

Review on Animal Free Strategies

Rosa Lappi*

VTT Technical Research Centre of Finland, Espoo, Finland

*Corresponding author: Rosa Lappi, VTT Technical Research Centre of Finland, Espoo, Finland, E-mail: lappi_r@gmail.com

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Description

A wide range of nutritional and non-nutritional factors influence milk fat synthesis and explain the large variation observed in dairy herds. The capacity of the animal to synthesize milk fat will largely depend on the availability of substrates for lipid synthesis, some of which originate directly from the diet, ruminal fermentation or from adipose tissue stores. The mobilization of non-esterified fatty acids from adipose tissues is important to support the energy demands of milk synthesis and will therefore have an impact on the composition of milk lipids, especially during the early lactation period.

Adverse Outcome Pathways

Such mobilization is tightly controlled by insulin and catecholamines, and in turn, can be affected indirectly by factors that influence these signals, namely diet composition, lactation stage, genetics, endotoxemia, and inflammation. Environmental factors, such as heat stress, also impact adipose tissue mobilization and milk fat synthesis, mainly through endotoxemia and an immune response-related increase in concentrations of plasma insulin. Indeed, as proposed in the present review, the central role of insulin in the control of lipolysis is key to improving our understanding of how nutritional and non-nutritional factors impact milk fat synthesis. This is particularly the case during early lactation, as well as in situations where mammary lipid synthesis is more dependent on adipose-derived fatty acids.

Methods and approaches that can be used in food and nutrition research are changing at a faster pace than ever. With regards to methods and approaches used to study the safety of foods and food ingredients, these have been reviewed in Part I and include the development of Thresholds Of Toxicological Concern (TTC), read-across and grouping strategies, Adverse Outcome Pathways (AOPs) and associated in vitro assays to determine perturbations to key events in AOPs. Members of the International Life Sciences Institute (ILSI) Europe have formed an expert group to review possibilities, opportunities and challenges for the potential use of non-animal testing strategies in nutrition research, which can ultimately be used in support of regulatory submissions for pre-market authorisation. In this article, non-animal methods or approaches refer to the 3Rs concept, meaning the use of animal-free methods when and

where possible, but any opportunity to reduce or refine would also be appropriate.

This article is part of a series evaluating the current legislative requirements in Europe in the field of food safety and nutrition research in light of the use of animal testing and opportunities for transformation or a paradigm-shift. Furthermore, it informs about approaches and methods to contribute to this transformation, following the principles of the 3Rs that were developed over 50 years ago. In section II, EU legislation pertaining to nutrition research and assessment are generally discussed with regards to animal and non-animal testing requirements. Section III discusses legislation of specific food groups, and section IV reviews regulations dealing with health claims on foods. Section V informs about approaches and methods with the potential to contribute to a shift to non-animal testing strategies in nutrition research and assessment, focussing on organoid cultures, organ-on-a-chip systems, and gastrointestinal tract simulators. In so doing, the article provides a framework for non-animal testing strategies for nutrition assessment to meet testing demands now and in the future.

Animal Product Scenarios

We investigated the potential contribution of animal products to a balanced diet in four different scenarios for each national FBDG. We solely focussed on animal products and therefore did not aim to provide realistic alternatives for the FBDGs used, but rather to explore the full range of options on the basis of LOCB for different nutritional foci. The scenarios all met the circular food system principle of avoiding feed food competition, meaning that animal products only originated from animals fed on LOCB. The availability of LOCB was restricted to the production pattern resulting from the plant products of the respective national FBDGs.

In the first alternative scenario, max prot, LOCB was allocated to the different animal production systems such that human-digestible animal protein was maximised. Along with protein, animal products contain multiple essential nutrients for humans, such as essential fatty acids, vitamins A, D3, and B12, calcium, iron, and zinc. To take the specific nutritional functions of animal products in the diet into account, we used three scenarios that put different emphasis on three main nutrient groups: omega-3 fatty acids, minerals, and vitamins. In each of these scenarios, one of the respective groups of nutrients was maximised instead

of protein. The scenario max fatty acids maximised the sum of the omega-3 fatty acids α -linolenic acid, Docosa Hexaenoic Acid (DHA), and eicosapentaenoic acid, the scenario max minerals maximised the sum of the minerals calcium, iron, and zinc (in mg), and the scenario max vitamins maximised the sum of vitamins A and B12 (in μ g). Vitamin D3 was not considered because ultraviolet B radiation from sunlight is the main source of its synthesis and only a small proportion is derived from dietary sources. We applied these three scenarios to show which nutritional functions of the original FBDGs could be met with animal products from LOCB, and which animal products are essential for which nutritional functions.

To our knowledge, this is the first study that assesses environmental consequences and nutritional contributions of

national food-based dietary guidelines while considering circular food system principles. We applied our approach to five case studies in Europe, and thereby provide a proof of concept for contrasting situations with different geographical and cultural settings. Although we found that all national guidelines recommend more and different animal-source food than would be optimal from a resource-use and environmental perspective, we also reported substantial differences between the five case study countries. These findings stress the importance of including environmental considerations in national guidelines, and provide an estimate for potential targets for the inclusion of circular livestock in dietary guidelines as well as in current diets.