

## Documents

Ghazali, I.<sup>a</sup>, Miskon, M.F.<sup>b</sup>, Razali, A.<sup>c</sup>, Hassan, N.A.<sup>d</sup>, Kasmuri, N.<sup>e</sup>, Ramli, M.Z.<sup>b</sup>, Yunus, K.<sup>a</sup>, Yusof, F.<sup>a</sup>, Faudzi, F.<sup>a</sup>

**Microplastic contamination in *Saccostrea cucullata*: a baseline study along the rocky shore in southwest area of Peninsular Malaysia off Strait of Malacca**

(2023) *International Journal of Environment and Pollution*, 73 (1-4), pp. 154-174.

DOI: 10.1504/IJEP.2023.139857

<sup>a</sup> Department of Marine Science, Kulliyah of Science, International Islamic University Malaysia (IIUM), Pahang, Kuantan, 25200, Malaysia

<sup>b</sup> Institute of Oceanography and Maritime Studies (INOCEM), Kulliyah of Science, International Islamic University Malaysia (IIUM), Pahang, Kuantan, 25200, Malaysia

<sup>c</sup> Department of Chemistry, Kulliyah of Science, International Islamic University Malaysia (IIUM), Pahang, Kuantan, 25200, Malaysia

<sup>d</sup> Department of Community Medicine, Kulliyah of Medicine, International Islamic University Malaysia (IIUM), Pahang, Kuantan, 25200, Malaysia

<sup>e</sup> School of Engineering, College of Engineering, Universiti Teknologi Mara (UiTM), Selangor, Shah Alam, 40450, Malaysia

### Abstract

*Saccostrea cucullata*, also known as rock oysters, are chosen as the targeted organisms on rocky shores to demonstrate the pathway of microplastic into sessile organisms as the concentration in biota can reveal adverse biological effects and provide information on ecological health of marine waters. Eight rocky shores along the Strait of Malacca were selected. *S. cucullata*'s soft tissues were digested and isolated particles were then examined under a stereo microscope for physical identification and ATR-FTIR characterisation for polymer identification. Out of all particles found, 58.5% had been identified as polymers. The microplastic abundance was between 0.0302 to 0.3586 microplastic items/wet weight and 0.1053 to 0.6000 microplastic items/individual of *S. cucullata* with typical filament-shaped, black colour, and ranging in size from 107.85 µm to 14,614.43 µm. The information gathered served as the starting point for further research into microplastic contamination of the marine environment and its inhabitants. Copyright © 2023 Inderscience Enterprises Ltd.

### Author Keywords

FTIR analysis; health risk analysis; Johor; marine pollution; Melaka; microplastic contamination; microplastic pollution; Negeri Sembilan; rock oyster; *Saccostrea cucullata*

### Index Keywords

Health risks, Marine pollution, Microplastic, Molluscs, Particle size analysis, Risk analysis; FTIR analysis, Health risk analysis, Johor, Melakum, Microplastic contamination, Microplastic pollution, Microplastics, Negeri sembilan, Rock oyster, *Saccostrea cucullata*; Risk assessment; 1,1 difluoroethane, cellulose triacetate, dimethyl terephthalate, dioxane, microplastic, monomer, polybutylene terephthalate, polycyclohexanedimethyl terephthalate, polyethylene terephthalate, polymer, polypropylene, polystyrene, polyvinyl acetate, polyvinylidene fluoride, styrene, unclassified drug, vinyl acetate; FTIR spectroscopy, health risk, marine environment, marine pollution, oyster culture, polymer, rocky shore; animal tissue, Article, attenuated total reflectance Fourier transform infrared spectroscopy, biota, calculation, coastal waters, data analysis, digestion, ecosystem health, estimated daily intake, exposure, extraction, health risk assessment, Malaysia, marine environment, Melaka, microplastic pollution, nonhuman, *Saccostrea cucullata*, sample, sessile species, soft tissue, water contamination; Strait of Malacca

### Chemicals/CAS

cellulose triacetate, 9012-09-3; dioxane, 123-91-1; polyethylene terephthalate, 25038-59-9, 60527-88-0, 9003-68-3; polypropylene, 25085-53-4, 9003-07-0; polystyrene, 9003-53-6; polyvinyl acetate, 9003-20-7; polyvinylidene fluoride, 24937-79-9; styrene, 100-42-5; vinyl acetate, 108-05-4

### Funding details

Ministry of Higher Education, Malaysia MOHEFRGS19-157-0766, FRGS/1/2019/WAB09/UIAM/02/2

This work was supported by Fundamental Research Grant Scheme (FRGS) under the Ministry of Higher Education (MOHE) of Malaysia: No. FRGS19-157-0766 and FRGS/1/2019/WAB09/UIAM/02/2.

