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Dry-heating of egg white proteins : how a multiscale approach may help to predict foaming properties from 2D interface measurements.

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Dry heating is performed in egg product industries to pasteurise egg white powder. This treatment (55 to 80°C during a few days) is also used to improve egg white powder functional properties among other foaming properties. Several studies have shown this foaming properties' improvement with dry heating length (Kato et al, 1989; Baron et al, 2003; Van der Plancken et al, 2007; Talansier et al, 2009) that Kato et al (1989) attributed to protein surface hydrophobicity increase. However, during these treatments, soluble and insoluble covalent aggregates were also generated (Kato, 1989; Van der Plancken et al, 2007; Talansier et al, 2009) that may be involved in foaming properties improvement. Conclusions from such a complex protein solution as egg white are difficult to draw; this is the reason why we choose ovalbumin, the major egg white protein (54% of total protein amount) and lysozyme (one of the most famous model protein) to identify the molecular species generated by dry heating that are responsible for foaming properties' improvement. Ovalbumin and lysozyme foaming properties are improved after dry heating (Kato, 1990a) and the protein undergoes some mild conformational changes close to the molten globule state as well as aggregation driven by hydrophobic interactions and disulfide bonding (Kato, 1990b; Matsudomi, 2001).

The present study has been performed to identify the molecular species generated by dry heating responsible for foaming properties improvement. Most of the data of the literature were confirmed as we found that ovalbumin and lysozyme aggregated and that deamidation occurred. We also identified less negatively charged ovalbumin that we attributed to dephosphorylation. We performed surface pressure and ellipsometric angle measurement on

dry heated ovalbumin but also on dephosphorylated, desamidated and aggregated forms. Dry heated ovalbumin and lysozyme show faster adsorption kinetics to air water interface than non-heated one. However the equilibrium surface pressure and surface concentration are quite close for ovalbumin whereas no equilibrium were reached for lysozyme. Shear elastic constant measurement showed higher values for dry heated ovalbumin during the first hour but no significant difference after 8 hours. Measurements of dilatational and shear modulus were also performed to complete the data. Foaming properties of the different molecular species were measured when possible. This multidimensional approach helped in the understanding of the characteristic of the interfacial film that explain foaming properties. It seems that more than the values of surface pressure, ellipsometric angle or complex modulus at the equilibrium, it is the evolution of these values in the first few stage that is important to predict foaming properties.

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