DOI:10.1021/jf9001022

JOURNAL OF AGRICULTURAL AND FOOD CHEMISTRY
ARTICLE

Agricultural and Food Chemistry: 50 Years of Synergy between AGFD and *JAFC*

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The Division of Agricultural and Food Chemistry (AGFD) and the American Chemical Society had the foresight to launch the *Journal of Agricultural and Food Chemistry* in 1953. *JAFC*, still closely connected with the Division, has grown to be the premier international journal in the field, providing an outlet for publishing original research articles, reviews, perspectives, and editorials, for agricultural and food chemists from many nations. *JAFC* has expanded coverage of current areas of intense interest, such as bioactive constituents of foods, biotechnology, and biobased products and biofuels, as well as continuing strong coverage of such mainstream categories as food chemistry/biochemistry, analytical methods, safety and toxicology, and agrochemistry. In 2008 alone, *JAFC* published over 1650 peer-reviewed manuscripts, several symposia (largely from AGFD symposia at ACS National Meetings), and a number of reviews. The synergy between AGFD and *JAFC* offers many benefits and exciting opportunities for advancing the science of agricultural and food chemistry for the future.

KEYWORDS: AGFD 100th Anniversary symposium; JAFC; history

INTRODUCTION

This symposium is an opportunity to acknowledge the accomplishments brought about by the interdependence of the ACS Division of Agricultural and Food Chemistry (AGFD) and the *Journal of Agricultural and Food Chemistry*. The close relationship of the Division and *Journal* dates back over 50 years, when the *Journal* was founded, as a result of the efforts of several Division members in 1953, and particularly through the strong leadership provided by the *Journal*'s first Editor, Walter J. Murphy. Through the years the *Journal* has been led by scientists with strong Division ties, and the source of many of its manuscripts has been from papers presented at Division symposia and general sessions at national and regional meetings of ACS. The synergy that has developed has propelled the *Journal* to its present standing as the leading international journal in its field. It has also brought well-deserved attention to the Division for its present-day leadership in most fields of agricultural and food chemistry, including analytical methods development, bioactive constituents, and composition of foods and feeds.

EARLY HISTORY

In the *Journal*'s first issue, Dr. Murphy took a line from then President Dwight D. Eisenhower's 1953 State of the Union address that "...research and scientific investigation conducted on an extensive scale are vital to the prosperity of our agriculture"(*1*). Modern agriculture is science driven and technology based, which are keys to its success. Dr. Murphy also noted that "...there is a common bond among the scientists who study agronomy, entomology, food processing, nutrition and the other sciences involved in feeding the world. That common bond is chemistry ... the planting of seed, fertilization, protection of the plant from insects and fungi, processing of the plant into a raw material for industry, and making proper nutritional use of the product." This represents a chain of events in which chemistry plays many key roles (*1*). Under Dr. Murphy's leadership the ACS Applied Journals, which included *JAFC*, developed into the largest scientific publication program in the world, with a total circulation of more than 165,000 in 1959 (*2*).

Dr. Murphy's successors as Editor—Rodney N. Hader (1956−1964), Philip K. Bates (1965−1982), Irvin E. Liener (1982−1999), and James N. Seiber (1999−present)—continued the tradition he established of a strong chemical science base. Liener served with two Associate Editors, G. Wayne Ivie (1982−1999) and Marshall Phillips (1988−present). Dr. Phillips continues to serve as Associate Editor, providing continuity to an Associate Editor group that now numbers nine. A third party that is key to the *Journal*'s success has been the USDA's Agricultural Research Service (ARS). Ivie is a long-time and current ARS Scientist at College Station, TX, and Phillips served with ARS at the National Animal Disease Laboratory in Ames, IA, until his retirement from ARS in 1991.

