Extended Lactation: Turning Theory into Reality

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Take Home Message

- Modern dairy cows are capable of maintaining production for considerable periods of time; drying-off at high yield is a growing problem.
- The traditional Intensive Lactation production system makes no attempt to exploit this attribute.
- High milk yield is increasingly associated with poor welfare and impaired reproduction.
- Intensive Lactation cycles rely for their economic success on a high peak milk yield, and thus exacerbate these problems: 60% of health-related veterinary costs are incurred in the first 40 days of lactation.
- Extended Lactation is a production system whereby dairy cows are managed for increased persistency and rebred to calve at around eighteen months rather than twelve; the emphasis is on modest daily yield sustained over a long period.
- Replacing three twelve month Intensive Lactation cycles by two eighteen month Extended Lactation cycles reduces exposure to this peak risk period by one-third.
- The number of dry periods reduces by the same amount.
- Extended Lactation is economically competitive provided lactation persistency is maximized.
- Persistency is improved by simple management procedures:
    - Milking more frequently
    - Feeding well and consistently
    - Intelligent use of management data
    - Attention to detail throughout the lactation cycle
- Automated milking systems help to achieve these goals.

- Extended Lactation represents a welfare friendly and economically viable alternative to Intensive Lactation and should be considered by progressive dairy farmers.

The Modern Dairy Cow

The productive capacity of the modern dairy cow is illustrated in Figure 1, which shows yield data for heifers on commercial dairy farms in the USA (Amburgh *et al,* 1997). A proportion of these were not rebred. Rather than focus on peak yield, I would ask you to note that these latter were yielding around 40 kg/d of milk at 365d post-calving, and were still producing large amounts when the data collection finished, at 500d. The message is clear. The modern dairy cow not only has high capacity, but can maintain that capacity for extended periods.

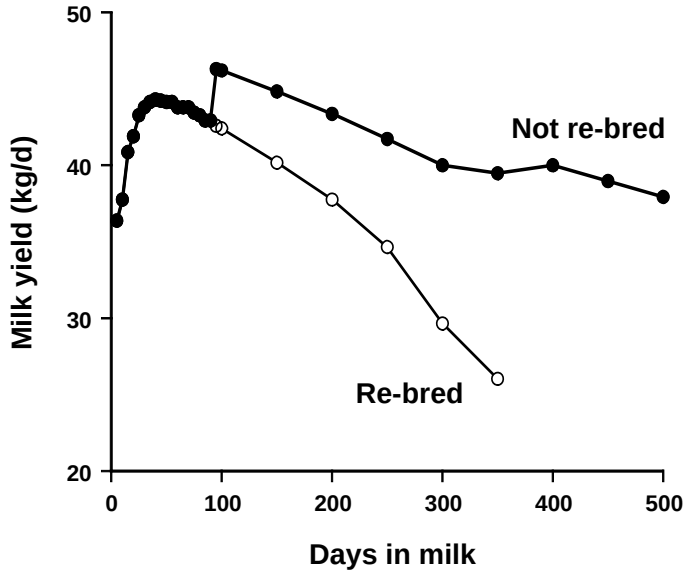

Figure 1. Milk yields of Holstein heifers over 500 days of lactation: comparison of re-bred and not re-bred. Adapted from Amburgh *et al* 1997.

Health and Welfare Considerations

It is generally accepted that breeding for increased yield has compromised health. The effect is small, but measurable. The most obvious consequence has been a concentration of health problems around the period between

calving and peak lactation (Figure 2). It is estimated that some 60% of ill health occurs during the first 40 days of lactation (Erb *et al,* 1984). The intensively managed dairy cow typically achieves three lactations in her lifetime and is thus exposed to three of these peak risk periods. The immediate benefit of extended lactation would be to reduce this exposure: replacing three twelve month cycles by two eighteen month cycles would decrease risk by one-third (Figure 3).

