
Discussions on Treatment, Prevention and Consumer Choice¹

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Participants in the workshop sessions explored themes raised by the keynote speakers and in the Q&A sessions—there were three broad areas of discussion:

- Applying agriculture to medicine: therapeutics and treatment. Presentations on this theme included *Why Medicine Needs Agriculture*, *Botanicals as Therapeutics*, and *Supplementing the Immune System with Plant-Produced Antibodies*.
- Applying agriculture to health: food to prevent disease. Presentations included *Where do Functional Foods Fit in the Diet?*, *Can We Have Allergen-Free Food?*, and *The Role of Edible Vaccines*.
- Towards healthy people: lifestyles and choice. Presentations included *The Evolving Wellness Consumer*, *Delivering on the Promise of Safe and Healthy Foods*, and *Farmers as Consumers: Making Choices*.

The 340 conference attendees each chose one of the three workshop sessions for their 2½-hour exchange of knowledge and expertise. Notably, three quarters of the conference attendees chose to participate in the session on prevention, or applying agriculture to health, perhaps indicating a strong view to the future and endorsement of the benefits to society of further integrating agriculture and medicine. Of the fifteen workshops, eleven focused on prevention, two on therapeutics and treatment, and two on consumer choice. Lists of questions (Table 1) helped initiate and perpetuate discussion and the assistance of two facilitators and one recorder in each of the fifteen workshop sessions (Table 2) helped to focus the participants on key ideas and move them to conclusions.

¹Prepared from session reports provided by nineteen recorders (Table 2).

TABLE I. WORKSHOP-SESSION QUESTIONS.

Agriculture and Medicine: Therapeutics and Treatment

- **Integration?** Hippocrates said food is medicine. Some suggest that since the 1500s, agriculture and medicine have diverged in key ways. Some suggest that the two have come together during the last 20 years. Is integration of the two desirable? If so, how can the agriculture/food production side and the health/medicine side better understand and work with each other? What innovative institutional relationships might be developed that would influence research, funding, education, public/private partnerships, others?
- **Technologies?** To date, modern technologies have been applied to medicine and agriculture. Biotechnologies have been applied to both. Papayas. Human insulin. *Bt* cotton. Herbicide-tolerant soybeans. Should research and application pause? Move forward? Be applied in medicine for treatment? In agriculture for nutrition, production? Neither? Both?
- **Botanical therapeutics?** Mushrooms, bee pollen, grape seeds, flower extracts. What opportunities can therapeutic botanicals and food derivatives provide? How does the public perceive natural products and their potential benefits? How do research and regulation address potentials and concerns?
- **Plant-produced antibodies?** Why are scientists pursuing the production of antibodies in plants? Would such a development have benefits to health? What about implications for the food supply? The environment? What kind of regulatory process would need to be in place? Who would grow antibody-producing crop plants? Where would they be grown?
- **Yield and value?** Some would say that agriculture is no longer a bushels-per-acre endeavor—it's value per acre. Is this true? Who would or should derive value from traditional or new crops? The farmer (small or large)? The developer? The processor? The general consumer? The patient?
- **Open question** to be defined by the group.

Foods to Prevent Disease

- **Functional foods?** Breakfast cereals that reduce cholesterol. Increased lycopenes in your catsup. Vitamin D in milk. Soy. Can “functional foods” help prevent disease? What are the risks and benefits of designing fortified foods? What are the regulatory and safety issues? Are increased nutritional constituents in foods a public good?
- **Allergenicity?** Would foods developed via biotechnologies carry proteins that might induce allergic reactions? Would biotechnology applications result in hypoallergenic foods and improved allergen detection methods? How should research and policy be used to address these issues?
- **Edible vaccines?** Why are scientists pursuing research on edible vaccines? How would plants carrying disease-prevention constituents be segregated from the food supply? Would health professionals, consumers accept edible vaccines?
- **Prevention?** How can the incidence of diet-related chronic diseases be reduced given the complexities of consumer attitudes and behaviors; suppliers; health professionals; changing policies; the structural forces that influence eating patterns indirectly?
- **Responsiveness?** How can the agricultural and food systems be more responsive to what is known about diet-related chronic disease and prevention? Can agriculture produce to improve nutrition and health?
- **Open question** to be defined by the group.

