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Impact of breed, sex and body mass on feed intake and energy expenditure for growth of young cattle – a meta-analysis of German and Austrian experiments

Einfluss von Rasse, Geschlecht und Lebendmasse auf Futteraufnahme und Energieaufwand für das Wachstum bei Jungrindern – eine Meta-Analyse deutscher und österreichischer Versuche

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In the last decades the milk yield of both Holstein and Simmental has significantly been enhanced by intensive breeding, i.e. selection of animals in terms of dairy type. As a consequence growth and body composition changed, as well. Additionally, frame and body size were increased due to the positive genetic correlation between milk yield and body size. The objective of the present work is to revise the feeding standards for growing and fattening cattle using data of feeding experiments with current types of animals.

Methods: Data of 42 experiments from nine research institutes in Germany and Austria were pooled and statistically analysed by meta-analysis considering the effect of institute and the experiment within institute. The data provided information on age (98 ± 31 , 42–170 days) and live weight (136 ± 35 , 80–219 kg) as well as the respective feed intake (DM), nutrient intake (protein, fibre) and energy intake (ME). The data ($N = 711$) were relatively well balanced regarding breed (Simmental [SI], Holstein [HO]) and sex (male [M], female [F]). The diet consisted of milk replacer (or milk), hay, corn silage and varying amounts of concentrates. The nutrient content of the feeds was on average (in DM): corn silage – 7.7% XP, 41.7% NDF, 10.9 MJ ME; hay – 13.5% XP, 55.1% NDF; 9.4 MJ ME; concentrates – 21.6% XP, 20.7% NDF; 12.4 MJ ME). The mean feed intake was 3.3 ± 1.3 kg DM, the proportion of concentrate $59 \pm 18\%$ of DM and mean energy concentration 12.2 ± 1.2 MJ ME/kg DM. A general linear model was used to analyse the fixed effects of breed (SI, HO), sex (M, F) and live weight (90, 110, 130, 150, 170, 190, 210 kg). Additionally, live weight gain (LWG), concentrate intake as well as energy concentrations of forage were used as regression variates. Energy expenditure for growth (ME_g) was calculated as total ME intake minus ME for maintenance (0.53 MJ ME/kg $LW^{0.75}$, GfE 1995).

Results: Mean feed intake was 3.80 ± 0.02 kg DM/d and mean energy expenditure for growth was 18.6 ± 0.2 MJ ME_g /d (Grand LS Mean \pm SE of Mean). Regarding both feed intake and energy expenditure for growth, live weight showed the most significant impact ($P < 0.001$). No significant effect of breed on intake and energy expenditure for growth was found. Significant interactions existed for live weight \times breed and live weight \times sex. The statistical analysis yielded the following results for the effects of breed, sex and body mass:

Mean feed intake for SI = 3.77 ± 0.04 and for HO = 3.83 ± 0.04 kg DM (LS Mean \pm SEMean)

Mean feed intake for male = 3.75 ± 0.02 and for female = 3.86 ± 0.04 kg DM (LS Mean \pm SEMean)

Mean feed intake for 90, 110, 130, 150, 170, 190, 210 kg LW = 2.05, 2.61, 3.42, 4.06, 4.48, 4.93, 5.08 kg DM

Mean ME_g for SI = 18.9 ± 0.34 and for HO = 18.3 ± 0.38 MJ ME/kg LWG (LS Mean \pm SEMean)

Mean ME_g for male = 18.0 ± 0.23 and for female = 19.1 ± 0.40 MJ ME/kg LWG (LS Mean \pm SEMean)

Mean ME_g for 90, 110, 130, 150, 170, 190, 210 kg LW = 7.8, 12.7, 17.6, 20.8, 22.1, 24.7, 24.6 MJ ME/kg LWG

From the LS Means for the breed, sex and live weight subclasses minus the Grand LS Mean the respective effects can be calculated as well as applied to predict the feed intake or energy expenditure for growth for specific combinations.

Example 1: Feed intake for SI (female, 210 kg LW) = $3.80 - 0.03 + 0.05 + 1.27 = 5.09$ kg DMI

Example 2: Energy for growth for HO (male, 130 kg LW) = $18.6 - 0.3 - 0.6 - 1.0 = 16.7$ MJ ME_g

The residual standard deviation (RSD) and the coefficient of determination (R^2) of the statistical model was 0.24 kg DM and 96.2% for DMI as well as 2.3 MJ ME_g and 87.8% for ME_g .

Conclusions: The presented models for predicting feed intake and energy expenditure for growth according to breed, sex and live weight show high statistical accuracy ($R^2 = 88 - 97\%$) and can be taken as a guidance for feeding cattle within their growing period from 80 to 220 kg liveweight. A more detailed information about this research can be found in Gruber et al. (2018).

1) GfE (1995): *Mitteilungen des Ausschusses für Bedarfsnormen*: DLG-Verlag, Frankfurt am Main, 85 S.

2) GRUBER L., ETTLE T., SCHWARZ F.-J., FISCHER B., PRIES M., JILG T., KOCH C., MEYER U., KUNZ H.-J., ROYER M., SUSENBETH A. (2018): 130. VDLUFA-Kongress, Münster, 18.-21. September 2018, Kongress-Band 2018, in press.

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