
# Society of Environmental Toxicology and Chemistry North America 39th Annual Meeting

4–8 November 2018 | Sacramento, California

Bridging Divides Between Environmental Stewardship and Economic Development

# Abstract Book

SETAC North America 39th Annual Meeting

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This book comprises the abstracts of the presentations for the platform and poster sessions of the Society of Environmental Toxicology and Chemistry (SETAC) North America 39th Annual Meeting, conducted at the Sacramento Convention Center from 4–8 November 2018 in Sacramento, California. The abstracts are reproduced as accepted by the Scientific Program Committee and appear in numerical order.

In each abstract, the presenting author's name is underlined. The author index cross-references the corresponding abstract numbers. Affiliation, session and keyword indices are also included.

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# About SETAC

The Society of Environmental Toxicology and Chemistry (SETAC), with offices in North America and Europe, is a non-profit, professional society established to provide a forum for individuals and institutions engaged in the study, analysis and solution of environmental problems, the management and regulation of natural resources, environmental education, and research and development.

Specific goals of the society are:

- Promote research, education and training in the environmental sciences
- Promote the systematic application of all relevant scientific disciplines to the evaluation of chemical hazards
- Participate in the scientific interpretation of issues concerned with hazard assessment and risk analysis
- Support the development of ecologically acceptable practices and principles
- Provide a forum (meetings and publications) for communication among professionals in government, business, academia and other segments of society involved in the use, protection and management of our environment

These goals are pursued through the conduct of numerous activities, which include:

- Conduct meetings with study and workshop sessions, platform and poster presentations, and achievement and merit awards
- Publish scientific journals, a newsletter and special technical publications
- Provide funds for education and training through the SETAC Scholarship/Fellowship Program
- Organize and sponsor chapters and branches to provide a forum for the presentation of scientific data and for the interchange and study of information about local and regional concerns
- Provide advice and counsel to technical and nontechnical persons through a number of standing and ad hoc committees

SETAC membership currently comprises about 5,400 individuals from government, academia, business and nongovernmental organizations with backgrounds in chemistry, toxicology, biology, ecology, atmospheric sciences, health sciences, earth sciences, environmental engineering, hazard and risk assessment, and life cycle assessment.

If you have training in these or related disciplines and are engaged in the study, use or management of environmental resources, SETAC can fulfill your professional affiliation needs.

All members receive the SETAC Globe newsletter highlighting environmental topics and SETAC activities, reduced fees for meetings and discounts on SETAC books. All members receive online access to *Environmental Toxicology and Chemistry* (ET&C) and *Integrated Environmental Assessment and Management* (IEAM), the peer-reviewed journals of the society. Members may hold office and, with the Emeritus Members, constitute the voting membership.

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cheap and rapid procedures for human exposure evaluation. Therefore, we developed a fast and easy approach for synthesis of hydroxy-fipronil, a potential urinary metabolite of fipronil. This standard was used to develop a sensitive analytical LC-MS/MS method with a limit of quantification of 0.4 ng/mL. Fipronil sulfone and hydroxy-fipronil were quantified in urine samples from fipronil treated rats. Fipronil sulfone concentration centered around 20 ng/mL, while the concentration of hydroxy-fipronil was dose-dependent ranging in 10-10000 ng/mL, therefore being a more sensitive marker of fipronil exposure. Immunoassays developed to fipronil also showed cross-reactivity to hydroxy-fipronil. We showed that immunoassay can measure fipronil and its metabolites in samples at levels relevant for human exposure monitoring. With fipronil crisis occurred in Europe in 2017, both the reagents for the immunoassay and a standard for hydroxy-fipronil are in high demand among international profit and non-profit organizations. The reagents are being applied for commercial kits and rapid tests production, instrumental analytical methods development and for monitoring of food and environmental samples. Fipronil immunoassay is also currently used by USGS for field studies.