TABLE 1. WORKSHOP-SESSION QUESTIONS. (continued)

Lifestyles and Consumer Choice

- **Information?** Health claims. Advertisements. Who do consumers trust? The government and its regulatory process? Labels? Research institutions? Consumer organizations? How can consumers sort out messages on food, nutrition and health, nutrient content, genetically engineered foods and therapeutics, natural products, plant-derived treatments, child nutrition, and food preparation and handling?
- **Consumer preferences?** Are consumers voicing their preferences? Are their voices being heard? What does ‘wellness’ mean to consumers? Can nutrition, public health, medical professions and other public education organizations help ensure that nutrition, health and wellness become a way of life?
- **Rural lifestyles?** How might rural lifestyles be affected by local production of pharmaceutical crops or specialty crops such as high-glucosinolate crucifers (cabbage and broccoli, for example) or increased acres in organic crops or increased emphasis on local food systems? What are the scales and profitability potentials for small farmers and larger farmers across the country?
- **International collaborations?** Do developed countries have a role in addressing hunger, improved diets, eradication of disease and improved agriculture in developing countries? If so, what types of science and technology developments for the future should be in the portfolio?
- **Open question** to be defined by the group.

TABLE 2. WORKSHOP FACILITATORS AND RECORDERS.

Facilitators

Mark Ascerno, <i>University of Minnesota</i>	Jean Kinsey, <i>University of Minnesota</i>
Susan Barefoot, <i>Clemson University</i>	Theodore Labuza, <i>University of Minnesota</i>
Dianne Bartels, <i>University of Minnesota</i>	Marshall Martin, <i>Purdue University</i>
Janet Bokemeier, <i>Michigan State University</i>	Helene Murray, <i>University of Minnesota</i>
William Brown, <i>University of Florida</i>	Darrell Nelson, <i>University of Nebraska</i>
Michael Burke, <i>Oregon State University</i>	Christopher Morton, <i>Minnesota Food Association</i>
G. Michael Chippendale, <i>University of Missouri</i>	James Orf, <i>University of Minnesota</i>
Gregory Cuomo, <i>University of Minnesota</i>	Frank Pflieger, <i>University of Minnesota</i>
Beverly Durgan, <i>University of Minnesota</i>	Maggie Powers, <i>Powers and Associates, Inc.</i>
Thane Dutson, <i>Oregon State University</i>	Steven Pueppke, <i>University of Illinois</i>
Walter Fehr, <i>Iowa State University</i>	Charles Scifres, <i>Texas A&M University</i>
James Fischer, <i>Clemson University</i>	Philip Schwab, <i>U.S. Department of Agriculture</i>
Vincent Fritz, <i>University of Minnesota</i>	Steven Slack, <i>Ohio State University</i>
Burle Gengenbach, <i>University of Minnesota</i>	Catherine Solheim, <i>University of Minnesota</i>
Ian Gray, <i>Michigan State University</i>	Neal Van Alfen, <i>University of California-Davis</i>
Richard Jones, <i>University of Florida</i>	Joseph Warthesen, <i>University of Minnesota</i>
Catherine Jordan, <i>University of Minnesota</i>	Gregory Weidemann, <i>University of Arkansas</i>
Kevin Kephart, <i>South Dakota State University</i>	Randy Woodson, <i>Purdue University</i>

Recorders²

Mary Buschette, *College of Agricultural, Food and Environmental Sciences*
 John Byrnes, *College of Agricultural, Food and Environmental Sciences*
 Allison Campbell, *Academic Health Center*
 Allan Eaglesham, *National Agricultural Biotechnology Council**
 Sarah Greening, *Minnesota Agricultural Experiment Station*
 Alicia Hall, *Graduate Research Assistant, Department of Philosophy*
 Brenda Hudson, *Academic Health Center*
 Sarah Iverson, *College of Agricultural, Food and Environmental Sciences*
 Jessica Krueger, *College of Agricultural, Food and Environmental Sciences*
 Jane Leonard, *Minnesota Rural Partners**
 Suzanne Livingston, *College of Agricultural, Food and Environmental Sciences*
 Shane Maefsky, *Undergraduate, College of Agricultural, Food and Environmental Sciences*
 Ann Kirby McGill, *University Relations*
 Jennifer Obst, *University of Minnesota Extension Service*
 Susan Parry, *Graduate Research Assistant, Department of Philosophy*
 Patrick Plonski, *College of Agricultural, Food and Environmental Sciences*
 Anne Pylkas, *Undergraduate, College of Agricultural, Food and Environmental Sciences*
 Cynthia Scott, *University Relations*
 Kelly Sullivan, *College of Agricultural, Food and Environmental Sciences*

²From the University of Minnesota unless indicated with an asterisk.

APPLYING AGRICULTURE TO MEDICINE: THERAPEUTICS AND TREATMENT

These discussions were summarized for the plenary audience by Catherine Solheim, University of Minnesota, and Kevin Kephart, South Dakota State University.

