Feed efficiency of beef cows within INRA feeding System

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Feed efficiency of beef cows: a way to improve their feeding allowances through the quantification of non-productive functions

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Application In the revised INRA feeding system for ruminants (INRA, 2018), it is now possible to take into account bodyweight variation for rationing beef cows.

Introduction Maintenance requirements of beef cows account for at least 70% of total energy requirements (Ferrell and Jenkins, 1984), compared to 40 to 50% for dairy cows. Energy for maintenance corresponds to the energy required to ensure the integrity of life functions, to maintain muscle tone, renal excretion, secretion of enzymes and hormones. Traditionally, maintenance requirements were defined as the minimum energy required for body weight gain or body energy balance equal to zero, but this is difficult to estimate directly. Estimates reported in literature are highly variable (91 to 180 kcal/kg$^{0.75}$, Ortigues *et al.*, 1993), due to the measurement methodologies used and factors linked to the animal (breed, level of production, body composition) and its environment (especially the feeding level). In the context of improvement of efficiency and robustness of beef production, a better knowledge of energy use, and in particular the partition of energy intake and its variation to physiological expenditure components, is needed.

Material and methods Beef cows were submitted to a nutritional challenge in order to measure their ability to cope with nutritional changes through the partition of available energy between productive and non-productive (NP) functions. From a systemic approach, the cow is considered as a dynamic system that takes up energy from the environment to maintain its function over a productive cycle. Changes in energy partition are known to be modulated by the stage of lactation and other various metabolic pathways (e.g. protein accretion and mobilisation or/and lipogenesis/lipolysis). The energy balance can be estimated over the duration of the nutritional challenge and summarises the partition of energy fluxes. Energy changes expressed in net energy for lactation (UFL; INRA, 2018) is: UFLreq = UFLreq_MY + UFLreq_ΔBR + UFLreq_gest + UFLreq_NP, where UFLreq is the total net energy requirements, UFLreq_MY is the energy requirements for milk production, UFLreq_ΔBR is the net energy equivalent to body reserves changes, UFLreq_gest is the energy requirements for pregnancy and UFLreq_NP is the net energy required to NP functions; all the terms are expressed in UFL/day. By definition, when body weight (BW) change is null, ΔBR is null and UFLreq_NP corresponds to maintenance requirements. The relative importance of UFLreq_NP was determined by quantitative analysis of the INRA "Beef Cows" database. It included 33 INRA challenge trials (from 1975 to 2014) on late-maturing 'continental' beef cows with simultaneous measurements of diet intake, BW, BW changes corrected for variations in DMI, body reserves changes (ΔBR) assessed by adipose cell measurements, milk yield assessed by the weigh-suckle-weigh method. Within this database, the energy equivalents were expressed in UFL (INRA, 2018) using the metabolic efficiency coefficients (kpf, kg and kls for protein and fat deposition, gestation and lactation, respectively). Feed (ingredient) intake was also expressed in UFL calculated according to INRA (2018). The database included 101 treatments differentiated by the production stage and the parity of cows: 54 treatments related to lactating multiparous cows, 26 to lactating primiparous cows, and 21 to dry or pregnant multiparous cows. Special attention was paid to the energy of NP functions linked to the lipid and protein composition of BW change.

Results From the quantitative analysis of the database, it was shown that: i) energy intake or mobilized from BR was mainly allocated to milk production whatever the level of feeding, ii) net energy equivalent of BW change was on average 2.4 UFL/kg BW (38 % lipids) in multiparous cows and 1.8 UFL/kg BW (21 % lipids) in primiparous cows, iii) NP functions can be expressed as the sum of maintenance requirements and energy to support BR changes. The net energy required for maintenance amounted to 0.043 and 0.049 UFL/kg BW$^{0.75}$/d in dry pregnant and in lactating cows, respectively. These values must be increased by 10 and 20 % in free-stalls and pasture environments, respectively.

Conclusion With this work, we have upgraded the beef cows' energy requirements for the revised feeding system, using a larger number of observed data. The improved knowledge about chemical composition of body reserves changes help to provide a more detailed and original model of energy partitioning. Although the model was derived using late-maturing 'continental' breeds, this approach can be used generically and adapted to other breeds.

References

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