In clinical diagnosis, X-ray computed tomography (CT) is one of the most important imaging techniques. Yet, this method lacks the ability to differentiate similarly absorbing substances like commonly used iodine contrast agent and calcium which is typically seen in calcifications, kidney stones and bones. K-edge subtraction (KES) imaging can help distinguish these materials by subtracting two CT scans recorded at different X-ray energies. So far, this method mostly relies on monochromatic X-rays produced at large synchrotron facilities. Here, we present the first proof-of-principle experiment of a filter-based KES CT method performed at a compact synchrotron X-ray source based on inverse-Compton scattering, the Munich Compact Light Source (MuCLS). It is shown that iodine contrast agent and calcium can be clearly separated to provide CT volumes only showing one of the two materials. These results demonstrate that KES CT at a compact synchrotron source can become an important tool in pre-clinical research.