Irradiated food = peroxidised food

Peroxidised food means food containing rancid fat and toxic material.

Synthetic diets

When, lipid peroxide formation from gamma irradiated food needed to be measured, researchers resorted to synthetic diets. These were mixtures containing starch with either lard or corn oil or herring oil.

Lard and corn oil are saturated fats and little peroxide developed. But in herring oil, high in unsaturated fats, much peroxide was found after irradiation with doses varying from 1 to 20 kGy. With higher doses more peroxide was formed.

When put in storage, peroxidation continued to the point of total destruction of essential fatty acids. This happened irrespective of the given irradiation dose.

It was concluded that irradiation would severely reduce the nutritional value of food and pollute it with toxic peroxides and other degradation products (1, 2)

Rancid fat

This dim view of peroxidised or rancid fat in food had been expressed many times before from the 1940s onwards in scientific journals on nutrition. No suitable technique had been available then to quantify lipid peroxide formation.

A nutritional journal of 1953 had remarked that rancid fat could provide a tool for studying nutritional requirements of animals under adverse dietary conditions (3).

This paper also speculated on what might be the cause of these adverse effects.

1 the presence of a toxic agent?
2 the hampering of normal fat digestion?
3 the destruction of other nutrients?
4 a change in intestinal bacteria and altered functioning of the intestine?
5 diminished food intake? Or, a combination of these factors? (3)

Quoting from scientific reviews this paper then summed up the nutrients which are partly inactivated or destroyed by rancid fat in the diet. They are: vitamin A and carotene, tocopherol (vitamin E), vitamin D, vitamin K, pantothenic acid (vitamin B_5), pyridoxine (vitamin B_6), biotin (vitamin B_{12}), ascorbic acid (vitamin C) and the essential fatty acids. These are linoleic, linolenic and arachidonic acids (3)

A review from 1960 on rancid oils and fats identified peroxides, hydroperoxides, rancid linoleic acid and monomeric cyclic compounds as the toxic culprits. In particular peroxides, hydroperoxides and rancid linoleic acid, as they were lethal to rats (4). Also was mentioned that organic peroxides yielded free radicals capable of causing mutations.

Carbohydrates

A review on food irradiation (5) confirmed that irradiated fats and fatty acids develop peroxides. It included a review on irradiated carbohydrates, which also develop peroxides of various kind. It reviewed irradiated sugar solutions and laboratory mediums and their toxic effects on bacteria and cell cultures. In addition to this, irradiated wheat in animal feeding trials was reviewed. Another review on irradiated foods covered similar ground (6). In both reviews the term **radiomimetic** was used when referring to the toxic effects from peroxides. It was suggested repeatedly that peroxides could well be only intermediate products leading to final toxic substances.

Radiomimetic effects

Radiomimetic means imitation radioactivity. So, you get the same effects from eating irradiated food for a prolonged time as from being exposed to ionising radiation.

In the case of ionising radiation high energy photons trigger off lipid peroxidation in body tissues. A high radiation dose can result in lethal doses of peroxides. But how could this be achieved with food that is not itself radioactive?

Could peroxides be absorbed by the gut and so enter the body? This indeed could trigger off lipid peroxidation inside the body. There has been a long debate whether or not peroxides could pass the gut wall in the world of nutritional research. Only more recently new light has been shed on this issue.

The small intestine is lined with a slime layer, which is there for protection. This mucus, as it is called, contains gluthatione, which is part of an enzyme system that dismantles peroxides. A research team was able, using rats, to tap into the flow of lymph that encircles the small intestine. This lymph collects all digested food that is absorbed through the gut wall. So, if peroxides could pass this wall, then they would end up in this lymph flow.

The glutathione concentration in the gut was artificially lowered, while a constant flow of lipid peroxides in the gut was maintained. It was found that at low glutathione concentrations the dismantling of peroxides became incomplete and that peroxides could pass the gut wall. And vice versa: with normal levels of glutathione plus increased amounts of peroxides, again peroxides passed the gut wall and showed up in lymph (7).

So, the glutathione enzyme system, effective as it may be under normal circumstances, can be overwhelmed by a heavy load of peroxides.

This point can be illustrated with radiomimetic effects from irradiated food such as polyploid lymph cells. One experiment was with humans and one with Chinese hamsters.

Experiment with humans

In 1975 the National Institute of Nutrition of India

The glutathione story

investigated how malnourished people (children) would cope with irradiated food. The wheat component of the diet was irradiated with 0.75 kGy as recommended for grain disinfestation. After four weeks only the first polyploid lymph cells showed up, with a steep increase after six weeks. Then the trial was halted (8).

Experiments with Chinese hamsters

Hamsters fed an irradiated, pelletised breeding diet, were given once a week additional vitamin supplements in their drinking water. Take note: a breeding diet is already extremely rich in nutrients This diet was irradiated with various irradiation doses and from 20 kGy onwards polyploid lymph cells showed up.

Another group of hamsters was fed unirradiated breeding diet plus some diluted hydrogen peroxide. And promptly polyploid lymph cells showed up (9).

Obviously the glutathione defense against peroxides in malnourished children was much weaker than in the pampered hamsters.

Lipid peroxidation

Lipid peroxidation has been implicated in the onset of cancer and in atherosclerosis.

References

1. Hammer, C. T. et al. 1979. The effect of ionising radiation on the fatty acid composition of natural fats and on lipid peroxide formation. Int. J. Radiat. Biol. 35 No.4: 323-332.
2. Wills, E.D. 1980. Studies of lipid peroxide formation in irradiated synthetic diets and the effects of storage after irradiation. Int. J. Radiat. Biol. 37 No.4: 383-401.
3. Greenberg, S.M. et al. 1953. Some factors affecting the growth and development of rats fed rancid fat. J. Nutr. 50: 421-440.
4. Rao, B.Y. 1960. Nutritional aspects of heated, oxidised & polymerised fats & oils. J. Sci. Industr. Res. A19: 430-437 (see Table 3 at 436)
5. Schubert, J. 1969. Mutagenicity and cytotoxicity of irradiated foods and food components. Bulletin WHO 41: 873- 904.
6. Kesavan, P.C. et al. 1971. Cytotoxic and mutagenic effects of irradiated substrates and food material. Radiation Botany 11: 253-281
7. Aw, T.Y. et al. 1992. Absorption and lymphatic transport of peroxidised lipids by rat small intestine in vivo: role of mucosal GSH. Am. J. Physiol. 262: G99-G106
8. Bhaskaram, C et al. 1975. Effects of feeding irradiated wheat to malnourished children. Am. J. Clin. Nutr. 28: 130-135
9. Renner, H.W. 1977. Chromosome studies on bone marrow cells of Chinese Hamsters fed a radiation sterilised diet. Toxicology 8: 213-222.

H. Julius

www.foodirradiationwatch.org