A COMPARISON OF THE MICROPLASTIC CONSUMPTION BY SMALL AND LARGE ANCHOVY FISH

Endar Widiah NINGRUM¹ and Mufti Petala PATRIA²

¹ Dept. of Biology, Universitas Indonesia
(Kampus UI, Jalan Margonda Raya, Pondok Cina, Beji, Depok, Indonesia)

E-mail: mpatria@sci.ui.ac.id*

² Associate Professor, Dept. of Biology, Universitas Indonesia
E-mail: endar.widiah@ui.ac.id

Recent studies have shown microplastics are also found on anchovy from Indonesia Sea. The anchovy is an abundant fish caught all year round because of the market demand in Asia. Generally, people do not like tiny anchovy pieces, and tend to consume anchovy as a whole, thus ingesting the digestive system as well. This study therefore broadens the perspective on data comparison from the previous study. In this study, four locations on the Indonesia Sea were assigned as the anchovy's sample origin. Subsequently, statistical analysis was conducted on comparison and regression for both microfiber and microfilm contamination found on each anchovy. The highest contaminated anchovy with microfiber (59.96 ± 0.63 particle idv^{-1}) and microfilm (68 ± 8.50 particle idv^{-1}) were discovered to be from Talisayan, East Kalimantan, while the lowest contamination on microfiber were from East Lombok (13 ± 4.58 particle idv^{-1}), and no microfilm contamination was found on Alor's anchovy. Furthermore, a comparison was conducted between the anchovy's weight, length, microfiber, and microfilm, and the results showed no correlation ($p > 0.05$). This issue is therefore more challenging for future research, as another probability of accumulation is open. The abundance of microplastics contamination is not related to the anchovy's body mass, however, there is currently an exception for the variable of location, and only microfilm contamination has a correlation to the sample locations ($r = 0.576$).

Key Words : *microplastics, anchovy, microfilm, microfiber*

1. INTRODUCTION

Microplastics, as pollution to the marine ecosystem are ingested by marine biota¹). Due to the relative abundance, microfragment and microfiber are typically the most commonly detected kinds of microplastic shapes^{2,3,4}). The previous study stated microplastics tend to be retained in fish digestive system and translocated to the lymphatic, blood, muscle and circulatory systems.^{5,6,7}

The study also showed the relationship between feeding types and microplastic uptake, indicating omnivores tend to ingest more microplastics, compared to carnivores and herbivores⁸). Furthermore, pelagic fish are more susceptible to LDPE, while the demersal fish tend to ingest more HDPE⁹). The present study however, uses data on the abundance of anchovy, a pelagic fish, in the Indonesia Sea. The critical point is the possibility of exposure to microplastics through ingestion, whether by

directly consuming the contaminated seafood during packaging or indirectly, by consuming seafood containing microplastics^{10,11}). Therefore, the aim of this research is to compare the results of anchovy contamination from four harbors, Alor, Balikpapan, East Lombok, and Talisayan.

2. METHOD

The secondary data was obtained from the publications on microplastics contamination in anchovy from the four harbors^{12,13,14}). A multiple comparison was applied to test for significant differences in microplastic types according to sample weight, and length. The weight and length were the independent variable, while the microplastics types (microfilm and microfiber) were dependent variable. Subsequently, a correlation analysis was applied between microfiber and the locations (four harbors), to determine the significance and no transformation was applied. Regression analyses applying the Pearson correlation, then were conducted to analyse the correlation between locations and microplastic shape. Meanwhile, the statistical analysis was conducted using the SPSS 25 Software.

3. RESULTS AND DISCUSSION

A total of 60 anchovy individual from total four harbors as shown **Table 1** were analyzed for microplastics contamination then compared by

locations, body weight, and total length, to identify the correlation. The microfiber contamination was discovered to be high on anchovy from Talisayan and East Kalimantan, compared to the other locations. In addition, the highest ingested value was 59.96 ± 0.63 particle idv^{-1} microfiber, while the lowest was 13 ± 4.58 particle idv^{-1} , from East Lombok. Meanwhile, the highest microfilm contamination was also from Talisayan, East Kalimantan (68 ± 8.50 particle idv^{-1}), and the lowest was from from Alor, with no microfilm detected. Subsequently, multiple comparison with the microfiber as a dependent variable was applied between the body weight and length, and an r value of 0.565 was obtained, while the comparison value between microfilm as another dependent variable, with body weight, and length, resulted in an r value of 0.493. The correlation also compared the locations and microplastics shapes to obtain more detailed information, and this resulted in r values of 0.302 ($p > 0.05$) and 0.050 ($p = 0.05$), for microfiber and microfilm, respectively. In addition, the regression analysis was only applied to the correlation between the locations and microfilm, the results produced an r value of 0.576, indicating the microplastic shape with correlation to the harbors is microfilm (**Fig. 1**).

