Enzymatic hydrolysis: An approach to improve the lubrication properties of plant proteins

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With the expanding scale of the plant-based market, plant proteins have been widely incorporated into various formulations. However, undesirable sensory attributes, particularly astringency, of plant proteins remain the major barrier to broader consumer acceptance. Astringency has been found strongly associated with high friction as measured in tribological experiments. Hence, we demonstrated a biochemical approach, *i.e.* enzymatic hydrolysis, to reduce the oral friction of plant protein dispersions. Friction of samples was measured using a Rheo-tribometer equipped with 3D printed biomimetic tongue-like surfaces. To investigate the role of bulk human saliva and salivary pellicle in plant protein lubrication, bovine submaxillary mucin (Mucin) was used, and an in- *vitro* model salivary pellicle was dynamically formed under tribological shear. Dynamic light scattering, contact angle measurements and rheological analysis were employed to examine physicochemical properties relevant to lubrication. Legumin-rich fraction (LR) from yea pea flour was extracted and hydrolysed to varying degrees of hydrolysis (%DH; 1-12%). We found that hydrolysis was effective in reducing protein boundary friction, which is at low sliding speed. Notably, a twofold decrease was observed for hydrolysates with 10 and 12% DH, which was likely due to smaller protein particle size and lower surface contact angle. Mixing protein samples with mucin, representing the bulk human salivary mucin, led to further friction reduction in hydrolysate with 12%DH. More interestingly, in the tribological model which involves dynamically formed mucin coating, the addition of parent plant proteins caused an immediate increase in friction, suggesting displacement of the pre-adsorbed mucin layer by LR. In contrast, hydrolysed samples maintained friction levels close to those of the mucin coating alone. These findings advanced the understanding of plant protein astringency and offered a feasible approach to formulating next-generation plant-based products with improved mouthfeel.

Keywords:
Plant proteins; Enzymatic hydrolysis; lubrication; astringency