Published on Web 08/31/2009

Figure 1. Editor and Associate Editors of the *Journal of Agricultural and Food Chemistry*, 2008. (Top, from left to right) Peter Schieberle, Chair for Food Chemistry, Faculty of Chemistry, University of Munich, Germany; Francisco Tomás-Barberán, CEBAS (CSIC), Spain; John W. Finley, Louisiana State University, Baton Rouge, LA; Marshall Phillips, Strategic Bioconnections, Thornton, PA. (Center)James N. Seiber, Editor-in-Chief of *JAFC* and Chair, Department of Food Science and Technology, University of California, Davis, CA. (Bottom, left to right) Russell Molyneux, Western Regional Research Center, U.S. Department of Agriculture, Albany, CA; Zhen-Yu Chen, The Chinese University of Hong Kong, China; Willis Wheeler, George Mason University, Bethesda, MD; Elizabeth Waters, The Australian Wine Research Institute, Australia.

The *Journal*'s first Advisory Board shows some other characteristics. It included 21 top experts in agricultural and food chemistry who consulted with the editors on programs and policies of the *Journal*. Many of the members were from industry—National Fertilizer Association, Corn Products Refining Co., General Cigar Co., American Potash Institute, National Dairy Products Association, Continental Can Co., to name some of them. It also included two USDA officials and six members from academia. Only one was female, and none were from outside the United States (*3*). A growth in diversity is reflected in the 2008 *JAFC* Associate Editors (**Figure 1**), which include four from outside North America, representing Germany, China, Spain, and Australia. The current (2008) Advisory Board (42 members) retains a breakdown similar to that of the first in terms of academic, industry, and federal agency (USDA and EPA) representation, but has 9 female members and 17 from outside the United States (*4*).

For the first two years of publication, the *Journal* was published biweekly, becoming a monthly publication in 1955. About half of its pages were devoted to features, such as news from Washington, DC, federal and state regulations, new products and equipment, research highlights with practical applications, and career notes about prominent scientists, along with editorials, letters to the editor, and a perspective/feature section. The *Journal* included frequent meeting announcements from AGFD, as well as other groups.

The needs of a hungry world were a frequently explored topic in the early years. Would agriculture be able to keep pace with an exploding world population? The risks and benefits of chemicals used to increase agricultural production and food preservation were actively discussed in business and regulatory news pieces and editorials. One of the early issues carried an analysis of bills introduced by Congressmen Delaney and Miller (*5*, *6*). These early measures caused many challenges in the pesticide and food additives industries, because the burden of proof for the safety of these chemicals was shifted from the government to the registrant. The Miller amendment, passed in 1954, provided a framework for pesticide residue tolerances on raw agricultural commodities, with a zero-tolerance level for any pesticide if the scientific data did not justify establishment of a greater tolerance. The Delaney clause, included in the Food Additives Amendment in 1958, provided that no cancer-causing substance could be deemed safe for addition to food. This zero-tolerance clause included pesticides that were allowed on the raw commodity but became

Table 1. *JAFC* Manuscript Categories as of 2008[a]

Analytical Methods	Crop and Animal Protection Chemistry
Bioactive Constituents	Environmental Chemistry
Biofuels and Bioproducts Chemistry	Flavors and Aromas/Chemosensory Perception
Chemical Aspects of Biotechnology/Molecular Biology	**Food Chemistry/Biochemistry**
Chemical Aspects of Food Safety	Molecular Nutrition
Chemical Changes Induced by Processing/Storage	Toxicology in Agriculture and Food
Chemical Composition of Foods/Feeds	

[a] Bold print indicates the largest categories in terms of numbers of manuscripts published.

concentrated during food processing. Crop protection chemicals could be used, but residues had to be either within tolerance or undetectable. Much of the content of *JAFC* from its early years to the present has been devoted to new methods of analysis that lowered detection limits to very low levels, sub-parts per billion in some cases, so that what was not detectable when Congress passed legislation containing the Delaney clause in 1958 became readily detectable by newer methods, giving fallacy to the zero-tolerance concept (*7*). From the cranberry crisis of 1959 (*8*) until the passage of the Food Quality Protection Act of 1996, which excluded pesticides from consideration under the Delaney clause, this issue preoccupied food safety assurance efforts of FDA, EPA, and the pesticide industry (*9*).

