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Investigating the effect of polyphenols from nuts on human carbohydrate digestion in vitro

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Recent studies have documented the importance of postprandial hyperglycaemia in the incidence of chronic diseases, including type 2 diabetes. Inhibition of digestive enzymes, including membrane-bound brush-border α-glucosidases, leads to slowed carbohydrate digestion and absorption, and reduced postprandial glycemia. Nuts are widely eaten around the world and have the potential to inhibit α-glucosidases through their content of polyphenols and other bioactive compounds. According to our recent systematic review[(1)], no study has investigated the inhibitory effects of nut extracts on human α-glucosidase activities. Almost all studies in this area have been conducted on yeast α-glucosidase, with only a few using rat α-glucosidase. While there is no sequence homology between yeast and human α-glucosidase, there is 74% to 78% sequence homology between rat and human α-glucosidases[(1)]. The lack of studies on the effect of bioactive compounds from nuts on human α-glucosidases, along with the growing attention to nuts as an important component of a healthy diet with the potential to reduce the risk of chronic diseases[(2)], highlights the need for research to evaluate the inhibitory effect of nut extracts on human α-glucosidases. The aim of the current study is to explore the inhibitory effect of extracts from nuts on human carbohydrate digestive enzymes. Walnuts and almonds were ground and defatted with hexane, extracted in 80% (v/v) acetone, and further purified using solid-phase extraction to obtain phenolic-rich extracts. The Folin–Ciocalteu assay was used to approximate the polyphenol content of the samples. Following our recently published detailed protocol[(3)], cell-free extracts from human intestinal Caco-2/TC7 cells were used as a source of α-glucosidase in enzyme inhibition assays, with sucrose, maltose and isomaltose as substrates and appropriate controls. The assay products were quantified using high-performance anion exchange chromatography with pulsed amperometric detection (HPAEC-PAD). Glucose production in the presence of various concentrations of phenol-rich nut extracts was compared using a one-way ANOVA and half-maximal inhibitory concentration (IC_{50}) values were calculated. The Folin–Ciocalteu data demonstrate that walnut extracts comprise a relatively high polyphenol content, with 18.1 ± 0.23 mg (epigallocatechin gallate [EGCG] equivalent) per gram of fresh weight, while almond extracts contain 0.87 ± 0.03 mg EGCG equivalent/g of fresh weight. The walnut phenolic-rich extract dose-dependently inhibited human intestinal sucrase and maltase activities (both $p<0.01$), with IC_{50} values of 1.67 mg/mL and 2.84 mg/mL, respectively. We demonstrate that phenolic-rich walnut extracts can inhibit human α-glucosidases *in vitro* and therefore walnuts may contribute to slowing carbohydrate digestion in humans. As such, we plan to assess the effects of walnuts on postprandial glycaemia *in vivo*.

Keywords: enzyme inhibition; walnut; α-glucosidase; postprandial glycaemia

Ethics Declaration

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