

Dimethylmonothioarsenate (DMMTA) in rice grains: Why should we care?

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Rice is typically grown under flooded conditions which mobilizes naturally occurring arsenic (As) from paddy soils. Besides the well-known oxyAs species (arsenate, arsenite, monomethylarsenate (MMA) and dimethylarsenate (DMA)), methylated and inorganic thioarsenates have recently been found in paddy soil pore waters. Amongst methylated thioarsenates, dimethylmonothioarsenate (DMMTA) is of particular relevance because its cytotoxicity exceeds that of arsenite, currently considered the most harmful As species for human health in terms of dietary exposure. DMMTA typically escapes detection in grains because routine acid-based extractions convert it into DMA (not regulated in food guidelines). However, recent studies using enzymatic extractions have shown the widespread occurrence of DMMTA in commercial and field rice grain samples.

Despite DMMTA's ubiquitous detection in grains and potential risk for human consumption, little is known about its uptake and metabolism in rice plants. We, therefore, exposed and tracked DMMTA in seedlings and mature rice plants. Species-selective extraction of rice roots and shoots showed that DMMTA is partially preserved but also transformed to DMA. Despite partial transformation to DMA, uptake and toxicity were much higher when plants were exposed to DMMTA than to DMA. Moreover, we confirmed that mature rice plants readily accumulated DMMTA in their grains, where DMMTA contents correlated to DMA contents. Better understanding DMMTA behavior in rice plants is mandatory for selecting agricultural management practices that can mitigate its accumulation in grains.