

## Plastic Particles in Silverside (*Stolephorus heterolobus*) Collected at Paotere Fish Market, Makassar

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**Abstract:** Plastics represent the latest contaminant in the marine environment. Although plastics without doubt represent a uniquely valuable material particularly in construction, packaging and fishing gear applications. Current research on plastic debris in digestive tract content of pelagic fish is part of ongoing collaboration between University of Hasanuddin and University of California at Davis. Locally caught and consumed Silverside (*Stolephorus heterolobus*) or widely known as anchovies has been the subject on this studies. Freshly landed fish were collected from Paotere fish market, which is also the biggest fish wholesale location at Makassar City, South Sulawesi, Indonesia. At laboratory fish digestive tracts were removed and digested in 10% KOH at 60° C overnight, followed with plastic particles observation using binocular microscope. Four out of 10 fish investigated were found to contained plastic particles in their digestive tract. This is the first work on plastic debris in fish gut ever conducted in the region, which is in accordance to previous works on plastics debris elsewhere and will be further discussed for their possible effects, both on food safety and human toxicology.

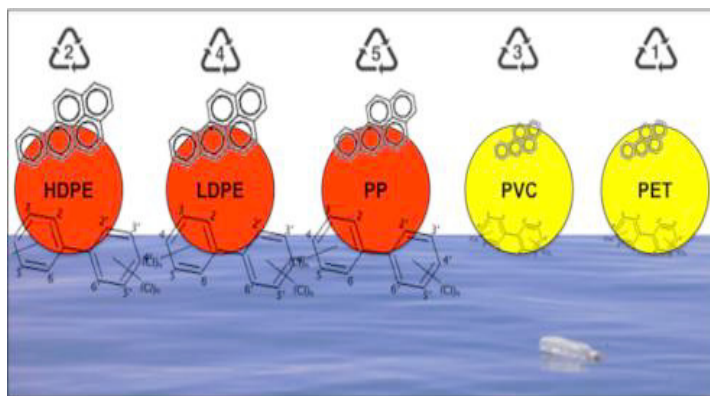
**Keywords:** Plastics particle; digestive tract; *Stolephorus heterolobus*

### 1. Introduction

Industrialized human society generates vast quantities of materials, many of which, end up as waste. Conventional materials such as glass, metal and paper are being replaced by cost effective plastic packaging. In the fishing industry, plastic materials and synthetics havereplaced natural fibers over the past 35 years and their widespread use has resulted insubstantial amounts of derelict fishing debris in ocean waters and on beaches (Henderson et al., 2001). Plastic has become widely dispersed over the oceans (Derraik, 2002;Sheavly, 2005) and the five most mass-produced and consumed types of plastics

are polyethylene terephthalate (PET), high-density polyethylene (HDPE), polyvinyl chloride (PVC), low-density polyethylene (LDPE), and polypropylene (PP) (Andrady, 2011; Fig.1).

This rubbish, which is present in the oceans and on beaches, is called marine debris. Studies on marine debris have shown that plastics consistently make up 80to 90% of all marine debris (Derraik, 2002; Balode and Muzikante, 2013). Synthetics like plastics are the most problematic debris because they resist natural degradation processes and are a threat to wildlife, as previously reported by Greenpeace (2006) that at least 267 different



**Figure 1.** The five most mass-produced and consumed types of plastics.

species are known to have suffered from entanglement or ingestion of marine debris including seabirds, turtles, seals, sea lions, whales and fish.

Plastic debris is a serious environmental concern, as a physical pollutant as well as a chemical pollutant when it breaks down in the marine environment. Recent studies have shown that plastics can also concentrate other pollutants, with significantly higher concentrations of toxic pollutants adhering to soft, rubbery plastics. Reports on accumulations of floating plastic debris in rotating ocean currents, or gyres, are abundant elsewhere have led to a growing awareness of the hazards from plastic pollution (Rochman *et al.*, 2013), with evident of having capability to accumulate toxic metals (Ashton *et al.*, 2010; Nakashima *et al.*, 2012; Rochman *et al.*, 2014a; Holmes *et al.*, 2014) and carried persistent organic pollutants/POPs (Rios *et al.*, 2007) and PBDEs (Rochman *et al.*, 2014b). These are reasons for us to conduct this initial stage of collaborative research on plastic debris evaluation and monitoring in consumed seafood from South Sulawesi.

## 2. Materials and Methods

### 2.1 Fish Sampling

Most importantly, we aimed for fish that are for human consumption, not bait fish. Fish that are planktivorous are most likely to have ingested plastic debris. Silverside (*Stolephorus heterolobus*) or locally named *ikan teri* or *mairo* is one of widely consumed by people in South Sulawesi and neighboring areas. The fish has a maximum length of 12 cm (Kuitert and Debelius, 2005), hence mostly consumed as a headed or whole fish (intact), freshly or salt-dried. The fish were collected at Paotere Fish Market Makassar City, South Sulawesi, and directly transported to the Ecotoxicology Laboratory, Department of Marine Science Hasanuddin University. In the lab, prior to dissection, picture of fish were taken, weight and length were measured to get condition factor.

### 2.2 Extraction of Plastic from Digestive Tract Content of Fish

Into 50-mL Polypropylene tubes (washed three times with distilled water), labeled with fish information, digestive tract of respective fish were added. Into the tubes

were then poured three times of volume of 10% KOH (100 g of analytical KOH crystal in 1000 mL distilled water). Tubes containing fish digestive tracts were then incubated at 60° C overnight. Fish were dissected with gloved hands, and between dissection of fish all dissecting kits were cleaned with 70% ethanol solution and wiped with clean tissue paper. Fish liver were also weight to calculate the hepato-somatic index.

