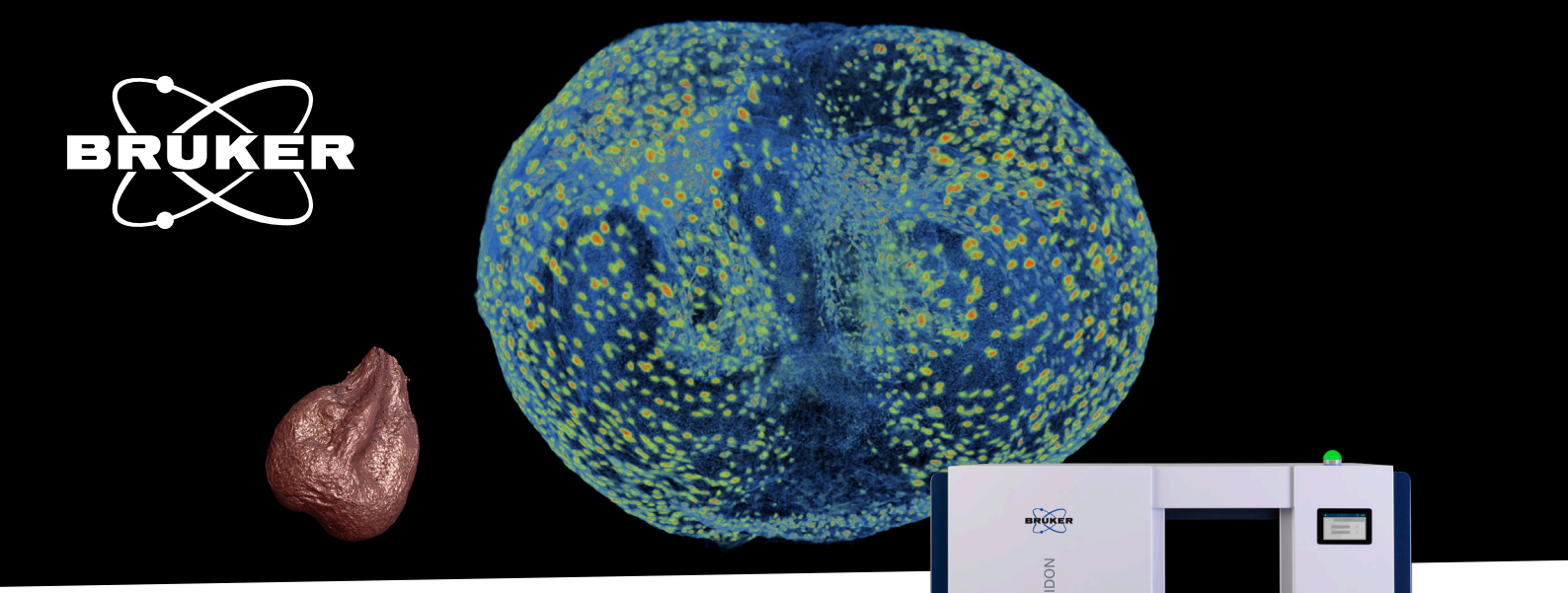

X-RAY MICROCOMPUTED TOMOGRAPHY

X4 POSEIDON – Grape seeds

Innovation with Integrity

Seeds are vital components of agricultural ecosystems and global food security, making their study crucial for enhancing crop yield, quality, and resistance to environmental stressors. MicroCT imaging has proven to be an indispensable technique for examining the internal structure of seeds, offering insights into their development, health, and viability.

MicroCT enables the visualization of the intricate internal features of seeds, such as the embryo, endosperm, and seed coat, in three dimensions. One common application is assessing seed viability by identifying abnormalities or damage within the embryo or storage tissues. For instance, microCT can detect mechanical damage, voids, or fungal infections that may compromise germination or growth.

Another critical application of microCT in seed research is analyzing the effects of breeding and genetic modification on seed morphology. By comparing the internal structures of wild-type and genetically modified seeds, researchers can evaluate the impact of specific genetic changes on seed development, nutrient storage, and resistance to stress. Additionally, microCT has been used to study seed hydration and desiccation processes, enabling a deeper understanding of how seeds adapt to environmental changes.

The technique is also instrumental in quality control for seed production and storage. MicroCT can monitor the structural integrity of seeds during storage, identifying early signs of deterioration or pest infestations.

