Annex 3- Wider Impacts Considered in Case Study Workshop

In this guide

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1. Introduction

1. Three case studies (aspartame, seaweed, nitrite/nitrate) were used to convene discussions among experts on possible wider impacts. Discussions were focused on major impacts or impacts highlighted in published work. It was possible to identify several marginal impacts. However, compiling an exhaustive list of all possible impacts was not considered practical; each case therefore focused on a short list of impacts. The long list of potential impacts summarised in Table 1 was used to align discussions and it became clear, for the case studies examined, that the significant impacts were wider human health considerations and environmental sustainability. In addition, wider consumer interests and technical feasibility of options featured in some of the discussions notably aspartame and nitrite/nitrate.

2. It was evident from these discussions that, for some impacts, there is a lack of scientific consensus and newly published data is emerging continuously, meaning a constantly changing evidence base. Therefore, the weight of evidence may vary considerably.

3. The workshop highlighted a key challenge overall in moving from consideration of the narrow and immediate impact of a single product in the diet to a holistic assessment of the impact on diet and food systems overall. An additional, but related, challenge was the need to combine the evaluation of different sources and types of evidence with different levels of weight and quality. Some peer-reviewed research may not be as trustworthy as in the past requiring additional assurance steps to ensure the quality of evidence. It was suggested that the process could be supported by the development of criteria for stratification of products and/or “at risk” groups.

4. In assessing the wider environmental/sustainability impact, it was noted that the evidence base is limited with some life cycle analyses and environmental impact assessments (EIA) in the USA and Europe. Moreover, the existing evidence has high context-dependency so that for a food such as seaweed, for example, existing evidence from very large-scale farms in Asia are unlikely to be applicable to lower intensity farming in UK and European waters (but still relevant to imports). Again, for seaweeds, EIAs carried out through the farm licensing process for territorial waters would not translate to deep sea farming in international waters (nor would the assessment indicate the cumulative impact of multiple farms).

5. Possible approaches to economic analysis were not discussed in the Workshop, but it was noted that economic data could be used once it was agreed that evidence indicated an impact (e.g., impacts of reductions in obesity on NHS costs, employers, etc).

6. Wider Impacts thinking cuts across sectors and national borders; there is need to avail of views and evidence from elsewhere in designing a best practice approach.

2. Public Health

2.1 Nutrition

7. The nutritional quality of diets is a major wider impact consideration. Beyond nutrients, diets contain many substances with demonstrated biological benefits (e.g., antioxidant phytochemicals, modulators of the gut microbiome). In addition, the development and availability of products that are lower in sugar, total and saturated fats and salt is a major route to better nutrition. The public health consequences of excess dietary sugars include overweight and obesity;

diabetes; coronary heart disease; dental caries; and several other associated pathologies. Government food policy responses have included education, labelling, taxation (in the case of carbonated beverages), and the encouragement of product reformulation by manufacturers.

8. While SACN (2023) did not consider wider impacts in relation to food processing and health, the report highlighted the limitations of the many current food classification systems, including relationship of classification systems and nutritional content, relationship with existing dietary recommendations and the use of subjective, poorly defined terms such as “natural”, “wholesome” etc. The SACN (2023) report recommended future research on potential adjustments to NDNS methodology, a classification system that could be reliably applied to foods consumed in the UK and a future risk assessment that would consider the full range of benefits and risks of food processing on the health of the UK population.

9. As the methodology and interpretation of the primary research data on the benefits of dietary low calorie artificial sweeteners is complex, evidence synthesis is heavily dependent on the consensus of professional bodies. The public health benefits are mainly nutritional and include the management of calorie intake and body weight as well as the reduction in post-prandial blood glucose levels, which is especially important in diabetes. As mentioned below, there are marked technical challenges in the replacement of sugars in solid foods compared with drinks.

