

The Impact of Selection for High Milk Yield on the Health and Welfare of Dairy Cattle



Introduction

Selective breeding of dairy cattle has led to a dramatic increase in milk yield over recent decades. Milk production per cow has more than doubled in the past 40 years and this increase in yield has been accompanied by declining ability to reproduce, increasing incidence of health problems, and declining longevity in modern dairy cows (Oltenu and Algers, 2005).

Two studies of the genetic relationships between health, fertility and production traits (Pryce *et al*, 1998 and Pryce *et al*, 1997) found that all genetic correlations between milk yield and health and fertility traits were antagonistic and highly statistically significant (Table 1).

Table 1: Genetic correlations between milk production level (305-day milk yield, kg) and health, welfare and fertility traits in dairy cattle from two studies.

	Pryce <i>et al</i> (1998)*	Pryce <i>et al</i> (1997)**
Calving interval (days)	0.28 ± 0.06	0.50 ± 0.06
Days to first service (days)	0.41 ± 0.06	0.43 ± 0.08
Conception at first service	-0.12 ± 0.08	-0.19 ± 0.11
Somatic cell score	0.16 ± 0.04	not reported
Mastitis	0.29 ± 0.05	0.21 ± 0.06
Milk fever	not reported	0.19 ± 0.06
Lameness	0.13 ± 0.06	0.29 ± 0.11

* Data from 10 569 lactation records

** Data from 33 732 lactation records

High-yielding dairy cows are generally in negative energy balance in early lactation and mobilise body reserves for milk production (Butler and Smith, 1989). Loss of body condition score is greater and more prolonged for higher yielding cows (Gallo *et al*, 1989). A negative energy balance may be associated with a higher incidence of metabolic disorders, impaired fertility and other health problems (Rauw *et al*, 1998).

Webster (1994) summarises the main welfare problems that may arise through breeding, feeding, housing, managing or otherwise manipulating cows for high productivity as follows:

- Hunger or acute metabolic disease, due to an imbalance between nutrient supply and demand;
- Chronic discomfort, through bad housing, loss of condition, etc.;
- Chronic pain or restricted movement due to distortion of body shape, bad housing or management;
- Increased susceptibility to infectious or metabolic disease;
- Metabolic or physical exhaustion after prolonged high production.

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Lameness

Higher milk yield is genetically correlated with a higher incidence of lameness (Table 1). Lameness is the single biggest welfare problem for dairy cows in the UK (Webster, 2000). Hyperalgesia (increased sensitivity to pain) occurs in chronically lame cows and may persist for a long period after resolution of the lesion (Whay *et al*, 1998). In addition to the direct effect on welfare of pain as a result of lameness, there are also other knock-on effects: lameness can result in weight loss, reduced milk yield and an increased risk of infertility, mastitis and culling (Weaver, 2000). Amory *et al* (2008) found that higher yielding cows were more likely to become clinically lame with sole ulcer or white line disease and that the milk production of affected cows fell to below the mean of unaffected cows and remained low after diagnosis; the loss of milk yield attributable to these conditions was around 570kg and 370kg over the lactation, respectively.

Around 75% of lameness cases occur in the outer claw of the hind feet: uneven load on the outer and inner claws, as a result of the greatly distended udder in modern high yielding cows, undoubtedly predisposes to lameness (Webster, 2004).

The incidence of lameness in dairy cows in Great Britain has increased dramatically since a farmer-based national survey of lameness in 1957/58 found an annual incidence of 4% (Leech *et al*, 1960). Surveys since the 1990s have reported mean annual incidences ranging from above 20% to over 50% (Clarkson *et al*, 1996; Whitaker *et al*, 2000; Esslemont and Kossaibati, 2002). Actual levels may be even higher than those recorded in these studies. Esslemont and Kossaibati (2002) comment: "One suspects that this [lameness] is the disease that is most under-recorded". Webster (2001) reports that nearly all newly-calved cows and heifers in typical UK cubicle housing systems show some degree of sole haemorrhage in early lactation.

