JOURNAL OF AGRICULTURAL AND FOOD CHEMISTRY

EDITORIAL

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Food Quality Traits for Sustaining Agriculture

During his prolific career, Professor John E. Kinsella (1938–1993) authored or co-authored 59 manuscripts published in the *Journal of Agricultural and Food Chemistry*. Much of his research, which carried into his mentoring and collaboration with generations of students, postdocs, and colleagues worldwide, including many of the authors cited in this Virtual Issue (http://pubs.acs.org/page/vi/2011/food-quality.html), were around the themes of health benefits of foods to consumers, including the contributions of what we now know as phytonutrients and nutraceuticals in foods. During his professional career, largely at Cornell University and the University of California, Davis, Prof. Kinsella espoused a central role for the consumer, as well as the concepts of sustainability and health in food production, processing, and delivery.

Food components and dietary choices are increasingly identified as causes and solutions for many challenges to human health.[1] The potential health benefits of consuming foods that contain natural chemicals with known or suspected health benefits have captured public fancy.[2] Many chronic diseases ranging from heart disease to cancer are widely believed to be caused or aggravated by poor diet choices. However, some diets are associated with lower mortality, such as the Mediterranean diet, which is rich in fish, cheese, yogurt, olive oil, fruits, whole grains, and fresh vegetables, supplemented by moderate consumption of red wine and accompanied by daily physical activity.[3] Consequently, there is growing scientific interest in phytonutrients or nutraceuticals in these foods. For example, the number of manuscripts published per year in the *Journal of Agricultural and Food Chemistry* on one group of phytonutrients, the antioxidants, has increased by nearly 5 times over the past decade.[4] Although the health and longevity of people consuming the "Mediterranean diet" is remarkable, making links between specific foods and specific phytonutrients and desirable health outcomes is difficult, and the science is still evolving. New tools, such as genomics and metabolomics, and improved methods of clinical assessment with humans are under intense development. New health claims are growing, and new healthy foods are finding ready markets. Examples will be provided of recent reports in this broad area and the challenges that exist for the future in the arena of health benefits of foods.

The *Journal of Agricultural and Food Chemistry* has published many studies dealing with the identification and science of chemistry-based traits associated with health foods. These include early work that helped define the field of health benefits of food[5,6] and functional foods, which extend beyond sustaining caloric intake and essentials of health supplied by carbohydrates, proteins, vitamins, minerals, and related dietary constituents that all of us need to survive.[7,8] It extends through the 1990s to the present, a period of intense development in the areas of polyphenolic antioxidants,[9−13] monounsaturated and polyunsaturated fatty acids,[14,15] proteins,[16−19] soluble fiber,[20,21] and a few other groups of health-beneficial chemicals. This virtual issue includes new work on a variety of emerging groups of health-beneficial chemicals, including oligosaccharides, glycolipids, and glycoproteins in milk.

We offer in this virtual issue a sampling of manuscripts published in the *Journal of Agricultural and Food Chemistry* exemplifying this broad field of science that appeared in a recent discrete period, from late 2009 to early 2011.

Foods and beverages must have aroma and taste to attract the attention of consumers, and it also helps if the food adds health benefits by way of phytonutrient or nutriceutical content. In the paper by Robinson et al.[22] (*J. Agric. Food Chem.*, DOI: 10.1021/jf902586n), sensory observations were coupled with headspace analysis to determine the effect of matrix composition on partitioning of volatiles to the gas phase in wines, thereby affecting aroma. Higher ethanol content in the wine reduced the headspace content of some volatile aroma compounds, which may explain the suppression of fruit aroma in higher alcohol content wines.

Several of the manuscripts explore the connection between chemical content of wine, beer, and foods and beneficial health effects for the consumer. Forester and Waterhouse[23] (*J. Agric. Food Chem.*, DOI: 10.1021/jf9040172) showed that gut microflora metabolites of ingested parent anthocyanins reduced cell proliferation in a Caco-2 model cell system, adding to existing knowledge of how moderate intake of wine can reduce the incidence of colon cancer. Leopoldini et al.[24] (*J. Agric. Food Chem.*, DOI: 10.1021/jf101693k) focused on molecular structural features of pyranoanthocyanins present in aged wines, which promote radical scavenging and, thus, the health-beneficial effects attributed to aged wines. Piazzon et al.[25] (*J. Agric. Food Chem.*, DOI: 10.1021/jf101975q) report on the phenolic acid content in different types of beer and attribute the antioxidant power of bock, abbey, and ale beers to the higher content of phenolic acids and polyphenols.