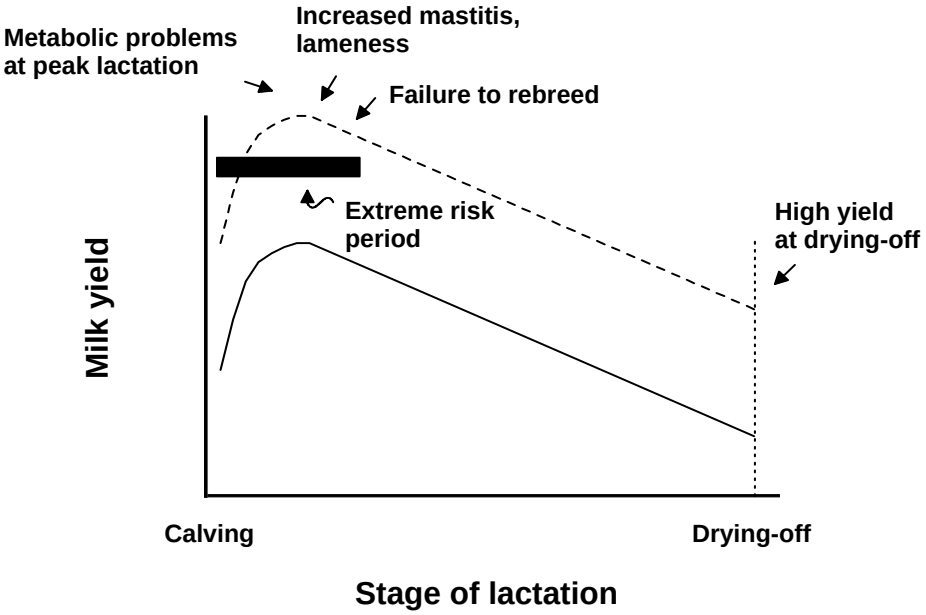

Figure 2. Diagrammatic representation of the consequences of increased output on health events and their concentration around a peak risk period in early lactation.

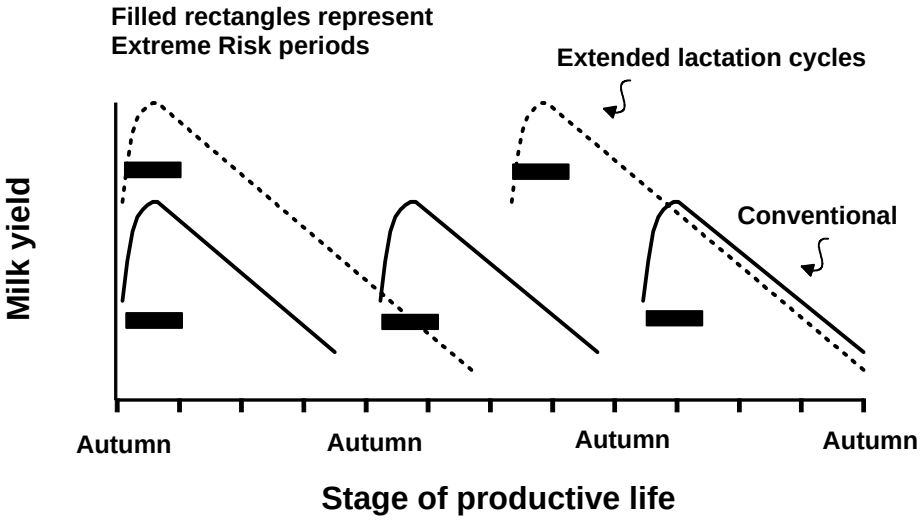

Figure 3. Risk analysis comparing conventional lactation cycles (solid lines) with extended lactations (dotted lines). Risk periods identified in Figure 2 are shown.

