A model of energy allocation to predict adaptive capacities in meat sheep

F. Douhard[1], G. Dubreuil[1], S. Lobón[2], M. Joy[2], L. Puillet[3], N.C. Friggens[3] and A. Lurette[4]
[1]GenPhySE, Université de Toulouse, INRAE, ENVT, 31326 Castanet-Tolosan, France, France, [2]CITA, Avda. Montañana 930, 50059 Zaragoza, Spain, [3]UMR 0791 MoSAR, INRAE, AgroParisTech, Université Paris-Saclay, 75005 Paris, France, [4]INRAE, CIRAD, L'Institut Agro Montpellier SupAgro, Univ Montpellier, UMR SELMET, 34000 Montpellier, France; frederic.douhard@inrae.fr

The sustainability of Mediterranean livestock farming systems largely depends on sheep breeds capable of dealing with underfeeding. However, adaptive capacities may trade-off against production traits (e.g. litter size, lamb growth) due to the limited amount of energy to allocate between competing demands. How such trade-off can be underpinned by the changes in energy acquisition and allocation priorities during lifetime remains mostly unknown so far. In particular, different ewe body reserves dynamics (e.g. stable vs variable) over successive production cycles may reflect different adaptive strategies. Here, we propose an energy allocation model in meat sheep that predicts changes in body weight and body reserves over growth and reproduction in response to dietary energy availability. A critical assumption of our model is to consider an interdependency between energy acquisition and allocation. Specifically, we assumed a negative feedback from body reserves on the desired intake. We show that the strength of this feedback can differentiate adaptive strategies: a weak feedback is associated to a low ewe priority to maintain body reserves in favour of lamb growth ('risky strategy') whereas a high feedback associated with a high ewe priority to maintain body reserves penalizes lamb growth during underfeeding periods ('conservative strategy'). Finally, we assessed these various strategies by fitting our model to data from contrasting breeds from different environments: a prolific breed from an extensive pasture-based system (Romane, France), and two less prolific long-lived breeds from Spain, one from a semi-intensive system (Rasa Aragonesa), and the other from an extensive system in a mountain area (Churra Tensina). Our individual-based model shed lights on energy allocation mechanisms underlying adaptive capacities. It then provides a tool to explore how individual variability in feeding responses can be managed to improve farm resilience.

Book of Abstracts of the 73rd Annual Meeting of the European Federation of Animal Science

Book of abstracts No. 28 (2022)
Porto, Portugal
5 – 9 September, 2022