### References

- Abidli, S., Lahbib, Y., Trigui El Menif, N.  
**Microplastics in commercial molluscs from the Lagoon of Bizerte (Northern Tunisia)**  
(2019) *Marine Pollution Bulletin*, 142, pp. 243-252.
- Affizah, N., Vedamanikam, V.J., Shazilli, N.A.M.  
**Concentration of arsenic and mercury in the oyster (*Crassostrea Iredalei*) from Setiu Lagoon, Terengganu**  
(2009) *Toxicological and Environ Chemistry*, 91 (2), pp. 259-265.

- Agusa, T., Kunito, T., Sudaryanto, A., Monirith, I., Kan-Atireklap, S., Iwata, H., Ismail, A., Tanabe, S.  
**Exposure assessment for trace elements from consumption of marine fish in southeast Asia**  
(2007) *Environmental Pollution*, 145 (3), pp. 766-777.
- Ajith, N., Arumugam, S., Parthasarathy, S., Manupoori, S., Janakiraman, S.  
**Global distribution of microplastics and its impact on marine environment—a review**  
(2020) *Environmental Science and Pollution Research*, 27 (21), pp. 25970-25986.
- Ali, S.N.M., Kammoo, M.F., Ali, N.N.N., Miskon, M.F.  
**Distribution pattern of rare earth elements in soft tissue of *Saccostrea cucullata* in Terengganu and east Johor coastal waters**  
(2019) *J. Clean, WAS*, 3, pp. 14-19.
- Bonello, G., Varrella, P., Pane, L.  
**First evaluation of microplastic content in benthic filter-feeders of the Gulf of La Spezia (Ligurian sea)**  
(2018) *Journal of Aquatic Food Product Technology*, 27 (3), pp. 284-291.
- Chen, Z., Hay, J.N., Jenkins, M.J.  
**The thermal analysis of poly(ethylene terephthalate) by FTIR spectroscopy**  
(2013) *Thermochimica Acta*, 552, pp. 123-130.
- Davidson, K., Dudas, S.E.  
**Microplastic ingestion by wild and cultured manila clams (*Venerupis philippinarum*) from Baynes Sound, British Columbia**  
(2016) *Archives of Environmental Contamination and Toxicology*, 71 (2), pp. 147-156.
- Dibbern-Brunelli, D., Atvars, T.D.Z., Joekes, I., Barbosa, V.C.  
**Mapping phases of poly(vinyl alcohol) and poly(vinyl acetate) blends by FTIR microspectroscopy and optical fluorescence microscopy**  
(1998) *Journal of Applied Polymer Science*, 69 (4), pp. 645-655.
- Digka, N., Tsangaris, C., Torre, M., Anastasopoulou, A., Zeri, C.  
**Microplastics in mussels and fish from the northern Ionian sea**  
(2018) *Marine Pollution Bulletin*, 135, pp. 30-40.
- Ding, J., Jiang, F., Li, J., Wang, Z., Sun, C., Wang, Z., Fu, L., He, C.  
**Microplastics in the coral reef systems from Xisha islands of south China sea**  
(2019) *Environmental Science and Technology*, 53 (14), pp. 8036-8046.
- Ding, J., Li, J., Sun, C., Jiang, F., He, C., Zhang, M., Ju, P., Ding, N.X.  
**An examination of the occurrence and potential risks of microplastics across various shellfish**  
(2020) *Science of the Total Environment*, 739, p. 139887.
- Ding, J., Sun, Y., He, C., Li, J., Li, F.  
**Towards risk assessments of microplastics in bivalve mollusks globally**  
(2022) *Journal of Marine Science and Engineering*, 10 (2), p. 288.
- Fei, P., Liao, L., Cheng, B., Song, J.  
**Quantitative analysis of cellulose acetate with a high degree of substitution by FTIR and its application**  
(2017) *Analytical Methods*, 9 (43), pp. 6194-6201.
- Fuad, M.M., Shazili, N.A.M., Faridah, M.  
**Trace metals and rare earth elements in rock oyster *Saccostrea cucullata* along the east coast of peninsular Malaysia**  
(2013) *Aquatic Ecosystem Health and Management*, 16 (1), pp. 78-87.
- Hamzah, S.R., Altrawneh, R.S., Tuan Anuar, S., Wan Mohd Khalik, W.M.A., Kolandhasamy, P., Ibrahim, Y.S.

