Meetings

Nutrition and New Food Technology

"Nutrition and new food technology" was the fourth central theme of Science and Man in the Americas, a meeting sponsored by the AAAS and the Consejo Nacional de Ciencia y Tecnología in Mexico City, 20 June to 4 July 1973. The purposes of the theme included (i) evaluation of the present and prospective capacity of the world to provide adequate food for its people; (ii) the devising of methods for disseminating nutrition information and the application of this information, especially by low-income people; (iii) evaluation of the kind of technology available and suitable for use in Mexico and the other Latin American countries; (iv) creation of methods and programs for the transfer of such technology; (v) reports on problems and progress in research relating to food safety; and (vi) the reporting and evaluating of national and multinational standards and regulation for assurance of safety, wholesomeness, and identity of food in domestic use and international trade.

The theme comprised six sessions, with 35 invited participants from institutions in Brazil, Canada, Chile, Colombia, Guatemala, Mexico, the United States, and the U.N. Food and Agriculture Organization.

Food Supply

Dana Dalrymple provided information and perspective on the impact of the Green Revolution, which started with high-yield wheat in Mexico about 1948. Within 12 years, high-yield varieties occupied 90 percent of Mexico's wheat land. The Green Revolution "took off" in Asia in the mid-1960's. Land planted in high-yield varieties of wheat and rice in Asia increased from 40,000 acres in 1965–66 to 50 million in 1970–71. These high-yield varieties require pesticides, chemical fertilizer, adequate water, and good soil. The use of them is more likely to displace than to help small cultivators, but they play an essential role in feeding an urban world.

E. F. Sprague reviewed the adaptive research on high-lysine corn being carried out at the Centro Internacional para el Mejoramiento del Maíz y Trigo in Mexico. Development and adoption of climatically adapted, culturally acceptable varieties high in this essential amino acid constitute a principal route to better nutrition for millions of people in the Americas and Africa. T. R. Preston described research in Mexico on the use of sugar cane waste as feed for cattle. Millions of tons of potentially useful bagasse are underutilized in all the countries that produce cane sugar.

G. Borgstrom reported that the harvest of marine finfish and shellfish trebled between 1948 and 1970. Fleets of factory ships, chiefly from industrialized countries, are harvesting fish in every productive portion of the oceans. Marine products were reported to supply at least one-seventh of the world's human food protein. Development of fish sausages in Japan, using all "dark meat" and flesh of less desired species, will increase the use of fish for food. A major portion of the world's fish catch has been used as fish meal for animal feed. Most developing countries have benefited minimally from the increased harvest.

Future yields may be jeopardized by overfishing. Borgstrom reported that "most experts seem to agree that the present ocean catches [about 50 million tons per year] could be doubled."

Socioeconomics of Food Distribution and Supply

Attaining and maintaining good nutrition among all peoples requires, in addition to adequate supplies of food, the transfer and adaptation of technology; the development of food delivery systems; and education in and acceptance of information essential to the selection, preparation, and consumption of nutritionally adequate diets. Technology transfer achievements and procedures in Mexico were reported by G. Viniegra and M. Szekely; the work of the Instituto de Nutrición de Centro América y Panama, by R. Bressani; the work of the Mother Craft Centers in dissemination of nutritional information, by Miriam Chavez; and the results of the U.S. Department of Agriculture's Expanded Food and Nutrition Education Program, by Evelyn Johnson. Since the inception of the program in 1968, more than 2 million low-income families have been reached with information on nutrition. These families have improved their diets through increased consumption of milk, fruits, and vegetables.

Food Technology

Food technology discussions were focused on products and product quality, preservation, new sources of food, and the corollary problems of reduction of spoilage and waste. C. M. Christensen noted that insecticides are generally effective in preventing insect damage to grain in international trade. Fungi may, however, cause heavy spoilage whenever temperatures or moisture content of grain, or both, are high. It is usually costly to dry grain produced in industrialized agriculture. Feed grains with a high moisture content may be ensiled or treated with propionic or acetic acid to control fungi. Grain so treated is not acceptable as human food.