Mastitis

Higher milk yield is genetically correlated with higher somatic cell score and higher mastitis incidence (Table 1). Mastitis is a very painful condition which should have declined greatly with improved methods of prevention and treatment (Broom, 2001). However, the incidence of mastitis has remained unacceptably high. A number of studies since the 1990s report a mean annual incidence of mastitis ranging from above 30 to over 70 cases per 100 cows (Esslemont and Kossaibati, 1996; Kossaibati *et al*, 1998; Esslemont and Kossaibati, 2002, Bradley *et al*, 2007).

Metabolic diseases

Metabolic or production diseases are a manifestation of the cow's inability to cope with the metabolic demands of high production (Mulligan and Doherty, 2008). According to Webster (1994), "In most practical circumstances, the capacity of the mammary gland to synthesize milk exceeds the capacity of the cow upstream to find, eat and digest enough food to supply the mammary gland with nutrients", leading to her feeling "simultaneously, hungry, 'full up' and physically tired".

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Metabolic or production diseases occur when the cow is unable to meet the acute or chronic metabolic demands of maintenance, pregnancy and lactation. In the most acute forms such as milk fever or grass staggers, the cow simply runs out of calcium or magnesium respectively and, if untreated, will die in a matter of hours or minutes; other diseases such as ketosis and fatty liver syndrome are due to abnormal demands on energy, especially fat, metabolism (Webster, 1994).

Cattle are adapted for a high fibre, low energy forage-based diet. The use of low fibre, high energy concentrate-based diets, in an attempt to meet the nutrient requirements of the high yielding cow, can lead to a range of production diseases, including rumen acidosis (Morgante *et al*, 2007).

Infertility

There is a large body of evidence linking selection for increased milk yield with infertility (Webster, 2000). Higher milk yield is genetically correlated with longer calving interval, increased days to first service and reduced conception at first service (Table 1).

In the UK, pregnancy rate at first service decreased from 56% in 1975-1982 to about 40% in 1995-1998, a decrease of about 1% per year (Royal *et al*, 2000). 43.7% of cows in the UK appear to have abnormal oestrus cycles (compared with 31.7% in 1982) and early foetal loss is also an increasing problem with 40% of pregnancies now affected (compared with 24% in 1982) (*Ibid.*). Infertility is the biggest cause of culling in dairy cows (Esslemont and Kossaibati, 1997; Whitaker *et al*, 2000).

Longevity

The drive to increase milk yield in the modern dairy cow has resulted in declining longevity.

Average longevity in many high genetic merit dairy herds in the UK is below three lactations. Not only has the welfare of the cow suffered, but the process is ultimately self-defeating for the farmer because the margin of milk sales over feed costs in the first three lactations is usually not large enough for the cow to make a profit so a cow becomes profitable only when she reaches her fourth lactation (Esslemont and Kossaibati, 1997). Optimal lifetime efficiency is reached after five or six lactations; for cows yielding 12 000 litres the loss in efficiency is 5% and 10% for lifetimes of three and two lactations respectively (Webster, 2000).

Infertility, mastitis and lameness are major causes of culling (Esslemont and Kossaibati, 1997; Whitaker *et al*, 2000) and hence important factors in the declining longevity of the dairy cow. Nørgaard *et al* (1999) conclude that a higher level of physiological stress due to higher milk yield and concentrate consumption has led to increased mortality in dairy cows.

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Conclusions

Selective breeding for increased milk yield is the root cause of declining longevity and unacceptably high levels of lameness, mastitis and metabolic diseases in the UK dairy herd. New breeding goals are needed as a matter of urgency to produce more robust cows with improved health, welfare, fertility and longevity.

Rauw *et al* (1989) comment that the fundamental solution is “to redefine the breeding goal in a broader perspective”, which means “breeding animals with a long economical (re)productive life at a production level that is economical (i.e. production in relation to veterinary costs, etc.) without giving any signs of disturbed welfare”.

Oltenacu and Algiers (2005) conclude: “The economic future of the dairy industry is related directly to public acceptance of its breeding and production practices. It is important to the dairy industry that welfare problems should be addressed before there is widespread condemnation of breeding and management practices. A new breeding goal aimed at improving fitness and tolerance of metabolic stress is necessary to prevent the decrease in the quality of life of dairy cows and instead, perhaps, enhance it.”

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2008

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