

Quantification of some heavy metal levels in commercial rice from Ebonyi state, Nigeria.

(ナイジェリア、エボニ州での流通米中の重金属元素濃度の数量化)

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Following the discovery of ore minerals in Ebonyi state in the southeast Nigeria, artisan mining activities have become a significant occupation in the region and a source of economic sustenance next to agriculture for the inhabitants. The region is popularly remarked for domestic rice production and artisanal mining of lead and zinc, which is likely to contaminate rice cultivated in the area. The concentration of heavy metals in the rice marketed in and around Ebonyi state was determined using inductively coupled plasma mass spectrometry (ICP-MS) and standard environmental certified reference materials of the national metrology institute of Japan (NMIJ CRM-7501-a, 7502-a), for food analysis to control the precision of the analytical procedure.

A total of 116 rice samples, consisting of 32 imported rice brand and 84 domestic rice samples collected from both market and rice fields were evaluated for heavy metals Cu, Zn, As, Cd and Pb. The highest concentration of Pb and As was found in domestic rice samples at 1.65 ppm and 0.71 ppm, respectively, above 0.2 ppm, a recommended permissible limit of the FAO/WHO for both heavy metals. The load of heavy metals detected in all the samples show that imported rice samples were within, and slightly above a safer limit, while most of the domestic rice samples were above the recommended permissible limits. T-test analysis between rice samples collected from mining areas and non-mining areas shows significant difference ($p < 0.05$) for Cu, Cd and Pb levels in both categories of samples, while no significant difference was observed for Zn and As, the *t*-test value indicated that mining had influence in bioavailability of Cu, Cd and Pb in the study area.

This study found that the domestic rice samples from the area were contaminated by Pb, with strong positive correlation of Pb and Cd observed in two areas (Enyigba: $r = 0.99$; Abakaliki: $r = 0.93$), elevated levels of both metals was noticed in rice samples cultivated closer to Pb/Zn mine as compared to samples from non-mining areas, the highest As concentration was observed in a sample collected from a non-mining area. This shows that Pb/Zn mining and use of agrochemical may be significant sources of the heavy metal burden, the daily intake of Pb at 2.8 mg/day/kg bw from Enyigba area was beyond 1.5 mg/day/kg bw, a recommended limit of the FAO/WHO, precautionary measures and impact mitigation monitoring in the area is necessary for the health and economic sustainability.