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MICROBES AND THE FOOD SUPPLY

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- Food-poisoning and infectious diseases of crops and livestock affect public health, animal welfare and trade.
- Microbiologists help combat these threats, to maintain a safe and secure food supply from plough to plate.
- Current microbiological research focuses on new methods to track food-poisoning, control emerging crop and livestock diseases, and recycle organic waste.

SUMMARY

Microbiology is vital to preserve a sustainable, safe and secure food supply. Microbiological knowledge helps us cut rates of food-poisoning, and monitor and control the microbes that cause disease in our crops and livestock. We also depend upon our knowledge of microbial chemistry to convert raw agricultural materials into key products such as bread, coffee, soy sauce, vinegar and yoghurt. Microbes can even be used to recycle food waste into bio-energy through a process known as anaerobic digestion. Current scientific research focuses on new methods to track cases of food-poisoning in our complex food system, control emerging crop and livestock diseases, and recycle organic waste.

FOOD SAFETY IN A COMPLEX SUPPLY CHAIN

Each year in the UK, bacteria such as *Salmonella*, *Escherichia coli* O157, *Campylobacter* and *Listeria* cause hundreds of cases of serious food poisoning.[1] Everyone in our complex, multi-national food supply chain – from farmers to food manufacturers, regulators, retailers and householders cooking meals at home – needs to be engaged in cutting the number of cases by upholding food safety standards.[2]

Microbiologists contribute by monitoring contamination in the food supply, advising the trade on hygienic practices and, in the event of an outbreak, identifying the source. These roles are vital to stop outbreaks from developing and causing major illness and, in a few tragic cases, deaths. They are also vital to maintain confidence in the food supply, improving food production and therefore protecting trade.

MOLECULAR EPIDEMIOLOGY

High-throughput DNA sequencing, or molecular epidemiology, is a new means to identify the micro-organisms that cause food poisoning. The method responds to the complexities of our food supply because it is faster, more accurate and potentially more cost-effective than currently available diagnostic tests. With a DNA-based surveillance system in place, the hope is that we could detect food poisoning outbreaks in real time and thus stop them from spreading more widely, saving healthcare costs and even lives.[3]

MICROBIAL THREATS TO CROPS AND LIVESTOCK

Micro-organisms rot crops, both in the field and in storage, and infect livestock – potentially reducing yields. They can also hit trade due to import bans, cause panic and impact the rural economy.

In the UK last year, 97% of winter wheat was infected with the fungus *Septoria tritici*.[4] The year 2012 was severe for late blight in potatoes, due to warm, damp weather, with a high potential for disease predicted for the current season.[5] On the livestock side, a new virus, Schmallenberg, appeared in sheep; and bovine tuberculosis remains a persistent problem.

Protecting our crops and livestock from these and other infectious diseases depends on good animal husbandry, careful use of appropriate chemical sprays for crops, development of safe and effective drugs and vaccines for livestock, breeding of disease-resistant varieties, surveillance, quarantine and, in extremis, a well-coordinated outbreak response.[6]

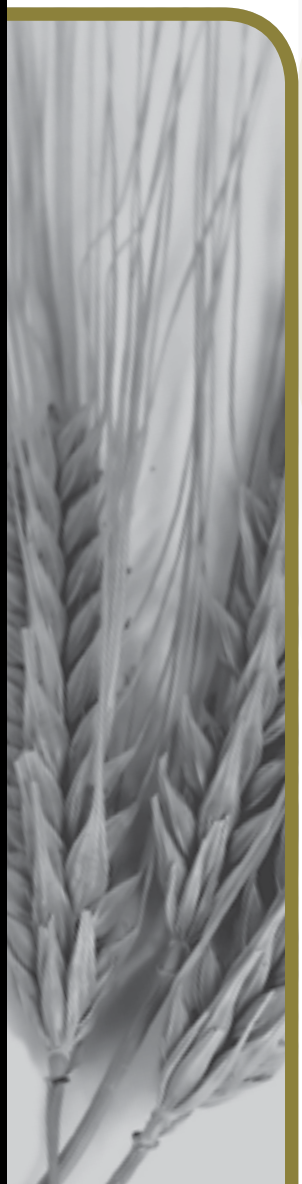
FOOD PRODUCTION

About a quarter of food production involves microbial fermentation.[7] Beer, bread, cheese, chocolate, coffee, kimchee, olives, soy sauce, tofu, vinegar, wine and yoghurt all need microbes in the manufacturing process. Microbial enzymes convert sugars and other natural chemicals into flavoursome by-products that make these foods distinctive. Microbiological science adds to traditional knowledge by letting us rationally design manufacturing processes that enable the production of novel and more consistent products.