EVOLUTION OF CATEGORIES

In 1960, *JAFC* underwent an abrupt change in content and format, dropping to six issues per year and concentrating on technical papers only, with no news or editorial features. This was an attempt to reduce production costs and make the *Journal* self-sustaining.

With more pages available for the technical section, symposium papers could now be published together as a group (*10*). The first set of symposium papers was from the Symposium on Soil Testing presented in September 1959 at the 136th ACS National Meeting, held by the Society's Division of Fertilizer and Soil Chemistry (*11*). This was followed later that year by publication of the AGFD's symposium on the Mechanism of Action of Pesticide Chemicals, held at the 137th ACS National Meeting in April 1960 (*12*). From then through the early 1980s symposia were frequently published in *JAFC*, many of them AGFD symposia. Some, such as the AGFD symposium on "Chemical Aspects of Natural Food Toxicants", which was originally published as a 19 paper set in the May/June 1969 issue of *JAFC*, were even reprinted in paperback form and sold for a nominal sum, with a special discount price for AGFD members(*13*, *14*). From the mid-1980s through the 1990s symposia were rarely published. In recent years this trend has been reversed. The publication of symposia and topical clusters in *JAFC* is increasing, and the publication of this 100th anniversary symposium is a good example of the cooperative relationship between *JAFC* and AGFD.

The *Journal*'s early manuscript categories included Pesticides, Plant Foods & Regulators, Nutrition, Food Processing, and Fermentation (*15*). The chemistry of flavors soon became a category of its own, reflecting increasing activity within the AGFD. In 1967, Editor P. K. Bates wrote "Increasing interest in the chemistry of flavors, which has brought about formation of the Flavor Subdivision in the ACS Division of Agricultural and Food Chemistry, suggests that there will be greater emphasis in this area. We feel our journal can provide a real and growing service in publishing reports of research in the chemistry of flavor" (*16*).

From 1969 to 1987 there were no table of contents categories at all, except those used to set off symposia manuscripts and communications. In 1988 table of contents categories were brought back, not only to organize the growing number of manuscripts published, but to make a home in ACS for food and agricultural biotechnology manuscripts, which due to their multidisciplinary nature were being published in the journals of many disciplines (*17*). *JAFC* now publishes manuscripts in 13 categories (**Table 1**), plus perspectives, reviews, recent books, and editorials.

From time to time, the keynote addresses given by award recipients from ACS divisions have been published in *JAFC*. "Mixed-Function Oxidase Involvement in the Biochemistry of Insecticide Synergists" by John Casida and "A Century of DDT" by Robert L. Metcalf are based on addresses given when each received the International Award for Research in Pesticide Chemistry in 1970 and 1972, respectively (*18*, *19*). An excerpt of the address on Plant Genetic Engineering given by Mary-Dell Chilton when she received the Sterling B. Hendricks Memorial Lectureship Award in 1987 was published "to inaugurate [*JAFC*'s] entry into the field of biotechnology" (*17*, *20*). Recently, a perspective was published based on the keynote lecture given by Bruce Dale, the recipient of the 2007 Hendricks Award (*21*), again emphasizing that *JAFC* encouraged manuscripts on the chemistry of biofuels and biobased products—a category expanded and renamed from Biobased Products in 2008. *JAFC* has also been the place of publication of formal histories of the AGFD (*22*−*26*), and tributes to noted members have been published from time to time (*2*, *27*−*30*).

