

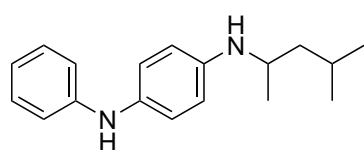
Toxic Products from Tire Antidegradants

Certain antiozonants are used in rubber products such as automobile tires to protect them from oxidative degradation. These compounds can enter aquatic ecosystems via water runoff and are recognized as chemical pollutants of environmental concern. These chemicals, their oxidation products, and their metabolites have been found in plants and animals. A commonly used tire antidegradant is N-(1,3-dimethylbutyl)-N'-phenyl-*p*-phenylenediamine (6-PPD), which becomes oxidized to 6-PPD-quinone (6-PPD-Q). 6-PPD-Q and its metabolites have been identified in fish, and they are associated with toxicity and death of certain species, some of them of high value for human nutrition, like Coho salmon. Cayman has developed a method to quantify 6-PPD-Q and its known metabolites in biological samples. The method can easily be adapted to include related compounds, as well as other environmental sources.

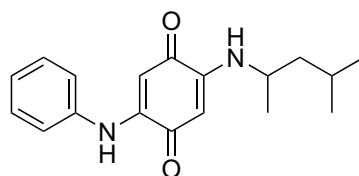
Analyte Coverage

We offer an analytical service for the analysis of 6-PPD, 6-PPD-Q, and some of its metabolites.

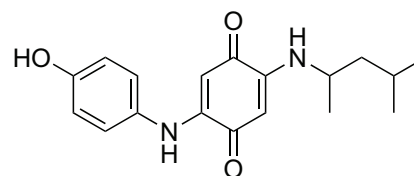
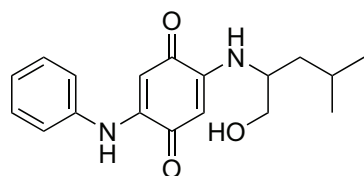
Analytes	Abbreviation
N-(1,3-dimethylbutyl)-N'-phenyl- <i>p</i> -phenylenediamine	6-PPD
2-[(1,3-dimethylbutyl)amino]-5-(phenylamino)-2,5-cyclohexadiene-1,4-dione	6-PPD-Q
2-[(4-hydroxyphenyl)amino]-5-[(4-methylpentan-2-yl)amino]cyclohexa-2,5-diene-1,4-dione	<i>p</i> -OH-6-PPD-Q
2-[(1-hydroxy-4-methylpentan-2-yl)amino]-5-(phenylamino)cyclohexa-2,5-diene-1,4-dione	6-PPD-Q-1-OH
2-[(4-hydroxy-4-methylpentan-2-yl)amino]-5-(phenylamino)cyclohexa-2,5-diene-1,4-dione	6-PPD-Q-4-OH
Internal Standards	Abbreviation
2-[(1,3-dimethylbutyl)amino]-5-(phenyl-2,3,4,5,6-d ₅ -amino)-2,5-cyclohexadiene-1,4-dione	6-PPD-Q-d ₅



