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EDITED AND REVIEWED BY
Christine Janet Nicol,
Royal Veterinary College (RVC),
United Kingdom

*CORRESPONDENCE

Jeff Wood
✉ jeff.wood@bristol.ac.uk

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Editorial: Animal-derived foods in our diets: nutrition, health and social implications

Jeff Wood^{1*}, Carlotta Giromini² and Ian Givens³

¹Bristol Veterinary School, University of Bristol, Bristol, United Kingdom, ²Department of Veterinary Medicine and Animal Science, University of Milan, Milan, Italy, ³Institute for Food, Nutrition and Health, University of Reading, Reading, United Kingdom

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Editorial on the Research Topic

Animal-derived foods in our diets: nutrition, health and social implications

Animal-derived foods (ADFs), including meat and meat products, milk and dairy products, fish and eggs, contribute vital nutrients to the diets of people around the world and low intakes have been linked to conditions such as stunted growth, poor bone development and anaemia. At the same time there is concern that some ADFs may pose a risk to health. There is also increasing worry about the environmental cost of some modes of ADF production and with the welfare of the animals involved. The aim of this Research Topic was to assemble a collection of research reports and reviews which give the reader insights into these important topics. Fourteen papers were published which included five reports on original research. Broadly, the papers have covered the whole food chain from the diet of the animal to food quality, human health, consumer attitudes, and food by-products.

Egelandsdal et al. highlighted the fact that animal breeding and feeding have been mainly focused on profitability and yield rather than improving the nutritional quality of ADFs. They proposed that sustainable food production from animals should be within the 'One Health' for animals and humans concept. Edirisinghe et al. reviewed the feed to fork concept for the use of sugarcane products as feeds for animals (pigs, poultry, ruminants and fish). They concluded that sugarcane products had promise for promoting growth in pigs, poultry and fish, in part by modulating inflammatory responses and enhancing immune cell activities. They also highlighted beneficial effects on meat tenderness but concluded that more research was needed. Another review examined the enrichment of ruminant meat with health benefiting fatty acids by appropriate animal diets (Ponnampalam et al.). They concluded that high quality pasture was superior for producing ruminant meat enriched with health enhancing fatty acids, notably those of the n-3 PUFA family. The paper of Halmemies-Beauchet-Filleau et al. showed that milled rapeseeds and oats in the diet of dairy cows not only reduced saturated fatty acids in the milk fat by 16-20%, increased *cis*-MUFA by about 50% but also reduced methane production by the cows by 20%. In addition, the organoleptic quality of the milk, butter, and cheese produced was not compromised by the modified lipid profile.

The paper of Eun demonstrated that changing dietary patterns in a region of South Korea, resulting from an outbreak of African Swine Fever, resulted in a reduction of

household carbon dioxide emissions. This illustrated the fact that human dietary change can have a direct impact on the environment. The review by Wood et al. compared the environmental impact of ADFs when expressed per 100g of protein produced vs. the traditional per kg of food product. The former is a more realistic comparison but still disregards other beneficial nutrients present in many ADFs. Both comparisons showed ruminant meat to be linked with the highest environmental impact among foods.

Wood et al. also highlighted the substantial variation that exists in the nutritional composition of the different ADFs which is often ignored when plant-based alternative foods are proposed as a replacement. Smith highlighted the health benefits of oleic acid in the diet and what animal related diet and genotype factors influence its concentration in beef. They also concluded that there is little correlation between concentrations of fatty acids and the flavour of beef unless there are differences in the diet of the animal which can contribute to flavour (e.g. grass vs. grains).