■ Economic Considerations

The economic benefits of short calving intervals have been recognized for decades, but the models presented have never taken account of different degrees of lactation persistency. A full economic analysis is beyond the scope of this short article, but the potential of enhanced persistency can be demonstrated very easily (Figure 4). This is a theoretical calculation of lifetime (3 year) yield based on a peak yield of 40l/d in the first lactation, dry periods of 60d and a 5% increment in yield between lactations. The typical rate of decline in milk yield post-peak is around 2% /wk. The extended lactation scenario benefits from one dry period rather than two, but at the same degree of lactation persistency the conventional system outperforms the extended. This is reversed, however, if persistency is improved from 2% decline to 1% in the extended lactation.

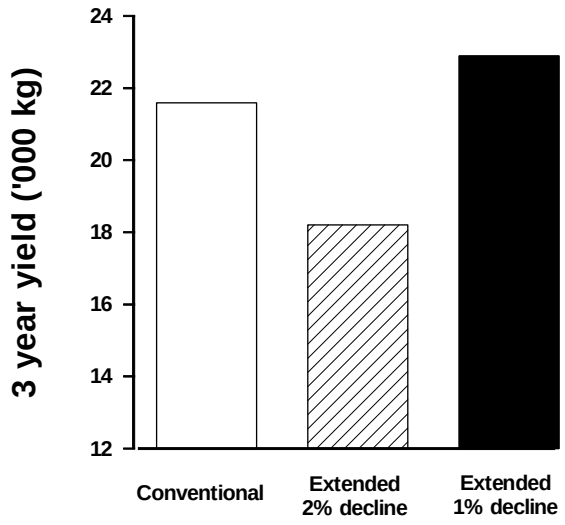

Figure 4. Theoretical lifetime milk yields to be expected from 3 conventional 12 month lactation cycles compared with two eighteen month cycles at two levels of lactation persistency. Based on 40kg/d peak yield, 60d dry periods and 5% increment between lactations. Conventional lactations assume 2% /week persistency decline.

■ Manipulating Lactation Persistency; Frequent Milking

It is evident from Figure 1 that persistency can be manipulated. Here I must admit to having cheated somewhat; the dairy farms from which these data came were using bST to stimulate yield, something not available to most farmers throughout the USA. However, persistency can be improved without use of bST. Many of these farmers were also milking thrice-daily. Moving from twice-daily to three-times daily milking increases milk yield typically by around 10% in a controlled situation, although under commercial conditions the amount will be dependent on the quality of management. The example shown in Figure 5 is from a half-udder study in heifers in which four-times daily milking was performed in one udder half (only) for 6 weeks (Hillerton *et al,* 1990). The increased yield of the frequently milked half is very obvious. This illustrates an

important aspect of the response, namely, that the effect is a localized one happening within the udder.