A. Gorgatti Natto presented the results of research at Campinas in Brazil on the postharvest handling of fruits and vegetables. Appropriate use of low-temperature, controlled storage atmospheres and chemical control of bacteria and molds can greatly reduce waste of many tropical fruits, thus making them available in Brazil throughout the year and increasing world trade.

A major problem in all countries is how to enable small cultivators to share in the benefits of technology. Subsistence farmers who live on or near the land they cultivate and who produce most of their own food, exchanging their surplus for things they do not produce, traditionally view farming as a way of life as well as a way of making a living. Amihud Kramer stated that agriculture in the developing countries must be and will be industrialized, a view challenged by

members of the audience. He noted that only 20 to 25 percent of the vegetative parts of food crops are used in the processed product. The discarded materials have potential value as livestock feed. (Their use of such materials may be complicated by the presence of pesticide residues or heavy metals, which could result in accumulation of excessive residues in animal food products.)

C. D. Chichester discussed the potential of using as human food marine organisms from lower trophic levels than those now yielding food. He estimates that the protein yield of such resources would be one to four times the present yield, but he noted the lack of technology for harvesting or processing such materials for food. Chichester further noted that oilseed proteins (for example, rapeseed, linseed, and sunflower seed) are currently underutilized as human food.

Food Processing

Luz María del Castillo reported current developments in the use of enzymes in processing food. Isolated enzymes are specific in catalyzing a desired chemical reaction without unwanted by-products. Enzymatic processes in the food industry have usually been batch operations without recovery of the enzymes. New processes immobolize enzymes on neutral substrates; the material to be treated flows over the immobilized enzymes without loss of enzymes.

The process may be used, for example, for the enzyme conversion of lactose in milk to a nonallergenic substance. Milk so treated may be consumed by people who cannot tolerate untreated milk. The same process may be used to convert lactose in whey, a by-product of treated milk. Whey so treated has wider potential food use than untreated whey. Many other uses of immobilized enzymes are being developed in industry in order to reduce product cost and to improve product quality.

Frank Horan noted that the flavor of food tends to be more important than the texture but that, when flavor is less pronounced, texture becomes the dominant food acceptability trait. Meat analogs, fabricated from soy or other vegetable protein or from a combination of animal and vegetable proteins, are being produced with meatlike texture, flavor, and appearance. Isolated soy protein is solubilized in an alkaline medium and passed through a spinneret to form fibers. Fibers are fabricated with coloring, flavoring, binders, and supplementary nutrients to simulate meat products. The process is patented.

H. A. B. Parpia noted the vast wastage of stored food products. He reported advances in the construction of grain and food storage facilities to protect them against infestation by rodents and insects. Construction and use of such facilities in developing countries could substantially reduce present stored product losses, which sometimes amount to as much as a third of the product stored.

William J. Gall reported that maximum gains from agricultural development depend on adequate processing, packaging, and marketing capabilities. In countries in which processing and packaging is an essential part of commodity exports, such as bananas, sugar, or pineapples, packaging may contribute as much as 70 percent to the value added in manufacturing. The World Packaging Organization, with headquarters in Hong Kong and several regional organizations in the Americas, promoted the development and transfer of packaging technology. The Organization of American States has expanded its program of technical assistance to include packaging. Food trade interests are also active in packaging technology transfer.

Gall reported several recent advances in packaging technology. He forecast the probable use of radiation-sterilized, plastic-prepackaged meat products. Heat-sterilized, plastic-lined, hermetically sealable aluminum containers have been developed for cooked foods in cases where refrigeration is not feasible.

Plastic bottles, which now comprise less than 1 percent of rigid food and beverage containers, were projected to comprise up to 25 percent of such containers in the United States.