**TP015 The Application of Monoclonal Antibody-Based Biosensor Analysis for Rapidly Quantifying PAH Concentrations in Porewater at Contaminated Sediment Sites**

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Advances in biosensor technology allow near real-time measurement of contaminants at sub-ppb concentrations in small volume (< 5 mL) aqueous samples providing spatial and temporal resolution of contaminants at scales not easily attainable by traditional analytical methods. Porewater measurements are an ideal application of this technology and have been shown to be important for evaluating the transport, bioavailability and toxicity of PAH in sediments. Correlations between polycyclic aromatic hydrocarbon (PAH) concentrations measured in porewater samples by biosensor (< 1 µg/L to > 600 µg/L) and those measured by GC-MS were excellent and the results can be used to evaluate contaminant distribution, transport and bioavailability. PAH concentrations in porewater samples were measured in the field within minutes after collection to map the spatial distribution of PAHs at contaminated sites undergoing different stages of remediation in the Elizabeth River, VA. Analysis of porewater samples collected at various depths by drive-point piezometer allowed vertical profiling of PAH concentrations within sediments suggesting the input of contaminated groundwater at depth and advective mixing with less contaminated surface water. The ability to measure low concentrations in small volume samples also allowed the collection and analysis of seepage meter output on an hourly basis to demonstrate that tidal pumping and advection were controlling PAH flux to the water column. Average biosensor concentrations were similar to concentrations measured by passive sampling but allowed finer temporal resolution to evaluate the tidal driven mechanisms controlling PAH transport on an hourly scale. The abundant data collected by biosensor allowed a direct comparison of sites under various stages of dredging or capping to evaluate remediation effectiveness and to develop better long-term remediation strategies where advection may play an important role in contaminant transport. At tidally influenced sites, remediation plans need to address advection of surface waters and mixing within contaminated sediments as an important transport mechanism that may hinder remediation success. Contaminant concentrations in porewater should be evaluated as an important factor contributing to sediment toxicity and flux to overlying waters. New antibody-based biosensor technology now provides a more rapid and economical method to make these aqueous phase measurements.

**TP017 Isolation of Ultra-specific Single Domain Antibody for the Detection of Sulfadimethoxine**

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Sulfadimethoxine (SDM) is a long-lasting sulfonamide antimicrobial medication frequently used in veterinary medicine throughout the world. To protect consumers from the risk related to SDM residue in animal derived food, maximum residue limits has been established in many countries. Immunoassays have the advantages of low cost, high sensitive and speed to detect residue in a variety of samples, but most antibodies produced in previous reports cannot distinguish SDM from other sulfonamides due to their similar structure. For this reason, we constructed a single domain antibody (sdAb) library from immunized alpaca and obtained an ultra-specific and sensitive anti-SDM sdAb (H1-17) by a well-designed biopanning strategy. H1-17 could only bind to SDM with negligible cross-reactivity value to other 28 kinds of sulfonamides. In H1-17 based indirect competitive ELISA, the 50% inhibition concentration for SDM was 1.1 ng $mL^{-1}$ in assay buffer and the detection range was from 0.36 to 3.63 ng $mL^{-1}$. To the best of our knowledge, this is the first time that SDM specific antibody was produced. The antibody developed by this technique provide means for developing extremely specific and sensitive analytical assays for measurement of SDM.

## Cradle to Grave Impacts of Nanotechnology

**TP018 Effects of a human food additive, titanium dioxide nanoparticles E171, on *Drosophila melanogaster* – a 20 generation dietary exposure experiment**

