#153

Cruciferin subunit composition affects oil-water interface stabilization and heat-induced structure development

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Globular proteins are critical for the formation and stabilization of oil-in-water emulsions and the generation of heat-induced gels, properties necessary for structure and texture development in foods. Cruciferin is an abundant storage protein of Brassica oilseeds; it has a hexameric quaternary structure with the individual subunits being contributed by multiple genes. Arabidopsis mutant lines producing homohexameric cruciferin consisting of single subunit types (CRUA, CRUB or CRUC) were studied and compared with the wild type (WT) counterpart for oil/water interfacial properties and heat-induced structure formation. All the cruciferins, except CRUC, emulsified canola oil or triolein with a dispersed volume fraction of 22-23% at pH 7.4. CRUC formed an emulsion at pH 2.0. Emulsions stabilized with CRUB- had the smallest droplet size of 6.8 and 8.6 µm (pH 7.4) with canola oil and triolein, respectively. At pH 7.4, the presence of 0.5 M NaCl reduced the level of adsorbed protein and protein load at the interface and destabilized the emulsion. Emulsions (pH 7.4, canola oil or triolein) of CRUA and CRUB showed higher stability than that of WT upon aging up to 15 days. Thermal denaturation temperatures of homohexameric cruciferin were in the decreasing order of CRUC (114°C), CRUA (101°C), CRUB (103°C) and WT (100°C). The storage (G′) and loss (G″) moduli, as well as loss tangent (δ), showed no heat-induced gel formation for CRUC (G′=0.3 Pa). The WT cruciferin resulted in the strongest gels (G′=4195 Pa), while CRUA and CRUB gels had medium gel strength (G′=389 and 305 Pa, respectively). Microstructure imaging confirmed the absence of microstructure formation by CRUC, smooth homogenous network by WT and coarse and heterogeneous gels by CRUA and CRUB. The observed differences in techno-functional properties of cruciferin homotrimers will be presented along with the three-dimensional structure models obtained through comparative modelling.