Integration Participants foresaw the accrual of great benefit from the further integration of agriculture and medicine. They addressed integration on two broad levels: higher education and cross-sector collaboration. First, they recommended that medical schools and colleges of agriculture both need to enhance curricula, and the preparation of students, using nutrition as a focal point. Future physicians and other healthcare professionals need an expanded understanding of nutrition as a component of disease treatment, prevention, and healthfulness. Similarly, because agricultural colleges tend to adhere to traditional emphases on production of commodity crops and food, the integration of nutrition into their curricula would help orient students in terms of food consumption, consumer preferences, and other end-use outcomes. The importance of human-resource issues was noted, to address the best approaches for educating healthcare professionals and agriculturalists, also to ensure continuing education for practitioners to foster attentiveness to new interdisciplinary approaches. Participants highlighted the industry model of structuring teams to approach specific problems and suggested that higher-education institutions should encourage more interdisciplinary team approaches and address the faculty-reward system that can be a barrier to teamwork. They also noted that a nutrition emphasis in K–12 education would serve as an important foundation for all students, not only for those who pursue careers in food systems and healthcare.

Second, participants noted that funding will be the driver for better integration of agriculture and medicine. Cooperatives and alliances that connect the producer with the consumer in innovative partnerships can be a mechanism for integration. Also discussed were sources of funding and public/private partnerships that can give integration a boost; it was noted that, whether from federal or state agencies or private concerns, funding is seldom free of special interests. Technology was cited as a tool that can assist in building new relationships and effective virtual partnerships.

Technology In general, participants were of the opinion that science and technology—in almost all disciplines—advances at a rate beyond that of society's ability to comprehend complex developments and their ultimate ramifications. A government mandate by any country to “pause” development and application of biotechnology would merely cause research and development to shift to other more-supportive settings.

There is need for a holistic approach to discussion and application of biotechnology in order to accommodate varied values and societal perspectives and integrate not only agriculture and medicine but also the public-private sector relationships, the environment, and economics. The discussants noted the special importance of inclusive discussions that engage the public on the challenges of the intersection of technological advancement with the religious and spiritual beliefs of some groups.

Botanical Therapeutics Participants suggested that the body of data on the safety, efficacy and potential of a range of botanicals is currently insufficient perhaps because of inadequate public investment in this area. Discussion focused largely on regulatory frameworks and the need for improved consumer information and education.

Plant-Produced Antibodies Similarly, participants discussed regulatory aspects of using plants as “factories,” e.g. a corn plant genetically modified to synthesize an antibody for the treatment of cystic fibrosis. Some suggested zero tolerance for “escapes” or potential pollen drift. Others felt that zero tolerance is an impossible endpoint given detection methods and suggested that risk/benefit analyses should be instituted. A body such as the National Research Council might be tasked to develop a protocol that would inform producers and also set a framework for combined U.S. Department of Agriculture/Food and Drug Administration guidelines and future legislation.

Yield and Value The financial benefits from new pharmaceutical crops will likely accrue chiefly to industry, through grower contracts, and land-access and distribution restrictions. Participants were divided on the issue of whether biotechnology and “pharming” herald a revitalization of rural America. The production of new crops might benefit small numbers of growers, but will likely not be a boon to rural vitality unless value-added components are processed near production areas. Some emphasized that neither biotechnology nor agriculture itself will be major forces in rural revitalization. It was suggested that the value added by biotechnology for farmers should be measured as savings of time and by increased diversity in crop rotations due to herbicide tolerance.

APPLYING AGRICULTURE TO MEDICINE: FOOD TO PREVENT DISEASE

These discussions were summarized for the plenary audience by Steven G. Pueppke, University of Illinois, and Joseph Warthesen, University of Minnesota.

Functional Foods Participants agreed that indeed functional foods have the potential to help lower the risk of chronic disease, as can individual changes in

behavior relating to diet, exercise and other risk factors such as smoking. Moreover, in the absence of changes in behavior, functional foods may help address nutrition needs. However, it is difficult to second-guess consumers; they indicate a preference for healthy foods, but do not necessarily buy them. Participants suggested that consumers are somewhat complacent about the role of food in their lives, particularly when it comes to disease prevention. They do not necessarily see a problem that needs to be addressed—prevention of diet-related chronic disease—and, therefore, do not see a need for fortified foods.

Potential risks should be addressed as functional foods are developed, including the amount of nutrient added to a food or product and the recommended level of intake, as well as potential interactions with other foods or medications. These considerations are particularly significant for infants and children.

Consumer education and information must take a holistic approach. Consumers might misinterpret information about a fortified product without weighing other aspects such as caloric or sugar content. More consumer education is needed regarding nutritional synergisms, antagonisms, displacement and cross-reactions across the diet. The benefits of functional foods may be more visible in developing countries, but conflicts are possible where opinion leaders who are interested in directions for healthy foods have reservations about the role of biotechnology.

Allergenicity Participants highlighted applications of new technology as ways to improve detection of allergens and predict the protein characteristics that might lead to allergic responses. They noted that the development of new animal models for allergenicity might be helpful.