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Although a recent human safety reevaluation of food grade E171 $TiO_2$ was performed by a European Food Safety Authority, not many new data were considered and a major lack of multigenerational studies with reproductive endpoints was noted. In this study, we exposed fruit flies to an estimated daily human E171 consumption concentration for 20 generations. Dietary exposure of 20 consecutive generations of *D. melanogaster* to E171 resulted in a change in normal developmental and reproductive dynamics, reduced fecundity after repetitive breeding, increased genotoxicity, and the appearance of aberrant phenotypes. This effect can be seen as one of the classical adaptations of the fruit fly population to a stressor. A pattern that was gradually observed over the 20 generations of flies was shorter developmental time coupled with higher fecundity and egg to adult viability in virgin females, but reduced fecundity at subsequent mating events Marks of adaptive evolution and directional selection were also exhibited. The larval stages were at a higher risk of sustaining damage from E171 as they had a slower elimination rate and therefore accumulated 10 times the quantity of $TiO_2$ compared to adults. This is particularly worrisome, since among the human population, children tend to consume higher daily concentrations of E171 than adults do. The genotoxic effect of E171 was statistically significantly higher in each subsequent generation compared to the previous one. Aberrant phenotypes were likely caused by developmental defects induced by E171 since the phenotypic features were not transferred to any progeny even after 5 generations of consecutive crossbreeding. Therefore, exposure to E171 during early developmental period carries a higher risk of toxicity, and again, in the human population, fetuses and young children would be the most endangered cohort. The fact that the daily human consumption

concentration of E171 is able to interfere with and influence fruit fly physiological, ontogenetic, genotoxic, and adaptive processes certainly raises safety concerns.

**TP019 Synthesis And Characterization Of Carbon Nano-particles From Soot And Dates Fruit (Phoenix dactylifera)**

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Carbon nanoparticle was synthesized from lamp soot, petrol soot and diesel soot. Carbon dots was also gotten from (*Phoenix dactylifera*) by microwave-assisted method. The synthesized carbon nanoparticles were characterized using FT-IR and the carbon dots was also characterized using UV – visible spectroscopy and luminescent study. The FT-IR of petrol soot, diesel soot and lamp soot shows IR absorptions, which indicate the functional groups present. The UV – visible spectra of the carbon dots showed absorption peaks. Photoluminescence study of the carbon nanoparticles from petrol soot, diesel soot and lamp soot revealed a characteristic of green and blue luminescence and also with that of carbon dots from date fruit (*phoenix dactylifera*) which showed a characteristic of green luminescence.

**TP020 Microbial Community Responses to Silver Nanoparticles in Freshwater Sediments: A Potential Risk to the Aquatic Ecosystem Health**

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Silver nanoparticles (AgNPs) are among nanomaterials increasingly incorporated into consumer products due to their antimicrobial properties. There are greater concerns about potential antimicrobial effects of AgNPs in aquatic ecosystems following a recent detection of the nanoparticles in treated municipal wastewater. Since treated wastewaters are released into surface waters and metals in aquatic systems eventually settle in sediments, we examined microbial community responses to AgNPs. We treated sediments from a local stream with different concentrations of AgNPs coated with either citrate or polyvinylpyrrolidone. Heterotrophic plate count, microbial enzyme assays, and community level physiological profiling (CLPP) using BIOLOG$^{TM}$ microplates were carried out to determine AgNPs effects on the microbial community. Each type of AgNPs exhibited more than a 60% decrease in microbial growth and glucosidase activity in exposed sediments at 0.431 mg Ag/kg with median inhibition concentrations (IC50) of 0.084 mg Ag/kg compared to the control sediment, but alkaline phosphatase activity was not affected by either AgNPs. CLPP results showed that microbial functional diversity and substrate richness were inhibited by AgNPs affecting carbon source utilization patterns. Principal component analysis demonstrated that microbial metabolic fingerprint patterns of exposed sediments were clearly different from the control sediment, suggesting that the ability of the microbial community to utilize different carbon sources or decompose organic matter decreased in the exposed sediments. The nominal concentrations at which inhibition occurred are below expected AgNPs concentrations in freshwater sediments. This implies that the growing application of AgNPs in consumer products may alter microbial communities in aquatic ecosystems, which may affect the quality of surface waters.

