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Specificity of β -lactoglobulin variants for spontaneous assembly with lactoferrin

G. Tavares^{a,b,c}, T. Croguennec^{a,b}, P. Hamon^{a,b}, A.F. Carvalho^c, S. Bouhallab^{*a,b}

^a INRA, UMR1253 Science et Technologie du Lait et de l'Œuf, Rennes, France

^b AGROCAMPUS OUEST, UMR1253 Science et Technologie du Lait et de l'œuf, Rennes, France

^c Laboratory of Research in Milk Products, Universidade Federal de Viçosa, Viçosa, Brazil

* said.bouhallab@rennes.inra.fr

Formation of self-assembled structures by spontaneous association of oppositely charged proteins has increasing interest for the design of reversible encapsulation devices for food, cosmetic and pharmaceutical applications. The mixing of lactoferrin (Lf), a basic protein, with β -lactoglobulin, an acidic protein, resulted in their spontaneous assembly into well-organized microspheres under specific experimental conditions. Optimal conditions were found at pH 5.5 and at a low ionic strength. Despite a perfect similarity of their tertiary structure, β -lactoglobulin A and B variants (β lg A and β lg B) exhibited specific assembly behavior with Lf.

At constant protein concentration and at a molar ratio β lg/Lf of 10, increasing the proportion of β lg A with respect to β lg B resulted in an increase of protein association. Formation of microspheres was detected only with high proportion of β lg A over β lg B. Also, the size of formed microspheres increased with increasing the proportion of β lg A. No microspheres were detected in solution with low proportion of β lg A. This is in agreement with the proportion of protein recovered in the microspheres: 60 % of the protein was recovered in the solution containing β lg A, against 30 % in solution having an equimolar mixture of both variants and only 4 % in solution containing β lg B.

The total protein concentration is a highly significant parameter for controlling the formation of microspheres. Even if β lg A was more prone than β lg B to form microspheres, mixture of β lg A and Lf did not form spheres at low total protein concentration (< 0.01 mM). In contrast, at high total protein concentration (> 0.4 mM), it was possible to form microspheres with a mixture of β lg B and Lf. This demonstrated that β lg A and β lg B have specific threshold concentration for forming microsphere with Lf.

The interaction parameters (K_a , n) between β lg A and Lf and between β lg B and Lf, as determined by Isothermal titration calorimetry (ITC) and Thermophoresis, were not found to be significantly different. Further investigations are presently conducted to understand the origin of the specific association of β lg variant with Lf, in particular the role of amino-acid substitutions from Asp and Val (β lg A) to Gly and Ala (β lg B).

