MIXED GELS OF GELATIN AND WHEY PROTEINS

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Mixed gels of gelatin and whey proteins, as well as pure gels, were studied by large and small deformation tests. The ratio between the polymers was varied in order to see if the components affect each other, if they co-operate and in that case how. Different microscopy techniques, transmission electron microscopy and light microscopy, were used as a tool to detect changes in the microstructure, for example phase inversions, and also to confirm and explain the rheological results.

The gels were studied at two pH-values, pH 5·4 and 7·5. At pH 5·4 the whey proteins form a particulate network with large dimensions, while at pH 7·5 the whey proteins form a fine-stranded network with small dimensions (Langton & Hermansson, 1991). The gelatin forms a fine-stranded network at both pH-values studied.

Small deformations were studied by oscillatory viscoelastic measurements, both during heating and cooling, making gel formation studies possible. The gel formation of the whey proteins was shown to be unaffected by the presence of gelatin while the gel formation of gelatin was shown to be somewhat affected by the presence of the whey proteins.

Large deformations were studied by tensile tests and the parameters measured were stress and strain at fracture and the elastic modulus was calculated. As the ratio was varied in the mixed gels, the rheological results showed a clear shift in rheological properties, both for pH 5·4 and 7·5. The properties of the mixed gels shifted from following the properties of pure whey to those of pure gelatin, or vice versa.

The rheological results obtained were successfully compared with the calculated results from a model which explains the mechanical behaviour of mixed gels (Clark, 1987; Walkenström & Hermansson, in press). The model predicts an upper and a lower bound for the elastic modulus of an heterogeneous mixed gel, containing well defined phase separated areas. The model also suggests detection of phase inversions.

Microstructural results indicate that a bicontinuous system is formed for both pH-values studied. No phase inversion in the proper sense takes place. Further, it shows that the whey protein network is unaffected by the presence of gelatin.

References

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THERMODYNAMIC PROPERTIES OF THE 11S GLOBULIN VICIA FABA-OVALBUMIN – AQUEOUS SOLVENT SYSTEM: LIGHT SCATTERING AND PHASE BEHAVIOR

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Mixtures of proteins are widely found in food formulations. In general, the state and potential behavior of the mixtures of the proteins is impossible to predict only on the basis of the properties of their components. Because of this, it is very important to systematically study the physico-chemical properties of mixtures of different proteins.

A thermodynamic approach can provide valuable information about the nature and intensity of the intermolecular interactions in multicomponent systems as well as about the potential states of the system. Thermodynamic factors are of importance in producing liquid solutions and gels of proteins as well as protein stabilized emulsions and foams.

For these reasons we have attempted to elucidate the thermodynamic properties of the mixture solution of the two different globular proteins. The oligomeric, globular protein-11S globulin and the monomeric globular protein- ovalbumin. Thermodynamic incompatibility of the proteins was observed above the proteins' isoelectric points.

Thermodynamic properties of the system were studied by phase analysis at moderate to high concentration and by light scattering on dilute solutions below the separation threshold. The two approaches provide consistent information. The effect of pH on thermodynamic properties of the system was investigated.

It was established that far from the proteins' isoelectric point (pH 7·8) the concentration area of the proteins' incompatibility shifts towards a high concentration of the proteins (the protein concentration at the critical point is typically 27% w/v). As pH (pH 7·0) is slightly closer to the proteins' isoelectric points a significant increase of the area of the phase separation was observed. The main factors determining thermodynamic incompatibility of the proteins are discussed.

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THE DEGRADATION OF GELATIN IN ACIDIC MEDIA

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Gelatin is widely used in food products because of its ability to form gels. In many applications the gelatin is subjected to an acid environment which in turn may influence its rheological and thermal characteristics. Work has been undertaken to study the influence of certain organic acids on the physico-chemical and gelation properties of gelatin. A food grade gelatin has been characterised using intrinsic viscosity measurements (giving $[\eta] = 0{\cdot}3462$ dl/g and $Mv = 5{\cdot}8 \times 10^4$ g/mol), gel permeation chromatography/laser light scattering (giving $Mw = 2{\cdot}1 \times 10^5$ g/mol and $Mn = 3{\cdot}2 \times 10^4$ g/mol). The bulk properties of the gelatin gel were assessed using rheological techniques and differential scanning calorimetry. Citric and fumaric acids are commonly used in food materials and were used in the degradation studies. Gelatin solutions were prepared at varying concentrations and were stored over a period of time at different temperatures (above and below the gelling temperature) in the presence and absence of the acid. The molecular weight distribution of the gelatin was monitored before and after treatment by fast performance liquid chromatography (FPLC) using UV detection. The rheological and thermal characteristics of the samples were also measured and compared.