SCCWRP #873

Interlaboratory comparison of in vitro bioassays for screening of endocrine disrupting chemicals in recycled water

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ABSTRACT

In vitro bioassays have shown promise as water quality monitoring tools. In this study, four commercially available in vitro bioassays (GeneBLAzer® androgen receptor (AR), estrogen receptor-alpha (ER), glucocorticoid receptor (GR) and progesterone receptor (PR) assays) were adapted to screen for endocrine active chemicals in samples from two recycled water plants. The standardized protocols were used in an interlaboratory comparison exercise to evaluate the reproducibility of in vitro bioassay results. Key performance criteria were successfully achieved, including low background response, standardized calibration parameters and high intra-laboratory precision. Only two datasets were excluded due to poor calibration performance. Good interlaboratory reproducibility was observed for GR bioassay, with 16-26% variability among the laboratories. ER and PR bioactivity was measured near the bioassay limit of detection and showed more variability (21-54%), although interlaboratory agreement remained comparable to that of conventional analytical methods. AR bioassay showed no activity for any of the samples analyzed. Our results indicate that ER, GR and PR, were capable of screening for different water quality, i.e., the highest bioactivity was observed in the plant influent, which also contained the highest concentrations of endocrine active chemicals measured by LC-MS/MS. After advanced treatment (e.g., reverse osmosis), bioactivity and target chemical concentrations were both below limits of detection. Comparison of bioassay and chemical equivalent concentrations revealed that targeted chemicals accounted for $\leq$5% of bioassay activity, suggesting that detection limits by LC-MS/MS for some chemicals were insufficient and/or other bioactive compounds were present in these samples. Our study demonstrated that in vitro bioassays responses were reproducible, and can provide information to complement conventional analytical methods for a more comprehensive water quality assessment.