A Canadian development is a pulp-molding machine that will shape large containers of such cellulosic materials as sugar cane bagasse or bagasse with waste paper.

Food Safety

In the session on food safety, Fred R. Senti discussed the mycotoxins that are sometimes formed in foods during production or storage. The fungal genera most frequently involved are *Aspergillus, Penicillium*, and *Fusarium*. Mycotoxins, which include aflatoxins, patulin, and other compounds, may cause damage to liver, kidney, or nervous tissue. Aflatoxins, which have produced cancer in test animals, have been found in foods produced in Asia, Africa, North America, and South America in rice, cassava, peanuts, corn, wheat, millet, barley, and food products.

The incidence of mycotoxin can be greatly reduced by prompt drying and dry storage of harvested grain and oil seeds. Means for such drying are often lacking, especially in the developing countries. Laboratory and pilot plant tests indicate that ammonia may be effective in detoxifying some materials contaminated by aflatoxin.

A. F. Novak, Donald Huisingh, and B. G. Tweedy reviewed problems of food plant sanitation and heavy metal and pesticide contaminants in foods, as well as measures to assure food safety.

Recent concern over the content of mercury in foods, especially freshwater fish contaminated by mercury pollution from chlor-alkali industrial plants, has been intense. Concentrations of mercury in swordfish were about as high many years ago as they are now. This concern has been exacerbated by the human tragedies resulting from the illegal use as food of cereal seed treated with mercurial fungicides.

Tweedy noted that restrictions on the use of chlorinated hydrocarbon pesticides, especially DDT, have led to the wider use of more toxic, although nonpersistent, organophosphorous compounds. He further noted that he could find no substantive evidence that consumption in the United States of foodstuffs containing residues of pesticides used in conformity with their legally registered labels has been injurious to man.

Sam R. Hoover reported measures now being used to reduce or eliminate water pollution from the wastes of food-processing plants. Dry caustic peeling of potatoes has greatly reduced pollution, increased food product yield, and produced a useful feed by-product. Other innovations recently adopted by industry include pasteurization, fresh-pack, and pure-culture pickle fermentation and new ways of cleaning and blanching fruits and vegetables with almost complete elimination of effluents.

Food Standards and Regulations

A. Olszyna-Marzys presented a paper on food standards and regula-

tions in Latin America, bringing together for the first time the food laws and regulations of the Latin American countries. There is extreme variability in approach by the various countries.

Robert Angelotti gave a succinct and unequivocal summary of U.S. requirements, which have a major impact on the massive U.S. imports of fresh and processed foods from other American countries.

E. R. Méndez reviewed the existing and prospective international agreements on food standards under this important multinational program sponsored by the World Health Organization and the U.N. Food and Agriculture Organization. The world urgently needs to accelerate the development and acceptance of standards under the *Codex Alimentarius*. It also needs more bilaterally accepted standards to expedite food trade among nations. Standards, however, only reflect quality. Adequate technology applied in food production, processing, storage, and distribution is essential to assure foods that meet adequate standards of quality, safety, and wholesomeness. Continuing communications among food technologists of the Americas can be highly productive.

William Darby noted the essential and growing role of food technology in the adequate nutrition of the peoples of the world. He addressed the problem of chemical residues and concluded that chemicals are necessary to the production and protection of an adequate and safe food supply. Residues must be kept at nonhazardous levels through careful use of chemicals and surveillance of residues in food products.

As Darby emphasized in his summary, technology cannot make food absolutely safe, but its application can, and should, assure that all food in commerce meets standards reflecting "acceptable minimal risk." He noted the recent formation in the United States of the Citizens Commission on Science, Law, and Food Supply, which will examine questions of risk-benefit and develop guidelines for decision-making on important issues related to foods.

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Environmental Mutagens

Increasing concern over release of genetically active materials into the environment was reflected in the organization of the First International Conference on Environmental Mutagens, held at Asilomar, California, 29 August to 1 September 1973. The conference was sponsored by the American Environmental Mutagen Society (EMS) and was organized by B. Ames (University of California, Berkeley), S. Wolff (University of California, San Francisco), and A. Sparrow (Brookhaven National Laboratory).

