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If we could design plant protein structures and tune properties in processed food

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Plant proteins from pea, wheat and quinoa during latest years have become attractive alternatives to replace imported soya in various food applications in Europe. Proteins in a form of protein-rich fractions (from pea and wheat), and the whole flour (from quinoa) can be highly attractive ingredients in making pasta, protein-rich snacks and various types of breakfast food. Structure, state of aggregation and morphology of protein components is a key factor determining of their functional properties in these foods and is greatly impacted by the processing method used. Therefore, a better control and understanding is needed on how protein structure and function are related in various protein containing systems of the processed food.

Here, we show few examples on structural-function relationship of the processed pea, wheat and quinoa proteins into pasta-like sheets, textured protein snacks and breakfast food. We studied the protein structure and protein interactions (including components, as dietary fiber) using synchrotron WAXS/SAXS, X-ray scattering tomography, SEM and HPLC techniques. Variation in processing conditions was high and low processing temperature, composition of a blend and a processing method used. The results indicated that pea protein fraction in a blend with pea fiber showed polymerization behaviour that was greatly depended on the protein to fiber ratio (more protein greater polymerization). An increase of dietary fiber in the blend with pea protein resulted into high amounts of unordered structures observed by FTIR and in an increase in the distances of the scattering elements observed by SAXS. The mechanical properties, as strength and extensibility, of the pea protein and fiber blends were the highest for greatest amounts of protein having blends, while the E-modulus was similar for all the studied blends. For wheat protein fraction, gliadin, the structure and polymerization of gliadin textured snack were influenced by the composition of the blend as was observed by X-ray scattering tomography. Large microstructural differences, mainly due to high processing temperature treatment, were observed in the quinoa extrudates studied by SEM and X-ray scattering tomography.

Here we conclude, that understanding on how to control structure on macro- and nano- levels is a key element when tuning functional properties for the diverse protein systems in food. Once the protein structure is better understood, it would allow better steering of processing and control of final end-use characteristics of the protein rich food products.

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