The risks of food poisoning from irradiated foods

What are we talking about ?

Most people know that food poisoning is caused by bacteria and so is food spoilage. But food poisoning bacteria are different from food spoilage bacteria.

Food spoilage bacteria

Spoilage bacteria are the **Pseudomonas** bacteria. Their natural function is to break down proteins of all kind. So, they grow on meat, fish, shell fish, milk products and any substance containing proteins. They cause rotting (breaking down of proteins) and their activity makes them a bit on the nose. They are real stinkers.

Are they dangerous? No, they just stink. But if the conditions are right for Pseudomonas bacteria to grow, then other bacteria could grow as well. So, Pseudomonas stench is a warning flag.

Pseudomonas is radiation sensitive

The stinkers are radiation sensitive (1, 2). A comparatively low dose of 2 kGy destroyed enough of them to double the shelf-life of vacuum packed cuts of sirloin steak to 10 weeks, when kept at 4ºC (3). And radiation with 2.5 kGy doubled the shelf-life of chickens to 24 days, when kept at 1ºC (4).

Food is also radiation sensitive

The maximum dose meat, fish and poultry can tolerate without getting the typical wet dog smell is 2.5 to 3 kGy (1, 3, 5).

The mentioned sirloin steak irradiated with only 2 kGy had a faint irradiation odour on the day of irradiation. Chickens irradiated with 3 kGy developed detectable changes in taste and odour after 15 to 19 days storage at 0ºC (1). These changes in taste and smell are caused by biochemical alterations in the food from ionising radiation.

The practice

In practice irradiation would be carried out at around 2 to 2.5 kGy to reduce the number of Pseudomonas bacteria and to prevent radiation damage of the food from higher doses. But after removal of the warning flag the public would have no way of knowing that the meat was no longer fresh and that it could contain dangerous bacteria.

Food poisoning bacteria

Salmonella bacteria are the dangerous ones. Over 2000 different Salmonella bacteria have been identified. They are all parasites of the gut (6) with optimal growth at 37ºC. People get ill from the infection, not from any toxin. Birds are notorious Salmonella carriers. The drip water of frozen chickens can contain Salmonella bacteria, which could infect kitchen sink or bench and then cold food there prepared.

Salmonella is radiation resistant

It turns out that food provides radiation protection. So, for the same Salmonella bacterium different elimination doses are needed depending on the food. For example, one research found that a number of Salmonella bacteria in laboratory broth would need 5 kGy for elimination, but on crabmeat much higher doses were needed (7).

Microbiological plating techniques found that Salmonella bacteria could still be recovered after irradiation with 3 kGy (8). The used plating technique corresponded with a medium level of contamination under practical circumstances. But an enrichment technique corresponding with higher levels of contamination recovered Salmonella bacteria after 9 kGy. And on shellfish the food protection was so good that at least 9 kGy was needed for elimination (8). A number of countries have approved irradiation for up to 7 kGy for Salmonella elimination.

Clostridium botulinum

The other food poisoner to focus on is **Clostridium botulinum**. There are over 200 different Clostridium botulinum bacteria (9). They are spore forming soil bacteria preferring an environment with little air. When the spore germinates a deadly toxin is released. A few toxic peas can cause illness and death. Canned food that has not been properly pasteurised and food sealed in plastic wrap with little air are candidates for trouble. C. botulinum has been found on meat, fish, fruit, vegetables and milk products.

Spores and toxins radiation resistant

The radiation resistance of botulinum spores varies widely. The spores of one C. botulinum required 47 to 50 kGy (10). The spores of another botulinum required 35 to 37 kGy (11), yet some other spores required much less (12). The toxins are also very radiation resistant: 50 kGy was still insufficient in one case (13) and 73 kGy did the job in another case (14).

Bacterial competition

In heavily contaminated environments (sewage, sludge, rotting food) no botulism toxin was found although botulism spores were present (15). When other bacteria were removed the botulinum spores started often to germinate and produce toxin. Based on this suppression by competitors a Joint Expert Committee on Food Irradiation of 1980 (FAO/IAEA/WHO) recommended irradiation of 2.2 kGy (average dose) to keep sufficient bacteria to suppress toxin formation. But they stipulated that the product should be kept at the temperature of melting ice as an additional safeguard against botulism (12).

The futility of irradiation

In 1960 similar findings were made. A research on chicken carcasses (4) found that low dose radiation did not achieve a high degree of sterility and that the spores of C. botulinum could grow from 3.3ºC onwards. It was concluded that the "necessity to maintain adequate refrigeration is a further limitation of radiation treatment, since the additional cost and inconvenience of freezing the carcasses are small, and the frozen carcasses can be stored for longer periods without loss of quality." This comment sums up the futility of the whole radiation treatment. Irradiation adds to production costs but does not give any return. Also, Salmonella starts to grow from 8ºC onwards. This is another reason why ongoing refrigeration is a must.

Conclusion

Food irradiation will be done in the 2 to 3 kGy range to remove Pseudomonas bacteria and because higher doses would cause changes in taste and smell of the food. This low dose is insufficient to control food poisoning bacteria, so ongoing refrigeration is needed., just as if the food had not been irradiated. Hence the futility of the irradiation treatment as it only adds to production costs.

References

1. Coleby, B. et al. 1960.Treatment of meats with ionising radiations. IV. J. Sci. Food Agric. 11: 678-684.
2. Thornley, M.J. 1963. Radiation resistance among bacteria. J. appl. Bact. 26: 334-345.
3. Niemand, J.G. et al. 1981. Radurization of prime beef cuts. J. of food Protection 44: 677-681.
4. Coleby, B. et al.1960. Treatment of meats with ionising radiations. III. J. Sci. Food Agric. 11: 61-71.
5. Hobbs, G. 1967. Toxin production by C. botulinum type E in fish. Microbiol problems etc. Panel Proceedings series, IAEA, Vienna 1967, pp.37-44.
6. Stanier, R.Y. et al. 1964. General Microbiology, McMillan & Co. Ltd., London, p.675
7 .Dyer. J.K. et al. 1966. Radiation survival of food pathogen in complex media. Appl. Microbiol. 14: 92-97
8. Quinn, D.J. et al. 1967. The inactivation etc. in: Microbiological problems in Food Preservation by Irradiation. Panel Proceedings Series, IAEA, Vienna 1967, 1-13.
9. Anelis, A. et al. 1962. Comparative resistance C. botulinum strains to gamma rays. Appl. Microbiol. 10:326-330
10.Wheaton, E. et al. 1962. Radiation survival curves C. botulinum spores. J. Food Sci. 27: 327-334.
11.Greenberg, R.A. et al. 1965. Radiation injury of C. botulinum spores in cured meat Appl. Microbiol. 13: 743-748
12.Grecz, N. et al. 1983. Action of radiation on bacteria and viruses. In: Preservation of Food by Ionizing Radiation vol.II. (Eds. Josephson et al.) CRC Press Inc., Boca Raton , Florida, p.179.
13.Skulberg, A. 1965. Radiation resistance of C. botulinum type E toxin. J. appl. Bact. 28: 139-141
14.Frazier, W.C. et al. 1978. Food Microbiology by McGraw-Hill Book Co., New York p.427.
15.Johannsen, A. 1965. C. botulinum type E in foods etc. J. appl. Bact. 28: 90-94.

Friends of the Earth

H. Julius

www.foodirradiationwatch.org

FOOD IRRADIATION WATCH