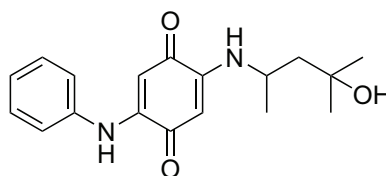
6-PPD



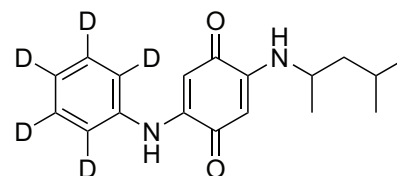
6-PPD-Q

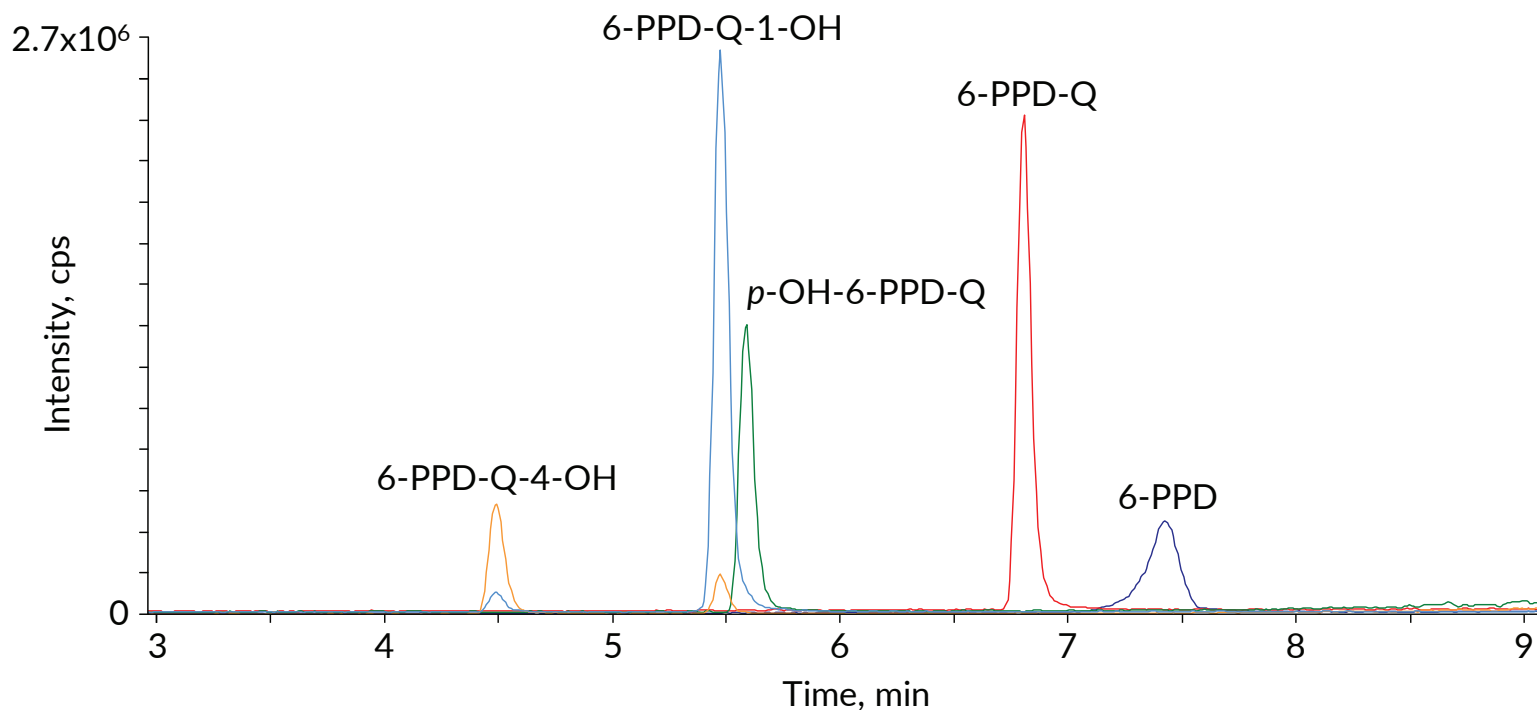
*p*-OH-6-PPD-Q

6-PPD-Q-1-OH



6-PPD-Q-4-OH

6-PPD-Q-d₅



LC-MS chromatogram traces of authentic standards of 6-PPD and related molecules.

Our Approach

We have optimized extraction and LC-MS methods for the analysis of 6-PPD, 6-PPD-Q, and some of its metabolites described in a recent publication resulting from a collaborative study between Cayman and the University of Saskatchewan: Ankley *et al. Environ. Sci. Technol.* **59(28)**, 14214-14225 (2025). The method has been tested with the analytes shown on the table above in different organs from fish, but it can be expanded to include quantification of several other related antiozonants or other types of samples.

Our Advantages

- Our scientists are expertly trained and have decades of collective experience in the analysis, synthesis, and evaluation of biological effects of antiozonants and other environmental pollutants.
- We use state-of-the-art instrumentation, reagents, and methods for all aspects of sample preparation, analyte extraction, LC-MS analysis, and data review to ensure consistent, high-quality data.
- The method is scalable, from pilot studies with a few samples to high-throughput studies with hundreds of samples.
- High-quality standards enable accurate calibration curve preparation and reliable quantitation.
- Collaborative, flexible approach. The method can be customized to include, remove, or substitute analytes, or to be adapted for the extraction of analytes in any type of biological or environmental samples. Please inquire for specific details.



See How We Can Meet Your Specific Project Needs

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