There is much to be learned from berries and fruits and their content of antioxidants and other health-promoting chemicals. Blueberries, for example, are of interest for potential in reducing diet-induced obesity and lessening the risk of diabetes and heart disease. Prior et al.[26] (*J. Agric. Food Chem.*, DOI: 10.1021/jf902852d) reported feeding studies with mice using blueberries and their juice and the purified anthocyanins in blueberries, which further strengthens the connection between blueberries and health benefits. From Khanal et al.[27] (*J. Agric. Food Chem.*, DOI: 10.1021/jf102916m), the same research group explored the bioavailability of epicatchins and catechins and these beneficial compounds may be more bioavailable from blueberries than cranberries. In still another contribution from this group, Hager et al.[28] (*J. Agric. Food Chem.*, DOI: 10.1021/jf102964b) explored the effect of juicing, pureeing, canning medium, and freezing on the composition of ellagitannins in blackberries and blackberry-based products, noting that some losses of these compounds can occur during juice processing. The rich bioactivity of the flavanones in orange juice and other orange beverages was studied in human volunteers by Vallejo et al.[29] (*J. Agric. Food Chem.*, DOI: 10.1021/jf100752j). Bioavailability correlated with

Published: March 01, 2011

solubility of the individual flavanones and was also influenced by gut microflora and glycoside/aglycone ratios in the gut.

Lee and Mitchell[30] (*J. Agric. Food Chem.*, DOI: 10.1021/jf1033587) studied the concentration and stability of quercitin, a flavanoid antioxidant, in onion varieties, processing co-products, and with differing storage conditions. LC(ESI)−MS/MS and HPLC were used to differentiate various flavanoid glucosides and aglycones. González-Barrio et al.[31] (*J. Agric. Food Chem.*, DOI: 10.1021/jf103894m) reported UV and mass spectrometry identification of the bioavailable metabolites of ellagitannins and ellagic acid in rodents, humans, pigs, squirrels, beavers, sheep, bull calves, birds, and insects. The broad variation in metabolites across species suggests a significant role for gut microflora and its dehydroxylation enzyme content in bioprocessing of dietary ellagitannins.

Resveratrol and its oligomers are bioactive secondary metabolites found in a number of plant genera and especially in the wine grape species of *Vitis vinifera*, with concentrations influenced by disease and other stressors on the plant. They have beneficial effects in the plant as phytoalexins and also on the health of consumers as antioxidants. Losso et al.[32] (*J. Agric. Food Chem.*, DOI: 10.1021/jf1012067) reports the inhibition by *trans*-resveratrol of hyperglycemia-induced inflammation associated with diabetes in retina pigment epithelial cells. Resveratrol also has the beneficial effect of enhancing the uptake of medicines in ophthalmic eye-drop preparations.

Resveratrol and its oligomers in winegrapes are believed to be responsible, in part, for reducing the incidence of cancer and heart disease associated with the "Mediterranean diet" and the "French paradox", which includes moderate consumption of red wine. Jiang et al.[33] (*J. Agric. Food Chem.*, DOI: 10.1021/jf102005z) used EPR spin-trapping to probe the mechanism of quenching of singlet oxygen by polyphenols, finding that quenching proceeded by both physical and chemical pathways. Resveratrol and its oligomers are believed to be effective in explaining the "French paradox", in part because of their antiradical properties. Potrebko and Resurreccion[34] (*J. Agric. Food Chem.*, DOI: 10.1021/jf900667d) examined the effect of UV treatment on elevating levels of *trans*-resveratrol and *trans*-piceid (*trans*-resveratrol-3-*O*-β-glucoside) in irradiated sliced peanut kernels. Combined ultraviolet−ultrasound treatments did not exhibit synergistic effects when compared to ultrasound treatments alone.

Wei and Shibamoto[35] (*J. Agric. Food Chem.*, DOI: 10.1021/jf101077s) explored antioxidant activity and chemical composition of several essential oils widely used in cosmetics and a variety of other household products, medicines, and foods and beverages, including in aromatherapy aimed at reducing inflammation. Thyme oil exhibited the greatest antioxidant effect among the essential oils tested (because of its high content of thymol and eugenol), while aloe vera oil exhibited the greatest lipoxygenase inhibitory activity.

Frankel published two notable Perspectives on extra virgin olive oil (EVOO), one on adulteration, stability, and antioxidants[36] (*J. Agric. Food Chem.*, DOI: 10.1021/jf1007677) and the second on the nutritional and biological properties of EVOO[37] (*J. Agric. Food Chem.*, DOI: 10.1021/jf103813t). Both Perspectives provide evaluation and critiques of published methods, for analytical methods in the first paper and for protocols and testing methods used to validate the complex nutritional properties of EVOO in the second paper. Better methods and more refined experimental protocols are needed in both cases to improve the detection of adulteration and to validate health/nutrition benefits of EVOO.

