Unraveling the influence of convective drying on vegetable seeds

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High-quality seeds are the starting point for successful agricultural plant production and for most of our food, hence they have an impact on the sustainability of our food production. Vegetable production is an important industry, facilitating the trend towards more vegetarian and healthy diets. Seed breeding companies are challenged by producing high-quality seeds for farmers and keeping the quality constant to assure healthy plants and high yields. Therefore, throughout the seed production process, many dedicated treatments and drying steps are applied. While hydrating treatments are well investigated, drying treatments have not yet been intensively studied. In particular, the specific effects of drying on seed properties, storability and germination, as well as optimal drying routes are largely unknown.

This project aims therefore at quantification of the influence of convective drying on vegetable seed quality. In our experimental and modelling studies we investigated the drying kinetics as well as the evolving moisture gradients and porosity in seeds during convective drying and we hope to link those to predictions of seed quality. We focus on a single seed level of spherical shaped cabbage seeds before investigating bulk seeds in fluid bed drying.

A model based on heat and mass transfer including independently determined isotherms and diffusion coefficients was developed to predict drying kinetics for different drying conditions with varying temperature and relative humidity of the air. For validation of the model we employed a custom-built small-scale dryer in combination with in-line measurements and controlled air conditions, as well as advanced imaging techniques like MRI and XRT for in-line observation of development of moisture gradients and structure. Our results show that the model successfully predicts the drying kinetics of cabbage seeds and with MRI and XRT we could accurately map evolution changes in porosity of drying seeds. In a next step the drying behaviour will be related to seed quality constraints, i.e. germination and glassy state.

Ultimately, these models will be employed to optimise drying regarding efficiency while adhering to quality constraints. This approach can contribute to new best practices in industrial seed drying and hence provide more sustainable and long-lasting high-quality seeds.