**TP021 Bioavailability of nanoparticles in eastern mosquitofish and freshwater snails following a 9-month exposure in wetland mesocosms**

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Engineered nanomaterials such as metallic nanoparticles (NPs) are ever more widely produced, used and released into surface waters, which may pose a risk to human and ecosystem health. While there is a growing body of research on the toxicity of NPs, risk assessments must account for the bioavailability of NPs at environmentally relevant exposure concentrations and in complex ecosystems. Here, we present results from a study in replicated outdoor wetland mesocosms exploring the bioavailability of metallic NPs in eastern mosquitofish (*Gambusia holbrooki*) and two freshwater pond snails (*Physella acuta* and *Lymnaea* sp.). These aquatic taxa were exposed weekly to pulse doses of either gold (Au) NPs (19 mg per week and primary particle size of 11.8 nm), large or small cerium dioxide ($CeO_2$) NPs (19 mg per week, 185.3 nm and 3.8 nm for large and small $CeO_2$ NPs, respectively), copper hydroxide NPs from Kocide 3000 (3588 mg N mg per week, 118.3 nm), or no NP controls. The Au NP, Kocide 3000 and control groups were also tested with or without weekly nutrient additions (88 mg N, 35 mg P per week) as a covariate. There were 3 mesocosm replicates for each unique treatment group. We quantified the accumulation of NPs in tissues quarterly using ICP-MS over the 9-month experiment (i.e. at 3, 6 and 9 months). During sampling, individuals were euthanized and preserved either immediately or after a depuration period of up to 7 days in clean water. Our results at 9 months indicate that *Physella* accumulated more NPs than *Lymnaea*, and both snails accumulated more NPs than *Gambusia*. The accumulation of copper (after subtracting control background levels) in all taxa was 1-3 orders of magnitude higher than Au or Ce, despite a similar NP dose mass, with *Physella* at the highest relative ratio and *Gambusia* the lowest. In snails, the small $CeO_2$ and Au NPs accumulated equally, both at significantly higher levels than large $CeO_2$ NPs, while in fish the small and large $CeO_2$ NPs and Au NPs all accumulated equally. Fish fully depurated copper NPs and both $CeO_2$ NPs within 12 hours, but were only able to depurate about 68% of the accumulated Au NPs even after 7 days. Preliminary results from the 6-month time point indicate the fish were at the same NP concentration for Au and $CeO_2$ NPs, demonstrating NP accumulation steady state was reached by 6 months. Finally, nutrient additions did not significantly influence long-term NP accumulation or retention.

**TP022 Nano-titanium dioxide enabled products – A review of current status and beyond from a life cycle perspective**

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Titanium dioxide ($TiO_2$) nanoparticles (NPs) are ranked in the top three most produced nanomaterials (NMs) worldwide, with applications as consumer products such as cosmetics, including sunscreens, were among the top usage at 70–80%, followed by plastics (20 %), paints (10–30 %), and cement (1 %). To improve the state of knowledge on the overall sustainability of nano-$TiO_2$ enabled products, the potential impact of nano-$TiO_2$ to human and environmental health should be assessed during their releases into main environmental compartments (water, air, and soil) throughout their lifetime (including manufacture, use, and disposal). Life cycle assessment (LCA) is a highly qualified tool quantifying all relevant environmental impacts of a product from extraction of the raw materials through its production and use up to its final disposal, which has been recognized for systematically evaluating the potential environmental impacts of engineered nanomaterials (ENMs) for the past decades. However, the large variety of existing ENMs and their unique physicochemical properties enhance the complexity and limitations of applying LCA on ENMs specifically. In this review poster, we present an overview of the current LCA performed on nano-$TiO_2$ enabled consumer products, synthesis methods, and identify the needs for future improvements of current progress. Characterization factors (CF) derived for $TiO_2$ NPs for use during LCA are summarized, and potential shortcomings are discussed and recognized. In addition, environmental concentrations and the potential toxicity of $TiO_2$NPs are identified during each of the main routes of NP releases. Based on this analysis, recommendations for LCA to be applied on nano-TiO2 enabled products are provided, which can also extrapolate to other types of NMs for use in LCA.