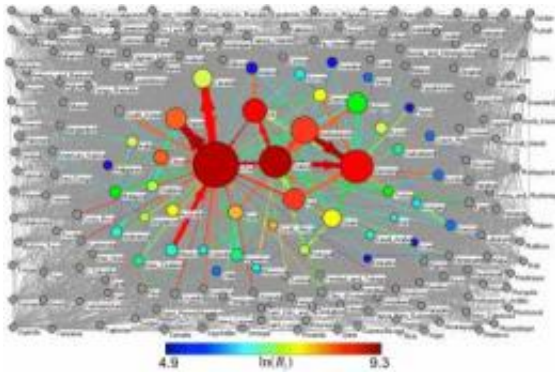


Why is it so difficult to trace the origins of food poisoning outbreaks?

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This graphic illustrates the complete International Agro-Food Trade Network in 1998. Credit: Ercsey-Ravasz M, Toroczka Z, Lakner Z, Baranyi J (2012) Complexity of the International Agro-Food Trade Network and Its Impact on Food Safety. PLoS ONE 7(5): e37810. doi:10.1371/journal.pone.0037810

As illustrated by the 2011 *E. coli* outbreak in Germany in 2011, any delay in identifying the source of food poisoning outbreaks can cost lives and cause considerable political and economical damage. An international multidisciplinary team of scientists have shown that difficulties in finding the sources of contamination behind food poisoning cases are inevitable due to the increasing complexity of a global food traffic network where food products are constantly crossing country borders, generating a worldwide network.

As consumers we are used to seeing country of origin labels on certain

foods, but what about on products with more than one ingredient? A recent study by the [Food](#) Safety Authority of Ireland showed that 53 countries contributed to the ingredients of an ordinary "Chicken Kiev" in a Dublin restaurant. This diversity of sources is partly to blame for the failure to identify the sources of food poisoning outbreaks, and has led to calls for international health agencies to initiate a system to monitor this 'human [food web](#).' But just how complex is the human food web? What is its structure, can we quantify it, and what can we learn from it?

In the first study of its kind, published in the journal [PLoS ONE](#), the scientists studied databases of food import and export to understand how 'food fluxes' generate a complicated [worldwide network](#). They were led by Professor József Baranyi of the Institute of Food Research, which is strategically funded by the Biotechnology and Biological Sciences Research Council.

Using agri-food import-export data from the UN and FAO databases, the authors chart out the worldwide food-transport [network](#) and show that it forms an amazingly [complex](#) transport web. With the help of network science methods they reveal that it has highly vulnerable hotspots and demonstrate that, without increased control, some of these are prime positions for making outbreak tracing difficult.

The research identifies a number of countries as being central to the network or holding particular influence due to the dynamics of the food traffic, and stricter regulation in monitoring food trade here could benefit the network globally. Countries that take in many ingredients, process these into products, and act as distribution hubs are of particular concern.

"We found that the current structure of international food trade effectively makes The Netherlands a combined melting pot and Lazy Susan, with the busiest link to Germany," said Professor Baranyi. "This

could explain why the tracing of the source suffered long delays in these countries in two serious outbreaks in 2011. This could be observed in both the *E. coli* outbreak in sprouts and the dioxin contamination in eggs."

The findings are supported by two types of analyses: one is based on the graph theoretical analysis of the structure of the international food trade network that allows the identification of the network core using the well-established "betweenness centrality" measures of nodes and edges for this purpose; the other is a measure based on the dynamics of the food-flow on the network, expressing to what extent a country is a "source" or a "sink".

Given the demonstrated complexity of the human food web, this work also introduces and validates for the first time a rigorous, quantitative methodology to help with biotracing and identifying the sources of [food poisoning](#) outbreaks, a problem that is only expected to increase in its magnitude, complexity and impact, in the face of current globalization trends.

More information: "Complexity of the International Agro-Food Trade Network and Its Impact on Food Safety" was published in *PLoS ONE* 31st May 2012 [dx.plos.org/10.1371/journal.pone.0037810](https://doi.org/10.1371/journal.pone.0037810)

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