



Short Communication

Protective effect of vitamin C in female Swiss mice dermally-exposed to the tannery effluent



Letícia Martins Rabelo ^a, Fernanda Neves Estrela ^a, Bianca Costa e Silva ^a,
Bruna de Oliveira Mendes ^a, Boniek Gontijo Vaz ^b, Aline Sueli de Lima Rodrigues ^c,
Guilherme Malafaia ^{a, c, d, *}

^a Laboratório de Pesquisas Biológicas, Instituto Federal Goiano – Campus Urutaí, GO, Brazil

^b Programa de Pós-Graduação em Química, Universidade Federal de Goiás – Campus Samambaia, Goiânia, GO, Brazil

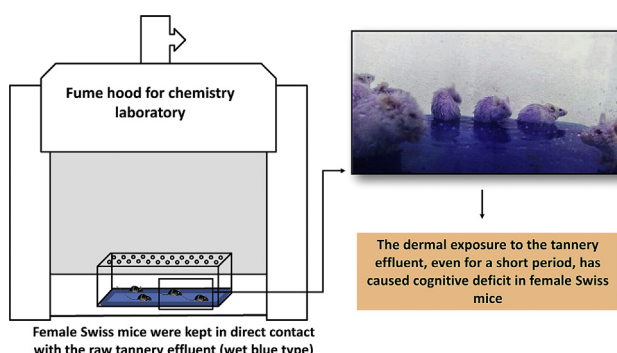
^c Departamento de Ciências Biológicas, Programa de Pós-Graduação em Conservação de Recursos Naturais do Cerrado, Instituto Federal Goiano – Campus Urutaí, GO, Brazil

^d Programa de Pós-Graduação em Biodiversidade Animal, Universidade Federal de Goiás – Campus Samambaia, Goiânia, GO, Brazil

HIGHLIGHTS

- Dermal exposure of Swiss female mice to tannery effluent cause cognitive impairment.
- Exposure to tannery effluent reduces object recognition memory in mice.
- Aversive memory was affected by tannery effluent.
- Exposure to tannery effluent may be causing oxidative stress.

GRAPHICAL ABSTRACT



ARTICLE INFO

Article history:

Received 31 January 2017

Received in revised form

28 March 2017

Accepted 25 April 2017

Available online 29 April 2017

Handling Editor: A. Gies

Keywords:

Agro-industrial waste

Tanneries

Rodents

Mammals

Dermal exposure

ABSTRACT

Previous studies involving the oral exposure of mice to tannery effluents have found neurotoxic effects. However, studies about the effects the dermal exposure to pollutant have on the cognitive function of females have not been found in the literature. Thus, the aim of the current study is to investigate whether the dermal exposure of female Swiss mice to tannery effluents (2 h/day for 20 days) can cause cognitive impairment, as it was already evidenced in male Swiss mice. Furthermore, based on the administration of vitamin C (before or after the exposure to the xenobiotic), the current study also aims to assess the protective effect of vitamin C in female Swiss mice dermally-exposed to the tannery effluent. Female Swiss mice exposed to the tannery effluent (without vitamin supplementation) have shown lower novel object recognition index during the test session of the novel object recognition task, and they have descended significantly faster from the inhibitory avoidance platform when they were compared to mice belonging to the other groups, therefore evidencing memory deficit. However, the test performance of females receiving vitamin C was similar to that of control animals. Thus, the current study confirms the initial hypothesis that the dermal exposure to the pollutant, even for a short period, causes cognitive deficit in female Swiss mice. The herein presented findings also provide evidence that the mechanisms of

* Corresponding author. Laboratório de Pesquisas Biológicas, Instituto Federal Goiano – Campus Urutaí, Rodovia Geraldo Silva Nascimento, 2,5 km, Zona Rural, Urutaí, GO, CEP: 75790-000, Brazil.

E-mail address: guilhermeifgoiano@gmail.com (G. Malafaia).

action of the tannery effluent in these animals are related to oxidative damages in specific brain regions directed to the formation of short memory to perform aversive and object recognition tasks.

© 2017 Elsevier Ltd. All rights reserved.

1. Introduction

Among the various types of waste generated we can include those produced by profitable industrial activities, such as processing of bovine hide. Even after the treatment in a particular installation, it was observed that tannery residues, including effluents, exhibit considerable organic and inorganic fillers, such as acids, phenols, sulfates and sulfides, as well as highly toxic metals, which are used during the tanning process (Lofrano et al., 2013). Thus, tanning effluent can be highly toxic to organisms that are in contact with the pollutant (directly or indirectly). Despite the awareness that the waste produced in tanning industries is one of the most polluting to the environment and organisms (Song et al., 2000; Bosnic et al., 2000), the investigations related to the possible effects of the exposure to these pollutant are incipient. Only recently, studies have demonstrated the harmful effects caused by the oral or dermal exposure of experimental mammalian models to tannery effluents (Souza et al., 2016a).

