ABSTRACTS

GOVERNMENTAL REGULATORY ISSUES

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The impact of technological change is being felt all along the food production chain, from the growing field to the grocer's shelf. The result is a highly complex food supply in flux. No one can say with certainty what lies ahead, but we do know that today's changes will determine tomorrow's issues. The coming decades will bring many changes in the way we grow, process, and distribute food. There is a great variety in the kind of products that are and will be developed using new technologies and variations of traditional methods. Biotechnology exemplifies an area of dramatic change in the food supply. Considerable attention is focused on biotechnology from the viewpoint of the consumer, the industry, and the regulator. One of the challenges for both government and industry will be to decide how to assess the safety of products of biotechnology for human health and the environment, and thus to ensure public confidence. This will be essential if these new developments are to reach fruition. A review of current regulations governing biotechnology will be presented. What FDA is in the process of doing now to deal with new technologies that permit new products will be discussed. The importance of industry, academia, and government cooperative initiatives to provide for continued safety of these products also will be discussed, as will agency efforts to refine its risk assessment process and develop effective risk communication strategies.

PROFILING CONSUMER PREFERENCE FOR FRUITS AND VEGETABLES

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This paper examines the usage, product and attitude trends for fruits and vegetables. Factors influencing consumers' perception and preferences for fruits and vegetables are described, including sensory properties, nutrition/health, safety, distribution outlet, and use conditions. Specific issues relevant to preferences and use that are considered are microwave ovens, organically grown products, irradiation, new processing methods, lifestyles, and genetic engineering.

NEW FRUIT AND VEGETABLE PHYTOCHEMICAL RESEARCH PROGRAM IN CANCER PREVENTION

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Hundreds of safe non-nutritive phytochemicals are found in edible plants. The phytochemicals in edible fruits and vegetables can be grouped into two general categories for relevance to cancer prevention studies applied to humans. The fruit category is comprised of those substances that are present in limited quantities, exhibit chemical uniqueness in their structures, and are found only in specific fruits and vegetables. By virtue of their uniqueness, these substances could rationally be incorporated into experimental foods as compliance markers. Substances in this category might include rare tocopherols, isomeric isoprenoids, unusual methoxylated flavanoids, and uncommon heterocyclic and hydrocarbon-based plant pigments. The second category of phytochemicals are those that are found in higher quantities, occur in several edible species, and may be ingested by humans daily in gram quantities. This second group exhibits a potential for modulating human metabolism in a manner favorable for cancer prevention. Examples of the phytochemicals include classes of indoles, sulfides, terpenes, isothiocyanates, phenolic glycosides, bioflavonoids, coumarins and other lactones, lignans, carotenoids, sterols, naphthoquinones, saponins, tetracyrroles, and polyacetylenes. Both of the above two general categories of fruit and vegetable phytochemicals merit intense study, but with different orientations. It is the major objective of this pro-

gram to develop analytical methodology for detecting and quantifying phytochemicals in experimental food fortifications, in the blood and urine of humans consuming these experimental foods, and for assessing metabolic changes pertinent to cancer prevention in humans.

CREATIVE TECHNOLOGY TO TAILOR PLANT NUTRIENT UPTAKE THROUGH COMPUTERIZED INDIVIDUAL NUTRIENT ELEMENT INJECTION

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Development of a computerized individual nutrient injector was undertaken to provide accurate, dependable, reproducible, and reliable means of applying and replenishing each specific nutrient required for plant growth and development. With the aid of this new tool, the daily uptake of N, P, K, Ca, Mg, S, and minor elements was determined and compared to a system using electrical conductivity (EC) control. The nutrient uptake was measured under three sunlight level intensities of 60%, 32%, and 13% for the vegetative and fruit development stage of a greenhouse cucumber crop. Results show that individual nutrient was influenced by environment. Fruit development stage produced major changes in the uptake of nutrients along with environmental variations, indicating that cucumber nutrient uptake is directly related to active plant metabolic functions rather than passive environmental changes.