Interest in plant storage proteins from legumes as health-beneficial food components is rising. Tang and Sun[38] (*J. Agric. Food Chem.*, DOI: 10.1021/jf904254f) characterized two globulins from mungbean (*Vigna radiata*). They found relationships between physicochemical properties and conformational features of the two globulins, providing a base from which these proteins might be improved by directed plant breeding or protein engineering.

Zhu et al.[39] (*J. Agric. Food Chem.*, DOI: 10.1021/jf903643p) investigated physicochemical and emulsifying properties of whey protein isolate conjugated with dextran and found improved emulsifying ability and emulsion stability when compared to gum arabic, a widely used emulsifier composed of naturally occurring glycoproteins.

Maestre et al.[40] (*J. Agric. Food Chem.*, DOI: 10.1021/jf901727x) addressed the issue of lipid oxidation in fish catalyzed by fish hemoglobin, a significant mechanism of quality deterioration particularly in dark-muscle fish species. The reductants associated with grape proanthocyanidins and reduced glutathion were effective inhibitors of oxidative degradation in fish muscle, even more than iron chelators, thus providing a way to improve fish store-ability and maintain its health-beneficial content of unsaturated fatty acids.

Sharma et al.[41] (*J. Agric. Food Chem.*, DOI: 10.1021/jf1002446) described the functional properties of edible oilseed proteins from such sources as almond, cashew nut, macadamia, pecans, pine nut, and pistachios, as well as peanut and soybean seeds. These proteins, together with lipids, constitute the major portion of seed weight and are significant determinants of seed properties that are attractive to consumers.

Selma et al.[42] (*J. Agric. Food Chem.*, DOI: 10.1021/jf902107d) studied the interaction between phenolics and gut microbes and how the microbial metabolite distribution might affect human health, a familiar theme throughout many of the manuscripts addressing phenolics and polyphenol antioxidants in the period from which manuscripts for this issue were selected. Modifying intestinal bacterial populations by probiotics or other means appears to offer much promise for improving human use of healthy components otherwise not bioavailable to consumers of potentially health-laden foods.

This theme has been elevated to a new level by recent studies of how human milk oligosaccharides interact with the developing gut microflora in babies[43] (*J. Agric. Food Chem.*, DOI: 10.1021/jf9044205). Human milk oligosaccharides are believed to regulate the intestinal microbiota of breast-fed infants by functioning as decoys for pathogens and as prebiotics to enhance beneficial bacteria. A total of 16 bacterial strains of 10 different genera were examined for their ability to grow on human milk oligosaccharides. Mass-spectrometry-based glycoprofiling revealed a preference among some microbes for fucosylated oligosaccharides, in effect acting as ready consumers of this oligosaccharide substrate. This combination of microbiology and analytical chemistry is providing new insight into how human milk oligosaccharides play pivotal roles in shaping intestinal microbiota that promote healthy infants.

Argov-Argaman et al.[44] (*J. Agric. Food Chem.*, DOI: 10.1021/jf102495s) explored the function of nanometer-sized lipid−protein particles termed "lactosomes" in human milk. The results revealed that a bioactive lipid−protein nanoparticle is secreted into milk not as an energy source for the infant but to function in protective and regulatory ways, perhaps including protection against pathogenic bacteria.

Froehlich et al.[45] (*J. Agric. Food Chem.*, DOI: 10.1021/jf100112x) addressed the intriguing area of post-translational modifications of milk proteins over the course of lactation. This study showed that lactoferrin, one of the most abundant glycoproteins in human milk, was dynamically glycosylated during the early phase of lactation. Post-translational modifications, particularly glycosylation, can influence protein structure, function, stability, and the infant's gut, where degradation products are formed, with potentially beneficial bioactivity, conferring significant advantages to the infant.

Clearly, new abilities to tackle complex questions in the bioactivity and health benefits of food components have entered a new phase, as interdisciplinary teams delve more deeply into interactions at the molecular level that just a few years ago were speculative, at best.

This virtual issue is meant to be illustrative rather than comprehensive. We have purposefully bypassed the exciting field of chemically based health benefits associated with traditional medicinal foods, herbal remedies, and supplements. We have focused here on health benefits of human foods, those commonly consumed by people in various parts of the world. We have also excluded food safety, while recognizing the tremendous advances being made in detecting and eliminating health-detrimental chemicals and microorganisms in foods.

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Editor

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