CURRENT CONTENT

JAFC has always had a strong emphasis on manuscripts dealing with analytical methods, for example, the analysis of complex mixtures that constitute flavors and aromas in fruits, vegetables, meat, dairy, and other products. In an early example, W. G. Jennings and his student C. S. Tang (*31*) applied capillary gas chromatography (GC) using a coated stainless steel capillary to resolve peaks among the many volatile components of apricots. The technique of capillary or open tubular GC advanced rapidly, with improvements in column technology to fused silica bonded to interactive stationary phases and the coupling of GC with mass spectrometry. It is now widely used for the analysis of flavor and aroma, other food components, and pesticides and other contaminants—with many reports presented first at the Division of Agricultural and Food Chemistry symposia and then published in *JAFC*.

In a recent application of advanced analytical methods, Tareke et al. stunned the food world with their report "Analysis of Acrylamide, a Carcinogen Formed in Heated Foodstuffs" (*32*). As the scientific community scrambled to understand the finding, how acrylamide was formed, its potential impacts on consumers, and how to prevent or minimize its formation, a number of papers were presented at ACS meetings, and particularly in two symposia organized by the Division of Agricultural and Food Chemistry. The first symposium was held in March 2004 at the American Chemical Society (ACS) National Meeting in Anaheim, CA, and published in the Springer series *Advances in Experimental Medicine and Biology* (*33*); the second was held at the August 2007 National Meeting of ACS in Boston, MA, and published as a collection of 28 manuscripts as a "spotlight issue"

Table 2. *JAFC* Citation Classics[a]

JAFC paper cited as a Citation Classic	"Citation Classic Commentary" date in *Current Contents*	citation count when declared "Classic"	current citation count[b]
Dorough, H. W.; Casida, J. E. Nature of certain carbamate metabolites of the insecticide Sevin. *J. Agric. Food Chem.* **1964**, *12*, 294−304	Jan 29, 1979	124	174
Hodge, J. E. Dehydrated foods: chemistry of browning reactions in model systems. *J. Agric. Food Chem.* **1953**, *1*, 928−943	March 19, 1979	>155[c]	914
Scott, P. M.; van Walbeek, W.; Kennedy, B.; Anyeti, D. Mycotoxins (ochratoxin A, citrinin, and sterigmatocystin) and toxigenic fungi in grains and other agricultural products. *J. Agric. Food Chem.* **1972**, *20*, 1103−1109	May 14, 1984	140	258
Bailey, G. W.; White, J. L. Review of adsorption and desorption of organic pesticides by soil colloids, with implications concerning pesticide bioactivity. *J. Agric. Food Chem.* **1964**, *12*, 324−332	Sept 3, 1984	145	245
Casida, J. E. Mixed-function oxidase involvement in the biochemistry of insecticide synergists. *J. Agric. Food Chem.* **1970**, *18*, 753−772	April 21, 1986	140	256
Gardner, H. W. Decomposition of linoleic acid hydroperoxides. Enzymic reactions compared with nonenzymic. *J. Agric. Food Chem.* **1975**, *23*, 129−136	May 15, 1989	130	182
Menn, J. J.; Erwin, W. R.; Gordon, H. T. Color reaction of 2,6-dibromo-*N*-chloro-*p*-quinoneimine with thiophosphate insecticides on paper chromatograms. *J. Agric. Food Chem.* **1957**, *5*, 601−602	May 22, 1989	115	120
Henrick, C. A.; Staal, G. B.; Siddall, J. B. Alkyl 3,7,11-trimethyl-2,4-dodecadienoates, a new class of potent insect growth regulators with juvenile hormone activity. *J. Agric. Food Chem.* **1973**, *21*, 354−359	Jan 15, 1990	145	186

[a] Information on Citation Classics can be found at http://garfield.library.upenn.edu/classics.html. [b] Citation Count in Web of Science on August 6, 2009. [c] Citations 1961−1979.

in *JAFC* (*34*). At the time the second symposium was held, the original article, by Tareke et al., had been cited 294 times by others—the leading *JAFC* manuscript for citations published since 2000. It remains so today, with over 450 citations, according to a search of ISI's Web of Science.

