFFECT OF MILK PROTEIN GENOTYPES ON THE CHEESEMAKING PROPERTIES OF MILK AND ON THE YIELD OF CHEESE

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INTRODUCTION

Milk protein genotypes affect the composition and cheesemaking properties of milk (see McLean 1982). β-lactoglobulin type-B milk has a higher casein content than type-A milk and the B variants of β-casein and κ-casein produce a firmer rennet curd than the A variants. Milk containing the B variant of κ-casein was found to be more suitable for making Parmesan cheese than milk containing the A variant and gave 6 to 10 per cent more cheese (Morini *et al.* 1979).

The objective of the experiment reported here was to determine differences in cheesemaking properties and cheese-yield between the milk of Friesian cows having the B genotypes of β-casein, κ-casein, and β-lactoglobulin and milk of cows having the A genotypes.

EXPERIMENTAL

Herds with the largest number of purebred, appendix, and grade Friesian cows of known sire were selected from the Adelaide metropolitan milk-supply area. Milk samples were collected from herd-recording test centres, defatted by centrifugation, and stored at −16°C.

Samples from approximately 6000 cows in seventy herds were typed by polyacrylamide and starch-gel electrophoresis for the caseins and β-lactoglobulin respectively. The twenty-four type-B cows selected had the protein genotypes of α_{s1}-casein-β-casein-κ-casein-β-lactoglobulin: BB-AB-BB-BB, BB-AB-BB-AB or BB-BB-BB-AB. The type-B cows were paired within herds with type-A cows (BB-AA-AA-AA) which were matched as closely as possible in age, stage of lactation, level of production, and freedom from subclinical mastitis (somatic cell count less than 750 000 cells per millilitre).

Combined evening and morning milk from each cow was standardised to a casein : fat ratio of 0.68±0.01 and pasteurised. Rennet curd firmness and the activity of starter bacteria were measured against time for each milk. Cheddar cheese was made from 12 kg of each milk, using traditional methods except for the use of direct-set starter and the use of pH to monitor acid development. The time of rennet addition to each milk was calculated to give the same curd firmness simultaneously for each vat at the curd-cutting time. The cheeses were weighed and analysed after pressing. The paired t statistic was used to compare differences between the A and B types. To simulate commercial manufacture more closely, cheese was also made on a pilot scale (188 kg milk), after combining milk according to type from thirteen pairs of cows.

RESULTS

The results of laboratory-scale cheesemaking are shown in Table 1. Milk from type-B cows had a higher casein concentration and reached the required rennet curd firmness 15 minutes earlier than type-A milk. A 9 per cent higher cheese-yield, corrected for moisture, was obtained from type-B milk.

Table 1: Manufacture of laboratory-scale Cheddar cheese

	Protein Genetic Type			
	A	*B*	*Ratio B/A %*	*Level of Significance**
No. of cheeses made	12	12		
Protein, g/100 g	2.99	3.10	103.7	NS
Casein, g/100 g	2.29	2.52	110.0	***
Time to RCF† 40 dg, min.	40	24		***
Cheese-yield, g	1 115	1 204	108.0	**
Cheese dry-matter yield, g	704	769	109.1	**
Fat recovery in cheese, %	85.7	86.0	100.4	NS
Protein recovery in cheese, %	79.5	82.2	103.4	**

* NS not significant; **P<0.01; *** P<0.001; † RCF rennet curd firmness.

The composition of the cheese from A- and B-type milk was not significantly different. Very similar differences were obtained from pilot-scale cheesemaking: for example, an 8 per cent higher cheese dry-matter yield was obtained from type-B milk compared with type-A milk.

These are preliminary results: it is intended to manufacture cheese from milk using each pair of cows on three occasions during the year.

DISCUSSION

The shorter rennetting time for type-B milks would result in reduced manufacture time in the commercial cheese factory and the associated higher curd firmness would minimise the effect of conditions which cause soft curd problems. The 9 per cent increase in cheese dry-matter yield from the same amount of type-B milk as A milk would be a bonus for the manufacturer as no extra cost would be incurred until the packaging stage.

If Australian dairy breeding strategies were developed to change the present milk protein gene frequencies to all B genotypes in the cow population, the potential increase in the yield of cheese would be approximately 5 per cent, or 7500 tonnes of cheese per annum. Future work will involve genetically typing bulls used in artificial breeding to promote the use of B-type bulls.

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