Representatives of the European, Japanese, and Indian Environmental Mutagen Societies were present; an International Association of Environmental Mutagen Societies had been formed before the end of the conference.

L. Fishbein (National Center for Toxicology Research, Jefferson, Arkansas) pointed out that about 500 new chemicals are introduced industrially each year; thousands are already in use. Most have not been adequately tested for mutagenicity, carcinogenicity, or teratogenicity. In his welcoming address, A. Hollaender (Oak Ridge National Laboratory) indicated that the EMS would like to see all chemicals that reach the public tested for mutagenicity.

T. Tazima (National Institute of Genetics, Mishima, Japan) emphasized that in our concern over man-made chemicals, we should not forget natural toxic compounds. The bracken fern *Pteridium aquilinum* is eaten in Japan and is now appearing in U.S. food markets. This fern contains an uncharacterized chemical which is carcinogenic and mutagenic in the fruit fly *Drosophila*. There is no evidence so far for species-specific carcinogens, according to U. Saffiotti (National Cancer Institute).

Cycads, used as both food and medicine in tropical and subtropical areas, contain toxic substances. Investigation revealed that nontoxic cycasin, methylazoxymethanol-β-D-glucoside, is metabolized to form methylazoxymethanol which is toxic and carcinogenic, and behaves as a mutagen in the bacterium *Salmonella* and in *Drosophila*.

The most important natural mutagens are the mycotoxins produced by various fungi which grow in stored grain and contaminate fermented food. Aflatoxins, the best known mycotoxins, induce mutations in mice, in *Vicia fava*, in *Salmonella*, and in human cells grown in tissue culture. Aflatoxins are also suspected to be a major cause of human liver cancer. Mycotoxins have a wide variety of chemical structures. The common element appears to be the presence of a lactone ring; destruction of this ring destroys their mutagenic effect. Besides mutations, mycotoxins cause mitotic injury, breaks in double-stranded DNA, and chromosome aberrations.

Among the more prevalent man-made mutagens are some herbicides and pesticides. Dioxins, potent teratogens found as impurities in the herbicide 2,4,5-T (Agent Orange of the Vietnam war), were discussed by Fishbein and S. Epstein (Case Western Reserve University School of Medicine). After it was discovered that dioxins were powerful toxic agents, efforts were made to decrease the dioxin content of 2,4,5-T and related herbicides, such as the widely used Silvex [2-(2,4,5-trichlorophenoxy)propionic acid]. The herbicide 2,4,5-T was banned for use on food crops but is still commonly used by state and federal forest service personnel. Dioxins are formed when these herbicides are pyrolyzed; herbicide killed brush is often burned off.

In an extensive study of the cytological effects of pesticides on the cells of vascular plants, W. Grant (McGill University) found the following abnormalities: chromosome breakage, endopolyploidy, C-mitoses, multipolar anaphases, multinucleate cells, chromosome stickiness, despiralization of chromosomes, chromatin clumping, chromosome rearrangements, anaphase and telophase bridges, lagging chromosomes, and nuclear swelling.

Pesticides may also react with substances in the environment to form mutagens. For example, R. Elespuru (Oak Ridge National Laboratory) found that carbaryl reacts with nitrite to form nitrosocarbaryl which is highly mutagenic in the bacteria *Hemophilus* and *Escherichia coli*.

Increasing concern is now being expressed for the mutagenic effects of various drugs. Licit as well as illicit drugs may be harmful. G. Röhrborn (University of Heidelberg) found isoniazide mutagenic in one system and inactive in another. The widespread use of isoniazide therapy and prophylaxis of tuberculosis makes it important to evaluate the hazard of this drug.

L. Zetterberg (Department of Genetics and Plant Breeding, Uppsala,