In recent years the Bioactive Constituent category has grown considerably with the focus on antioxidants and other healthy constituents in what are often referred to as "functional foods". Manuscripts reporting the identity and levels of antioxidant compounds and other healthy constituents in foods have increased dramatically. Manuscripts reporting on food constituents that either contribute to, or increasingly can prevent, high cholesterol (believed to be a leading cause of atherosclerosis and heart disease) and diabetes are also on the rise (*35*). Interest in the chemistry of individual foods or food components believed to contribute to good health, such as olive oil, has been reflected by numbers of manuscripts dealing with them in recent years (e.g., for olive oil, 13 published in 1997 and 60 in 2006).

JAFC and the Division partnered in sponsoring Antioxidant Workshops—the first held in June 2004 in Orlando, FL. *JAFC* Associate Editor John W. Finley was a proponent of the Antioxidant Workshop. *JAFC* helped to publicize the workshop by running color announcements on the back cover of several issues, providing links on its Website, and eventually publishing the results as white papers (*36*). AGFD has sponsored two symposia at national meetings on antioxidants since 2000. Scientific interest in the topic is reflected in numbers of citations of leading reports, for example, by Wang, Cao, and Prior, "Total Antioxidant Capacity of Fruits" (*37*), cited 625 times as of this writing, according to the ISI Web of Science database.

JAFC has published some controversial manuscripts. For one, "Comparison of the Total Phenolic and Ascorbic Acid Content of Freeze-Dried and Air-Dried Marionberry, Strawberry, and Corn Grown Using Conventional, Organic, and Sustainable Agricultural Practices" (*38*), a comment was received and published (*39*) along with a rebuttal by the authors of the original report (*40*). Editor Seiber distilled some guidelines for these reports for other authors to follow when publishing reports on contents of organic versus conventionally grown produce, which are applicable to most other comparisons of products grown under different conditions (*41*). The Division of Agrochemicals convened a symposium on the topic of the health benefits of conventional versus organic foods at the Fall 2004 ACS National Meeting and a closely related one at the Spring 2005 ACS National Meeting. This topic will likely continue to be explored and debated and remain a topic of interest for future symposia.

In the 20 years from 1988 to 2008, *JAFC* has experienced an increase in manuscripts submitted from 500 in 1988 to about 4000 for 2008. During that time the rate of rejection of manuscripts increased from about 30% to over 55%. Total citations have increased from 12,313 in 2001 to over 45,000 for 2007, according to *Journal Citation Reports* (*42*, *43*). The ISI Impact Factor increased from 1.58 in 2001 to 2.562 in 2008—the most recent complete year for compiling this factor.

The most highly cited manuscript in the 2000s was the report by Tareke et al. on acrylamide in certain cooked foods, which, as previously noted, generated a great deal of interest and research (*32*). From its beginnings, *JAFC* has had a number of highly cited manuscripts. John E. Hodge, a notable USDA scientist, published a 1953 review on browning reaction chemistry (*44*) that has been cited 914 times and continues to be cited several times each year. This paper was recognized as a "Citation Classic" in the March 19, 1979, issue of *Current Contents/ Agriculture, Biology & Environmental Science* (*45*). *Current Contents* published a regular feature, "Citation Classic Commentaries", from 1977 to 1993. The most highly cited papers in a particular discipline were identified as "Citation Classics", and the principal author was asked to write a personal commentary about their work. Eight *JAFC* papers were regarded as Citation Classics during this period (**Table 2**), spanning topics from pesticide chemistry to mycotoxins to food chemistry.

