Improving the feed efficiency of beef cattle

David Kenny, Sinéad Waters and Mark McGee
Teagasc, Grange Animal & Grassland Research and Innovation Centre, Dunsany, Co. Meath

Summary

- Feed is the single largest cost incurred in beef cattle enterprises, accounting for 60-80% of variable costs
- The efficiency with which feed is utilised by the animal for productive purposes such as growth and lactation is critical to both the economic and environmental sustainability of beef cattle production systems.
- The relative performance of cattle on different rearing regimes (i.e. high concentrate versus high forage diets) may not be consistent and is currently under investigation. This is critical to future breeding programmes in order to better match animals to our grass-based production systems.
- Despite its importance to profitability, much is still unknown about the biological control of feed intake and efficiency in cattle and this has resulted in little genetic progress. Teagasc research is currently examining the key genes affecting feed efficiency in cattle and how this information might be incorporated into a genomic selection programme.

Introduction

Feed is the single greatest variable cost in beef cattle systems, typically accounting for between 60 to 80% of the variable costs of production. Additionally, up to 70% of the dietary energy consumed by the animal is used for body maintenance while in the region of 75% of dietary nitrogen is excreted and thus, unavailable for productive proposes. Consequently, there is significant worldwide interest in feed efficiency (FE) as a means of improving both the economic but also the environmental sustainability of beef production systems. Despite this, however, when compared with monogastric species, such as pigs and poultry, little direct improvement in FE has been achieved to-date for cattle.

Feed efficiency

Traditionally, feed efficiency of livestock has been expressed as the level of bodyweight or carcass growth attained for a given quantity of feed. It is generally agreed that use of this type of ratio trait, commonly referred to as 'feed conversion efficiency' or its inverse 'feed conversation ratio (kg feed per unit of gain) in breeding programmes generally leads to selection of larger animals that grow faster but also have a higher feed requirement. Thus there has been much interest, worldwide, in examining alternative feed efficiency traits. The concept of residual feed intake (RFI), rather than feed conversion ratio, is becoming the preferred measure of FE across many livestock production enterprises, and in particular for beef cattle. Animals with low RFI (efficient) eat less than expected based on their weight and growth. We and others have also demonstrated significant genetic variance in the trait and that, genetically, it is not antagonistically associated with desirable growth or carcass traits in growing beef cattle. Indeed, Teagasc research has shown that in any group of growing cattle or suckler cows there can be up to 20% difference in the feed consumed by the most efficient compared to the least efficient animals for the same level of growth and performance. The challenge is, therefore, to reliably and cost-effectively identify these feed

efficient animals and proliferate their genetics through structured animal breeding programmes. However, the main impediment to genetic progress and adoption of selection strategies based on FE is the difficulty and enormous expense of measuring individual animal body weight and feed intake over a sufficiently long period. In Ireland, such measurements are routinely carried out by the Irish Cattle Breeding Federation at its Tully test facility in Co. Kildare, though the number of records generated per annum (c. 500) is very low when compared with other important traits such as carcass weight or conformation. Consequently, developing cost effective predictive biological markers specifically for improved FE is an attractive and necessary alternative to direct measurement on large numbers of cattle. Our own work at Teagasc to date has also clearly shown that FE is a complex multifaceted trait, under the control of many biological processes. These include inter-animal variation in feeding behaviour, digestion, absorption, metabolism, nutrient partitioning, and cellular energetics, as well as, potentially, susceptibility to stress. We have also shown that feed efficient cattle are likely to have different profiles of microorganisms in their rumen (forestomach) and emit less methane than their inefficient contemporaries. Additionally, there is evidence from our own work, and that of others, that although relatively repeatable, ranking of beef cattle for FE offered the same diet is not necessarily consistent over different phases of their lifetime, and this may be further exacerbated when diets differing in energy density are fed successively (i.e. forage versus concentrate based diets), as per commercial practice. This strongly indicates the presence of what is termed a 'genotype x environment' interaction for the trait, in other words that the relative feed efficiency of a particular animal depends on the type of feed it is offered or management system within which it is reared. However, the existence of such a phenomenon has not been adequately tested to-date.

Current Teagasc research on feed efficiency

Worldwide, breeding values of bulls for feed intake or FE are typically derived from progeny performance based on *ad libitum* access to energy dense rations whereas, in many countries including Ireland, the lifetime gain of most commercial beef cattle is achieved from diets consisting, to a significant extent, of lower energy density feeds such as grazed grass and/or ensiled forages. Recently, a large research programme, funded by the Department of Agriculture, Food and the Marine, has commenced at Grange with the objectives of (i) better understanding the biology underpinning improved feed efficiency in cattle; (ii) the repeatability of performance across different diets and (iii) identifying the key genes controlling the trait so that such information can ultimately be incorporated into the planned genomic selection based breeding programme for beef cattle in Ireland. This should, in time, aid the identification of animals that are most profitable to produce under our grass based production systems.