- Ingestion of microplastics by the estuarine polychaete, *namalycastis* sp. in The Setiu Wetlands, Malaysia**  
(2021) *Marine Pollution Bulletin*, 170, p. 112617.
- Ibrahim, N.R., Mat Noordin, N.N.  
**Understanding the issue of plastic waste pollution in Malaysia: a case for human security**  
(2020) *Journal of Media and Information Warfare*, 13 (1), pp. 105-140.
  - Ibrahim, Y.S., Azmi, A.A., Abdul Shukor, S., Tuan Anuar, S., Abdullah, S.A.  
**Microplastics ingestion by *scapharca cornea* at setiu wetland Terengganu, Malaysia**  
(2016) *Middle-East Journal of Scientific Research*, 24 (6), pp. 2129-2136.
  - Ibrahim, Y.S., Rathnam, R., Anuar, S.T., Khalik, W.M.A.W.M.  
**Isolation and characterisation of microplastic abundance in *lates calcarifer* from Setiu wetlands, Malaysia**  
(2017) *Malaysian Journal of Analytical Sciences*, 21 (5), pp. 1054-1064.
  - Ibrahim, Y.S., Tuan Anuar, S., Azmi, A.A., Wan Mohd Khalik, W.M.A., Lehata, S., Hamzah, S.R., Ismail, D., Lee, Y.Y.  
**Detection of microplastics in human colectomy specimens**  
(2021) *Journal of Gastroenterology and Hepatology*, 5 (1), pp. 116-121.
  - Jaafar, N., Azfaralariff, A., Musa, S.M., Mohamed, M., Yusoff, A.H., Lazim, A.M.  
**Occurrence, distribution and characteristics of microplastics in gastrointestinal tract and gills of commercial marine fish from Malaysia**  
(2021) *Science of the Total Environment*, 799, p. 149457.
  - Jung, M.R., Horgen, F.D., Orski, S.v., Rodriguez, C.V., Beers, K.L., Balazs, G.H., Jones, T.T., Lynch, J.M.  
**Validation of ATR FT-IR to identify polymers of plastic marine debris, including those ingested by marine organisms**  
(2018) *Marine Pollution Bulletin*, 127, pp. 704-716.
  - Kamaruzzaman, Y., Miskan, M., Fikriah, F., Rahman, M.M., Chuan, O.M., Shaari, H.  
**Rare earth elements behaviour at west coast of peninsular Malaysia rocky shore ecosystem using *Saccostrea cucullata* as bioindicator**  
(2017) *Asian Journal of Chemistry*, 29 (10), pp. 2211-2215.
  - Karbalaei, S., Golieskardi, A., Hamzah, H., Abdulwahid, S., Hanachi, P., Walker, T.R., Karami, A.  
**Abundance and characteristics of microplastics in commercial marine fish from Malaysia**  
(2019) *Marine Pollution Bulletin*, 148, pp. 5-15.
  - Kazemi, A., Riyahi Bakhtiari, A., Mohammad Karami, A., Haidari, B., Kheirabadi, N.  
**Bioavailability and variability of Cd, Pb, Zn, and Cu pollution in soft tissues and shell of *Saccostrea cucullata* collected from the coast of Qeshm Island Persian Gulf, Iran**  
(2013) *Iranian Journal of Toxicology*, 7 (21), pp. 836-841.
  - Kershaw, P.J., Rochman, C.M.  
(2016) *Sources, Fate and Effects of Microplastics in the Marine Environment: Part Two of a Global Assessment*,  
4 Albert Embankment, London
  - Khalik, W.M.A.W.M., Ibrahim, Y.S., Tuan Anuar, S., Govindasamy, S., Baharuddin, N.F.  
**Microplastics analysis in Malaysian marine waters: a field study of Kuala Nerus and Kuantan**  
(2018) *Marine Pollution Bulletin*, 135, pp. 451-457.
  - Kolandhasamy, P., Su, L., Li, J., Qu, X., Jabeen, K., Shi, H.  
**Adherence of microplastics to soft tissue of mussels: a novel way to uptake microplastics beyond ingestion**  
(2018) *Science of the Total Environment*, Vols. 610–611, pp. 635-640.
  - Le, Q.D., Bach, L.G., Arai, T.  
**Monitoring heavy metal contamination using rocky oyster (*Saccostrea glomerata*) in**

