



Proteins of the future

TEAGASC researchers are exploring opportunities for a more sustainable supply of protein as part of the ReValueProtein project.

Despite the fact that the protein needs of the growing global population, from a nutritional perspective, can be met by existing supply levels, the projected growth in demand for protein will require more sustainable and novel sources of supply. A recent paper published by Teagasc researchers in *Foods* (Henchion *et al.*, 2017) reviews current and potential future sources of protein, considering nutritional, environmental, technological and market/consumer factors.

It concludes that varying protein sources will be important for the future but that there are significant, and somewhat different, challenges in realising their potential as sustainable sources, and in ensuring food security.

Vegetal sources

Vegetal sources currently account for the vast amount of protein supply globally (57%); meat (18%), dairy (10%), fish and shellfish (6%), and

other animal products make up the remainder. Cereal proteins are particularly important in the human diet in developing countries; however, some plants do not contain high amounts of proteins (e.g., rice) and many lack one or more essential amino acids. Combining different protein sources and dietary supplements are two options to address this deficiency for individuals who want to increase the proportion of vegetal protein in their diets. Coeliac disease (auto-immune disease) and non-coeliac gluten sensitivity limit the role of such protein sources in some populations.

Cereals can offer additional health benefits due to the presence of bioactive peptides, which are known to have antioxidant, anti-inflammatory, cholesterol-lowering, satiety, anti-diabetic and other health benefits.

Plant-based protein is preferable to animal-based protein from a land-use and greenhouse gas emissions perspective, but high-intensity plant protein production has negative associations regarding water use, soil degradation and pollution.

Emerging protein sources include pulses, insects, algae and *in vitro* meat. Many of these offer significant environmental benefits; however, net environmental benefits cannot be assumed.

Animal sources

Concerns about animal-based protein relate to greenhouse gas production, land, water and energy use, biodiversity loss, and social and public health impacts. Many improvements have already been made in these areas as a result of better breeding, feeding and management; however, adoption of such technologies and practices is still low, and there is a need for significant knowledge transfer initiatives to be undertaken globally to achieve increased efficiency. On the positive side, animal-based protein is seen as important from a nutritional perspective and ruminants in particular have an important role in relation to food security, converting fibrous material, e.g., grass, which cannot be digested by humans, into high-quality protein. Animal-based protein is also generally well accepted by consumers and has a significant role in diets, lifestyles and culture. While there is some evidence of initiatives aimed at reducing animal-based protein consumption in developed countries, and meat and dairy production is restricted for religious reasons in some societies, animal-based protein is generally seen as “natural, normal, necessary and nice” (Piazza *et al.*, 2015). Livestock production is also important from an economic perspective in developing countries and, more locally, it is very important to Ireland’s rural economy, providing significant social benefits in such areas.

Emerging protein sources

Emerging protein sources include pulses, insects, algae and *in vitro* meat. Many of these offer significant environmental benefits; however, net environmental benefits cannot be assumed. Ethical benefits, e.g., animal welfare and the opportunity to develop products with high value added, are other benefits cited by supporters. Food safety, technical difficulties, production costs, and consumer issues present some challenges. Consumer attitudes towards many of these have not yet been fully formed due to their novelty; how these develop will clearly have a significant influence on adoption levels.

Future demand for protein

Given the projected growth in the global population, along with increased urbanisation and lifestyle changes, the future demand for protein is expected to increase significantly. Many sources of protein will be required to ensure that this demand is met in a sustainable manner and this will require a shift away from viewing sources of protein as ‘good’ or ‘bad’. Determining the optimum mix of sources will be a significant challenge, with great care required to ensure fair and appropriate comparisons between different sources and to give due consideration to economic, environmental and social aspects. All the necessary knowledge to make such decisions is not yet available. While life cycle assessments have indicated that plant-based diets use less land, for example, than animal-based diets, land use optimisation models have reported different results. Related research which finds that certain livestock systems can produce protein for humans more efficiently than crops could result in a reconceptualisation of livestock from being sources

of high-quality protein to being vehicles to use resources that cannot otherwise be used for food production (e.g., grasses and food by-products). Value chain developments will be important for both types of protein sources. New value chains will need to be developed for novel sources, but some restructuring of value chains for current sources will also be required. Stakeholders will be required to undertake roles in governance as well as in commercialisation to ensure that trade-offs are fairly accommodated and food security is ensured without compromising on sustainability. Multi-stakeholder action is required – highlighting the need for traditional actors in the supply chain to engage with NGOs and civil society actors, as well as policy makers.

Acknowledgements

This work forms part of the ReValueProtein Research Project (exploration of Irish meat processing streams for recovery of high-value protein-based ingredients for food and non-food uses; Grant Award No. 11/F/043) supported by the Department of Agriculture, Food and the Marine (DAFM) under the National Development Plan 2007-2013, funded by the Irish Government. Mark Fenelon, Anne Maria Mullen and Brijesh Tiwari, Teagasc Food Research Programme (Moorepark and Ashtown) also contributed to this work.

Further reading

Henchion, M., Hayes, M., Mullen, A.M., Fenelon, M. and Tiwari, B. (2017). ‘Future protein supply and demand: strategies and factors influencing a sustainable equilibrium’. *Foods*, 6 (7): 53. Available at: <http://www.mdpi.com/2304-8158/6/7/53>.
Piazza, J., Ruby, M.B., Loughnan, S., Luong, M., Kulik, J. Watkins, H.M. and Seigerman, M. (2015). ‘Rationalizing meat consumption. The 4Ns’. *Appetite*, 91 (1): 111-128. Available at: <https://doi.org/10.1016/j.appet.2015.04.011>.

Authors

Maeve Henchion

Head of Department of Agrifood Business and Spatial Analysis, Rural Economy and Development Programme, Teagasc, Ashtown, Dublin 15

Correspondence: maeve.henchion@teagasc.ie

Maria Hayes

Research Officer, Food Bioscience Department, Food Research Programme, Teagasc, Ashtown, Dublin 15

