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Defining the Forefront of Food Science by Integration with Nanotechnology and Nutrigenomics

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The convergence of nanotechnology and biotechnology is creating exciting new possibilities for scientists. Leveraging nanotechnology in food-related research is critical to enhance the well-being of human. On the other hand, advancements in identification, extraction, and processing of natural biological materials have expedited the development of functional ingredients, both in variety and in quantity. Quality assurance of bioactivity remains an important issue with these emerging ingredients, and becomes more critical for study of diet-gene interactions. Since mapping the human genome four years ago, biotechnologists have raced to understand how genes react with diet to determine why some people develop osteoporosis, Alzheimer's, even cancer. This fast-growing field, called nutritional genomics or nutrigenomics, is attracting serious research funding, and dieticians are predicting a "revolution" in preventative health. This present to food scientists opportunities and challenges while developing effective and reliable *in vitro* protocols for evaluation of functional bioactivities of natural products. Presented as an example are the efforts in integrating biosensing with cytotoxicity assessment to assess *Ephedra*, the major source of ephedrine-type alkaloids (ETA), that has been used in the Far East to treat asthma, nose and lung congestion, and fever. Indiscriminate consumption of ETA-containing products in the U.S. has resulted in more than 1,100 reported cases of poisoning and other serious side effects since 1993. The quality of *Ephedra* is usually determined by the contents of total ETA. However, although individual ETA has similar pharmacological activity, they vary significantly in potency. Therefore, to characterize the toxicity of *Ephedra*, a more complicated bioassay is needed. The bioactivity of *Ephedra* was measured by its cytoxicity against representative cell lines, whereas the cellular stress responses were assessed using a panel of biosensing strains. Also discussed is the philosophy of Chinese medicinal food, which is conceptually identical to nutrigenomics. Further understanding of nutrigenomics is essential to leverage the value of food products while nanotechnology aids in safeguarding food processing and applications.