10. The British Dietetic Association (2016) policy statement on the use of artificial sweeteners states that “adding an artificial sweetener to a food product instead of sugar enables food manufacturers to provide an alternative for consumers which can be a useful strategy for those individuals seeking to control their calorie intake and manage their weight”. The UK National Centre for Clinical Excellence (NICE, 2015), guideline on preventing excess weight gain recommended several evidence-based approaches including the avoidance of sugary drinks that contain free sugars and included products containing non-nutritive sweeteners in the list of alternative products. The WHO (2023) issued a guideline on the use of “non-sugar sweeteners” with a conditional recommendation that “non-sugar sweeteners not be used as a means of achieving weight control or reducing the risk of noncommunicable diseases”.

11. There is much interest in the use of seaweeds to alleviate metabolic risk factors such as hyperglycaemia, hypercholesterolemia and hyperlipidemia with candidate bioactive components being isolated, polysaccharides (alginate,

fucoidan), proteins (phycobiliproteins), polyphenols (phlorotannins), carotenoids (fucoxanthin) and n-3 long-chain unsaturated fatty acids (eicosapentaenoic acid). Although there are some specific systematic reviews in some aspects of health benefits/risks from seaweed consumption, evidence is generally lacking. Consumption of seaweeds might also replace some minerals usually obtained through consumption of red meat.

12. It would be expected that any evidence for human health benefits/risks would have high context-dependency varying with geographic location/season/seaweed species/harvesting technique/processing methods etc. and also be influenced by the method of food preparation adopted by the consumer.

13. Indirect human health impacts through livestock-fed seaweed have rarely been studied.

2.2 Consideration of population sub-groups including vulnerable consumers

14. It was noted that impacts may differ across population sub-groups. This may necessitate careful analysis of distributional impact, e.g., disease and health status, income, age, geography, etc. While an overall (or average) impact may be low, for some groups the evidence may be stronger and/or the impact may be significant. In the context of the three case studies, the only obvious example of a sub-group needing special consideration was consumers managing (pre)diabetes.

15. For consumers managing (pre)diabetes, blood glucose control is essential. The European Association for the Study of Diabetes (EASD, 2023) concluded that there was moderate evidence supporting the use of non-nutritive sweeteners in carbohydrate management in diabetes. The Diabetes UK (2018) Position Statement concluded that replacing free sugars with low calorie sweeteners can be a useful strategy in glucose management in diabetes.

2.3 Dental health

16. There is evidence for a benefit to dental health of sugar replacement with intense non-nutritive sweeteners. Non-fermentable, non-acidogenic substitutes pose a much lower risk than fermentable sugars (Gupta et al., 2013). The Workshop suggested that low sugar does not automatically mean an improvement in dental health as many factors, notably frequency of consumption, are involved.

2.4 Wider Food Safety Considerations

17. While the primary technological purpose of nitrite/nitrate containing products is the prevention of C. botulinum germination and growth, there may be a secondary benefit of growth inhibition of some other pathogens such as Listeria monocytogenes and E. coli O157:H7 (Fraqueza et al., 2021). A lack of quality data makes it difficult to weigh the evidence of wider impacts. Cases of botulism are now rare for a variety of reasons (not limited to the use of nitrite and nitrate in meat curing). Product quality is generally much higher than in the past.

18. Production of seaweeds in polluted inshore waters can lead to accumulation of heavy metals such as cadmium, lead and mercury. Regulation for seaweeds is patchy. There is an absence of Codex standards or guidelines for food safety aspects of seaweed production, processing and use.

19. Wild harvesting of seaweed for personal consumption from areas close to shore may raise health concerns if the local water is contaminated with sewage and/or heavy metals.

3. Wider Consumer Interests

20. The Workshop pointed to a need for more analysis of what could be considered “misleading” especially in the context of emerging claims and products perceived as more healthy. The Digital Markets, Competition and Consumers Act 2024 does not give specific food examples. Product comparisons should take care not to mislead the consumer or to denigrate products complying with current regulations. Greenwashing was highlighted as an area of concern at the Workshop. Currently the Green Claims code published by the Competitions and Markets Authority applies whenever a green claim is made by a business for a consumer. The Green Claims Code (UK Competition and Markets Authority, 2021) sets out the principle’s businesses need to know to ensure the environmental claims they make are accurate and not misleading.

