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0144-8617(94)00085-9

Carbohydrate Polymers 25 (1994) 215–230
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News and Views

CONFERENCE REPORT

Biopolymer Mixtures

Biopolymer Mixtures was the 56th meeting in the Easter School Series of Meetings in Agricultural and Food Sciences which are held at the Sutton Bonington Campus of the University of Nottingham. Despite the title of the meeting series, Biopolymer Mixtures was held from 19 to 21 September 1994. The format followed the traditional Easter school approach with invited speakers presenting primarily review-type papers. As a consequence it is often possible to provide a coherent programme. The meeting was roughly divided into two sections covering phase separated and interacting systems. A nice feature was that it brought together scientists interested in biochemical applications of two phase systems such as protein and cell separation processes, and the large group of workers interested in food applications. One of the major issues that emerged was the relative importance of spinodal decomposition and aggregation phenomena involving more specific interactions. This clearly depends on the kinetics of the two processes. We appear to be reaching a consensus on the mechanisms for some of the major polysaccharide synergisms. The meeting had 120 participants. As one of the organisers it is inappropriate for me to comment on its success, or otherwise, but I would like to thank my co-organisers, Sandra Hill and Steve Harding. All three of us owe a debt to the speakers and poster presenters and to Kath Brasnett for the many hours she put in as conference secretary. The twenty-three oral presentations will be published in book form by Nottingham University Press. There was a very strong poster session and the Abstracts of the majority of these are given below.

J. R. Mitchell

Abstracts of posters presented at 'Biopolymer Mixtures'

A CSLM-BASED METHOD FOR THE DETERMINATION OF PHASE DIAGRAMS OF MIXTURES OF BIOPOLYMERS

J.C.G. BLONK, J. van EENDENBURG, M.M.G. KONING, P.C.M. WEISENBORN and C. WINKEL

Unilever Research Laboratory, Olivier van Noortlaan 120, 3133 AT Vlaardingen, The Netherlands

On mixing different types of high molecular weight biopolymers in an aqueous solution, phase separation often occurs. In some cases, the occurrence of phase separation may be readily observed, because due to density differences the heaviest of the two phases is accumulated at the bottom of the vessel in which the mixture is contained. By using classical techniques, the composition of the two phases may be determined. In case the density differences are not so large, and the viscosity of the system is high, the two phases remain intimately mixed in the form of a water in water emulsion. An alternative route to determine the phase behaviour of these systems might be a microscopic technique (confocal scanning light microscopy, CSLM), using the fluorescence intensity of especially labelled biopolymers to quantify their concentration and phase volume in the system.

Experiments were performed with several mixtures of sodium alginate, fluorescently labelled with fluorescein, and sodium caseinate, fluorescently labelled with Texas Red. The viscosity of the mixtures studied was low enough to allow bulk phase separation of the phases by using an ultracentrifuge. Results for the phase volumes, and the composition of the phases, obtained independently by applying the two different methods (CSLM, or analysis of the separate phases after centrifugation) were compared and found to be in reasonable agreement.

LIGHT SCATTERING INVESTIGATION OF THE ROLE OF THE BIOPOLYMER STRUCTURE IN INTERACTIONS BETWEEN DIFFERENT BIOPOLYMERS IN DILUTE SOLUTIONS

M.G. SEMENOVA and L.B. SAVILOVA

Institute of Food Substances of Russia, Academy of Science, Vavilov Street 28, 117813 Moscow, Russia

In studies of biopolymer solutions light scattering is one of the most informative methods which makes it possible to get valuable structural (molecular weight, size, of the macromolecules) and thermodynamic (parameters of the intermolecular interactions polymer–polymer, polymer–solvent in solution) information from one experiment. Such information is of fundamental importance for understanding both the nature of a biopolymer's functionality and the main factors affecting the functionality of the biopolymers in real food systems.

This paper will review our recent studies of the main factors controlling character and intensity of the interactions between different biopolymers in aqueous medium. Such investigations were generally carried out at ionic strengths close to the physiological value (0.1 M). Under these conditions the results obtained were relevant to the behaviour and properties of the biopolymer *in vivo* and charge effects will be substantially suppressed.