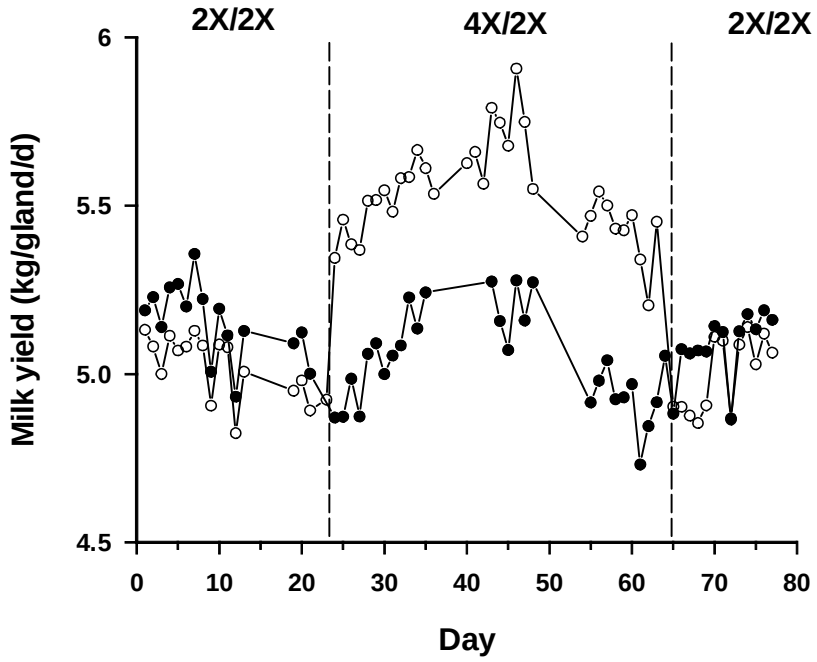

Figure 5. Half-udder milk yield of heifers milked twice-daily (filled circles) or four-times daily (open circles) where indicated.

Recently we have extended the half-udder frequent milking approach to look at effects of milking frequency on lactation persistency (Knight and Sorensen, 2000). We did not use bST! Starting at peak lactation, half of the udder was milked three-times daily for the remainder of the lactation whilst the other half continued to be milked twice-daily. Our objective was to extend the lactation beyond its normal ten months duration, so the cows were not rebred until nine-months post-calving to achieve an eighteen-month calving interval. The effects of thrice-daily milking on lactation persistency are shown in Figure 6. For the period between weeks 9 and 64 of lactation, persistency was improved by almost 20%. By comparing cows fed conventionally with others allowed 3kg/d additional concentrate as well as cows calving in autumn or spring we were able to show that lactation persistency was also improved by additional concentrate feeding and by calving in the autumn. The *potential* combined effect of these three management routines is shown schematically in Figure 7. For the period up to week 32 the fitted slopes are based on actual data, but

beyond week 32 they are extrapolated. Had the predicted yields been achieved, the most persistent group of cows would have been yielding only 2.5kg/d less at the end of the lactation (week 65) than at peak lactation. In fact this was not achieved, for two reasons. Firstly our nutritional management was not up to the challenge of the late-summer decline in grass quality (although in a subsequent lactation we overcame that problem). Secondly, having rebred the cows it was very evident that persistency was negatively affected during the last third of the pregnancy (Figure 8).

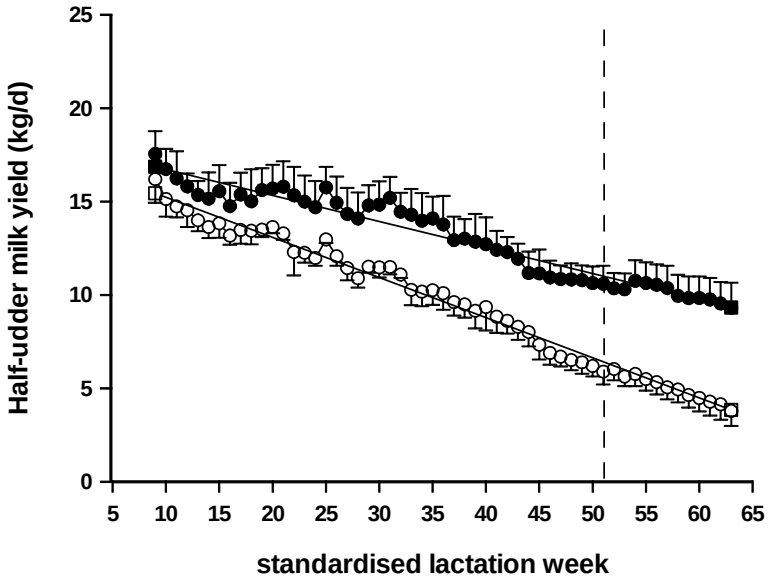

Figure 6. Lactation persistency for udder-halves of cows milked twice-daily (open circles) or thrice-daily (filled circles).

