Breeding for improved efficiency in a growing herd

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Summary

- The vast majority of life-time efficiency is already captured in the EBI; nonetheless, large exploitable variability among dairy bulls in efficiency metrics still exist.
- Successful breeding schemes require routine access to large datasets that are not always available for difficult to measure traits such as feed intake and methane emissions.
- Low-cost tools that are already routinely available are being investigated as proxies for use in breeding for efficiency.

Introduction

One of the easiest approaches to breeding for life-time efficiency is to breed for longevity in tandem with greater milk output, while simultaneously avoiding any increase in cow size; this is the approach adopted within the EBI, which also selects for longer lactations via improved fertility. In fact, approximately 72% of the variability in daily feed efficiency is already captured within the EBI; furthermore, every €10 increase in EBI is associated with a 2% reduction in the carbon footprint per kg fat and protein corrected milk yield produced. Notwithstanding this, inter-animal variability does exist in both feed intake and carbon emissions independent of EBI, and thus strategies to capture these warrant investigation.

The extent of variability in feed-related efficiency

Dry matter intake at grass, milk yield, body weight and body condition score are regularly recorded at Moorepark, thus providing a rich source of information to quantify inter-animal variability in efficiency. The grass intake of mid-lactation grazing Holstein-Friesian dairy cows averaged by sire (where each sire had at least five daughters with feed intake measures) is illustrated in Figure 1; all cows were fed grass only. Clear differences exist, but of course, on average, larger cows that milk more tend to eat more. Once account is taken of differences in live-weight, body condition score and milk energy yield, large differences among sire progeny still exist as evidenced by the *feed difference* metric in Figure 1 (negative is deemed more efficient). Based on 1,801 records from 704 cows sired by 63 different bulls, a difference of three kg in grass dry matter intake per day existed even when adjusted to the same live-weight, body condition score and milk energy yield (Figure 1).

Genetic differences in methane emissions

While inter-animal variability in daily methane emissions is known to exist in Ireland, the proportion of this variability that is due to genetics is currently unknown for Irish cows. International studies in dairy cows suggest that up to 30% of the variability in daily methane emissions is due to genetics, indicating that it is possible to breed for reduced daily methane emissions. Research is underway to quantify the rate of genetic gain achievable to reduce methane emissions without sacrificing much in the rate of genetic gain for other traits within the EBI.

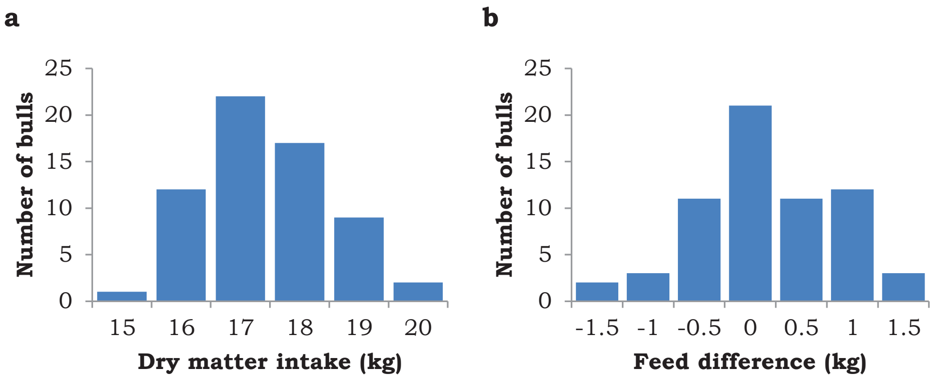

Figure 1. *Average (a) dry matter intake, and (b) feed difference in mid-lactation dairy cow progeny of 63 Holstein-Friesian AI bulls*

Potential breeding strategies for improved efficiency

The measurement of feed intake and methane emissions in grazing dairy cows is resource intensive, thus limiting the ability to achieve accurate genetic evaluations. Moorepark boasts the largest database globally on actual grass feed intake measures in grazing dairy cows, with feed intake records on 1,380 animals with accompanying genetic information. Far fewer records exist for methane emissions. Nonetheless, Moorepark pioneered research on predicting feed intake from milk samples. All milk samples taken in Ireland, either on individual cows or bulk-tank samples, are subjected to a technology called infrared spectroscopy. This entails shining light in the infrared region of the electromagnetic spectrum on each sample, and the pattern of absorbance is used to routinely predict milk fat, protein and lactose (globally). Moorepark has demonstrated that this technology can also be used to predict feed intake and energy balance. International research has reported that it is also possible to predict methane emissions; research has just started in Moorepark to test the latter hypothesis using grazing Irish cows. A genetic evaluation was undertaken for Moorepark cows based on their feed intake predicted from their milk sample; their predicted genetic merit for feed intake was subsequently correlated with their actual grass intakes with the conclusion that indeed genetic evaluations for feed intake based on milk samples do segregate animals on actual grass intake.

Conclusions

Although the vast majority of life-time efficiency is already implicitly captured within the EBI, there is still scope for improvement as evidenced by the large inter-sire variability in feed efficiency. Because milk samples are routinely tested for different constituents, the potential to use these data in a breeding program aimed at improving efficiency is well underway.