Blend or not to blend? Functional and Colloidal Properties of Yeast–Pea Protein Mixtures

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Alternative protein sources are needed to meet the growing global population and food protein consumption. However, protein extracted from legumes or microbes often lacks the techno-functional and nutritional properties of animal proteins when used alone. A promising approach to overcome these limitations is blending protein with different sources (1–2). However, the interactions among these ingredients remain poorly understood and require further investigation. The aim of this research is to investigate the techno-functional properties of yeast (YP) and pea (PP) proteins blended in different proportions. Solubility of protein suspensions resulted in low values for both proteins, ranging from 4.33% for pure YP (YP_{100})to 30% for pure PP (PP_{100}). When the two proteins were blended, solubility increased to 10%, 17%, and 22% for the formulations with YP:PP ratios of 75:25, 50:50, and 25:75, respectively. In the emulsion systems, YP_{100} exhibited large oil particles with a $D_{4;3}$ of 20.44 μm and a span of 2.85, whereas PP_{100} emulsion showed a $D_{4;3}$ of 0.96 μm and a span of 1.83. In the blended formulations, YP_{25}:PP_{75} reached the highest value of 63.81 μm, while lower intermediate values were observed in the other blends that did not differ significantly from each other ($p > 0.05$). This behavior suggests an antagonistic interaction between YP and PP, leading to a poorly stable emulsion, mainly due to flocculation phenomena. The foaming properties showed that YP_{100} has lower foaming capacity (FC) than PP_{100}, with an FC of 14% and 169%, respectively. In the blends, FC increased to 30%, 76% and 126% as PP increased. The YP:PP blend seemed to have a synergistic effect on the Foam stability (FS) for the formulation YP_{75}:PP_{25}, with a value of 24%. The gelation kinetics showed a decreasing trend in the G' at the end of the cooling phase ($G'_{20°C}$) with values of 33.77 Pa for YP and 2170.34 Pa for PP. $G'_{20°C}$ increased in YP_{75}:PP_{25}, YP_{50}:PP_{50} and YP_{25}:PP_{75} gels with values of 35.58 Pa, 260.95 Pa, and 861.66 Pa, respectively, thus demonstrating a sinergystic effect between the YP and PP of PP. $G'_{20°C}/G'_{95°C}$ was used to investigate the main bounds participating in gelation process (5). The protein network was mainly formed by disulphide and hydrophobic interactions for YP alone with a value of 3.59, while in PP hydrogen bonds and electrostatic interactions were mainly contributing to the gel strength, with a value of 13.05 (5–8). $G'_{20°C}/G'_{95°C}$ decreased to 0.82 and 2.11 for the YP_{75}:PP_{25} and YP_{50}:PP_{50} gels respectively, while increased to 16.29 for the YP_{25}:PP_{75} formulation. This behavior might be attributed to new intermolecular interactions occurring during co-gelation that alter the protein network. Large Amplitude Oscillatory Shear analysis (LAOS) at a strain amplitude (y_0) of 1% showed that all the samples had a thin, elliptical elastic curves. As y_0 reaches 10% all the gels, with the only exception of YP_{25}:PP_{75}, showed an expansion of the area within the curve and a deviation of G' from the linearity, indicating a reduction in the gel's energy storage capacity. Upon increasing y_0 to 63%, all the gels, with the only exception of YP_{75}:PP_{25}, exhibited rhomboidal curves, indicating a reduction in the gel's strength and a transition from elastic to viscous behaviour. YP_{75}:PP_{25} gel reported a rectangular shape curve, indicating the almost complete disruption of the structure. Indeed, YP_{25}:PP_{75} gel showed a shift toward rhomboidal curve and increase in the enclosed area at higher strain with respect to PP_{100} gel. These results indicate that multiple synergistic and antagonistic interaction mechanisms occur among proteins in blends, strongly influencing the techno-functional properties of each component. Understanding the functional properties of each individual ingredient, and how these change when combined at different ratios, is crucial for selecting the optimal formulation for the desired model system.

Keywords:
Alternative proteins, Plant proteins, Protein blends, Functional properties

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