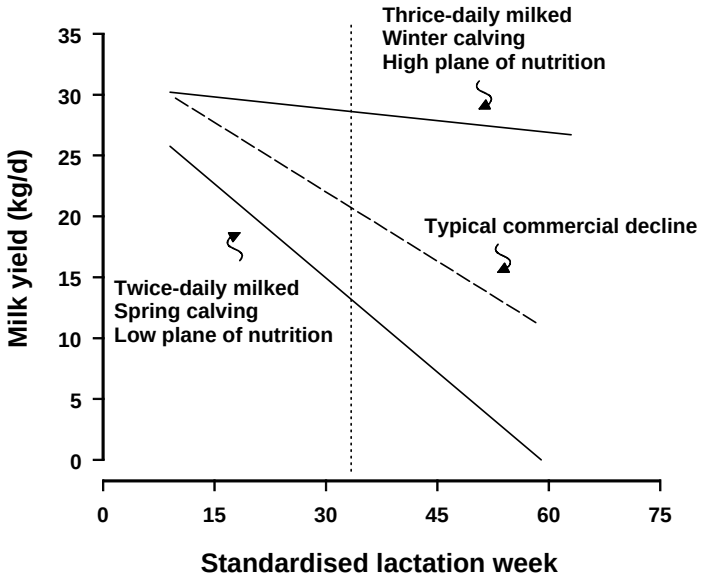

Figure 7. Actual and extrapolated lactation persistencies for cows on different treatments. Extrapolation begins at vertical dotted line.

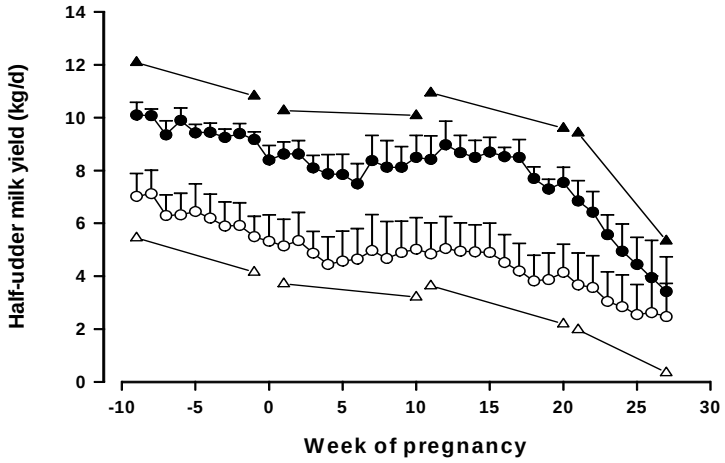

Figure 8. Lactation persistencies for half-udders of cows milked twice-daily (open circles) or thrice-daily (closed circles). Data is standardized to week of recurring pregnancy to show decline during last third.

To assess the effects on annualised output we maintained the cows on two consecutive eighteen-month extended lactations. This not only provided a more rigorous analysis but also specifically removed the compounding influence of calving season. All of the extended lactation groups performed better than the herd average. The best of the extended-lactation groups (thrice-daily milked on increased nutrition) produced 8,300kg/year, which is modest by modern standards but should be seen in the light of our herd average over the same period of 5,800kg/year for cows managed conventionally. This represents a 43% improvement in annual yield, considerably more than the 10% or so we would have expected from changing to thrice-daily milking (Figure 9).

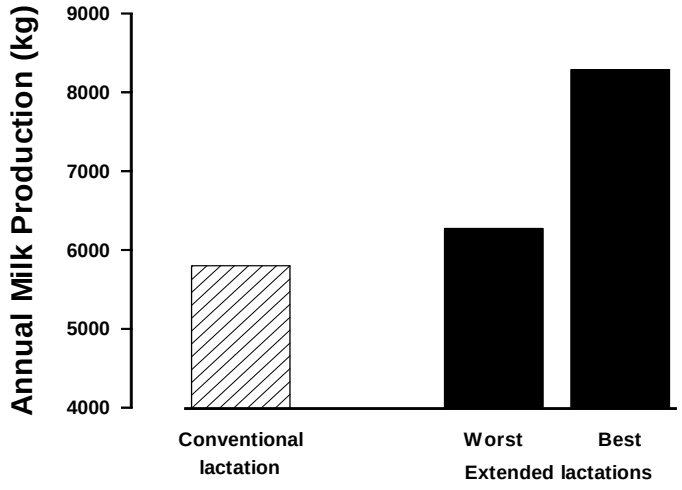

Figure 9. Calculated annual milk production from two consecutive eighteen month extended lactations compared with herd average for conventionally managed cows. The worst case was twice-daily milking and conventional nutrition. The best case was thrice-daily milking and increased feeding.

