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Induction of detoxification systems in wild red mullet *Mullus surmuletus* after Microplastic ingestion

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INTRODUCTION

Marine litter greatly affects marine species and ecosystems[1]. Recent research has suggested microplastics (MPs) can induce carcinogenesis, endocrine disruption, physical harm (including internal abrasion and blockage) and toxicity[2]. Histopathological alterations have been already demonstrated in fishes *in vivo*[3].

Objective: The aim was to investigate the effects on the enzymatic response in the liver of *Mullus surmuletus* due to the ingestion of MPs.

METHODS

Wild red mullets (n=428) were obtained from both artisanal trammel nets fishery and trawl fisheries in waters of Mallorca. Intestinal tracts were examined with a stereomicroscope (Euromex NZ 1903-S) with optical enhancement from 6.7x to 40.5x, under controlled conditions to avoid airbone contamination. A subset of liver samples from individuals of *M. surmuletus* containing MPs and without visible MPs in their intestinal tract were dissected (n=20/group). Antioxidant enzymes –catalase (CAT) and superoxide dismutase (SOD)– and the detoxification enzyme glutathione-S-transferase (GST) activities and malondialdehyde (MDA) levels were determined.

RESULTS

118 individuals (27.3%) were reported to have ingested MPs. Mean number of MPs in the affected group was 4.08 ± 0.58 MPs/individual. All biomarkers analysed have higher values in fish with ingested MPs although significant differences were only found for GST ($p < 0.05$). No significant differences between biomarkers and fish size nor fishing gear were found.

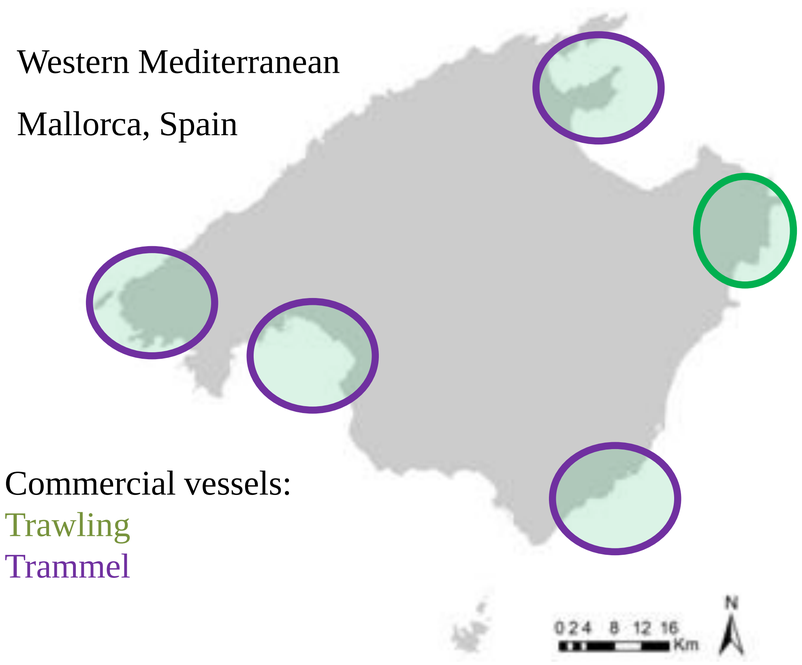

Figure 2: Sample stations in the waters of the Mediterranean sea (Mallorca, Balearic Islands, Spain) where red mullets were sampled.

	Control group	MPs group
Catalase (mKat/g protein)	25.8 ± 3.6	30.9 ± 5.3
SOD (pKat/g protein)	1.3 ± 0.3	2.3 ± 0.5
MDA (nmol/mg protein)	12.2 ± 0.8	13.2 ± 1.0

Table 1: Enzymatic activities and MDA levels in the liver of *M.* surmuletus. Data represent mean ± SEM (n=20/group). No differences were found between groups (t-student analysis). SOD: superoxide dismutase; MDA: malondialdehyde.

