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Dietary fibre from seeds of Australia native Plantago species as modulators of quality and glycaemic response in starch gels

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Dietary fibre (DF) is a non-digestible nutrient which has important roles in the digestive system including mantaining regularity, and reducing the risk of certain cancers and non-communicable diseases, such as metabolic syndrome. Even though the positive health effects of DF have long been established, it has been shown that DF intake for children and adults in Australia is below the recommended range – less than 20% of adults met the suggested intake for reducing risk of chronic diseases[(1)]. *Plantago ovata*, also known as psyllium, is widely used as DF supplement with evidence showing positive effects on weight control, hyperglycaemic response, cholesterol levels, and irritable bowel syndrome[(2)]. *P. ovata* seed husk produces a highly viscous gel called mucilage when seeds are exposed to moisture. This mucilage is nearly pure DF and has an intricately layered structure which can be further fractionated and studied as a proxy for different gelling systems. Interestingly, Australia is home to many mucilage-producing *Plantago* species, most of which are underexplored and underutilised, but show remarkable gelling properties and hypoglycaemic potential[(3)]. In this work, we compare structural and functional properties of fractionated DF from *P. ovata*, and two promising Australian native relatives, *P. turrifera* and *P. drummondii*, and their effect on enzymatic hydrolysis in potato starch gels. Using a 3-step fractionation method, we have separated distinct fractions and explored their individual properties[(4)]. *P. turrifera* and *P. drummondii* have higher water absorbing capacity, DF yield, and viscosity compared to *P. ovata*. Monosaccharide composition of all three species is similar – they are highly substituted heteroxylans with minor pectic component. Notably, arabinose to xylose ratio in all species increases with further extraction steps, which is different from cereal arabinoxylans. In an attempt to explore impact of DF in starch-rich systems, we have fabricated DF-potato starch gels and measured enzymatic hydrolysis (with porcine pancreatic α-amylase), freeze-thaw stability, and colour change. Addition of DF reduced syneresis (water separation) during 15 day freeze-thaw cycle measurement, which can lead to prolonged storage stability and has positive implications for shelf life. Colour change was most noticeable when *P. drumondii* DF were added, while colour of *P. ovata* and *P. turiferra* DF gels was similar to control potato starch gel. Effects on α-amylase starch hydrolysis were significant as well, and depended on species and fractions. Certain DFs had impacts on constant *k* (speed of hydrolysis), while effects on the extent of hydrolysis are still being explored. In conclusion, utility of Australia native *P. turrifera* and *P. drumondii* DFs are evident when applied to starch gels, and should be further explored in food products such as bread to increase DF intake and possibly lower glycaemic index.

Keywords: dietary fibre; Plantago; starch; α-amylase

Ethics Declaration

Yes

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