| Table 4‑10. Studies of potential food sources and human consumption of 6PPD and 6PPD‑q | | | | |
| --- | --- | --- | --- | --- |
| Location | Information | Concentration | Method | Detection Limit |
| [Beijing, China](https://www.sciencedirect.com/science/article/abs/pii/S0308814622016028?via%3Dihub)  (Ji et al. 2022) | Fish and honey were purchased from a local supermarket and fish market. Samples were analyzed for 6PPD and 6PPD-q. | Fish: 6PPD  Snakehead (0.669 μg/kg) Weever (0.481 μg/kg)  6PPD‑q: Spanish mackerel (< LOQ) Honey: ND | Modified QuEChERS methods with (HPLC/MS-MS) | LOD:  6PPD:  Fish: 0.00025 mg/kg Honey: 0.0003 mg/kg  6PPD‑q: 0.0003 mg/kg  LOQ:  6PPD:  Fish: 0.00043 mg/kg Honey: 0.0001 mg/kg  6PPD‑q:  0.001 mg/kg, |
| [Laboratory in Hangzhou, China](https://www.sciencedirect.com/science/article/abs/pii/S0048969723022143?via%3Dihub)  (Fang et al. 2023) | Zebrafish were analyzed after laboratory exposure to 6PPD. | After 7 days  6PPD in Zebrafish Larvae: TWA in Water  351 ng/g:1.35 ng/g BAF 265  2,685 ng/g:28.2 ng/g BAF 103 | QuEChERS with (HPLC/MS-MS) | LOQ: 0.1 ng/mL |
| [Laboratory in Wenzhou, China](https://doi.org/10.1016/j.jhazmat.2023.131601)  (Zhang et al. 2023) | Zebrafish were analyzed after laboratory exposure to 6PPD or 6PPD‑q. | After 10 days, 6PPD and 6PPD-q in larvae was significantly higher at 0.2 and 0.8 mg/L exposure vs. control, but not at 0.025 mg/L exposure. Levels of 6PPD were higher than 6PPD‑q. BAFs were not calculated. | Homogenization, poly filtration, and UPLC/MS-MS | Not specified |
| [Laboratory in Norway](https://doi.org/10.3389/fenvs.2023.1219248)  (Hägg et al. 2023) | Lumpfish were exposed to seawater with fish feed mixed with crumb rubber in the lab for 7 days then fed uncontaminated feed for 14 days. Blood was analyzed for 6PPD and 6PPD‑q (among other chemicals) at various timepoints throughout. | 6PPD max on Day 9 of 1,206 pg/g  6PPD‑q not detected in blood  DTPD and TPPD also detected in blood | Blood was spiked with D5‑6PPD‑q, centrifuged, and run by GC-HRMS | Instrumental LOD  6PPD LOD: 0.1 pg  6PPD‑q LOD: 0.5 pg |
| [Laboratory in Germany](https://doi.org/10.1021/acs.est.3c02819)  (Grasse et al. 2023) | Zebrafish were analyzed after 24, 48, 72, and 96 hours of exposure in the lab. | Ratio of internal:external concentration  6PPD (exposure of 6.3 and 1.28 µg/L)  Max of ~3,000 at 48 hours  6PPD‑q (exposure of 20.0, 11.3, and 4.8 µg/L)  Max of ~225 at 48 hours | HPLC/MS-MS Fish: FastPrep homogenizer, sonication, and centrifuging | LOD (ng/mL)  6PPD‑q: 0.089  6PPD: 0.130  LOQ (ng/mL) (6PPD‑q:6PPD)  0.439:0.638 |
| [Laboratory in Austria](https://doi.org/10.1021/acs.est.2c05660)  (Castan et al. 2023) | Hydroponic solutions of lettuce were spiked with 1 mg/L of 6PPD‑q or constantly leaching TWP over 14 days to analyze uptake and metabolism. | Spiked compounds max:  6PPD 0.78 µg/g 6PPD‑q 2.19 µg/g  Tire leachate max:  6PPD 0.4µg/g 6PPD‑q 0.02 µg/g | Tissues extracted using acetonitrile, then run on LC-MS | Not specified |
| [Laboratory in Toronto](https://doi.org/10.26434/chemrxiv-2023-pmxvc)  (Nair et al. 2023) | Rainbow trout were exposed to 6PPD‑q (and other PPD-q) for 96 hours at 0.2, 0.8, 3, 12, and 50 µg/L, then the whole fish body was analyzed for 6PPD‑q. | Dose-dependent increase of 6PPD‑q concentration (n.34–432 ng/g)  Whole-body BCFs of 6PPD‑q were calculated as 2.9, 19, 25, and 17.2 293 L/kg at the water concentrations of 0.8, 3, 12, and 25 µg/L, respectively | Tissues extracted using acetonitrile, centrifuged, then run on LC-MS | Not specified |
| [Laboratory in Japan](https://doi.org/10.1021/acs.estlett.2c00683)  (Hiki and Yamamoto 2022) | *S. leucomaenis pluvius*, *S. curilus*, and *O. masou masou* were exposed to up to 3.5–3.8 µg/L 6PPD‑q for 24 hours, then brain and gill were analyzed for 6PPD‑q. | 6PPD‑q max (brain/gill) (µg/kg-wet) *S. leucomaenis pluvius* ~50, *S. curilus* 25/70, *O. masou masou* 4.7/38  6PPD‑q-OH (more in brain vs. gill) (µg/kg-wet) *S. leucomaenis pluvius* ~50, *S. curilus* ~50, *O. masou masou* ~25  ILC50 in *S. leucomaenis pluvius* of 4.0 µg/kg (brain) and 6.2 µg/kg (gill) | LC-MS/MS in the exposure solution. Tissue extracted using acetonitrile | Not specified |
| [Canada](https://www.sciencedirect.com/science/article/abs/pii/S0048969722084777?via%3Dihub)  (Wu et al. 2023) | Researchers measured levels of 6PPD‑q‑dG from tissue of frozen capelin from a Canadian supermarket.  6PPD‑q-dG is the isomer of 3-hydroxy-1, N2-6PPD-etheno-2′-deoxyguanosine. | Liver: median=6.69 (4.24–8.03) lesions/108 nucleosides Roe: median=10.9 (4.45–16.8) lesions/108 nucleosides Gill: median=11.2 (8.47–15.5) lesions/108 nucleosides | UPLC-ESI-MS/MS | LOD: 0.017 ng/mL  LOQ: 0.056 ng/mL |

Notes: µg/kg=micrograms per kilogram, µg/L=micrograms per liter, BAF=bioaccumulation factor, BCFs= bioconcentration factors, GC-HRMS=gas chromatography–high-resolution mass spectrometry, HPLC-MS/MS=high–performance liquid chromatography–tandem mass spectrometry, LC-MS=liquid chromatography / mass spectrometry, LC-MS/MS=liquid chromatography / tandem mass spectrometry, L/kg=liters per kilogram, LOD=limit of detection, LOQ=limit of quantitation, mg/kg=milligram per kilogram, mg/L=milligram per liter, ND=nondetect, ng/g=nanogram per gram, PPD-q=para-phenylenediamines-quinones, QuEChERS=A solid-phase extraction method: Quick, Easy, Cheap, Effective, Rugged, and Safe, TWA=time-weighted average, TWP=tire-wear particles, UPLC/MS-MS=ultra-performance liquid chromatography–tandem mass spectrometry, UPLC-ESI-MS/MS= ultra-performance liquid chromatography-electrospray ionization–tandem mass spectrometry

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