21. Several publications have pointed to the provision of consumer choice and manufacturer options to formulate healthier products. Sweet taste is an integral part of the enjoyment of food. Removing or replacing sweetness in the diet can be very challenging. In response to continued consumer demand, and more recently also in response to sugar taxes introduced to combat obesity, producers of soft drinks have further reformulated products to reduce sugar substantially. It was underlined that the technical solutions applicable to soft drinks are not easily

translated to sugar replacement in solid foods (see Technical Feasibility of Options).

22. The UK Soft Drinks Industry levy (UK Government, 2023) applies to ready-to-drink products and from diluted concentrates containing >5% w/v sugar. The levy is payable by the packagers. Without reformulation or product withdrawal, the added costs are borne by consumers and businesses. Non-sugar sweeteners enable the delivery of alternative products.

3.1 Labelling

23. The drive to produce “clean label” products coupled with consumer concern about some food additives and ingredients has driven innovation in recent years (e.g., “no added nitrite” claims). Research on effective alternatives to nitrite and nitrate has taken place for several decades.

24. A dietary shift involving significantly higher seaweed consumption may require additional regulatory measures (e.g., labelling) if, for example, some consumers were found to be at risk of excessive iodine consumption.

3.2 Risk and Benefit Perception

25.Some products may have a “halo” effect leading to a perception of healthiness that may lead to unintentional consequences e.g., overconsumption. It was noted that the communication of risks and benefits was complicated by information in the social media. There is an opportunity to draw out the different dimensions of consumer perception including the generation of evidence and its application in decision making. This implies a need to develop a deeper understanding of the relationship between perception and behaviour, i.e. the “why” of consumer decisions and not just the outcome.

26. A key factor in supporting consumer interests and health will be the provision of information on available options in making healthy dietary choices. Aspartame has received a great deal of media attention due to a number of controversial studies published in the scientific literature. Recent regulatory reviews of aspartame have been undertaken and offer reassurance that products containing the sweetener are safe.

27.For a variety of reasons, there is consumer perception that added nitrite salts in meat curing are potentially harmful. There is little publicly available data with which to compare alternatives. Generally, information available on websites and

on social media makes stronger claims than can be used on labels. The association between processed meats and cancer is well established. A perception that some products are safer could drive higher consumption. The promotion of products claiming benefits of dietary nitrate (e.g., for athletes) alongside the concerns raised about safety may contribute to consumer confusion.

4. Agrifood System

4.1 Technical Feasibility of Options

28.Workshop participants agreed that an understanding of technical options and alternatives is key. In the area of sugar replacement, the technical feasibility of the various options plays an important role in determining choice of sweeteners. Different high-intensity sweeteners have different technological applications and limitations. For example, the main application of aspartame in food formulation is in soft drinks where the sugar does not have a role as a bulking agent. In many solid foods, sugar may contribute to bulk, mouthfeel and other properties as well as sweetness. In many instances, technical solutions may need to identify an alternative non-sugar bulking agent to replace the sugar.

29. The processes for curing meats have grown more diverse in recent years. Data on efficacy of the various approaches for prevention of pathogen growth are not always publicly available. Based on the large volume of research to date, it would appear, at least for some applications, that published data are not available to support the replacement of nitrite in all preservation applications. Equally, it is not yet clear how much of a risk can be ascribed to nitrite and nitrate salts deliberately added in meat curing compared with naturally occurring nitrite and nitrate.

4.2 Other factors

30. Increased production of seaweeds in UK waters may contribute beneficially to local and UK economies but will result in a requirement for onshore processing facilities and disposal of waste.

31. Imported seaweed products may raise issues of the acceptability of labour protection and standards.

32. There is limited evidence and contradictory evidence on the effect of feeding seaweeds on greenhouse gas emissions from ruminant animals and limited and contradictory evidence for animal health/productivity outcomes. Source and production/processing method to produce animal feed can all be anticipated to affect these.

