6PPD Innovation Forum: Context and Background

Last name: Kolodziej

SDB Popularity ranking: 8341

“Kō-lō-jay”

This Old Polish surname is one of several variant spellings based around a development from the medieval "Kolo" meaning "the wheel". The name is occupational for a "wheel maker" and is equivalent to the English job descriptive wheel-wright or even coach builder. Most early Polish surnames

Edward P. Kolodziej, Jen McIntyre
and various awesome collaborators
Center for Urban Waters, Tacoma WA

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The Problem: Why can't fish and people co-exist??

PNW example: Fall stormwater kills coho salmon near people

Miller Creek URMS, October 18, 2016 (video taken by Kristine Feldman)

https://www.youtube.com/watch?v=PZW_P8OkT-&list=PLph6mcGs10HJpK_eZHJPSKeMfx78u6cc&index=4

Science

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A ubiquitous tire rubber–derived chemical induces acute mortality in coho salmon

Zhenyu Tian[1,2], Haoqi Zhao[3], Katherine T. Peter[1,2], Melissa Gonzalez[1,2], Jill Wetzel[4], Christopher Wu[1,2], Ximin Hu[3], Jasmine Prat[4], Emma Mudrock[4], Rachel Hettinger[1,2], Allan E. Cortina[1,2], Rajshree Ghosh Biswas[5], Flávio Vinicius Crizóstomo Kock[5], Ronald Soong[5], Amy Jenne[5], Bowen Du[6], Fan Hou[3], Huan He[3], Rachel Lundeen[1,2], Alicia Gilbreath[7], Rebecca Sutton[7], Nathaniel L. Scholz[8], Jay W. Davis[9], Michael C. Dodd[3], Andre Simpson[5], Jenifer K. McIntyre[4], Edward P. Kolodziej[1,2,3*]

Acute Toxicity of the Tire Rubber-Derived Chemical 6PPD-quinone to Four Fishes of Commercial, Cultural, and Ecological Importance

Markus Brinkmann, David Montgomery, Summer Selinger, Justin G. P. Miller, Eric Stock, Alper James Alcaraz, Jonathan K. Challis, Lynn Weber, David Janz, Markus Hecker,* and Steve Wiseman

Brook trout LC_{50} (24 hr): 590 ng/L
Rainbow trout LC_{50} (72 hr): 1000 ng/L

The Tire-Derived Chemical 6PPD-quinone Is Lethally Toxic to the White-Spotted Char *Salvelinus leucomaenis pluvius* but Not to Two Other Salmonid Species

Kyoshiro Hiki* and Hiroshi Yamamoto

White spotted char LC_{50}: 510 ng/L

SETAC 2022: Atlantic salmon fry??

Hua et al. (2022): Chronic intestinal toxicity to C. elegans

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6PPD-Quinone: Revised Toxicity Assessment and Quantification with a Commercial Standard

Zhenyu Tian,* Melissa Gonzalez, Craig A. Rideout, Haoqi Nina Zhao, Ximin Hu, Jill Wetzel, Emma Mudrock, C. Andrew James, Jenifer K. McIntyre, and Edward P. Kolodziej*

Juvenile coho salmon LC_{50}: 95 ng/L (ongoing: 70-130 ng/L)

USGS LC_{50}: 85 ng/L (J. Hansen, personal comm.)

Table 1. Comparison of the Toxicity of 6PPD-Q to Coho Salmon with Those of the Most Toxic Chemicals for Which the U.S. Environmental Protection Agency Has Established Aquatic Life Criteria[a]

chemical class	name	most sensitive species	LC_{50} (ppb)	95% CI	ref	CMC (ppb)	EPA document
OP	parathion	*Orconectes nais*	0.04	0.01–0.2	25	0.065	EPA 440/5-86-007
quinone	6PPD-Q	*O. kisutch*	0.10	0.08–0.11	this study	not available	not available
OC	mirex	*Procambaris blandingi*	0.10	not reported	26	0.001	EPA 440/5-86-001
OP	guthion	*Gammarus fasciatus*	0.10	0.073–0.014	25	0.01	EPA 440/5-86-001
OP	chlorpyrifos	*Gammarus lacustris*	0.11	not reported	27	0.083	EPA 440/5-86-005
OC	endrin	*Perca flavescens*	0.15	0.12–0.18	28	0.086	EPA 820-B-96-001

