**Changes in the molecular structure and functional properties of whey protein isolate (WPI) caused by heat-induced interaction with sugar beet pectin (SBP) in solution**

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A co-product of the cheese-making process with high nutritional benefits, whey proteins are increasingly used in products such as meal-replacement beverages and recovery sports drinks. However, whey proteins are known for their poor stability in ready-to-drink protein shakes when subjected to heating or other processing. Research has found that complexation with low methoxyl pectin from citrus peels could alleviate this impediment and thus improve the functional properties. We carried out a study on combining whey protein isolate (WPI), a commercial food ingredient, and sugar beet pectin (SBP), one of the most versatile yet under-utilized polysaccharides, in solution under mild conditions (60 °C, pH 6.75), with the aim of improving the thermal stability and oil-water emulsion stability of the whey protein-based formulations1. The level of SBP was varied at 1, 1.5 and 3% (w/v) while WPI was kept at a constant (3%). Changes that occurred in the molecular structures of whey protein as a result of interacting and conjugating with SBP, at the secondary and tertiary levels, were studied by circular dichroism and fluorescence spectroscopy techniques, respectively. Results showed that the antiparallel -sheet content of whey protein decreased by over 5% with increasing amounts of SBP, possibly correlated with the improved emulsion stability as observed. The UV-VIS spectroscopy indicated significant changes in the molecular electronic transition states and conformations of both WPI and the feruloyl moieties of SBP upon heat-induced interaction (physical) and conjugation (via a Maillard type reaction). These strong molecular interactions were also confirmed by both the steady-state and time-resolved fluorescence experiments. These molecular changes were less pronounced than those that took place in the dry-state at the same reaction conditions2 (temp and duration), suggesting the interaction and reaction were less productive and effective in the solution state. The volume-weighted particle size distribution measurements demonstrated that the WPI-SBP complexes and conjugates formed at the concentration ratio of 3%:3% were the most effective at stabilizing O/W emulsions at acidic pH (3.2) but the ratio of 3%:1% formed the most stable emulsifier at neutral pH (6.75). This study provided a fundamental understanding of the effect of SBP on the molecular structure of whey protein pertaining to the improved functional properties in solution. It will help design new whey protein-enriched beverage formulations that contain high levels of protein and are also resistant to heat treatment.

*References:*

1. Xiao, Y.; Qi, P. X.; Wickham, E. D. (2018). Interactions, induced by heating, of whey protein isolate (WPI) with sugar beet pectin (SBP) in solution: Comparisons with a dry-state Maillard reaction. *Food Hydrocolloids, 83,* 61-71.

2. Qi, P. X.; Xiao, Y.; Wickham, E. D. (2017). Stabilization of whey protein isolate (WPI) through interactions with sugar beet pectin (SBP) induced by controlled dry-heating. *Food Hydrocolloids, 67,* 1-13.