5. Environmental impacts and sustainability

5.1 Food Waste

33. Impacts on product organoleptic quality associated with the designed technological purpose may lead to a reduction in food spoilage and help minimise waste. For example, nitrite improves the colour of processed meat products. Traditionally cured meat products are generally less susceptible to oxidation than uncured meats. It might be possible to elucidate whether such factors might impact food waste from available data (e.g., industry or WRAP, Waste and Resources Action Programme).

34. Manufacturing considerations may impact heavily on waste and emissions. For example, products with shorter shelf lives may necessitate shorter production runs with more frequent retail deliveries, higher costs and potentially the cost of less export opportunities. Most of the data relating to production costs are not in the public domain.

5.2 Carbon, Ecology and Biodiversity

35. The Workshop highlighted the growing availability of data on the environmental impact of manufacturing in particular carbon footprints. For example, an environmental life cycle assessment of aspartame indicated a reduction in global warming potential compared with an equivalent sweetness of sucrose (Suckling et al., 2023). However, there is considerable uncertainty in this analysis due to the shortage of publicly available data.

36. While growing seaweeds would contribute to carbon sequestration, processing (e.g., freezing/drying) and transport would also contribute to greenhouse gas emissions.

37. Several organisations are currently preparing guidance on minimising environmental damage resulting from seaweed aquaculture (e.g., The Nature Conservancy (2021). Other sources of evidence might arise from:

- Evidence mapping, further systematic reviews, expert elicitation (cognitive diversity), recognising context dependency of impacts. The process used for this is key – e.g., systematic mapping, PAS440 (responsible innovation), Foresight approaches. Stratification of evidence by, for example, geographic location affects impacts.

- Adoption of hierarchical approaches – e.g., initial regulation against harmful production practices/potentially invasive species, followed by health and/or environmental impact assessment for individual farm plans. Note, the environmental impacts of imports are not captured in existing UK impact assessment frameworks.

38. Experimental approaches to evaluate and monitor impacts at scale (cf. action research) may also be required.

39. The increased prevalence of diseases and pests affecting aquaculture production worldwide is a major global concern. This issue is intensified by a reduction in genetic diversity associated with the domestication of wild seaweed species making crops more susceptible to abiotic stressors, disease and parasites. Cultivation sites will replace existing habitats with novel man-made habitats by virtue of physical and biological changes associated with suspended cultivation infrastructure. Habitats created may be characterised by: increased complexity including the physical presence of the structure itself; the addition of hard artificial substrate; pulses of seaweed growth consistent with growing cycles; and altered physical and chemical properties of the surrounding water.

40. Domestication of wild seaweed cultivars may be an unavoidable consequence of large-scale seaweed cultivation practices. Cultivated seaweeds would most likely be characterised by a human imposed shift in their reproductive strategy (e.g., from outcrossing to self-fertilizing and from sexual reproduction to vegetative reproduction) introducing genetic bottlenecks that may narrow the genetic diversity of cultivated stands potentially making them more susceptible to environmental changes and disease.

41. Sea-based farms may act as stepping stones for non-native species thereby spreading parasites and pathogens that can reduce the productivity of native species and/or obstacles for fauna. There is also the possibility that any introduced farmed species may become invasive and/or provide obstacles for

native fauna. Competition for light is important in structuring aquatic algal communities, and this has been demonstrated in the changed algal communities occurring in shaded understoreys. Light intensity and its quality is directly altered by the water column itself, as well as indirectly by vegetation. Maerl beds and seagrass communities should be avoided when considering possible sites.

42. Competition between cultivated algae and phytoplankton can be expected at times in the production cycle where algae growth is rapid and natural renewal of nitrogen resources is affected by altered water exchange. Where projects are large-scale and have high stocking densities, depletion of phytoplankton communities could have negative implications for some aquatic species in affected areas.

43. The removal of carbon dioxide by cultivated algae in an open, freely-moving water body is likely to have a negligible effect on pH and unlikely to lead to any other detrimental effects on water chemistry within cultivation sites and surrounding areas. When CO2 reacts with water it forms a balance of ionic and non-ionic chemical species including free carbon dioxide, carbonic acid, bicarbonate and carbonate, the ratio of which depend on many factors such as temperature and pH.

