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Soft materials in food: Ultrasound induced modification of β-lactoglobulin into mesoscopic amyloid structures

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β-lactoglobulin, a globular protein, is a major constituent of whey obtained from milk. It has been used as one of the model proteins for the synthesis and study of amyloid structures [1]. Proteins undergo structural modifications and aggregate into amyloid configurations that are rich in β-sheet elements in the secondary structure composition. Controlled synthesis has helped in study and characterization of amyloid fibrils. There have been attempts to study these structures in context of soft materials to be used in food systems and β-lactoglobulin being a milk protein, makes ideal choice for such work [2,3]. The past few decades have experienced abundant research on the fundamental aspects of ultrasonics and have been witness to sonochemistry developing into a complete discipline. Consequently, application based research has become the current focus in the field. Ultrasound being viewed among the potential green technologies of the future, multiple fields are attempting to adopt the technology and assimilate it. Ultrasonics find widespread use across multiple industries but is of particular interest for application in the food industry [4]. The application of ultrasound produces desirable results in food modification which have been found to be superior and more efficient as compared to those achieved by other processing technologies. Acoustic cavitation, produced during sonication, is the key to such improved outcomes, as in effect, it results in enhanced mass transfer, high local shear, confined zones of extreme heat and pressure at the minuscule level. With improved efficiencies demonstrated in operation, ultrasound is used in industrial processes such as extraction, emulsification, membrane-filtration, sonocrystallisation etc [4,5]. The present study is focused on β-lactoglobulin, to establish the characteristics of mesoscopic amyloid structures formed when the protein is treated with low-frequency ultrasound (20 kHz). This work is a step forward in that direction, as it elaborates on the relatively rapid and controlled synthesis of these amyloid structures. SANS (QUOKKA) is being used to study such synthesis to document the modifications taking place during amyloid formation with an ultrasonic stimulus, and to elaborate on the chemistry of such structural modifications in proteins. The ability to rapidly synthesise these structures with ultrasound, in their given state is important as it opens gateways for practical application of these structures in food systems, corresponding to theoretical propositions offered so far.

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