- Haiphong-Halong coastal area, north Vietnam**  
(2015) *International Journal of Environmental Research*, 9 (4), pp. 1373-1378.
- Li, J., Qu, X., Su, L., Zhang, W., Yang, D., Kolandhasamy, P., Li, D., Shi, H.  
**Microplastics in mussels along the coastal waters of China**  
(2016) *Environmental Pollution*, 214, pp. 177-184.
  - Li, J., Yang, D., Li, L., Jabeen, K., Shi, H.  
**Microplastics in commercial bivalves from China**  
(2015) *Environmental Pollution*, 207, pp. 190-195.
  - Lusher, A.L., Welden, N.A., Sobral, P., Cole, M.  
**Sampling, isolating and identifying microplastics ingested by fish and invertebrates**  
(2017) *Analytical Methods*, 9 (9), pp. 1346-1360.
  - Martinelli, J.C., Phan, S., Luscombe, C.K., Padilla-Gamiño, J.L.  
**Low Incidence of Microplastic Contaminants in Pacific Oysters (*Crassostrea gigas* Thunberg) from the Salish Sea, USA**  
(2020) *Science of the Total Environment*, 715, p. 136826.
  - Mathalon, A., Hill, P.  
**Microplastic fibers in the intertidal ecosystem surrounding Halifax Harbor, Nova Scotia**  
(2014) *Marine Pollution Bulletin*, 81 (1), pp. 69-79.
  - Mottalib, M.A., Zilani, G., Suman, T.I., Ahmed, T., Islam, S.  
**Assessment of trace metals in consumer chickens in Bangladesh**  
(2018) *Journal of Health and Pollution*, 8 (20), p. 181208.
  - Mukai, Y., Goto, A., Tashiro, Y., Tanabe, S., Kunisue, T.  
**Coastal biomonitoring survey on persistent organic pollutants using oysters (*Saccostrea mordax*) from okinawa, Japan: geographical distribution and polystyrene foam as a potential source of hexabromocyclododecanes**  
(2020) *Science of the Total Environment*, 739, p. 140049.
  - Najihah, M., Ismail, M.S., Yap, C.K., Ku Yaacob, K.K.  
**Microplastics occurrence in waters off the northwest coast of peninsular Malaysia: a spatial difference**  
(2020) *Journal of Basic and Applied Sciences*, 16 (1), pp. 50-60.
  - Nallasamy, P., Mohan, S.  
**Vibrational spectroscopic characterization of form II poly(vinylidene fluoride)**  
(2005) *Indian Journal of Pure and Applied Physics*, 43, pp. 821-827.
  - Nam, P.N., Tuan, P.Q., Thuy, D.T., Amiard, F.  
**Contamination of microplastic in bivalve: first evaluation in Vietnam**  
(2019) *Vietnam Journal of Earth Sciences*, 41 (3), pp. 252-258.
  - Phuong, N.N., Poirier, L., Pham, Q.T., Lagarde, F., Zalouk-Vergnoux, A.  
**Factors influencing the microplastic contamination of bivalves from the French Atlantic coast: location, season and/or mode of life?**  
(2018) *Marine Pollution Bulletin*, 129 (2), pp. 664-674.
  - Phuong, N.N., Zalouk-Vergnoux, A., Kamari, A., Mouneyrac, C., Amiard, F., Poirier, L., Lagarde, F.  
**Quantification and characterization of microplastics in blue mussels (*Mytilus edulis*) protocol setup and preliminary data on the contamination of the French Atlantic Coast**  
(2018) *Environmental Science and Pollution Research*, 25, pp. 6135-6144.
  - Qu, X., Su, L., Li, H., Liang, M., Shi, H.  
**Assessing the relationship between the abundance and properties of microplastics in water and in mussels**  
(2018) *Science of the Total Environment*, 621, pp. 679-686.

