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Encouragement of Studies on Reproductive Toxicology in Exposed Animals to Tannery Effluent

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Abstract

Tannery effluents constitute highly polluting residues, which can cause negative impacts to people's health and the environment. However, studies that have investigated the effects of the exposure to these xenobiotics on the reproductive aspects of mammal experimental models are rare. This mini-review draws attention to the lack of studies involving this issue, encouraging the development of new research. Studies related to this aspect are important in view of its implications for the generation of scientific knowledge related to health, considering the hypothesis that exposure to tannery effluent can lead to increased sensitivity to pathological events.

Keywords Xenobiotic; Experimental models; Mammals; Tannery effluent; Reproductive toxicology

Introduction and Contextualization

The generation of specific residues containing inorganic and organic compounds, which come from the most different anthropogenic activities, can cause impacts both on the environment and people's health [1,2]. According to Misra et al. [3], industry has become an essential part of modern society, and waste production is an inevitable outcome of the developmental activities. A material becomes waste when it is discarded without expecting to be compensated for its inherent value. These wastes may pose a potential hazard to the human health or the environment (soil, air, water) when improperly treated, stored, transported or disposed of or managed.

One of the sectors that cause the most harmful pollution to the environment is the one linked to tannery industries. The cowhide industry covers diverse products and industrial processes. Cowhide tanning covers the treatment of raw materials, i.e., the conversion of raw hide or skin into cowhide and finishing it so that it can be used in the manufacture of a

wide range of consumer products. The footwear, garment, furniture, automotive and cowhide goods industries are the most important outlets for tanners' production [4].

According to Freitas et al. [5], many cowhide processing units focus specially on the activity named wet blue, in which chromium is the main chemical component used. Wet blue is one of the basic processes of the tanning action and helps the conservation of cowhide for long periods for further treatment. Cowhide can even be transported to other countries in order to receive a final treatment, for example, coloring.

The problems linked to the generation of large amounts of this effluents are intensified by the fact that in many tannery industries there is disposal of waste directly into water bodies without any treatment, which implies a high risk of environmental contamination [4,6,7]. 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 elements such as chromium, which is used during the tanning process [8,9].

In the experimental field involving ecotoxicology related to tannery effluents, it has already been demonstrated teratogenicity in species of sea urchin, reducing the growth of microalgae and a variety of toxic effects on microcrustaceans [10]. Other studies involving exposure of fish, plants and bacteria to tannery effluents have also shown harmful effects [11-15].

However, it is important to consider that these organisms are suitable for determining, e.g., the lethality, but does not allow evaluation of signs and symptoms observed in mammals to be accomplished, opening a gap in the knowledge that deserves investigation. Regarding the effects of the exposure to tannery effluents on mammals and the possible impacts on the healthy organisms, research is scarce.

The studies of Siqueira et al. [16], Moysés et al. [17], Almeida et al. [18], Rabelo et al. [19] and Silva et al. [20], are highlighted, in which the exposure occurred by ingestion of

water containing tannery effluents in concentrations that varied from study to study. Siqueira et al. [16] showed that male Swiss mice exposed to ingestion of 1% untreated tannery effluent diluted in water for only 15 days presented anxiogenic behavior. On the other hand, Moysés et al. [17], studying neurotoxicity and hepatotoxicity induced by the chronic exposure of male Wistar rats to tannery effluents, have observed no changes in the assessed variables. Almeida et al. [18] concluded that the exposure of female Swiss mice to tannery effluents (5% and 10% diluted with water) causes behavioral changes, possibly related to the neurotoxicity of this waste, without causing physical changes in the animals. On the other hand, Rabelo et al. [19] showed that the exposure to tannery effluent caused memory deficit in Swiss mice in a similar way for both sexes, reinforcing previous findings that these pollutants affect the central nervous system and attests the hypothesis that dermal exposure to tannery effluents containing neurotoxic substances causes behavioral disorders in C57Bl/6J and Swiss mice. Thus, these studies are important, because they contribute to expand the knowledge on the effects of the exposition to tannery effluents.

Therefore, as can be seen, there is a lack of studies that evaluated the effects of exposure of xenobiotics on reproductive aspects and considering playing an intrinsic factor for the survival of the species, it is very important to know the effects caused by contaminants on reproduction of experimental models. Until now only [21,22] studied aspects of reproduction of mammals exposed to tannery effluents. Kumar et al. [21] suggests that the effluents from leather industry have potential endocrine disrupting chemicals demonstrating androgenic activities. It is known that, the synthesis of steroid hormones is one of the crucial processes in the endocrine regulation. It consists of sensitivity regulated steps and it may be affected by different endocrine disrupting chemicals. To the best of your knowledge, Kumar et al. [19] is the first report on leather industry effluents as a source of androgenic endocrine disruptors. The content of this effluent can interfere with transcriptional activity of major steroidogenic enzymes and the downstream effects, thus amplifying its potential endocrine disrupting impact. The fact that some of its components may affect the androgen-signaling pathways in a different manner depending on the dose should reinforce the concept that environmental xenobiotics, though present at low doses may pose a threat to human health.

After Kumar et al. [21], only recently another study involving reproductive aspects and exposure to tannery effluent was published. Guimarães et al. [22] aimed to evaluate the effects of the mice parental generation exposure to tannery effluent on the anxiety and depression behaviors in its offspring, based in previous findings that demonstrate central nervous system damage in adult mice exposed to xenobiotic. For this, adult mice C57BL/6J were exposed for 60 days to the experimental treatments: tannery effluent diluted in water at concentrations of 7.5%, 15% or only drinking water (control group). Male and female mice were put for mating and the pregnant females continued exposure to effluent in the treatment groups, until

lactation period. After weaning the offspring were submitted to behavioral tests, elevated plus-maze test (predictive of anxiety) and forced swim test (predictive of depression). The authors demonstrated the tannery effluent effects the offspring, increasing their anxiety index, decreasing the time in open-arms ratio and the frequency of open-arms entries, indicating an increase in anxiety-like behavior. Regarding forced swim test, we observed increased time in immobility in the experimental groups, indicating depression-like behavior. Thus, Guimarães et al. [22] support the hypothesis that parental exposure to tannery effluents, containing neurotoxic substances, cause anxiety and depression-like behavior in the offspring.

Thus, it notes that several reproductive parameters must be better investigated in animals exposed to tannery effluent (highly toxic xenobiotic). It is important to note that different studies should consider aspects such as: gender, age, type of tannery effluent (originating from different stages of bovine leather processing), species and rodent lineage, the concentration of the effluent and route of exposure. These aspects can be important to obtain different results between studies.

Concluding Remarks

As prospects for further studies, it may be asked: how would the sexual behavior of male mice exposed to tannery effluent? Exposure to tannery effluent would be able to affect the production and morphology of sperm, as well as cause pathological changes in reproductive organs of these animals? Exposure to these effluents cause reproductive toxicity in animals, resulting in reproductive losses when placed in mating with females? With regard to females, nothing is known about the effects that exposure to these xenobiotics can cause the estrous cycle of small mammals (mice). Also we do not know if female reproductive organs are affected by different substances that make up these waste. Do these effluents can cause changes that lead to reproductive failure in female mice?

Thus, it is essential that more studies on reproductive toxicology induced by exposure to tannery effluent are encouraged. In many regions, the questioning of the incorrect disposal of tannery effluent is a serious problem and can cause harmful effects to the health of populations. Studies related to this aspect are important in view of its implications for the generation of scientific knowledge related to health, considering the hypothesis that exposure to tannery effluent can lead to increased sensitivity to pathological events.

Conflicts of Interest

None

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