44. In an open, freely moving water body the effects of carbon removal from large scale cultivation is likely to have a negligible effect on pH. Seaweed farms require water flow to encourage growth and will absorb and deflect tidal and wave energy altering flow conditions in connected habitats (including local geomorphology at large scales). How cultivation structures alter coastal hydrology is an important factor in determining the ecological implications at different scales.

45. The largest proportion of artificial material added to the marine environment will likely consist of a mixture of synthetic polymer rope (e.g., polypropylene). These materials are typically designed to be highly resistant to degradation in the marine environment. Pollution caused by discarded or lost components may contribute to marine pollution if seaweed farms are improperly managed. Once lost from the farm, debris may contribute to existing environmental pollution issues such as increasing levels of plastics in marine food webs or social concerns such as the reduction in coastal amenities due to drifting debris. These negative impacts should be mitigated through best practice guidance and regulation.

References

Boobis, A., Chiodini, A., Hoekstra, J., Lagiou, P., Przyrembel, H., Schlatter, J., Schütte , J., Verhagen, H. and Watzl, B. (2013), Critical appraisal of the assessment of benefits and risks for foods, 'BRAFO Consensus Working Group', Food Chem. Toxicol. 55, 659–675 (https://doi.org/10.1016/j.fct.2012.10.028)

British Dietetic Association (2016), Policy Statement on The Use of Artificial Sweeteners, (https://www.bda.uk.com/static/11ea5867-96eb-43df-b61f2cbe9673530d/policystatementsweetners.pdf)

Conners, C., Malan, L., Esposito, M., Madden, C., Trikka, N., Cohen, M., Rothery, F., Reynolds, C., Sheppard, C., Canavan, S., Saint Warrens, S., Sissoko, F., Coker, E., Tulej S. and Birch, R. (2022), The UK Public's Interests, Needs and Concerns Around Food, Research conducted for the Food Standards Agency and Food Standards Scotland by Bright Harbour, in partnership with Esposito Research and Strategy and And Good, (https://doi.org/10.46756/sci.fsa.ihw534)

https://www.food.gov.uk/sites/default/files/media/document/The%20UK%20Public%27s%20%20Main%20UK%20report.pdf

Department for Business and Trade (2023), Better Regulation Framework, September 2023.

Department for Energy Security and Net Zero (2023), Valuation of energy use and greenhouse gas (GHG) emissions, November 2023.

Department for Environment, Food and Rural Affairs (Defra)(2023a), Enabling a Natural Capital Approach Guidance (ENCA).

Department for Environment, Food and Rural Affairs (Defra)(2023b), Policy paper

Environmental principles policy statement, Updated 31 January 2023

Diabetes UK (2018), The use of low, no calorie sweeteners. Position Statement (Updated: December 2018). Diabetes.org.uk.

Digital Markets, Competition and Consumers Act (2024),https://www.legislation.gov.uk/ukpga/2024/13

EASD (2023)(European Association for the Study of Diabetes, The Diabetes and Nutrition Study Group), Evidence-based European recommendations for the dietary management of diabetes, Diabetologia 66, 965–985; https://doi.org/10.1007/s00125-023-05894-8.

EC (2006), COMMISSION REGULATION (EC) No 1881/2006 of 19 December 2006 setting maximum levels for certain contaminants in foodstuffs

EC (2008), REGULATION (EC) No 1331/2008 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 16 December 2008 establishing a common authorisation procedure for food additives, food enzymes and food flavourings

EFSA (2010), Scientific Committee. Guidance on human health risk–benefit assessment of food. EFSA J. 8, 1673–1713.

