National Research Programme NRP 69
Healthy Nutrition and
Sustainable Food Prodution

Reducing the risk of Staphylococcus-induced food poisoning

Prof. Roger Stephan
Institute for Food Safety and Hygiene,
University of Zurich

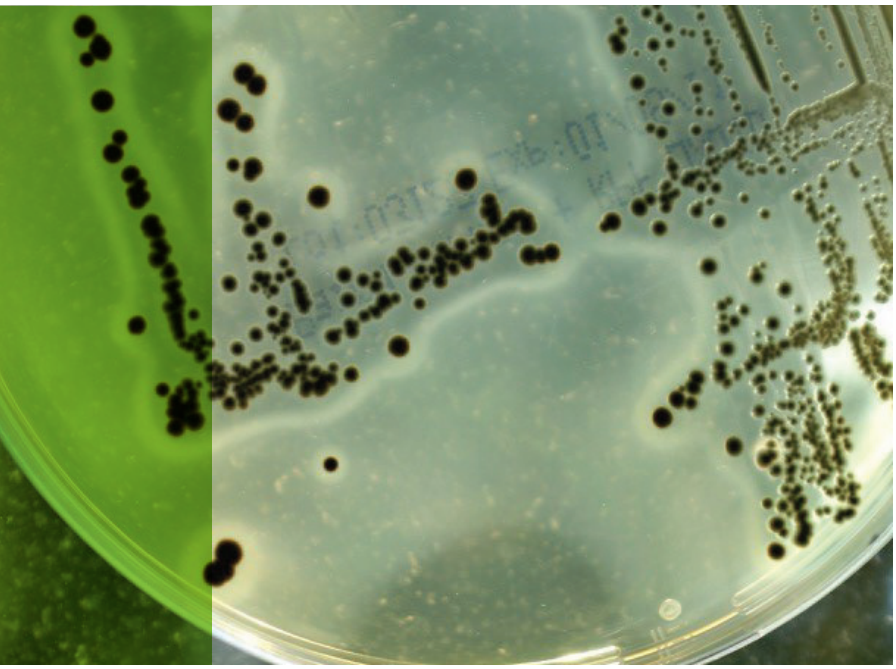
New strategies to prevent food-borne risks associated with staphylococci

Staphylococci are among the primary causes of bacterial food poisoning worldwide. The researchers showed that various factors in food production can reduce, but also promote the proliferation of the germ and the formation of enterotoxins leading to food poisoning. However, the individual bacterial strains reacted very differently to a number of stress factors such as salt, sugar, pickling salt and lactic acid. The researchers recommend developing new systems capable of detecting enterotoxins in food, thus improving consumer protection.

The bacterium *Staphylococcus aureus* can reproduce even under adverse conditions and is one of the primary causes of food poisoning worldwide. The growth of this germ in food is often suppressed by competing bacteria that are harmless to humans. However, if this robust germ encounters conditions in food that prevent competing organisms from growing, it may proliferate rapidly and form toxins known as enterotoxins, that endanger consumer health. Enterotoxins cause severe vomiting and diarrhoea within hours of ingestion. Symptoms commonly subside within 24 hours, but for young children, the elderly, and sick people, staphylococcal food poisoning can evolve to severe clinical conditions, sometimes even life-threatening. Little is known about the effect of food-related stressors on the production of staphylococcal enterotoxins and about successful risk mitigation strategies.

It emerged that the bacteria released less of the enterotoxins investigated in an environment that contained a high level of salt or sugar.

The results of the NRP 69 project fill gaps in the existing research and make it possible to assess the risk of enterotoxin-induced food poisoning more accurately.



Individual bacterial strains react very differently to stress factors. For this reason, risk analysis should also include the detection of the toxins in food.

The researchers from the University of Zurich investigated the impact of four stress factors on the formation of various staphylococcal toxins. They analysed the effect of high levels of salt, sugar, pickling salt and lactic acid (low pH), since these factors occur frequently during food processing and storage. It emerged that the bacteria released less of the enterotoxins investigated in an environment that contained a high level of salt or sugar. Depending on the bacterial strain and toxin studied, pickling salt and lactic acid either increased or reduced enterotoxin production. It was shown in general that individual bacterial strains react very differently to the stress factors tested. For this reason, risk analysis should not be based solely on the number of staphylococci present, but should also include the detection of the toxins in food. The researchers recommend developing new detection strategies for this purpose (see box below).

Further information:
www.nrp69.ch

Sustainable strategy to limit enterotoxin formation successfully implemented

As part of the project the researchers optimised a process for producing barbecue cheese. They worked with a company that uses a manual production process without additives, and that faced contamination problems due to staphylococcal toxins. Barbecue cheese needs to be produced at a pH above 6 to prevent it from melting on the grill. However, this comparatively high pH value facilitates the growth of staphylococci and thus the formation of enterotoxins.

The cheese production process uses bacteria that are harmless to humans as "starter cultures". These bacteria improve the flavour and the shelf-life of the products. The researchers reproduced the production process of the barbecue cheese in the laboratory and exchanged the starter culture. The selected harmless bacteria grow better than *Staphylococcus aureus* under the given conditions. They cut off the supply of nutrients to the germ, thus inhibiting its proliferation and the formation of enterotoxins. By adopting this sustainable strategy, the company was able to increase the safety of its products.

Recommandation

Develop new detection systems

The current legislation in Switzerland and other European countries merely specifies upper limits for the number of bacteria in food. If this limit is exceeded, affected food products are destroyed for safety reasons. However, this approach does not always fully address the health risks posed by *Staphylococcus aureus*. On the one hand, food may contain toxins even though the germs responsible for them have already been destroyed by heating. On the other hand, this system may result in food products being assessed as dangerous even though no toxins have been formed and the products therefore pose no risk to consumer health. No simple detection systems capable of detecting all dangerous staphylococcus enterotoxins in food are currently available. The development of such detection systems is likely to increase food safety for consumers and help to reduce food losses.