ENERGY FROM FOOD WASTE VIA ANAEROBIC DIGESTION

The UK generates 16 million tonnes of food waste a year.[8] Microbes can process this waste (alongside other organics) into biogas for power generation. The process, called anaerobic digestion, is an old technology, but one recently revived.

In the 2010 Coalition Agreement, the UK government committed to promote '*a huge increase in energy from waste through anaerobic digestion*'.[9] Since 2011, Defra, and the Department of Energy and Climate Change have backed a UK-wide anaerobic digestion strategy, predicting that the technology could deliver 3–5 terawatt hours of electricity nationally by 2020.[10]



MAKING A NEW FOODSTUFF

Innovation can take perseverance, adaptability and vision – and investments of money, time and expertise from private firms, government funders and scientific researchers. Quorn, now commonly found on supermarket shelves as vegetarian sausages, ham and burgers, is a mycoprotein extracted from the fungus *Fusarium venenatum*. The product arose from scientific interest in microbial protein for human and animal nutrition that developed in the 1960s. The chemical firm ICI had an animal feed product known as Pruteen, made from bacteria grown on methanol, which proved uneconomic following the oil price increases in the 1970s. Rank Hovis McDougall had their own mycoprotein product, grown on carbohydrate, which was intended as human food. Using the ICI plant originally built for Pruteen production, collaboration between the two companies led to Quorn coming on the market in the 1980s.[11]

SGM has produced a Position Statement on Food Security and Safety *that expands on the issues covered in this briefing. The statement is available at:* ***www.sgm.ac.uk/en/all-microsite-sections/food-security-and-safety/index.cfm***

Details of references cited in this briefing can be found at ***www.sgm.ac.uk/en/policy/briefings.cfm/publication/food-supply***

SGM BRIEFINGS

The Society for General Microbiology (SGM) aims to highlight the important issues relating to microbiology to key audiences, including parliamentarians, policy-makers and the media. It does this through a range of activities, including issuing topical briefing papers. Through its many members, the SGM can offer impartial, expert information on all areas of microbiology.

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2 For data on the complexity of the modern food supply chain, and the risks it poses, see: **Ercsey-Ravasz, M., Toroczkai, Z., Lakner, Z. & Baranyi, J. (2012).** Complexity of the international agro-food trade network and its impact on food safety. *PLoS One* **5**, e37810. doi:10.1371/journal.pone.0037810

3 Speech made by Professor Sarah O'Brien at the launch of the FSA Chief Scientist's annual report on 27 September 2012. **http://bit.ly/ZOIpHu**

4 CropMonitor – winter wheat commercial crops survey 2012. **http://bit.ly/10NX34c**. See also: **Spink, J., Kennedy, S. & Kildea, S. (2013).** Cereal yields in 2012: what went wrong? *Teagasc Research* **8(1)**, 34–35.

5 Analysis prepared by Glyn Harper, AHDB Potato Council, for SGM, based on data from the 'Fight against Blight' survey 2012.

6 The Rural Economy and Land Use (RELU) programme has produced policy notes on crop and livestock disease. See, for example: Note No. 16 (Policy-making for animal and plant disease: a changing landscape?); Note No. 19 (Bovine Tuberculosis: a problem for farmers, conservationists and policymakers); Note No. 31 (Plant disease risk, management and policy formulation); Note No. 34 (The governance of livestock disease: putting epidemiology in context); & Note No. 36 (Lost in Translation: Assessing knowledge sources, exchange and effectiveness in animal disease control). **http://bit.ly/11YrcjW**

7 **FAO/WHO (2001).** *Safety assessment of foods derived from genetically modified microorganisms*. Report of a Joint FAO/WHO Expert Consultation on Foods Derived from Biotechnology, WHO Headquarters, Geneva, Switzerland, 24–28 September 2001, Food and Agriculture Organization of the United Nations/World Health Organization, p. 5.

8 **Defra (2011).** *Anaerobic Digestion Strategy and Action Plan: A commitment to increasing energy from waste through Anaerobic Digestion*. Department for Environment, Food and Rural Affairs, p. 10.

9 *The Coalition: our programme for government*, p. 16.

10 **Defra (2011).** *Ibid.*, p. 2.

11 **Watchorn, N., Matthews, J.F. & Rout, A.E. (1978).** Single-cell protein. In: Jealott's Hill: *Fifty Years of Agricultural Research 1928–1978* (ed. F.C. Peacock), Imperial Chemical Industries Limited, pp. 137–144; **Trinci, A.P.J. (1992).** Mycoprotein: a twenty year overnight success story. *Mycological Research* **96**, 1–3; & **Ottewell, S. [undated].** He's as good as gold: chemical engineer lands UK's top engineering award. *Chemical Processing*. **http://bit.ly/16UrrvK**