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Occurrences of Tire Rubber-Derived Contaminants in Cold-Climate Urban Runoff

J. K. Challis, H. Popick, S. Prajapati, P. Harder, J. P. Giesy, K. McPhedran, and M. Brinkmann*

6PPDQ: 80-1400 ng/L in roadway runoff

similar studies in China, Australia, Canada, even >10 µg/L

6 PPDs
81% of $PM_{2.5}$

Occurrence of Substituted *p*-Phenylenediamine Antioxidants in Dusts

Wei Huang, Yumeng Shi, Jialing Huang, Chengliang Deng, Shuqin Tang, Xiaotu Liu, and Da Chen*

5 PPDQs, more stable

New Evidence of Rubber-Derived Quinones in Water, Air, and Soil

Guodong Cao,† Wei Wang,† Jing Zhang, Pengfei Wu, Xingchen Zhao, Zhu Yang, Di Hu, and Zongwei Cai*

Pathways to human exposure

Widespread *N*-(1,3-Dimethylbutyl)-*N*′-phenyl-*p*-phenylenediamine Quinone in Size-Fractioned Atmospheric Particles and Dust of Different Indoor Environments

Ying-Jie Zhang,‡ Ting-Ting Xu,‡ Dong-Min Ye, Ze-Zhao Lin, Fei Wang, and Ying Guo*

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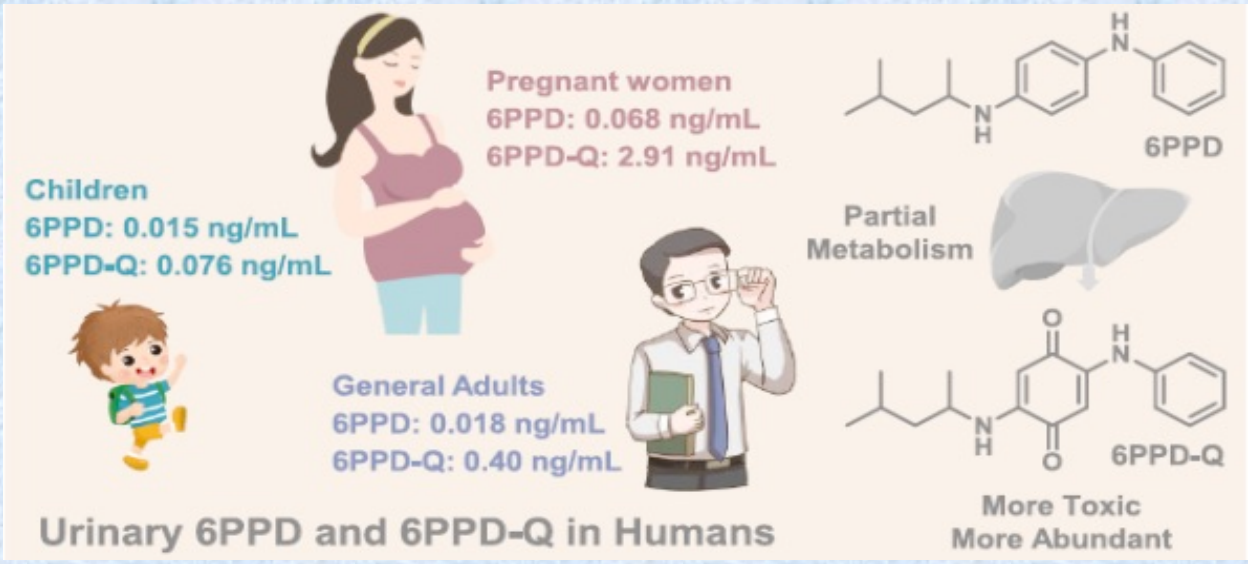

60-100% detection frequency

First Report on the Occurrence of *N*-(1,3-Dimethylbutyl)-*N*′-phenyl-*p*-phenylenediamine (6PPD) and 6PPD-Quinone as Pervasive Pollutants in Human Urine from South China

Bibai Du, Bowen Liang, Yi Li, Mingjie Shen, Liang-Ying Liu, and Lixi Zeng*

Implications for "Safe" Tires and PPDs??

-6PPDQ transformation product: highly toxic to multiple fish species

-Widespread in water, soil, dust, air, humans

-Many PPDs form stable PPDQ products, also widespread

-Track tire rubber and rubber chemicals easily

-Computational predictions: often inaccurate, data limited

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