Kevin Pearce and the late John Kinsella's 1978 article on a turbidimetric method for analyzing the emulsifying properties of proteins has been cited 658 times (*46*), and Michael Hertog, Peter Hollman, and Martijn Katan have received 633 citations for their 1992 paper on anticarcinogenic flavonoids in fruits and vegetables commonly consumed in The Netherlands (*47*). These authors or their topics have figured heavily in the programs of the AGFD—John Kinsella received the Advancement of Application of Agricultural and Food Chemistry Award, and in 1995 the Division again recognized his work by holding a memorial symposium on Food Proteins and Lipids at the 210th ACS

National Meeting. Compounds in fruits and vegetables that prevent disease have been treated in many symposia throughout the years.

JAFC has been the consistent choice for publication of research articles involving the Maillard reaction. An analysis of papers indexed to this reaction in *Chemical Abstracts* showed that, of over 4000 publication sources, *JAFC* has been the most frequent single place of publication for manuscripts on this topic, with 710 manuscripts to date. The highly cited 1953 review by Hodge in *JAFC* mentioned above (*44*) resulted from a paper presented at the AGFD's Symposium on Dehydrated Foods, held during the 123rd ACS National Meeting in Los Angeles, CA, in March 1953 (*48*).

JAFC has long been a popular place for publication of reviews. The *Journal* added the perspectives category in 2002 and is more active in publishing symposia and topical clusters in recent years. Just in 2008 alone, 6 perspectives, 4 symposia/topical clusters, and 12 reviews have been published, and several more are submitted or in process. These categories allow authors to provide critical insights into current areas of intense interest in agricultural and food chemistry and help in the development of hot areas that will receive more scientific studies in the future.

INTERNATIONAL IMPACT

The international impact of *JAFC* has changed dramatically in recent years. In 1986, Editor Irvin Liener noted that "43% of all manuscripts submitted to *JAFC* came from 34 different countries, and that over 50% of the subscribers are from foreign countries" (*49*). Presently (2008), over 83% of its received and 73% of its published manuscripts originate from outside North America. China now leads all nations in numbers of manuscripts submitted, and Korea, India, and Brazil are all in the top 10. In 2000, manuscripts from China, Korea, and India each accounted for less than 3% of the manuscripts submitted, and submissions from Brazil amounted to just over 1%. In response to this internationalization of *JAFC*, the *Journal* has established Associate Editor offices in Germany, Australia, China, and Spain, and added Advisory Board members from those nations as well as the United Kingdom, Italy, France, Brazil, Canada, Denmark, and Japan. *JAFC* Editors and Associate Editors regularly represent *JAFC* at international meetings, such as the second International Symposium on Pesticide and Environmental Safety, held at China Agricultural University, Beijing, China, in 2005 and the U.S./Brazil Presidential Symposium and Sociedade Brasileira de Química (SBQ) held in São Paulo, Brazil, in 2007. Typically, workshops with authors and prospective authors take place at those meetings to inform them of expectations for manuscripts to be published in *JAFC* and the most common reasons for rejection. This outreach effort by *JAFC* is paying off with increased acceptance rates for manuscripts submitted from China (up by 13% in 2007 over 2005) and Brazil (up by almost 7% in 2007 over 2006).

One of the most gratifying characteristics of *JAFC* is the media attention it has received. Research published in *JAFC* has been highlighted on television and radio programs and in newspapers, general interest magazines, and trade periodicals. Some journalists, such as Harold McGee, writer of "The Curious Cook" column for the *New York Times*, routinely screen *JAFC* for developments of interest to their readers (*50*). This secondary pickup of the science can increase the impact, including transfer of technology and better understanding on behalf of consumers and health professionals (*35*).

The association between AGFD and *JAFC* has been long and fruitful. The synergy achieved when a vibrant scientific organization such as AGFD is closely associated with a first-rate international scientific journal such as *JAFC* results in rapid publication of carefully reviewed, cutting-edge research for the advancement of science and the benefit of humanity and the Earth.

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Received for review January 9, 2009. Revised manuscript received March 9, 2009. Accepted July 27, 2009.