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Effect of Cd pollution on Se-biofortified wheat: competing interactions and influence on the selenium species stored in the grains

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Selenium (Se) plays a vital role in regulating the metabolic activities in humans as it is needed for the thyroid gland functioning, effective immune response, fertility, and detoxification of free radicals.[1] Unfortunately, the Se content in foods depends on the Se present in the cultivation soil which can be very low in certain regions to satisfy the dietary requirements. Indeed, around a billion people worldwide are affected by Se-deficiency with the consequent health issues.[2]
Biofortification of crops with Se is an effective way to incorporate this essential nutrient into the human food chain to overcome Se-deficient diets.[3] Plants can transform inorganic Se species present in soil into organic ones (e.g., seleno-amino acids) which are more bioavailable for humans.[4] However, this metabolization can be altered by the presence of pollutants hindering the benefits of the biofortification process. In that respect, cadmium (Cd) is a common pollutant that presents a global concern since it can be biomagnified in the food chain.[5]
In this study, we have assessed the influence of Cd in Se biofortified wheat plants grown hydroponically, by changing the Se(IV)/Se(VI) ratio in the nutrition solution. Our results show that the Se uptake is reduced under Cd pollution and that the Cd translocation from roots to grains increases in the presence of Se. In addition, the total grain weight is inversely proportional to the level of Cd or Se accumulated in the grains. X-ray absorption spectroscopy (XAS) at the Se K-edge allows identifying selenomethionine (SeMet) and selenocystine (SeCyst) as the predominant Se species forming in grains for the Se treated samples. In the presence of Cd, selenomethylcysteine (SeMeCys) is forming mainly at the expense of SeMet species. μXAS showed that the spatial distribution of the Se and S species is not affected by the Se treatment applied. We conclude that the effect of Cd on Se biofortification mainly affects the total Se translocation and accumulation in grains since SeMet and SeMeCys are similarly bioavailable by the human body. Considering the Se speciation and total Se accumulation reported, the 50/50 Se(IV)/Se(VI) treatment seems the most effective for wheat Se biofortification.

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