On the following day, digestive tracts content were poured into clean petri dishes and spread over evenly at the bottom, plastic particles were then observed and counted under binocular microscopes by three observers within a defined time (2 minutes for each paralleled observation). Plastics were removed with tweezers and put onto a labeled (with sample information) aluminum foil, pictures taken and recorded on data sheets. Amount and details of plastic debris

were also recorded. All steps are repeated for each fish sample.

### 3. Results and Discussion

From 10 fish examined, selected based on their physical features and freshness, turned out to be all males with mature gonads. Fish weight ranges from 5.4 to 10 g (mean:  $7.01 \pm 2.29$ ), total length of 8.7 – 9.7 mm (mean:  $9.29 \pm 0.31$ ) with liver weight ranging from 0.01 – 0.1 g (mean:  $0.03 \pm 0.02$ ) (Fig. 2).

Condition factor ( $K$ ), calculated from mean value of fish weight and total length, resulted in value of  $K = 0.88$ , meaning that fish were not at an ideal physical shape ( $K = 1$ , is an ideal value). Of the hepato-somatic index ( $HI$ ) value, calculated as a percentage of liver weight to the total body weight, resulted in  $HI = 0.005$  (Table 1).

**Table 1.** Fish Morphometric Measurement and Plastic Count.

No.	Sex	Weight (g)	Length (mm)	Liver weight (g)	Plastic Count (nos.)
1	M	10	9.3	0.1	0
2	M	6.8	9.1	0.02	5
3	M	7.5	9.5	0.02	1
4	M	7	9.3	0.02	0
5	M	8.4	9.6	0.01	0
6	M	7	9.6	0.04	3
7	M	5.9	9	0.02	0
8	M	6.5	9.1	0.02	0
9	M	5.4	9.7	0.05	2
10	M	5.6	8.7	0.03	0
	Average	7.01	9.29	0.033	
	Stdev	2.29	0.31	0.026	

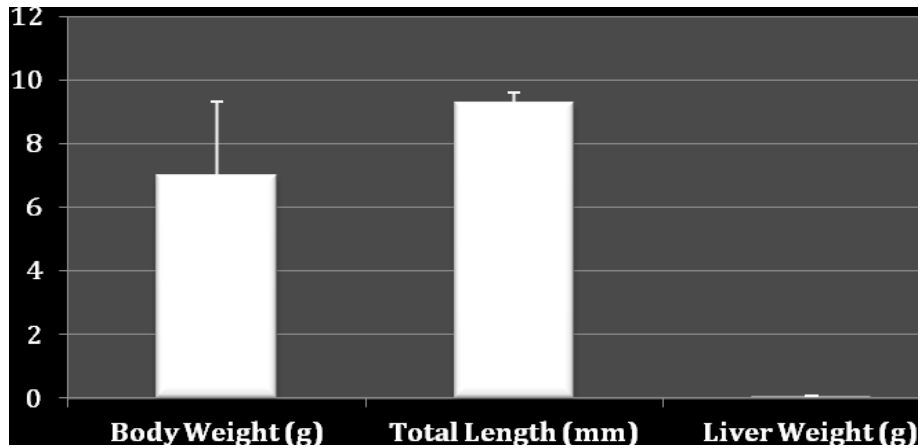


Figure 2. Mean Values of 10 Fish Morphometric Measurement.

Table 2. Individual Fish Contained Plastic Particles with Description.

Fish No	Fish Appearance	Plastic Particle	Plastic Description
2			small clear and sinks
3			small, blue and sinks
6			blue and sinks
9			long, clear and 2 small blue ones

Plastic particles discovered in the fish digestive tract were different in color, shape, durability characteristics and possibly of their origins (e.g. plastic pellets, monofilament of plastic rope, fishing line or Styrofoam) (Table 2). With the fact that the annual global production of plastics is increasing and the build-up of these materials in the environment may become problematic, where under influence of UV-

light and mechanical forces plastics also tend to break down into smaller particles in the size range of 1 mm or even smaller, fish might have been deceived by this small aged particles as floating food.

This is the first finding of plastic particles in fish digestive tract from South Sulawesi and was quite astonishment, particularly with respect to the size of fish and its feeding behavior as planktivorous. The

fish was ranked on second or third levels at the food chain. Having known the position of fish at the food chain and the fact that plastics are well known of having capacities such as: transport medium of toxic chemicals such as PCBs, DDE, and nonylphenols/NP (Mato *et al.*, 2001) and a wide range of heavy metals (Ashton *et al.*, 2010; Nakashima *et al.*, 2012; Holmes *et al.*, 2014), plastic debris obviously posed a serious threats both as hazards to the remaining higher levels at marine food chain and human health. Sad to says that there is no more seas on earth without plastic debris.

#### 4. Conclusion

Plastic particles observed in silverside digestive tract revealed that even small sized fish are already affected by wide distribution of ocean surface floating micro-plastic. Indeed, this finding has endorsed recent notion on the badly predisposed world ocean surfaces by this latest synthetics pollutant. It is therefore not to recommend of eating the fish entirely as commonly practiced by local people, since it obviously posed serious threats on human health.

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