■ Turning Extended Lactation Into Reality

Our observation of increased persistency as a result of increased milking frequency is new. In Israel, Moshave (family farms) almost invariably milk twice daily whilst most Kibbutz milk three-times. Analysis of the national milk records database confirms that the yields of Kibbutz farms are higher, but there is no

detectable difference in lactation persistency between the two. All the cows were, presumably, being managed for traditional twelve month lactations. I suggest, therefore, that it is the combination of frequent milking, appropriate nutrition and delayed rebreeding that creates the more persistent extended lactation. This inevitably introduces an element of risk. With conventional rebreeding management, provided the cow gets back in calf the farmer need not worry too much about persistency as yield will be restored after the next calving, whereas if rebreeding has been delayed, milk output has to be maintained. But is it not time that more effort was given to doing exactly that? It is my experience of talking to dairy farmers that they pay little account to stage of lactation, or to changes in milk yield happening over weeks or months. The modern computer-based milking system is perfectly capable of gathering and storing information on milk yield at each milking, collating it into a daily yield, collating that into a weekly yield and presenting this as a graphed output of how the lactation is progressing for each cow in the herd. The step from that point to producing predictive 'early-warning' computer software that automatically identifies individual cows that are deviating from the desired lactation curve should not be impossible, in my view. If one is managing for persistency, the question that then arises is why is that cow not doing as well as she should? At that point one would go through an iterative process something like this:

- Is this a sudden drop in yield? If yes, the cow may be ill and should be examined by herdsman and, possibly, vet. If no (ie yield is falling gradually) one goes to next question.
- Is the drop in one quarter only? If yes, examine for infection. If no, one goes to next question.
- Is nutrition adequate and is it being consumed? If no, one increases feed or again examines the cow for digestive disturbance of some sort. If yes, one goes to next two questions.
- Is the cow putting on excessive weight?
- Is the cow attending for milking often enough (a question relevant to automatic milking systems)? These questions are asked in tandem because they are interrelated. The cow that is not being milked very often and is putting on weight is well known to farmers as one that 'puts it on her back'. The solution is to enforce more frequent milking so as to restore the milk output stimulus. The cow that is not attending often and is not putting on weight needs to be treated the same, but in addition her nutrition needs to be re-examined.
- Is the cow in the latter third of pregnancy? If yes, accept decline in yield and manage for calving. If no, one goes to next question.
- Is there no obvious reason why the cow is not performing? At this point the system would examine historical records for the cow in question and her ancestors. Previous management interventions that have or have not been

successful could be identified, but the end conclusion could be that this cow has genetically-entrained poor persistency and should not be used for breeding.

This may or may not be an exhaustive description of what can be done, but the point is that these are all simple management issues that are capable of being addressed using existing technologies. Some of these technologies go hand in hand. Automatic milking systems not only provide the potential for cows to be milked frequently without additional labour costs, but also provide accurate yield data on a quarter-basis. Automated weighing is reliable if done frequently in a relatively standardised way (eg at milking, before feeding) whereas once-weekly weighing is fraught with inaccuracies due to rumen-fill. Other technologies may be added; the milk yield:bodyweight:nutrition interrelationships might be improved by pedometer-based activity monitoring, for instance. The challenge is to use the available information in a way that has a definable objective, and in the scenario that I have described this means managing the cow to achieve greater persistency. By doing so, extended lactation becomes reality.

■ References

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