Amyloid aggregation in self-crowded conditions

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Fundamental studies on protein aggregation are of great interest in several areas. A huge number of investigations have concerned amyloid fibrils, due to their role in relevant diseases [1]. More recently, amyloid aggregates were also exploited to develop functional hydrogels, as novel biomaterials for biomedical and biotechnological applications [2]. The role of amyloid aggregation as a way to improve food products was also considered [3]. Interestingly, the capability of forming amyloid aggregates upon denaturation, seems a rather general property of globular proteins, independently on their secondary structure [4,5]. In this context, lysozyme was deeply studied as a model protein, owing to its tendency to form amyloid fibrils in acidic conditions [4]. Very often, protein samples at relatively low concentrations were considered, while less efforts were devoted to study highly concentrated systems (protein concentrations greater than ~100 mg/ml), when excluded volume and viscosity effects could be relevant in determining unfolding and aggregation features. Nevertheless, protein assembly in self-crowded samples might represent a convenient route to form specific amyloid aggregates and hydrogel with tailored features, of possible relevance in different fields including biology, pharmaceutics, food technology and material science. In this contribution, a procedure will be presented to rapidly form lysozyme hydrogels in highly concentrated samples (~240 mg/ml). Molecular insights on the gelation process were obtained by *in situ* FTIR spectroscopy. These were then connected with the results of related approaches, which probe structural properties at mesoscopic and macroscopic length scales [4]. Our results demonstrate that transparent and thermoreversible protein hydrogel can be easily produced in self-crowded conditions. Their properties were explained considering the formation of amyloid oligomers that further interconnect through weak (reversible) interactions. This type of hydrogels, constituted by amyloid oligomers, might represent an interesting class of functional biomaterials, in analogy with the more conventional fibrillar hydrogels.

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