

Cocaine damages the muscle of the eels

The increasing use of illicit drugs by humans resulted in a gradual contamination of surface waters, since these substances, excreted with the urines, are not always efficiently removed from sewage effluents in sewage treatment plants. Today, the presence of illicit drugs as cocaine has been observed worldwide in many rivers and seawaters; since these substances have a strong pharmacologic activity, their presence raises concern for the health of the aquatic organisms living in these waters.

Therefore, we started a study aimed to evaluate the effects on fish of the most frequent illicit drugs found in surface waters. In our first studies we examined the effects of environmental concentrations of cocaine, one of the most widespread drugs in surface waters, on the European eel, a species under threat, whose decline was attributed to many causes, including overfishing, habitat loss, presence of parasites, climate change and water pollution. We found that when the eels were chronically exposed to an environmentally relevant concentration of cocaine, they accumulated this substance in their tissues undergoing endocrine disruption. Moreover, the exposed eels showed alterations of peripheral organs as skin and intestine.

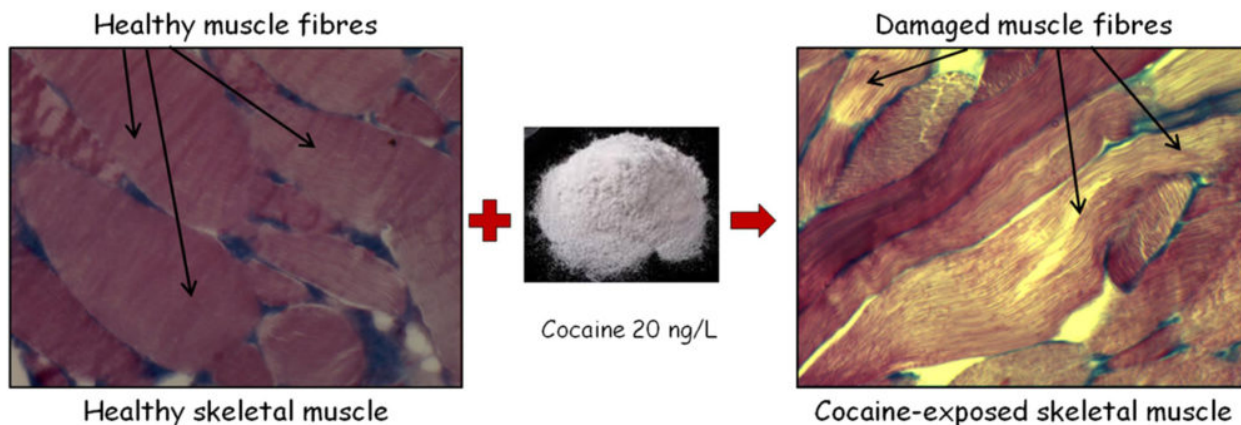


Fig. 1.

In the present study, we evaluated the effects of cocaine on the skeletal muscle. Indeed, 1) the eel skeletal muscle accumulates cocaine after chronic exposure 2) during their life cycle, eels undergo a reproductive migration across 6000 km of open sea to the Sargasso sea; therefore, damages to the skeletal muscle could compromise the eel reproductive fitness 3) since the European eel is an edible species, and the skeletal muscle is the edible part of the eel, the study of the changes induced by cocaine is informative from a human health point of view. The eels were exposed for 50 days to an environmental cocaine concentration (20 ng/L); at the end of the exposure period, some

of the exposed eels were deprived of cocaine and exposed only to tap water for 3 and 10 days, respectively, to evaluate the ability of the eels to recover from the changes induced by cocaine.

In the skeletal tissue, the following parameters were evaluated: the general morphology of the tissue; the expression levels of the main muscle proteins; the oxidative metabolism, indicative of the energy requirements of the organism; the presence of apoptosis, a process of programmed cell death responsible for the ordered removal of superfluous, aged, or damaged cells; the serum levels of the enzymes creatine kinase, lactate dehydrogenase and aspartate aminotransferase, well established biomarkers of skeletal muscle damage.

The skeletal muscle of cocaine-exposed eels showed signs of injury as muscle breakdown and swelling, similar to those typical of rhabdomyolysis, a syndrome characterized by the breakdown of muscle fibres and induced in humans by a number of causes including illicit drugs as cocaine. Moreover, an increase in the mean diameter of the muscle fibres was observed, indicative of muscle damage. In addition, cocaine induced in the skeletal muscle 1) an increase of the oxidative metabolism, mainly after the interruption of cocaine exposure, that could be related to an increased energy requirement for the detoxification process 2) the stimulation of the apoptosis, indicative of muscle damage 3) an increase in the level of the serum enzymes, correlated with the muscle breakdown and indicative of muscle damage. These damages were still present 10 days after the interruption of cocaine exposure. In contrast, the expression of the main muscle protein was unchanged after cocaine exposure.

The results of this study demonstrate that even low environmental cocaine concentrations damage the eel muscle, suggesting possible adverse effects on the survival of this species.

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Publication

[Effects of environmental cocaine concentrations on the skeletal muscle of the European eel \(*Anguilla anguilla*\).](#)

Capaldo A, Gay F, Lepretti M, Paoletta G, Martucciello S, Lionetti L, Caputo I, Laforgia V
Sci Total Environ. 2018 Nov 1