Arsenic Bioaccumulation in Rice and Vegetables and subsequent transmission in food chain

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Arsenic is a metalloid of great environmental concern because of its highly toxic nature and wide abundance. Arsenic contamination in groundwater has been reported in Bangladesh, India, China, Taiwan, Vietnam, USA, Argentina, Chile and Mexico. The use of arsenic contaminated groundwater for irrigation purpose in crop fields elevates arsenic concentration in surface soil and in the plants grown in arsenic contaminated areas. The arsenic concentrations in the edible parts of a plant depend on the availability of the soil arsenic and the accumulation and translocation ability of a plant. High amount of arsenic can be accumulated in edible vegetables including arum, *Colocasia antiquorum* and *Ipomea sp.* Other plants like maize, barley and ryegrass, *Spertina alterniflora* can also accumulate arsenic efficiently into plant bodies. Accumulation of arsenic was found in various food composites (potato skin, leaves of vegetables, rice, wheat, cumin, turmeric powder, and cereals) in different locations of Bengal Delta, which is the most acutely arsenic affected geological province in the world. In many arsenic-affected countries, including Bangladesh and India, rice is reported to be one of the major sources of arsenic contamination. Rice is much more efficient at accumulating arsenic into the grains than other staple cereal crops. Rice is generally grown in submerged flooded condition, where arsenic bioavailability is high in soil. As arsenic species are phytotoxic, they can also affect the overall production of rice, and can reduce the economic growth of a country. Arsenic accumulation in soil irrigated by arsenic contaminated water and its transfer into rice may vary depending on the soil types, cropping pattern, arsenic concentration in irrigation water, distance from the water source, depth of water source and duration of the monsoon flood. It has been reported that the concentration of arsenic in cooked rice was higher than that of raw rice. The concentration of arsenic in rice is increased when it was cooked with arsenic contaminated groundwater and the gruel was not discarded after cooking. The arsenic was absorbed in the cooked rice from water, thus increased the concentration. Arsenic concentration in *boro* rice is much higher than in *aman* variety, because much higher amount of water is needed for *boro* cultivation compared to *aman* cultivation. Rice straw is often used as a cattle feed in South Asia. This represents another entry route of arsenic into the food chain, as rice straw typically contains much higher amount of arsenic than grains. Cattle population also used to drink water contaminated with arsenic in those areas, which, in turn, can further increase the toxicity level. Cattle manure is often used as fuel in household purposes, which can also increase the contamination risk. Besides, the dry straw often been used by people as fuel, which can release arsenic in air as oxides, and can cause pollution and health hazards. Large-scale use of rainwater in irrigation systems, bioremediation by arsenic-resistant organisms and hyper accumulating plants, and the aerobic cultivation of rice are some possible ways to reduce the extent of arsenic bioaccumulation in rice and other edible plants. Intensive investigation on a complete food chain is urgently needed in the arsenic contaminated zones, which should be our priority in future researches.

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