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Editorial: 7th ISEP: Present and future challenges in energy and protein metabolism and their implication in animal nutrition

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The EAAP International Symposium on Energy and Protein Metabolism and Nutrition (ISEP) is the heir of the International Symposium on Energy Metabolism (1958–2000) and the International Symposium on Protein Metabolism and Nutrition (1974–1999). Thanks to the collaboration of the Spanish National Research Council (CSIC), the University of Granada and the European Association of Animal Science (EAAP), the 7th ISEP was held in Granada, Spain, 12–15 September 2023, gathering on site 301 attendants from 22 countries presenting 207 oral and poster presentations (https://www.sciencedirect.com/journal/animal-science-proceedings/vol/13/issue/3) covering hot topics (Reduction of the environmental burden of livestock; feed processing, additives and novel feeds; the impact of environmental challenges on livestock) and methodological aspects (Methods and technologies for research and smart nutrition; modelling) around protein and energy metabolism and nutrition.

The present issue of Animal, the International Journal of Animal Biosciences, is dedicated to cover the main lectures presented by keynote speakers at ISEP 2022.

Lapierrre et al. (2023) discussed the way the efficiency of utilisation of essential amino acids can be applied in dairy cow nutrition. The efficiency of utilisation of individual essential amino acids can be calculated as the sum of protein secretions and accretions divided by metabolisable essential amino acid supply for a given ration, intake, production and physiological status. Target efficiencies of utilisation were proposed to estimate optimal individual amino acid recommendations. Furthermore, efficiencies of utilisation can be predicted based on the ratio of amino acid supply to digestible energy supply. These efficiencies offer good predictions of milk true protein yield and help assess if individual amino acids are in short supply.

Continuing with ruminants, Girard and Duplessis (2023) focused on the importance of folates and cobalamin for dairy cow metabolism. Their review is an extended version of the first Rank Lecture in Animal Nutrition awarded to C.L. Girard during ISEP2022. Folic acid and vitamin B12 supplements, especially when given together, alter energy partitioning in dairy cows during early or mid-lactation as indicated by the increase in milk, energy-corrected milk, or milk component yields without a change in DM intake and BW or even with reductions in BW or body condition loss. Folate and cobalamin subclinical deficiency interferes with the efficiency of gluconeogenesis and fatty acid oxidation and possibly alters responses to oxidative conditions. These effects indicate that meeting the needs for these two vitamins improves metabolic efficiency in dairy cows.

Regarding the environmental impact of livestock on greenhouse gases emissions, Morgavi et al. (2023) challenged the premise that reducing enteric methane production in ruminants does not result in an improved energy balance as the potential gains in net energy that could be used for production are theoretically and empirically of low biological significance with the inhibition rates of 20 to 30% commonly reported in the literature. The authors have identified knowledge gaps in both the calculation of energy flows at the animal scale that could improve the accountability of energy transactions when methanogenesis is inhibited and also, at the microbial scale, the production, pharmacokinetics and utilisation of hydrogen and other fermentation products that can affect microbial and animal functions.

To wrap up ruminant nutrition topics, Tedeschi (2023) suggested combining different modelling concepts and ideas to solve existing limitations of ruminant modern feeding systems. The development of mathematical animal models to assist sustainable development in agriculture-related businesses might benefit drastically by merging existing animal models, more specifically those related to nutrition, given the amount of available data already collected worldwide and many different well-throughout concepts. However, problems in merging existing models include different paradigms, structural decisions, and parameterisation processes that could render the merging undertaking infeasible. Another reason is that the predictability of the merged model might increase due to offsetting errors that cannot be thoroughly studied, creating an invalid model. Connecting concepts rather than calculation routines might be more achievable and promising.

On the non-ruminant side, Lindberg (2023) dealt with the supply of nutrient and energy in monogastric food-producing animals reducing environmental and climatic footprint and improving gut

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health. The negative impact of monogastric animal food production on the environment and climate can be reduced if recently published data on ways to increase the efficiency of utilising dietary nutrients and energy are adopted. Furthermore, there are possibilities to diversify production systems, modify diet composition with respect to feedstuffs included and for more extensive use of free amino acids in feed formulation.

Concerning the topic about feed processing, additives and novel feeds, Bikker and Jansman (2023) reviewed the composition and utilisation of animal feed by monogastric animals in the context of circular food production systems. In a circular food production system, cropland is primarily used for food production while farm animals receive diets based on crop residues, co-products from the food industry, grass from lands unsuited for food production, and food waste. Such diets have a lower starch and energy content, and a higher protein, fibre, and phosphorus content than commonly used diets. This has consequences for feed intake, digestive processes, the microbiome in the digestive tract, and the type and availability of nutrients for the animal. These consequences and future research questions for a better understanding and improved utilisation of such diets are discussed.

With regard to the topic about methods and technologies for research and smart nutrition, Sciascia and Metges (2023) updated our knowledge on methods and biomarkers to investigate intestinal function and health in pigs. Against the background of an increasingly critical public towards animal production and experiments in farm animals, the review reports methods and biomarkers to measure gut function and health recently used in pigs. A focus is on minimally or non-invasive methods that have already been used in pigs or can potentially be used but have not yet been validated in pigs. Future research is necessary to develop, standardise and validate new methods and biomarkers as well as tools that do not require the collection of animal samples such as sensors or modelling.

Finally, translational research was covered by Posey and Davis (2023) who wrestled with the nutritional regulation of muscle growth in neonatal swine. Understanding the mechanisms that regulate protein synthesis and lean growth in the neonate is instrumental for optimising the nutritional support for neonatal pigs. Additionally, challenges faced by low birth weight and early-weaned piglets are similar to morbidities in preterm and low birth weight infants, making the neonatal piglet a valuable model for both agriculture and biomedical research in elucidating anabolic pathway regulation. Improved understanding of the pathways regulating lean growth in the neonatal pig will provide important information to promote sustainability and efficiency for swine production and to improve health outcomes for at-risk infants.

Overall, these review papers provide comprehensive analyses of potential foresights on protein and energy metabolism and nutrition for a sustainable agriculture in the actual global panorama.

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Data and model availability statement

Not applicable.

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