These results present a new perspective on microplastics contamination being unrelated to fish body's mass, and total length. This means both small and big fish share the same

Table 1 Comparison of Total 50-500um MPs particle from four locations in Indonesia Sea

Location	n	Dry Weight (g $\pm$ SD)	Total length (mm $\pm$ SD)	Microfiber particle idv^{-1}	Microfilm particle idv^{-1}	Reference
Alor	15	1.20 $\pm$ 0.11	71.41 $\pm$ 0.59	24 $\pm$ 6,51	0	Ningrum & Patria, 2019b
Balikpapan	15	1.18 $\pm$ 0.11	75.65 $\pm$ 0.79	37 $\pm$ 2,89	56 $\pm$ 1,00	Ningrum & Patria, 2019b
East Lombok	15	1.18 $\pm$ 0.13	75.96 $\pm$ 1.68	13 $\pm$ 4,58	7 $\pm$ 6,93	Ningrum & Patria, 2019a
Talisayan	15	0.68 $\pm$ 0.06	59.96 $\pm$ 0.63	44 $\pm$ 10,12	68 $\pm$ 8,50	Ningrum, Patria, & Sedayu 2019

contamination potential, due to ingestion of the microplastics contamination. Meanwhile, another finding shows the exception for contaminated sea water as the habitat of marine biota. Only the abundance of microfilm ingested by the anchovy is related to the contamination of seawater. This issue opens the probability of accumulation, and is therefore more challenging for further research.

4. CONCLUSION

The new perspective was drawn from the microplastic contamination on anchovy, and this is unrelated to fish body mass and total length. Furthermore, microfilm on anchovy is the only microplastic shape related to the seawater contamination.

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APPENDIX

Fig.1 Regression standardized residual between microfilm abundance (particle idv⁻¹) and the sample location.

REFERENCES

- 1) Teng, J., Zhao, J., Zhu, X., Shan, E., Zhang, C., Zhang, W. and Wang, Q.: Toxic effects of exposure to microplastics with environmentally relevant shapes and concentrations: Accumulation, energy metabolism and tissue damage in oyster *Crassostrea gigas*, *Environmental Pollution*, Vol. 269, pp. 116169, 2021.
- 2) Alomar C., Deudero S.: Evidence of microplastic ingestion in the shark *Galeus melastomus Rafinesque*, 1810 in the continental shelf off the western Mediterranean Sea, *Environmental Pollution*, Vol. 223, pp. 223-229, 2017.
- 3) Savoca M. S., Tyson C. W., McGill M., Slager C. J.: Odours from marine plastic debris induce food search behaviours in a forage fish, *Proceedings of the Royal Society B: Biological Sciences*, Vol. 284, pp. 20171000, 2017.
- 4) Wang W., Ge J., Yu X.: Bioavailability and toxicity of microplastics to fish species: a review, *Ecotoxicology and Environmental Safety*, Vol. 189, pp. 109913, 2020.
- 5) Feng Z., Zhang T., Li Y., He X., Wang R., Xu J., Gao G.: The accumulation of microplastics in fish from an important fish farm and mariculture area, Haizhou Bay, China, *Science of the Total Environment*, Vol. 696, pp. 133948, 2019.
- 6) Sun X., Li Q., Shi Y., Zhao Y., Zheng S., Liang J., Liu T., Tian Z.: Characteristics and retention of microplastics in the digestive tracts of fish from the Yellow Sea, *Environmental Pollution*, Vol. 249, pp. 878-885, 2019.
- 7) Zhang F., Wang X., Xu J., Zhu L., Peng G., Xu P., Li D.: Food-web transfer of microplastics between wild caught fish and crustaceans in East China Sea, *Marine Pollution Bulletin*, Vol. 146, pp. 173-182, 2019.
- 8) Mizraji R., Ahrendt C., Perez-Venegas D., Vargas J., Pulgar J., Aldana M., Ojeda F. P., Duarte C., Galbán-Malagón C.: Is the feeding type related with the content of microplastics in intertidal fish gut?, *Marine Pollution Bulletin*, Vol. 116, pp. 498-500, 2017.
- 9) Lusher A. L., McHugh M., Thompson R. C.: Occurrence of microplastics in the gastrointestinal tract of pelagic and demersal fish from the English Channel, *Marine Pollution Bulletin*, Vol. 67, pp. 94-99, 2013.
- 10) Rahmawati, Nur HF, and Mufti P. Patria. "Microplastics Dissemination from Fish *Mugil dussumieri* and Mangrove Water of Muara Teluknaga, Tangerang, Banten.", *In Journal of Physics: Conference Series*, Vol. 1282, No. 1, pp. 012104. IOP Publishing, 2019.
- 11) Fitri, Syaidah, and M. P. Patria. "Microplastic contamination on *Anadara granosa* Linnaeus 1758 in Pangkal Babu mangrove forest area, Tanjung Jabung Barat district, Jambi." *In Journal of Physics: Conference Series*, Vol. 1282, No. 1, pp. 012109. IOP Publishing, 2019.
- 12) Ningrum E. W., Patria M. P.: Ingestion of microplastics by anchovies from east Lombok Harbour, Lombok Island, Indonesia, *AIP Conference Proceedings*, Vol. 2120, pp. 040002, 2019a.
- 13) Ningrum E. W., Patria M. P.: Microplastics and mercury detection on anchovy from Alor and Balikpapan harbors, Indonesia. *Proceedings 7th IEEE Region 10 (Asia Pasific) Humanitarian Technology Conference*, Vol. 47129, pp. 254-257, 2019b.
- 14) Ningrum E. W., Patria M. P., Agung, S.: Ingestion of microplastics by anchovies from Talisayan harbor, East Kalimantan, Indonesia. *Journal of Physics: Conference Series*, Vol. 1403, pp. 033072, 2019.

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