- Rodrigues, R.J., Nasnodkar, M.R., Nayak, G.N., Tiwari, A.K.  
**Bioaccumulation of metals by edible bivalve *Saccostrea cucullata* and its application as a bioindicator of metal pollution, tropical (Zuari) Estuary, Goa, India**  
(2021) *Arabian Journal of Geosciences*, 14 (12), p. 1192.
- Saelee, P., Wongsoonthornchai, M., Phasukphan, N.  
**The contamination of microplastics in mussel (*Mytilus edulis*), and oyster (*Crassostrea gigas*): a case study from a fish market, Chonburi province**  
(2021) *Burapha Science Journal*, 26 (3), pp. 1726-1744.
- Sarijan, S., Azman, S., Mohd Said, M.I.  
**Microplastics in sediment from Skudai and Tebrau river, Malaysia: a preliminary study**  
(2018) *SEPKA-ISEED International Symposium, Johor, Malaysia, MATEC Web of Conferences*, 250, p. 06012.
- Sarijan, S., Azman, S., Mohd Said, M.I., Lee, M.H.  
**Ingestion of microplastics by commercial fish in Skudai river, Malaysia**  
(2019) *EnvironmentAsia*, 12 (3), pp. 75-84.
- Shakouri, A., Gheytsi, H.  
**Bioaccumulation of heavy metals in oyster (*Saccostrea cucullata*) from chabahar bay coast in Oman sea: regional, seasonal and size-dependent variations**  
(2018) *Marine Pollution Bulletin*, 126, pp. 323-329.
- Sharif, R., Chong, E., Meng, C.K.  
**Human health risk assessment of heavy metals in shellfish from Kudat, Sabah**  
(2016) *Malaysian Journal of Nutrition*, 22 (2), pp. 301-305.
- Song, Y.K., Hong, S.H., Jang, M., Kang, J.H., Kwon, O.Y., Han, G.M., Shim, W.J.  
**Large accumulation of micro-sized synthetic polymer particles in the sea surface microlayer**  
(2014) *Environmental Science and Technology*, 48 (16), pp. 9014-9021.
- Taha, Z.D., Md Amin, R., Tuan Anuar, S., Abdul Nasser, A.A., Sohaimi, E.S.  
**Microplastics in seawater and zooplankton: a case study from Terengganu estuary and offshore waters, Malaysia**  
(2021) *Science of the Total Environment*, 786, p. 147466.
- (2018) *Appendix Q - Waste Analysis at Facilities that Generate, Treat, Store, and Dispose of Hazardous Wastes*,  
US Environmental Protection Agency (USEPA) Publicatio EPA530-SW-88-016
- (1987) *Styrene*,  
CASRN 100-42-5, Chemical Assessment Summary, US Environmental Protection Agency
- (2002) *Dimethyl Terephthalate (DMT)*,  
CASRN 120-61-6, Chemical Assessment Summary, US Environmental Protection Agency
- (2010) *1,4-Dioxane*,  
CASRN 123-91-1, Chemical Assessment Summary
- Webb, S., Ruffell, H., Marsden, I., Pantos, O., Gaw, S.  
**Microplastics in the New Zealand green lipped mussel *perna canaliculus***  
(2019) *Marine Pollution Bulletin*, 149, p. 110641.
- Yang Hwi, T., Shuaib Ibrahim, Y., Wan Mohd Khalik, W.M.A.  
**Microplastic abundance, distribution, and composition in Sungai Dungun, Terengganu, Malaysia**  
(2020) *Sains Malaysiana*, 49 (7), pp. 1479-1490.
- Zainuddin, A.H., Aris, A.Z., Zaki, M.R.M., Yusoff, F.M., Wee, S.Y.  
**Occurrence, potential sources and ecological risk estimation of microplastic towards coastal and estuarine zones in Malaysia**  
(2022) *Marine Pollution Bulletin*, 174.

- Zhu, J., Yu, X., Zhang, Q., Li, Y., Tan, S., Li, D., Yang, Z., Wang, J.  
**Cetaceans and microplastics: first report of microplastic ingestion by a Coastal Delphinid, Sousa Chinensis**  
(2019) *Science of the Total Environment*, 659, pp. 649-654.

**Correspondence Address**

Miskon M.F.; Institute of Oceanography and Maritime Studies (INOCEM), Pahang, Malaysia; email: fuadm@iiium.edu.my

**Publisher:** Inderscience Publishers

**ISSN:** 09574352

**CODEN:** IJVLE

**Language of Original Document:** English

**Abbreviated Source Title:** Int. J. Environ. Pollut.

2-s2.0-85198388107

**Document Type:** Article

**Publication Stage:** Final

**Source:** Scopus

---

**ELSEVIER**

Copyright © 2024 Elsevier B.V. All rights reserved. Scopus® is a registered trademark of Elsevier B.V.

 **RELX Group™**