**Zooming in on structural properties of mealworm protein gels with and without added CaCl2 – a study combining rheology and SAXS**

M. Klost1, S. Gleisenberg1, S. Drusch1, B. Wu2, O. Holderer, S. Förster2, T. Heiden-Hecht2

*1Technische Universität Berlin, Faculty III Process Sciences, Institute for Food Technology and Food Chemistry, Department of Food Technology and Food Material Science, Straße des 17. Juni 135, 10623 Berlin, Germany*

*2Jülich Centre for Neutron Science (JCNS) at Heinz Maier-Leibnitz Zentrum (MLZ), Forschungszentrum Jülich GmbH, Lichtenbergstraße 1, 85747 Garching, Germany*

In 2022 frozen, dried and powder forms of yellow mealworm were officially added to the list of authorised novel foods in the European Union (Implementing Regulation (EU) 2017/2470). However, corresponding research on mealworm protein and its techno-functional properties is only just emerging and does not yet provide a sufficient understanding of the structural properties of these gels on all relevant length scales.

To this purpose, our study aimed to elucidate on changes to structural properties at molecular, floc and gel length scales by combining FT-IR-, fluorescence- and UV-Vis spectroscopy with SAXS and rheological measurements. In an additional set of samples, we investigated the impact of the addition of a divalent salt (CaCl2).

From SAXS we derived the existence of multiscale structures as indicated by a lack of plateau in the low Q region. On the molecular length scale, difference spectra from FT-IR spectroscopy indicated an increase in inter- and intramolecular β-sheet structures upon addition of CaCl2. The gelation process led to a decrease in amide I and II bands for both samples indicating an overall decrease in ordered structures as well as a slight loosening of β-sheets upon heating and cooling. This corresponded to a slight red shift in fluorescence spectroscopy of diluted solutions indicative of increased exposure of tryptophane residues and was accompanied by an increase in the UV-vis absorption at 290 nm which was related to aggregation, especially if CaCl2 was added.

For the characterisation on the floc length scale, we derived fractal dimensions from the scattering exponents in the lower Q region. These indicated mass fractals in both unheated samples, with larger values implying denser flocs if CaCl2 was added. After gelation, the structure at the floc length scale in samples without CaCl2 could be described as a surface fractal with rough structure but could still be characterised as (even denser) mass fractals in the presence of CaCl2.

On the gel length scale scaling of rheological results according to Wu and Morbidelli showed contributions of both, inter- and intrafloc interactions with an increasing contribution of intrafloc interactions and higher storage modulus in samples with added CaCl2, again indicating an overall denser structure of these samples also on the gel length scale.

In summary, we were able to obtain a deeper understanding of the structural properties of heat induced mealworm protein gels on all relevant length scales and how they were affected by a change in environmental conditions. In future, this knowledge could be used towards customising gel properties for specific applications.