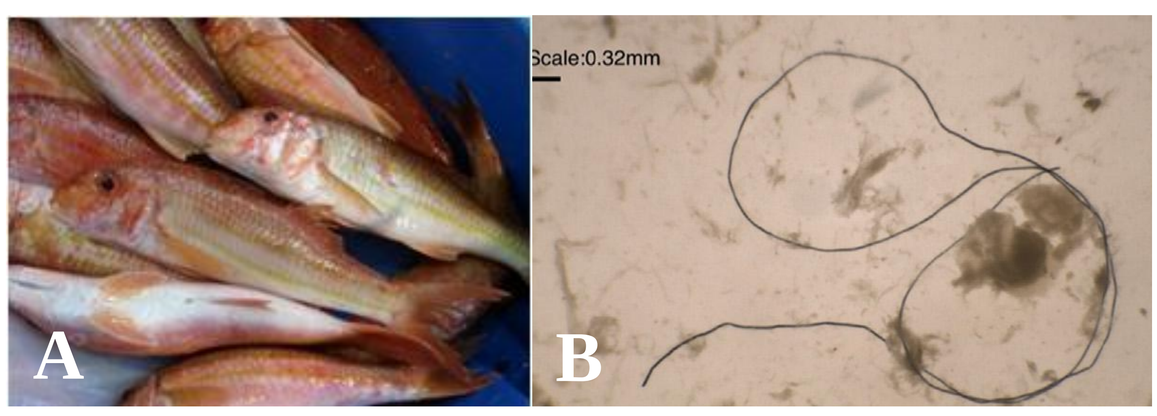

Figure 2: A total of 428 red mullets were studied, from which 27.3% had ingested microplastics (MPs). Most of the MPs found in *M. surmuletus* (A) were filaments (B) (4.08± 0.58 MPs/fish).

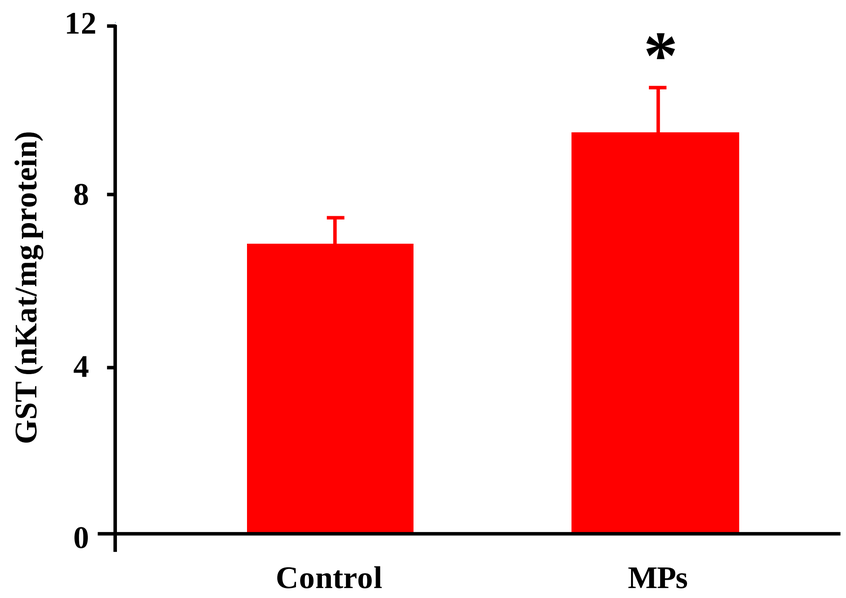

Figure 3: GST activity in the liver of *M. surmuletus*. Bars represent mean ± SEM (n=20group). * $p<0.05$ when compared with the control group (t-student analysis). MPs: microplastics; GST: glutathione-S-transferase.

In **conclusion**, MPs in the intestinal tract of *M. surmuletus* increased the GST activity suggesting an induction of the detoxification systems, but without evidence of oxidative stress or cellular damage in the liver. Absence of cellular damage or evidence of oxidative stress could be either indicative of no apparent effect of MPs in fish's liver or a short time exposure of red mullets to MPs which enables symptoms to show up and be diagnosed. Results reflect the dissimilarities and difficulties of studying MPs effects in wild populations compared to experimental investigations where the real exposure time to a defined pollutant and exact concentrations supplied are known.

References

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