By using static light-scattering we have studied the binary (polymer–solvent) and ternary (polymer1–polymer2–solvent) solutions of a number of individual biopolymers whose structure in aqueous medium are strongly different and well known. These include dextrans, pectinate, alginate, carboxymethyl cellulose, 11S globulin, ovalbumin and fibrinogen. Molecular weight and size of the biopolymers were obtained in the binary solutions. Second virial coefficients characterizing the nature and intensity of the pair interactions polymer–polymer and polymer–solvent were calculated from light scattering data. The correspondence between the character of biopolymer interactions and the phase state of the mixture solutions at moderate concentration was observed. The relationship between the conformations of the biopolymers and the character of their interactions was determined. The coordinates of the critical points of the phase separation in systems were calculated. Systematic correlations of the difference of the affinity biopolymers to the aqueous medium with the intensity of the polymer1–polymer2 interactions and the biopolymer's concentration at the critical point were carried out.

THE INFLUENCE OF BIOPOLYMERS ON EMULSION STABILITY

LUKE HEENEY[a], ERIC DICKINSON[b] and IAIN CAMPBELL[a]

[a] *Unilever Research, Colworth House, Sharnbrook, Beds MK44 1LQ, UK*

[b] *Procter Department of Food Science, Leeds University, Leeds LS2 9JT, UK*

The correlation between the phase behaviour of aqueous solutions of caseinate + guar gum and the stability of oil-in-water emulsions stabilized by caseinate and containing guar gum has been investigated in the presence and absence of added salt at pH 6·7. The aqueous phase behaviour of sodium caseinate + dextran T40, T500 or T2000, in the presence and absence of added salt, was also investigated as a comparative model system.

The water–caseinate–guar system displayed visible phase separation in 0·2 M NaCl at 20°C and pH 6·7. The system maintained homogeneity in the absence of added salt. Tubidity measurements supported the observed phase behaviour and provided evidence for phase separation in the presence of salt.

Oil-in-water emulsions prepared with 10 wt% oil and 2 wt% caseinate displayed extensive creaming. A self-depletion mechanism is proposed. The presence of unadsorbed guar gum (0·001–0·2 wt%) in 10 wt% oil emulsions prepared with 1 wt% caseinate gave rise to enhanced creaming and serum separation due to depletion flocculation. Relative rates and extents of emulsion creaming were determined over a 50-day period at 5°C. The effects of ionic strength on creaming and flocculation were investigated.

In the absence of aqueous phase separation, emulsion stability was reduced with respect to creaming and flocculation by the mechanism of depletion. The concentration of guar gum required to destabilize the emulsion was much lower than that required to cause thermodynamic phase separation in the absence of oil at the same ionic strength and caseinate concentration. Relationships between aqueous phase behaviour and emulsion stability are discussed with a view to developing a predictive model to enable future biopolymer selection to be made on the basis of rheological and emulsion destabilization properties.

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PROTEIN–POLYSACCHARIDE INTERACTIONS AT THE OIL/WATER INTERFACE

R.S. WARD-SMITH, M.J. HEY and J.R. MITCHELL*

Department of Chemistry, The University, Nottingham NG7 2RD, UK

**Department of Applied Biochemistry and Food Science, Sutton Bonington Campus, University of Nottingham, Leics LE12 5RD, UK*

Electrophoretic mobilities of emulsion droplets of di-*n*-butyl phthalate formed in the presence of methemoglobin alone, methemoglobin plus alginate or carboxymethyl cellulose have been measured. At pHs below the protein isoelectric points addition of the polysaccharide conferred a net negative charge on the emulsion droplets. For pHs up to approximately 2 units above the isoelectric point the mobilities of the polysaccharide containing emulsion droplets were substantially more negative than for the protein covered droplets. At higher pHs the observed mobilities were similar for both systems. Measurements of alginate surface loadings confirmed that polysaccharide was located at the surface of the oil droplets stabilised with methemoglobin at pHs above the protein isoelectric point. The surface concentration of alginate was approximately 2 mg/m^2, independent of pH in the region pH 5·0–8·0 (Ward-Smith *et al.*, 1994).

Creep measurements were done on hemoglobin, hemoglobin–alginate and hemoglobin–CMC emulsions at 3 pHs and oil volume fractions up to 60%. The instantaneous elastic compliance, due to deformation within a floc, decreased with increasing oil concentration, and provides a useful method of studying how flocculated a system actually is. The point at which the oil volume fraction is large enough to cause bridging flocculation can be easily determined.

Reference

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EFFECT OF THE HYDROCARBON–DECANE AND FATTY ACID SALT–SODIUM DECANOATE ON THE THERMODYNAMIC PROPERTIES OF THE PROTEINS IN THE AQUEOUS MEDIUM

L.A. WASSERMAN and M.G. SEMENOVA

Institute of Food Substances of Russia, Academy of Science, Vavilov Street 28, 117813 Moscow, Russia

Proteins, polysaccharides and lipids are the main components of real foods. It is well known that the mechanisms of food