STORAGE POTENTIAL OF TOMATOES HARVESTED AT THE BREAKER STATE USING MODIFIED ATMOSPHERE PACKAGING

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Breaker tomatoes packed in polymeric film of known permeability were stored at 15C for 23 days. The ratio of weight of fruit to surface area of film necessary to achieve 2.5% to 4.5% O₂ and 3.5% to 8.0% CO₂ was determined. The gaseous composition of the atmosphere so generated (CO₂, O₂, ethylene, acetaldehyde, and ethanol) was monitored throughout the experiment. No evidence of anoxia conditions was detected as regards to acetaldehyde and ethanol readings. Modified atmosphere delays ripening processes such as changes in acidity, soluble solids, texture, and color as well as in polygalacturonase (PG) activity. Changes in PG activity seem not to be related to changes in texture. After 23 days of modified atmosphere storage, the treated fruit were exposed to the atmosphere at 22C. The fruit ripened normally. Sensory evaluation of treated and control fruit was made 30 days after harvest. Flavor and color of the modified atmosphere-packaged fruit had superior texture. This study demonstrates that modified atmosphere packaging and 15C storage can allow harvesting of fresh-market tomatoes at an advanced ripeness stage vs. the mature-green stage, which allows for increased sensory quality without significant loss of storage and distribution life.

THE BURP INDEX

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Bruce Ames and associates have generated a HERP (Human Exposure/Rodent Potency) index that is useful for putting relative carcinogenicities in perspective. His data can be made more useful by translating to a common denominator, as has been done in the BURP (Better Understanding of Relative Potencies) index, showing, for example, that a liter of wine is 18,000 times more carcinogenic (for the ethanol) than a liter of chlorinated water (for the chloroform). For the ethanol, 1 liter of beer is 8000 times; for formaldehyde, 1 liter of kola is 7700 times; for the safrole, 1 liter of old-

fashioned root beer is 575 times; for symphytine, 1 liter of comfrey leaf tea is 125 times; and, for the unsymmetrical dimethylhydrazide (UMDH), 1 liter of apple juice is only 10 times as carcinogenic as 1 liter of tapwater. In the FNF (Father Nature's Fannacy) database, biologically active compounds in plant foods are quantified (parts per million). Where available, LD₅₀s, ED₅₀s, and ID₅₀s of these biologically active compounds are incorporated to index, respectively, relative acute toxicities, effective doses, and inhibitory concentrations, in indices that parallel the HERP and BURP indices.

PRANDIAL "PSEUDOPRESCRIPTIONS"

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Superposed over a map of the centers of origin of vegetables of the world are tabulations of some ailments the vegetables might prevent or ameliorate. Following the U.S. Surgeon General's recommendation to ingest a greater quantity and variety of fruits and vegetables, guidelines might be established to suggest which fruits and vegetables might be better recommended for persons vulnerable to such diseases as, e.g., colon cancer (beans, broccoli, brussels sprouts, cabbage, wheat bran), hepatitis (artichoke, beet, burdock, dandelion, milk thistle), high blood pressure (garlic, onion, tomato), lung cancer (carrots, spinach, pumpkin, squash, tomato), obesity [catabolic or lipolytic herbs such as cinnamon, coffee, coriander, ginger, mustard, pepper (hot)], and ulcers (bananas, cabbage, celery, chile, fenugreek, ginger, licorice, peppermint). In cooperation with the National Institutes of Health, the Agricultural Research Service of the U.S. Department of Agriculture is developing a database quantifying the salubrious and deleterious phytochemicals present in food plants of the world. This FNF (Father Nature's Farmacy) database can be manipulated to generate "prandial pseudoprescriptions", suggesting which fruits, nuts, vegetables, spices, and herbs might rationally be augmented in soups, salads, cocktails, and teas served persons vulnerable to preventable or dietarily ameliorated ailments.