Scan parameters

- Detector: 16 MP sCMOS
- Voxel size: 1.2 µm
- Source: Transmission type
- Source settings: 40 keV, 4 W
- Filter: No filter
- Rotation step: 0.15° over 360°

Cover Image: A grape seed imaged at 1.2 µm isotropic voxel size

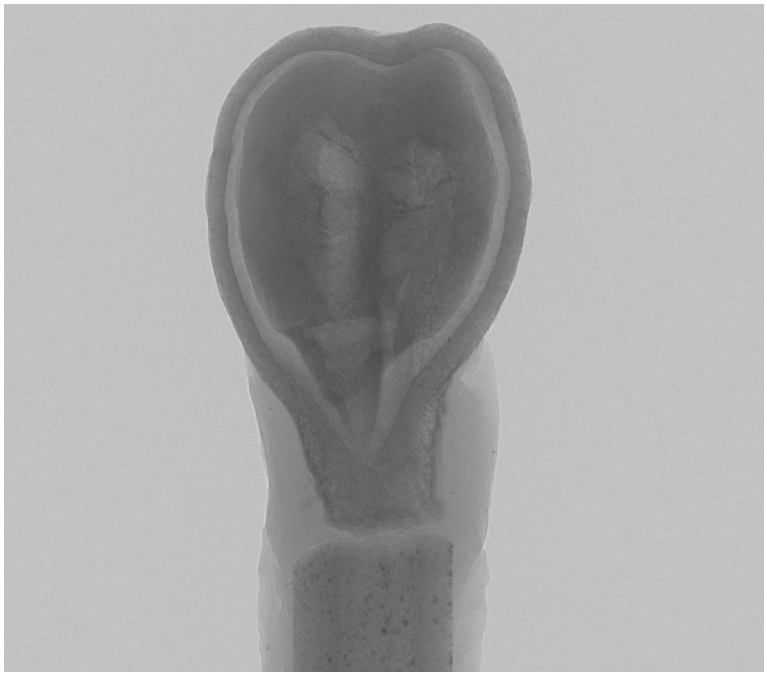

Figure 1: Projection image of a grape seed, 1.2 µm isotropic voxel size

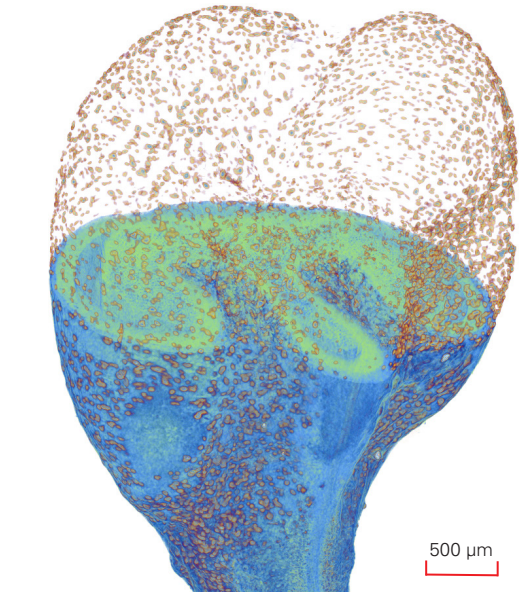

Figure 2: 3D volume rendering of a grape seed, enabling the segmentation of oil-containing cells, 1.2 µm isotropic voxel size

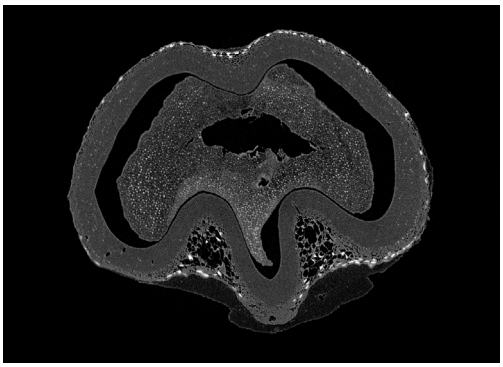

Figure 3: Cross-sectional image through a grape seed, 1.2 µm isotropic voxel size

Automated segmentation algorithms and quantifying seed components using Bruker 3DxSUITE software allows researchers to measure parameters such as seed volume, surface area, and internal density distribution.

The X4 POSEIDON microCT system, featuring the high-resolution sCMOS detector, allows for precise analysis of seed's internal structure. The combination of the transmission X-ray source with the sCMOS detector enhances microCT scanning of seeds by delivering a highly focused and intense X-ray beam, enabling exceptional resolution and contrast. The transmission source is able to maintain a small, stable focal spot allows for detailed imaging of intricate seed structures, such as the embryo and endosperm, without compromising resolution. Paired with the fast acquisition and low noise of the sCMOS detector, this setup ensures precise, high-speed 3D imaging, making it ideal for studying seed morphology, viability, and internal defects.

The Bruker 3DxSUITE software package includes all the necessary tools for image processing and analysis, allowing the creation of 3D models through volume and surface rendering algorithms (Figure 2).

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