FAO (2018), Sustainable Food Systems. Concept and Framework. www.fao.org

FAO and WHO (2022), Report Of The Eighty Third Session Of The Executive Committee Of The Codex Alimentarius Commission Rome, 14-18 November 2022, Appendix II: Guidance For Codex Chairpersons And Members On The Application Of The Statements Of Principle Concerning The Role Of Science In The Codex Decision Making Process And The Extent To Which Other Factors Are Taken Into Account, https://www.fao.org/fao-who-codexalimentarius/meetings

FAO and WHO (2023a). Codex Alimentarius Commission Procedural Manual. Twenty-eighth edition, revised. Rome. https://doi.org/10.4060/cc5042en

FAO and WHO (2023b), Application Of The Statements Of Principle Concerning The Role Of Science In The Codex Decision-making Process And The Extent To Which Other Factors Are Taken Into Account (Sop), (Analysis of responses to CL 2023/32/OCS-CAC), CX/CAC 23/46/21 October 2023, https://www.fao.org/fao-who-codexalimentarius/meetings

Food Standards Act (1999), www.food.gov.uk.

FSA Board Paper (19-03-08) Risk analysis: assurance. https://webarchive.nationalarchives.gov.uk/ukgwa/20210724132509/https://www.food.gov.uk/fsa-board-meeting-march-2019

Fraqueza, M.J., Laranjo, M., Elias, M. and Patarata, L. (2021), Microbiological hazards associated with salt and nitrite reduction in cured meat products: control strategies based on antimicrobial effect of natural ingredients and protective microbiota, Curr. Op. Food Sci.38, 32-39. (https://doi.org/10.1016/j.cofs.2020.10.027)

Green Book (2022), Central Government Guidance on Appraisal and Evaluation, HM Treasury.

Gupta, P., Gupta, N., Pawar, A.P., Birajdar, S.S. Natt, A.S. and Singh, H.P. (2013), Role of Sugar and Sugar Substitutes in Dental Caries: A Review; ISRN Dentistry Vol. 2013, Article ID 519421, http://dx.doi.org/10.1155/2013/519421.

House of Commons (2023), House of Commons. Environmental Audit Committee (2023), Environmental Change and Food Security, Second Report of Session 2023-24, 29 November 2023. www.parliament.uk/eacom/

Magenta Book (2020), Central Government Guidance on Evaluation, HM Treasury.

NICE (National Centre for Clinical Excellence) (2015), Preventing excess weight gain. NICE guideline [NG7] https://www.nice.org.uk/guidance/NG7/chapter/1-recommendations.

OFT (2008), Guidance on the Consumer Protection from Unfair Trading Regulations 2008, Office of Fair Trading.

Renn, O (2006), White paper on Risk Governance. Towards an Integrative Approach, IRGC, Lausanne. www.irgc.org.

SACN (Scientific Advisory Committee on Nutrition)(2023), SACN statement on processed foods and health, www.gov.uk/government/groups/scientific-advisory-committee-on-nutrition

Suckling, J., Morse, S. Murphy, R., Raats, M., Astley, S., Halford, J.C.G, Harrold, J.A., Le-Bail, A., Koukouna, E., Musinovic, H., Raben, A., Roe, M., Scholten, J., Scott, C. and Westbroek, C. (2023) Environmental life cycle assessment of production of the non-nutritive sweeteners aspartame (E951) and neotame (E961) from chemical processes: The SWEET project, Journal of Cleaner Production, 424, 138854. (https://doi.org/10.1016/j.jclepro.2023.138854)

Tait, J., Banda, G. and Watkins, A. (2017), Proportionate and Adaptive Governance of Innovative Technologies (PAGIT): a framework to guide policy and regulatory decision making. Innogen Institute Report to the British Standards Institution. https://web.archive.org/web/20200530195125/http://www.innogen.ac.uk/sites/default/files/04/PAGIT%20FrameworkReport-Final_170717.pdf

The Nature Conservancy (2021) Global Principles of Restorative Aquaculture. Arlinton, VA, USA.

UK Competition and Markets Authority (2021), Green Claims Code, https://greenclaims.campaign.gov.uk/

UK Government (2023), https://www.gov.uk/money/soft-drinks-industry-levy.

World Health Organisation (WHO)(2023), Use of non-sugar sweeteners. WHO Guideline, WHO Geneva.

World Trade Organisation, Agreement on Technical Barriers to Trade, www.wto.org/english/docs_e/legal_e/17-tbt_e.htm