学位論文内容の要旨
Abstract of the dissertation

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学位論文題名
The title of the doctoral dissertation

Assessment of lead pollution in dogs around mining area and verification of effects of soil amendments on tissue lead concentrations and toxicity in mouse model
（鉱山地域のイヌにおける鉛汚染の評価と土壌改良が及ぼすマウスの
組織中鉛濃度および毒性影響への効果検証）

Lead (Pb) contamination poses significant risks to health, especially near mines. Pb bioavailability varies with its chemical form, and soil amendments can reduce Pb mobility. However, there is a gap to examine these amendments' effects on mammals through environmental realistic exposure. This dissertation addresses this gap by investigating heavy metal accumulation in dogs from Kawbe, Zambia, evaluating chicken manure's efficacy against Pb toxicity in mice, and assessing the impact of phosphate and lime amendments on Pb-spiked soils and its efficacy on tissue accumulation in mice.

Brain, spleen, heart, stomach, stomach content, small intestine, kidney, liver, and bone samples were collected from 29 stray dogs (14 from locations within 3 km of the mine and 15 from sites 7 km distant from the mine) to investigate the current accumulation of heavy metals in dogs' tissues around the Pb-Zn mine in Kawbe, Zambia. The lungs, kidney, and bone were found to have the highest concentrations of As, Cd, and Pb, respectively. In contrast, higher Cu and Zn concentrations were measured in the liver than in other tissues. Dogs near the mine had significantly higher mean concentrations of Cd and Pb than dogs far away. Neither sex nor age-related differences were observed in the metal distribution in most tissues.

To evaluate the in vivo efficacy of chicken manure amendment on Pb toxicity using mice, six

C57BL/6J mice per group were raised for 30 and 98 days on Pb-spiked soil (3000 mg/kg) with chicken manure applied as an immobilizer. Chicken manure significantly reduced Pb concentrations in the brain, kidneys, and lungs at day 30 with similar reductions in the brain, kidneys, liver, and bone, except for the lungs and trachea, at day 98. There was a significant difference in Nrf2, HMOX1, SOD1, CAT, BCL2, and Bax mRNA expression in the brain between Pb exposed and remediated groups after 98 days.

Mice were exposed with soils spiked with one of three Pb species (3000 mg/kg) [$2PbCO_3 \cdot Pb(OH)_2$, $PbSO_4$, and PbS] and Pb-spiked soils amended with phosphate (5% of TSP or PA) and liming (5% of CD) amendments via environmentally realistic exposure pathways for three months. XANES analysis revealed that Pb carbonates were the dominant phase in all Pb-spiked soils. Mice exposed to $2PbCO_3 \cdot Pb(OH)_2$ had the greatest Pb accumulation in the brain, trachea, kidneys, liver, bone, and blood, but not in the lungs, whereas the PbS-exposed mice accumulated more Pb than the others in the lungs. TSP was the most effective immobilizer, reducing Pb accumulation in the $2PbCO_3 \cdot Pb(OH)_2$, $PbSO_4$, and PbS exposure groups was 68–88%, 44–62%, and 6–49%, respectively.

Taken together, these findings highlight the ongoing environmental pollution in Kabwe and emphasizes the need for remediation efforts. Specifically, the use of chicken manure was proposed to mitigate Pb mobility accompanied by activation of antioxidant genes in the brain of mouse model. $2PbCO_3 \cdot Pb(OH)_2$ causes more burden in the mammalian body than other Pb species. Moreover, the study evaluated different soil amendments' efficacy in stabilizing Pb, with TSP identified as the most effective chemical stabilizer.