Edible Vaccines Edible vaccines may ultimately be the most highly visible benefit from biotechnology—a benefit that the consumer can directly see as relevant to daily life. A vaccine as a food product will be perceived as more attractive than injected inoculation, and significant benefits are possible particularly for developing countries. Public-education and information programs were recommended in anticipation of new products to ensure that safe, beneficial and life-saving vaccines are accepted by consumers rather than discounted due to misinformation or confusion.

Participants noted the need for safety measures, including physical separation of crops and staggered plantings. Also discussed were measures, such as geographic isolation of vaccine crops and contained environments, to ensure segregation.

Prevention The prevention of diet-related chronic disease is beyond the realm of science and technology in important ways. Prevention is linked to behavioral

psychology. A key recommendation was for improved integration across agriculture and medicine, certainly across institutions of higher education that focus on teaching, research, and outreach. Participants highlighted partnerships that should be fostered among universities and social service providers, across K–12 educational systems and with the participation of federal policy leadership. Connections need to draw upon capacity of national organizations, corporations and healthcare providers. Broad collaborative efforts may help avoid unintended consequences—messages to reduce dietary fat and consume new “fat-free” products, for example, resulted in over-consumption of carbohydrates and sugar.

Responsiveness The agricultural and food system can be most responsive to nutrition and health interests by understanding its customer. The traditional agricultural and food-system customer has been the farmer, who, in turn, sees the grain cooperative or the food-processing plant as his or her customer. It has been easy for the system to push improvements such as enhanced agronomic traits into the market place, because they were readily accepted by the customer. Now, however, the real customer—the consumer—has stepped forward with a growing voice. Consumers are describing their preferences, and articulating what they do not want. Now, the agricultural and food system finds the need to respond to a demand for food quality and variety that is very different from the traditional farmer awaiting a new production technology. The system, including institutions of higher education, must listen and understand consumer messages, by forming new partnerships and by including a wider range of views and perspectives.

Participants acknowledged the critical role of federal policy, noting that the current Farm Bill does not integrate—and perhaps highlights the chasm between—food production and diet and health. They also noted opportunities for addressing prevention through policy relating to school-lunch and food-stamp programs, for example. They posed the question of what agriculture and food production might look like if it were based on dietary guidelines and the USDA’s food pyramid. The role of the media was emphasized in terms of the need for comprehensive messages on food and health aimed at consumers.

TOWARDS HEALTHY PEOPLE: LIFESTYLES AND CHOICE

These discussions were summarized for the plenary audience by Janet Bokemeier, Michigan State University, and Maggie Powers, Powers and Associates, Inc.

Information There is no monolithic consumer. Information on food and health must be accessible and appropriately tailored to a variety of audiences. There is an important distinction between the myriad sources of information on food,

nutrition, and health and the sources that consumers trust. Information for consumers could be improved by increased collaboration among physicians, nutritionists, agriculturalists, and healthcare organizations—but it should not be simply to add to information overload. Federal agencies and universities are regarded as relatively unbiased sources of information; however, leadership at the federal and state levels will be required to ensure high-quality, synthesized information that stands out to consumers.

Consumer Preferences There was general agreement that consumers are being offered a wider range of choices based on demand. However, the voices of only some consumers are being heard. Those of limited resources and of some ethnic and age groups may not be considered. It was suggested that, indeed, consumer preferences and demands are being met—for food that is fast, tasty and inexpensive—showing that such consumers have not linked food preferences to health preferences. However, demand attributes include not only convenience and price, but also health and environmental and social values as shown by the growing demand for organic foods and other new products.

Rural Lifestyles Participants in the consumer-choice workshops echoed those in the “applying agriculture to medicine” workshops: the introduction of pharmaceutical crops will do little to reverse the trends of consolidation in agriculture or to revitalize rural America. Overall acreage devoted to “pharm” crops will be minimal. Pharmaceutical crops might elevate farm income for small numbers of producers and increase demands for a better-educated workforce in some regions. Improved relations between farmers, retailers, and wholesalers might enlarge urban specialty markets (for local seasonal fruits and vegetables, for example), thereby creating more opportunities for sustainable growth in rural areas. Community Supported Agriculture (CSA), with individuals participating with local farms, and organic agriculture were identified as potential mechanisms for rural community revitalization. Participants’ views were mixed, however, on whether CSA and organic food production would increase to a level that could strengthen and support vibrant rural economies.

International Collaboration Developed countries have a responsibility to address hunger, improve diets, help eradicate disease and improve agriculture in developing countries. Participants specified that assistance should:

- help developing countries develop their own solutions to their own problems,
- engage the collaboration of a variety of in-country and international entities specific to an issue or problem, and
- focus on long-term objectives rather than short-term fixes.

In sum, participants in the consumer-choice workshops emphasized the importance of information. They stated that quality information will enable consumers to make choices that can enhance rural and urban lifestyles in the United States. Integrated research and improved information can also lead to international collaborations for improved health worldwide.