
Editorial

SILENT SPRING – FORTY YEARS LATER

At present, concerns about food safety focus on microbiological problems. A very different situation prevailed from the mid-1950s until a few years ago, when the presence of residues of man-made chemicals in food preoccupied food scientists and toxicologists as well as legislators, the media, and the general public. Such chemicals were suspected of increasing the risk of cancer in man, and a first important outcome of that thinking was the introduction in 1957 by U.S. Representative James J. Delaney of amendments to the U.S. food law, containing the famous Delaney Clause, which stated that no food additive will “be deemed safe if it is found to induce cancer when ingested by man or animal.” Pesticide residues in processed food were classified as food additives, with the result that in processed food the Delaney Clause allowed no trace of a pesticide that had caused cancer in animal tests, regardless of how exaggerated the dose administered to the test animals may have been. Developments in food legislation in other countries were much influenced by the American model.

A culmination of chemophobia was reached with the publication in the United States of Rachel Carson’s *Silent Spring* in 1962. The book was soon translated into many languages and became a world bestseller. It opened with an apocalyptic fantasy: birds vanished, baby pigs died, hens ceased to have chicks, people grew ill, and there were no bees to pollinate the apple blossoms. Man had caused this, implied Carson, by using chemicals recklessly. Man-made chemicals rendered toxic the air, the water, the soil, and the food. We were, said Carson, being progressively poisoned by the food from farm, market, and grocery, which had been contaminated by chemical pesticides and food additives, all of which were interacting in unknown ways in our bodies. For Carson, nature was benevolent, whereas modern technology was hideous. In her opinion, few natural carcinogens existed, such as arsenic, radioactive minerals and ultraviolet light; the bulk of carcinogens present on earth was produced by man. Toward the end of the book, she warned that the use of man-made chemicals could wipe out the entire human race in about twenty years.

The influence of Carson on our time can hardly be exaggerated. All over the world, the use of pesticides and food additives was more and more restricted in the following years. Enormous sums were invested in animal studies designed to test the carcinogenic properties of various chemicals. Protocols of such studies were refined in order to make sure that no adverse effect of a test substance would remain undetected: the maximum tolerated dose (MTD) was administered to the test animals, animal strains known to be particularly prone to developing cancer were chosen, the tests were conducted during the whole lifetime of the animals and were even continued in several following generations. The sensitivity of analytical methods to detect residues of pesticides and other xenobiotics in food was enormously improved. Large scale epidemiological studies were initiated with the aim of finding correlations between eating habits and cancer rate in population groups.

Carson's dramatizing was probably needed to make mankind aware of the dangers of indiscriminate use of pesticides, particularly those of the persistent organochlorine type. However, recognition of her merits as a warner must not keep us from taking account of research carried out during the last four decades. As a result of that research, some of the basic assumptions made by Delaney, Carson and other environmentalists of their time, must now be considered untenable. The idea that there is an epidemic of human cancer caused by synthetic industrial chemicals is false. Age-adjusted cancer mortality is decreasing in most countries and life expectancy shows an amazing increase. There is no convincing evidence that synthetic chemical pollutants in food are important as a cause of human cancer. About half of all chemicals tested in high-dose animal feeding studies, whether occurring naturally or produced synthetically, caused cancer. Extrapolation of results obtained in animal studies done at MTD exposure have been misinterpreted to mean that the very low doses to which man is typically exposed are relevant to human cancer. All plants contain natural pesticides which serve to protect the plant against microbes, insects and animal predators. Most of the chemicals humans ingest are of natural origin. Our body cells have numerous defence mechanisms that make them well buffered against low doses of carcinogens and other toxins, whether synthetic or natural. Epidemiologic studies indicate that dietary practices (overnutrition and unbalanced diets), tobacco, chronic infections, hormonal factors influenced by life-style, and genetic factors are the most important causes of cancer, not environmental contaminants, and certainly not food additives.

American biochemist and cancer researcher Bruce Ames and his collaborators have recently proposed that common micronutrient deficiencies, as associated with inadequate consumption of fruit and vegetables, cause DNA-damage by the same mechanisms as radiation and as many carcinogenic chemicals, and may be a major cause of cancer. Whereas in the past the most important question in nutrition-oriented cancer research was: Which substances in food cause cancer?, to many cancer researchers today the more interesting questions are: Why, in spite of all those carcinogens in our environment, do we not all suffer an early death from cancer? What are the anticarcinogenic substances in food that protect us? How do they function? Why do they often eventually fail to protect an individual against cancer? Besides laboratory studies designed to answer such questions, more than 30 large epidemiologic studies are currently underway in various regions of the world, which will provide further insights into the role of diet in cancer causation.

The Delaney Clause was based on a zero risk concept. Scared by Carson's vision of a poisoned world, a growing number of consumer representatives demanded zero contamination of food with pesticide residues, and zero tolerances for food additives suspected of causing adverse health effects - and everything synthetic was suspected. However, as analytical chemistry advanced, more and more substances, both natural and man-made, were detected in food. At the same time, results of high-dose feeding studies in animals required reclassification of ever more chemicals as carcinogenic. Adherence to the Delaney Clause became increasingly difficult. In order to circumvent these difficulties, the 'de minimis' concept was introduced in the 1980s: some substances causing cancer in animals but posing only a trivial risk to humans were permitted as food additives. Demands of zero risk were recognized as unrealistic, and the concept of negligible risk gained acceptance. Negligible risk is usually interpreted as an increased cancer risk of less than one in one million over a 70-year lifetime. In the United States a new food law was passed in 1996, the Food Quality and Protection Act, which regulates pesticide residues without mentioning the Delaney Clause. Tolerance limits are set at 'safe' levels, defined as a reasonable certainty that no harm will result from exposure to the chemical residue.

Many food toxicologists now accept the concept that a Threshold of Toxicological Concern (TTC) can be identified for any chemical. If human intakes are below such a threshold, extensive toxicity testing and safety evaluations are not required. The main aim of the TTC concept is to focus the limited resources of toxicological testing institutions on evaluation of substances with greater potential to pose risks to human health and to contribute to a reduction in the use of animals.

Clearly, safety evaluation of food residues and additives has come a long way since the days of Delaney and Carson. Regrettably, the general public has taken little note of these developments. Journalists, consumer representatives and politicians all too often denounce the presence of a chemical in a particular foodstuff, just because that substance has been detected. How much was detected with the aid of one of today's incredibly sensitive analytical methods and whether a concentration of a few micro-, nano- or picograms/kg is a real risk or a negligible risk, often seems to be of no interest. To many of our contemporaries, nature is benevolent and modern technology abhorrent, as it was to Rachel Carson. Not a few food manufacturers support this attitude by labeling their products as 'all natural', 'bio-something', 'country style', 'no preservatives added' and - more recently - 'not irradiated' or 'contains no genetically modified ingredients'. Consumers' misconceptions are thus aggravated and advances in food production and food processing are impeded.

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