Reporting guidelines for microplastic research: Checklist

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How to use:

The Checklist is meant for those already familiar with the methods and reasons for reporting outlined in the other documents. This document outlines the essential elements to report about microplastic research methods to make them reproducible and comparable. This attempts to cover most of the common methods in the field but some methods have not been covered and researchers will need to develop their own guidelines for those. Groups of methods are in bold. To use these guidelines, first assess which groups of methods apply to your study. Next, assess which of the subgroups (tab separated to indicate more detailed levels of grouping) apply to your study. These can be highlighted for easy reference. At the level of the most detailed subgroups that apply to your study, all italicized criteria must be defined, described, or discussed for the method to be reproducible and comparable. All criteria always apply to groups that do not have subgroups. When units are given, they are examples not prescriptive. Whenever “i.e.” is used we think that all the stated components are important to report. Guidelines indicated with an asterisk (*) were recommended during the review process and added. All other guidelines were voted on by at least a majority (51%) of coauthors of this document. Finally, we recognize that these guidelines should not be the sole criteria for determining what is suitable for publication, but should be a tool used to help reporting methods in publications improve in general.

Reporting Guidelines Checklist

Components to Report in All Procedures

- materials
  - *all manufacturers of materials and instruments and their calibration*[1]
  - *all software used and their calibration*[2]
- quality assurance/quality control
  - error propagation
    - *how instrumental, methodological, and/or statistical error was propagated*[3–5]
  - replicates
    - *number of replicates*[6]
    - *how replicates were nested within samples*[7]
  - limit of detection
    - *quantitative detection threshold*[8]
    - *plastic morphology, size, color, and polymer limitations of method*[9–19]
    - *method of accounting for nondetects*[20,21]
  - blank controls
    - *number of controls*[9,22]
    - *characteristics of plastics found in blanks with same rigor as samples*[12]
    - *potential sources of contamination*[23]
    - *point of entry and exit to method*[23]
  - positive controls
    - *morphology, size, color, and polymer type of positive controls*[9,22,24]
    - *positive control correction procedure*[22,24]
    - *point of entry and exit to method*[24]
  - contamination mitigation
    - *clothing policies*[9,25]
    - *purification technique for reagents*[17,26]

glassware cleaning techniques[27]
containment used (e.g. laminar flow cabinet/hoods, glove bags)[9,17,28–30]
data reporting
share raw data and analysis code as often as possible[2,31–34]
Field Sampling
where (e.g. region) and when (e.g. date, time) the sample was collected[20,35–40]
size (e.g. m3, kg) and composition (e.g. sediment, water, biota) of the sample[9,41]
location at the site that sample was collected (e.g. 3 cm depth of surface sediment)[42]
sample device dimensions and deployment procedures[22,43–46]
environmental or infrastructure factors that may affect interpretation of results[46–52]
how samples are stored and transported[9,53,54]
Sample Preparation
homogenization
homogenization technique[55]
splitting/subsetting
sample splitting/subsetting technique[46]
drying
sample drying temperature and time[56]
synthesized plastic
synthesized plastic polymer, molecular characteristics, size, color, texture, and shape[57,58]
synthesized plastic synthesis technique[57,59]
fluorescent dye
dye type, concentration, and solvent used[60–62]
dye application technique[60]
sieving strategy
sieve mesh size[55]
if sample was wet or dry sieved[55]
density separation
concentration, density, and composition (e.g. CaCl2, ZnCl) of solution[53,63,64]

- *time of separation*[65]
- *device used*[29,65–69]
- digestion
  - *duration and temperature of digestion*[70–72]
  - *digestion solution composition*[24,70,72]
  - *ratio of digestion fluid to sample*[24,70,72,73]
- filtration
  - *filter composition, porosity, diameter*[17,74,75]

Microplastic Identification

- visual identification
  - imaging settings
    - *image settings (e.g. contrast, gain, saturation, light intensity)*[31]
    - *magnification (e.g. scale bar, 50X objective)*[76]
  - light microscopy
    - *magnification used during identification*[61]
    - *shapes, colors, textures, and reflectance, used to differentiate plastic*[76–78]
  - fluorescence microscopy
    - *magnification used during identification*[61]
    - *fluorescence light wavelength, intensity, and exposure time to light source*[61,62,79]
    - *threshold intensity used to identify plastic*[79]
  - scanning electron microscopy (SEM)
    - *coating used (e.g. metal type, water vapour)*[80]
    - *magnification used during identification*[80]
    - *textures used to differentiate plastic*[80]
- chemical identification
  - pyrolysis gas chromatography mass spectrometry (py-GC/MS)
    - *pyrolysis reacting gases, temperature, duration*[16,81]
    - *GC oven program, temperature, carrier gas, and column characteristics*[16,81]
    - *MS ionization voltage, mass range, scanning frequency, temperature*[16,31]

py-GC/MS matching criteria (i.e. match threshold, linear retention indices (LRI), and kovats index)[16,82]
py-GC/MS quantification techniques[81]
raman spectroscopy
acquisition parameters (i.e. laser wavelength, hole diameter, spectral resolution, laser intensity, number of accumulations, time of spectral acquisition)[1,33,83–87]
pre-processing parameters (i.e. spike filter, smoothing, baseline correction, data transformation)[24,84,87,88]
spectral matching parameters (i.e. spectral library source, range of spectral wavelengths used to match, match threshold, matching procedure)[1,17,33,40,83–87,89]
Fourier-transform infrared spectroscopy (FTIR)
acquisition parameters (i.e. mode of spectra collection, accessories, crystal type, background recording, spectral range, spectral resolution, number of scans)[33,34,75]
pre-processing parameters (i.e. fourier-transformation (ft) parameters, smoothing, baseline correction, data transformation)[31]
matching parameters (i.e. FTIR spectral library source, match threshold, matching procedure, range of spectra used to match)[2,17,34,84]
differential scanning calorimetry (DSC)
acquisition parameters (i.e. temperature, time, number of cycles)[90]
matching parameters (i.e. parameters assessed, reference library source, comparison technique)[90]
Microplastic Categorization
shape, size, texture, color, and polymer category definitions[91–93]
Microplastic Quantification
units (e.g. kg, count, mm)[9,94]
size dimensions (e.g. feret minimum or maximum)[31]
quantification techniques[31]
Toxicology Considerations
dosed plastic age, polymer, size, color, and shapes[95–104]
animal husbandry[105,106]
exposure concentration, media, and time[106–112]
*effects evaluation metrics (e.g. what markers were evaluated?)**
*biota metrics (e.g. which tissues were analyzed?)**

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