BALANCING QUANTITY AND QUALITY IN IMPROVING DAIRY CATTLE

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INTRODUCTION

Dairy cattle breeding has been cited as a case of the successful application of quantitative genetics to animal improvement (Jones, 1991). Australian Breeding Values (ABV) for protein and fat yield have increased by about 1% of yield per year, over the last twenty years. This has resulted from a number of factors, such as investment in breeding programs by Artificial Breeding (AB) Organisations, importation of semen from North America, availability of ABVs, demand by farmers for semen from bulls with high ABVs.

In the pursuit of high yield, there is naturally concern that the selection for increased yield may lead to lowering of milk quality. Some farmers have expressed concern over the number of bulls with negative ABVs for protein per cent.

INDUSTRY BACKGROUND

Milk is used for a number of products, for which the components of milk have different value. Milk for liquid consumption has received a premium. At present, farmers receive about twice as much for this milk as for manufacturing milk. In return for this premium, the consumer has milk available at a constant price all the year round, despite changing costs of production through the year.

The manufacturing industry developed largely on butter, the cream cheque being used by farmers in the wheat sheep belt to pay the grocery bills, skim milk being used to feed pigs. Improvements in transport and manufacturing, development of new products, and concentration of the dairy industry lead to expansion of whole milk collection after the war.

The historical importance of butter lead to the continued importance of butterfat in payment for manufacturing milk. In at least one state, legislation required that payment be on butterfat. In response to pressure from farmer organisations, payment taking account of protein was commenced in most states in the eighties.

CURRENT PAYMENT SYSTEMS

Liquid milk

In New South Wales, Western Australia and much of Queensland, milk for liquid consumption is supplied according to quotas, while in the other states, all farmers have the same proportion of their milk being paid the liquid milk premium at any one time. Increased proportions going to liquid milk in times of milk shortage (e.g. autumn, winter) and seasonal premiums reward farmers for producing out of season milk in these states sufficiently for liquid milk to be readily available. There are bonuses or penalties for milk with protein and fat above or below critical concentrations.

Manufacturing milk

Payment systems vary throughout Australia, but in general, there is payment for protein and fat with a penalty for volume. Because payment on protein is fairly new (1988 in Victoria), the relative prices of fat and protein vary from about 2:1 protein to fat, to almost entire payment on protein.

IMPACT ON BREEDING GOALS

Industry as a whole

The size of the liquid milk market is stable, so the benefits from increasing volume per cow flow to the industry as a whole only from changes in efficiency. Any increase in yield will be used in manufacturing. The dairy industry, as a whole, will benefit most by concentrating on the goals of manufacturers.

Individual farmers

Because of payment systems, the goals of some farmers may differ from those of the industry as a whole. For farmers with a liquid milk quota, main gains in increased production will come from the value of over quota milk. This will go mainly to manufacturing.

In some states, minimum levels of protein and fat for use as liquid milk are set. In general, the penalty for being below these levels is much greater than any reward for being above the level. For such farmers, production of milk at a concentration that just minimises the possibility of being under test, is most profitable. Fear of such a penalty causes some farmers to be more concerned about test percentage, than suppliers of manufacturing milk.

The development of manufacturing payment systems, with penalties for volume, have lead to concerns about protein percentage. Farmers can take account of percentage by selecting against volume. It seems simpler to select for a x protein - b x volume, than to include protein per cent. Percentage is 100 x protein/ volume.

As well as the penalty by factories for volume, some farmers have other concerns about volume. Costs such as refrigeration are proportional to volume. Also, some farms have little surplus storage capacity. Any increase in volume may lead to need for investment in a larger vat.

The payment system of the factory offers a suitable starting point in determining breeding objectives. At present, there is a range of payment systems, and they are constantly changing. Factories are reluctant to say what future payment systems are likely to be. However, there is fairly general agreement, that protein will remain substantially more valuable than fat, and should remain the major component of the breeding objective.

If payment systems develop so that there is a reasonable agreement on the relative value of protein and fat, and factories have similar volume penalties, it would be desirable for a payment breeding value to be published. ABVs are produced for milk, protein, fat, protein + fat, and protein and fat percentages. Protein + fat is seen to some extent as an index, and a list is supplied of the top bulls for this function. As the range in ABVs is higher for fat than protein, fat has more effect than protein on this function.

New Zealand produce a payment breeding index. If there is agreement among farmers on likely payment systems, a suitable index could be supplied.

LIKELY CHANGES IN COMPOSITION

Most of the top AB bulls in Australia have negative breeding values for protein percentage. Farmers are concerned that protein percentage will decline with time. There is a high positive correlation between ABVs for protein yield and volume, and a small negative correlation between ABVs for protein yield and protein percentage. Some of this correlation is due to population differences. The North American Holstein population has a higher protein yield and lower percentage, than the old Australasian Friesian population. As a result, a gradual replacement by the North American population was expected to lower protein percentage.

An analysis using young current cows suggest there is still a negative correlation between protein yield and percentage (Table 1). Farmers are likely to want to ensure that protein percentage doesn't decline further, even though, such a choice may sacrifice some genetic gain for overall profit compared to giving the correct economic weight to each character (Gibson,1982).

Table 1. Correlation between breeding values of bulls, using lactations of current young cows

	Milk	Fat	Fat %	Protein	Protein %	Prot+Fat
Fat	.58		.27	.70	-.03	.95
Fat %	-.63	.27		-.38	.68	.01
Protein	.89	.70	-.38		-.18	.89
Prot %	-.60	-.03	.68	-.18		-.10
Prot+fat	.76	.95	.01	.89	-.10	

With selection just on protein yield, we would expect a fall in protein percent of about 0.002 for each increase in yield of 1kg. Selection on an index of 5 protein - .04 milk would lead to a negligible change in protein per cent.

ALLOWING FOR INDIVIDUAL CHOICES BY FARMERS

As well as production, farmers want to consider other characters in their breeding goals. These include workability and type characters. A package has been developed at VIAS by Dr. P. Bowman, called $electabull. This will allow farmers to put their own emphasis on any character, to maximise overall profitability. It will take account of different payment systems, and will enable farmers to make sound economic decisions in their choice of semen.

PROTEIN COMPONENTS

A number of studies have found that single genes for some casein loci have an effect on processing quality. Ezra et al. (1994) conclude that the economic benefit of BB genotype over AA genotype is 4% for b-lactoglobulin and 5% for k-casein. With modern DNA techniques, animals can be characterised for these loci. If payment systems develop to reward improved protein quality, these loci can be taken account of in breeding programs.

MASTITIS

An important concern of breeders is the possible increase in mastitis with selection for yield. For example, Reents et al.(1984) found a small positive genetic correlation between milk yield and somatic cell count, which is an indicator of sub-clinical mastitis. As well as the loss in production and cost of treatment of mastitis, factories are now paying incentives for farmers to reduce somatic cell count. A number of countries, e.g. Sweden, U.S.A., are now producing breeding values for somatic cell count, or susceptibilty to mastitis. Recording of somatic cell count is increasing, so computation of breeding values for somatic cell count is now feasible. It is not clear how much effort farmers should place on selecting for low cell count. Somatic cell count has a skewed distribution, so farmers may choose to reduce cell count by culling the few cows with high count, although any culling has costs.

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