By using mouse models, these studies have found different effects, converging to the finding of the neurotoxic potential of tannery effluents based on the observation of predictive anxiety behaviors (Siqueira et al., 2011; Silva et al., 2016; Guimarães et al., 2016a), anxiolytic behaviors (Almeida et al., 2016), depression predictors (Souza et al., 2016b), antidepressants (Mendes et al., 2016), memory deficit (Rabelo et al., 2016; Silva et al., 2016), as well as on the observation of neurobehavioral effects detrimental to the offspring of parents exposed to the xenobiotic (Guimarães et al., 2016b,c). According to Souza et al. (2016a), variables such as sex, age, effluent types (derived from different bovine leather processing stages), rodent species and lines, effluent concentration and exposure route are important factors contributing to the diversity of results.

When it comes to the impacts of mice exposure to tannery effluents on cognitive functions required in the novel object recognition task (NORT), it is worth highlighting the studies by Silva et al. (2016), Rabelo et al. (2016) and Guimarães et al. (2016a). Silva et al. (2016) have found that male C57Bl/6J and Swiss mice dermally exposed to tannery effluents, although for a short period – (2 h/day, during 15 days), presented memory deficit. Rabelo et al. (2016) have found that the oral exposure to 1% tannery effluent diluted in water, also for 15 days, was sufficient to cause similar memory deficit in male and female Swiss mice during NORT. Guimarães et al. (2016a) were pioneers in demonstrating that the offspring of C57Bl/6J mice born from parents exposed to tannery effluents (7.5% and 15%) presented memory deficit shortly after weaning. It is worth highlighting the study by Guimarães et al. (2016a), who assessed the effects of the exposure to tannery effluents, mainly on female C57Bl/6J mice, and found different neurobehavioral changes, such as short- and long-term memory deficit, measured 1 h and 24 h after the NORT training session.

One limitation in these studies lies on the fact that the mechanisms responsible for the effects observed in mice exposed to the pollutant have not been investigated so far, therefore, they are still unknown. Only Moysés et al. (2014) have analyzed the impacts of the exposure to tannery effluents on the behaviors of an experimental mammalian model, as well as analyzed the possible mechanisms related to the observed effects. However, the oral

exposure of male Wistar rats to water contaminated with different xenobiotic concentrations (0.1, 1 and 5%) did not cause any behavioral changes related to anxiety, depression or memory deficit. Furthermore, no changes were observed in the neurochemical parameters (lipid peroxidation and superoxide dismutase activity) assessed in the encephalic structures of rats.

The absence of changes in the parameters assessed by Moysés et al. (2014) may be related to the physiological features of the experimental model they used (Wistar rats), as well as to the period of exposure. Furthermore, it is important highlighting that the metabolism of drugs or xenobiotics varies from species to species due to physiological differences. It may result in variations in the final forms of metabolic products, as well as in higher toxicity in some species than in others (Mitchell et al., 1976; Nogueira et al., 2003; Meotti et al., 2003). Therefore, it is questioned whether there is any relation between the behavioral effects observed in mice exposed to tannery effluents and the possible imbalance between the cellular production of reactive oxygen species and the counteracting antioxidant mechanisms (oxidative stress).

It is known that, the antioxidants can decrease the oxidative damage directly *via* reacting with free radicals or indirectly by inhibiting the activity or expression of free radical generating enzymes or enhancing the activity or expression of intracellular antioxidant enzymes (Lü et al., 2010). Thus, since the ascorbic acid (vitamin C) is a potential antioxidant (Duarte and Lunec, 2005), the aim of the present study was to investigate whether the dermal exposure of female Swiss mice to tannery effluents can cause cognitive impairment, as it was already evidenced in male Swiss mice (Silva et al., 2016). Furthermore, based on the administration of vitamin C (before or after the exposure to the pollutant), the current study also aimed to assess the protective effect of vitamin C in female Swiss mice dermally-exposed. The initial hypothesis was that the exposure to pollutant could cause cognitive deficits in female Swiss mice, with possible protective effect of vitamin C.

2. Materials and methods

2.1. Animals and experimental design

Sixty (60) nulliparous adult female Swiss mice (2–3 months old) were stored in the bioterium of the Biological Research Laboratory at Instituto Federal Goiano – Campus Urutaí (Urutaí, Goiás State, Brazil). The mice were stored in polypropylene boxes (30.3 × 19.3 × 12.6 cm, at most five animals per box). All the animals were kept under 12/12 h light/dark cycle, on a ventilated shelf, and under controlled temperature and humidity conditions (22–25 °C and 55–60% humidity).

The animals were counter-balanced according to the co-variables “age” and “body mass” so that the mean age and mean body mass of the experimental groups were statistically constant. Subsequently, the mice were distributed in the following experimental groups (n = 12 per group): i) control group, composed of mice that were not exposed to the tannery effluent and did not receive ascorbic acid; ii) control + vit. C group, composed of mice that were not exposed to the tannery effluent, but received vitamin supplement (ascorbic acid - vit. C - 200 mg kg⁻¹, according to Bisong et al. (2016)); iii) effluent group, composed of animals that

Download English Version:

<https://daneshyari.com/en/article/5747146>

Download Persian Version:

<https://daneshyari.com/article/5747146>

[Daneshyari.com](https://daneshyari.com)