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# Maternal productivity of beef suckler cows with low and high residual feed intake

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## Introduction

The biological efficiency of producing beef from the suckler herd is low with a very large maternal cost to production. The cow herd uses approximately 0.85 and 0.66 of the total energy requirement in calf-to-weanling and calf-to-beef systems, respectively with about two-thirds and a half, respectively of the total energy consumed going towards maintenance of the cow herd. As feed is the largest variable cost in beef production, consequently feed efficiency is an important trait to consider when developing programmes to identify cattle that are more economically and environmentally sustainable to produce. Traditionally, feed efficiency was expressed as the ratio of weight gain to feed intake but selection for this measure leads to an increase in mature size and thus maintenance requirements. An alternative measure of feed efficiency proposed is residual feed intake (RFI) or net feed efficiency. This is defined as the difference between an animals actual intake and its predicted intake (negative or low values desirable) and is largely independent of growth and body size. The objective of the present study was to characterise maternal productivity traits and metabolic profiles in beef suckler cows with low and high RFI.

## Materials and Methods

A total of 56 spring-calving beef suckler cows comprising 20 upgraded Charolais (C) and 36 Beef × Friesian (BF) were individually offered grass silage *ad libitum* pre-partum (*in vitro* dry matter digestibility (DMD) 686 g/kg). Cow liveweight, body condition score (BCS methods: Lowman *et al.*, 1976 and Agabriel *et al.*, 1986) and blood metabolites were monitored regularly pre-partum, and calving difficulties and calf birth weight were recorded. Using early-calving cows, individual *ad libitum* intake of grass silage (*in vitro* DMD 767 g/kg) for 37 d post-partum (n=30), cow serum immunoglobulin (Ig) concentrations pre-partum, colostrum yield, Ig concentration and calf Ig status (n=38), and milk yield (weigh-suckle-weigh) and calf daily gain (n=29) were determined. Expected feed intake (FI) was calculated for each genotype (G) separately by regressing average daily FI (kg DM) on average daily liveweight gain and mid-test liveweight$^{0.75}$ over a 64-d period in late pregnancy using the GLM procedure of SAS (2001). The RFI for each animal was then calculated as actual FI minus the FI predicted from the regression model generated. Within each G the cows were ranked on RFI and 0.5 were classified as having low and high RFI. Subsequent statistical analysis was carried out using PROC GLM with a model containing fixed effects for RFI group, G and RFI × G. Cow lactation number and calving day were included as covariates. Models pertaining to cow progeny had additional fixed effects for calf gender and sire.

## Results and Discussion

Compared to cows with low RFI those with high RFI had a similar liveweight, liveweight daily gain and BCS ($P>0.05$) but a higher feed intake (1.3 kg DM/day, $P<0.001$) and calf birthweight ($P<0.05$) (**Table 1**). Intake was also numerically higher ($P=0.10$) post-partum in cows with high RFI than low RFI. There was a RFI × G interaction for plasma NEFA whereby values were higher for C cows with low RFI than high RFI compared to no difference in BF cows. There was no effect ($P>0.05$) of RFI on colostrum yield and Ig concentration and subsequent calf Ig status or on cow milk yield and calf daily gain.

## Conclusions

These results show that beef suckler cows with lower residual feed intake are more energy efficient and their calves have lower birthweight, which may have implications for ease of calving.

**References**

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Lowman, B.G., Scott, N.A. and Somerville, S.H. (1976). Bull. No. 6, East of Scotland College of Agriculture, 31 pg.

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**Table 1**: Maternal productivity and metabolic traits (s.e.m.) in cows with low and high RFI

| | Residual Feed Intake | | Sig. |
|---|---|---|---|
| *Parameter* | Low | High | |
| Expected feed intake (kg DM/day) *[n=56]* | 9.7 (0.12) | 9.8 (0.12) | NS |
| Actual feed intake (kg DM/day) | 9.1 (0.18) | 10.4 (0.17) | *** |
| Liveweight (kg) | 728 (11.5) | 724 (11.4) | NS |
| Average daily gain (g/day) | 485 (51.6) | 571 (50.8) | NS |
| *Average body condition score (0-5)* | | | |
| Lowman *et al.* (1976) – Scotland | 3.1 (0.04) | 3.1 (0.04) | NS |
| Agabriel *et al.* (1986) – France | 2.6 (0.03) | 2.5 (0.03) | NS |
| | | | |
| *Plasma metabolite concentrations* | | | |
| Glucose (mmol/l) | 3.47 (0.043) | 3.43 (0.040) | NS |
| Non-esterified fatty acids (NEFA) (mmol/l) | 0.47 (0.032) | 0.40 (0.029) | * RFI × G |
| Beta-hydroxybutyrate (mmol/l) | 0.28 (0.011) | 0.26 (0.010) | NS |
| Acetoacetate (mmol/l) | 0.05 (0.003) | 0.05 (0.003) | NS |
| Albumin (g/l) | 33.8 (0.30) | 33.4 (0.28) | NS |
| Creatinine (micromol/l) | 163.5 (3.23) | 155.7 (2.97) | P=0.08 |
| Urea (mmol/l) | 3.11 (0.091) | 3.15 (0.084) | NS |
| | | | |
| Calving difficulty (scale 1-5) | 1.5 (0.23) | 1.5 (0.22) | NS |
| Calf birth weight (kg) | 45.3 (1.21) | 49.4 (1.18) | * |
| | | | |
| Cow serum $IgG_1$ (mg/ml) *[n=38]* | 15.7 (1.08) | 18.1 (0.84) | P=0.09 |
| Colostrum yield (ml) | 3770 (403.9) | 3504 (313.9) | NS |
| Colostrum total Ig (mg/ml) | 178 (14.0) | 177 (10.9) | NS |
| Calf serum total Ig @ 48-h (mg/ml) | 59 (4.3) | 52 (3.4) | NS |
| | | | |
| Intake post-partum (kg DM/day) *[n=30]* | 8.9 (0.23) | 9.4 (0.15) | P=0.10 |
| Milk yield (kg/day) *[n=29*] | 7.7 (0.44) | 7.9 (0.29) | NS |
| Calf gain (g/day) [37-d period] | 795 (69.1) | 824 (45.5) | NS |