Various aspects of the associations between ADFs and human health were covered in eight of the contributing papers. Wood et al. reviewed associations with chronic diseases in some depth with key conclusions that milk/dairy products have a broadly neutral association with CVD with some evidence that fermented dairy has been associated with a reduced risk of type 2 diabetes. A key conclusion was that higher intakes of processed meat are associated with increased risk of CVD, colorectal cancer and possibly dementia. This supports the current dietary guidance that consumption of processed meat should be low. There is still no clear understanding of what are the damaging components of processed meat and which processed meats pose the greatest problems. Ruedlinger et al. reported on a cross-sectional study in Chile examining processed meat consumption in the MAUCO cohort. Processed meat consumption is increasing and this study found that high consumption of it was associated with frequent consumption of other unhealthy foods and alcohol and was associated with increased risk of CVD. No association was found between self-reported cancer and processed meat, but the cohort does reside in a region with a high mortality rate for colon cancer. It is notable that Fairweather-Tait highlighted that haem iron, typically present in red meat, has a bioavailability consistently higher than non-haem iron present in plants and cereals and discusses the implications of this for vegetarian and vegan diets. It is recommended that vulnerable groups such as teenage girls and women of child-bearing age should have careful monitoring of their iron status. Xu et al. reviewed the health effects of naturally occurring trans fatty acids in foods from ruminants with focus on evidence from mainly observational studies suggesting their association with reduced risk of type 2 diabetes. It was concluded that this benefit has not been seen in some animal studies or human clinical trials although so far, the number of such studies is low. Nutritional issues in low- and middle-income countries (LMIC) were reviewed by Tiwari et al. with a focus on the benefits of ADFs, and eggs in particular, for improving nutrition, health and growth of young children. Whilst the evidence for the benefits of eggs is strong, there are few studies in LMIC, where there are social and cultural barriers to egg consumption. A key conclusion is that governments should develop policies that make eggs more

affordable and have education targets to counter sociocultural factors which restrict egg consumption.

Additional aspects of consumer attitudes relating to food quality were considered by other contributing papers. Mulders et al. examined the factors which drive fresh pork purchase in China. They concluded that buying fresh meat is mostly driven by the anticipated pleasure and less by perceptions of quality, safety and healthiness. Lavranou et al. reported on the attitudes of Irish consumers towards hypothetical food products derived from beef offal sources which have been shown to contain worthwhile amounts of high-quality protein. Overall, they found that consumers who had been given benefit information regarding health and the environment of consuming the protein-containing products from beef offal had a more positive attitude toward the products. However, interestingly, the provision of benefit- and risk-orientated information at the same time also had a positive effect on deliberative evaluations. It was concluded that the results have implications for the development of new products and for strategies concerning sustainable food production and consumption.

The recycling of meat processing by-products is covered in two papers. The work of Lavranou et al. clearly represent a route by which products at the end of the meat processing chain can be usefully used. This subject of dealing with meat processing by-products was tackled in depth by Woodgate. Their review gives a history of the so-called rendering process and how it was impacted by the bovine spongiform encephalopathy (BSE) epidemic in Europe. It concluded that rendering is now regarded as an essential part of the food chain that correctly prioritises human and animal health and can now produce safe and environmentally sustainable products which benefit society.

Some papers in the Research Topic noted differences between countries and regions of the world in the conclusions from studies and in the approaches taken by governments. Wood et al. showed that the harmful effects of some ADFs on health have mainly been observed in high-income rather than LMIC. This could be due to differences in intakes. In some high-income countries, governments have considered the use of legislation to reduce the production of ADFs.

We are certain that this special Frontiers Research Topic has stimulated the production of excellent contributions that are concerned with many of the issues in the pathway of food production from animals through food processing, choice, consumption, human health and environmental impacts plus the final step of dealing with the end products of meat processing. The papers also confirm the high degree of diversity both within and between ADFs. This and related nutrition and health characteristics of these foods need to be fully accounted for in decisions concerning their replacement by plant-based alternatives. As always, there are issues that need further research, but the papers have highlighted many of these topics which will aid future thought and research planning.

Author contributions

JW: Writing – original draft. CG: Writing – original draft. IG: Writing – original draft.

Conflict of interest

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