THE ASIAN VEGETABLE RESEARCH AND DEVELOPMENT CENTER GARDEN PROGRAM

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Home gardens. The horticultural approach is a viable long-term solution to some human health problems in the developing world. Nutritional deficiencies among low-income groups in developing countries can be alleviated by people growing their own home vegetable gardens that contain nutrients deficient in their diets. The Asian Vegetable Research and Development Center (AVRDC) has, since 1981, developed small, efficient home gardens that produce significant amounts of a family of five's recommended daily dietary allowance (RDA) for protein, calcium, iron, and vitamins A and C. Gardens have been developed for Indonesia, Thailand, and the Philippines. A vitamin A garden was also developed to show that home food production of this nutrient can be a long-term alternative to vitamin A capsule distribution and inoculations. Results this year show that these gardens can contribute significantly to a family's needs for the mentioned nutrients. *School garden.* A school garden can be a way to introduce a variety of vegetables to children early in life, as well as provide supplementary nutrients to their school lunches. During the year, the AVRDC school gardens grew 24 different vegetables, which provided, on a daily basis, more than one-hundred 113-g (½-cup) portions of nutritious vegetables to add to ricebox lunches the children bring to school. Each 113-g portion can provide significant amounts of a 10-year-old child's RDA for iron and vitamins A and C. *Urban gardens.* Growing nutritious crops in boxes or pots can be a way for urban families in developing countries to provide needed nutrients for their growing children. In two types of city gardens, a small selection of crops was planted in containers. Data were collected on yield and nutritional outputs, and the gardens were evaluated in terms of their contribution to the RDA of two preschool children.

Yields of the urban garden and 45-pot garden averaged 0.3 kg/day. The nutritional contribution to the RDA of two preschoolers was good for protein and calcium and excellent for iron and vitamins A and C. The 45-pot garden also gave excellent contributions of vitamins A and C. Both gardens produced a high number of daily harvests throughout the year.

CONSUMER CONCERNS ABOUT HORTICULTURAL PRODUCTS

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Many recent articles in the popular press have questioned the safety of some horticultural production and processing techniques. A study was conducted to document consumer concerns about the food supply and to relate these concerns to food production issues. Seventy-four percent of respondents believed chemical residues remained in fresh produce. Most were skeptical about the validity of carcinogenicity testing of chemicals, and 64% believed that pesticides in food may contribute to a high incidence of human cancer. Less than 15% reported very little concern about the use of pesticides for food production. Food irradiation was unfamiliar to 54% of the subjects. However, 89% believed that irradiated foods should be labeled. Results indicate that opportunity exists for education on safety of certain production and processing methods. Consumers appear to be trying to keep informed about safety of foods available to them. Producers and processors of horticultural products need to be sensitive to these concerns.

DIETARY CONCERNS AND FOOD CONSUMPTION PATTERNS OF HORTICULTURAL PRODUCTS

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Since the initial release of the Dietary Guidelines in 1980, consumers have become increasingly aware of the effects of foods on their diet. A study of Washington Cooperative Extension clientele found that 86% of the subjects had adopted dietary changes due to concerns about health and fitness issues. Adopters of dietary change were seeking to decrease fat, sugar, sodium, cholesterol, and calories while increasing fiber. More than 60% of the adopters had increased fresh fruits and vegetables to implement these desired changes in food components.

FOOD QUALITY GENES AND GENETIC MODIFICATION OF FRUIT AND VEGETABLE PRODUCE

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For many branded food products, the raw material is purchased as a commodity. Food companies provide added-value based on processing technology or marketing. The tools of plant biotechnology, which shorten the time for crop improvement and permit development of novel germplasm, offer the food industry the opportunity to modify raw materials and develop proprietary branded products. Such modifications will permit development of plant cultivars specifically selected for traits with added-value for the processor or the consumer. Biotechnology-developed cultivars offer the opportunity to develop produce that can be branded. The cell genetics tools of clonal propagation, somaclonal variation, gametoclonal variation, and protoplast fusion permit new cultivar development in an intermediate time scale, making them attractive for market introduction of proprietary products. When integrated with conventional breeding, these intermediate-term technologies will permit modification of fruits and vegetables over the course of the next several years. The longer-term technologies of plant genetic engineering will continue to have an impact on manipulation of specific traits, resulting in second-generation products specifically designed for consumers.