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Ecological risk assessment for small omnivorous mammals exposed to polycyclic aromatic hydrocarbons: A case study in northeastern Mexico

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HIGHLIGHTS

- An ecological risk assessment was performed using the hazard quotient (HQ) method.
- HQs were obtained for omnivorous mammals exposed to polycyclic aromatic hydrocarbons.
- Risks for the oral exposure route were less than benchmarks in all cases (HQ < 1).
- More research must be done in Mexico aimed primarily at obtaining TRVs for mammals

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ABSTRACT

An ecological risk assessment (ERA) was performed using the hazard quotient (HQ) method to evaluate the risks of oral exposure to polycyclic aromatic hydrocarbons (PAHs) for medium sized omnivorous mammals. This is the first in a series of three papers. In Mexico there is little experience in performing this kind of assessment for the terrestrial compartment, in particular for birds and mammals exposed to hydrocarbons. The purpose of this paper is to perform an ERA and to establish if the omnivorous mammalian species living in the area are at risk of adverse effects. The studied site is a land that in past years had been used for the disposition of petroleum tank bottom sludges, and scrap metals. Soil and water samples were collected and analyzed, and we obtained a list of the site's wildlife species as well as samples of the specimens, which were analyzed also. HQs were calculated for the hydrocarbons identified as chemicals of potential ecological concern (COPECs) and the omnivorous mammals of the site were evaluated. Toxicity reference values (TRVs) were taken from the appropriate literature, and the doses of exposure were estimated considering the ingestion of water, soil, and diet. Results indicated that potential risks associated to the oral exposure route were less than benchmarks for effects (in all cases HQ < 1). The methodology is adequate in terms of the parameters considered in the calculations, but it was concluded that in order to reduce uncertainty, more research is required in Mexico. This should be primarily aimed at obtaining TRVs for mammals, and consider test species with body weights more similar to those found in the local fauna.

1. Introduction

The application of quantitative ecological risk assessment methodologies, e.g., the hazard quotient (HQ) method, for terrestrial wildlife in Mexico has a short history. Ecotoxicological studies have primarily focused on the effect of metals, pesticides and, to a lesser extent, hydrocarbons in the aquatic environment; cladocerans, algae, and oysters are the most popular organisms studied (Bernal-Hernandez et al., 2010; Carvalho et al., 2009). Ecotoxicological studies focused on soil microorganisms and macrofauna, mainly earthworms, have been performed with certain regularity (Espinosa-Reyes et al., 2010; Hernández-Hernández et al., 2007).

Most investigations address the issue of the health of organisms by measuring both effects and exposure biomarkers, or concentrations of contaminants in the tissues, but they do not indicate if the concentrations in the natural media pose a risk to organisms of upper trophic levels and the magnitude of the risk. Organisms in the upper trophic levels, e.g., herbivorous, carnivorous, or omnivorous vertebrates, are rarely chosen as ecological receptors for assessment and, as a consequence, terrestrial risk assessments are almost non-existent in Mexico. Some studies have focused on the study of biomarkers in rodents, reptiles, and birds (Ilizaliturri-Hernández et al., 2008; Tovar-Sánchez et al., 2012) or on measuring residual concentrations of contaminants in tissues, mainly organochlorine substances (Pardío et al., 2012;

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