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Anti-diabetic potential of selected Malaysian seaweeds

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Abstract The emergence of type 2 diabetes mellitus (T2DM) as the pre-eminent global non-infectious disease has driven the search for new anti-diabetic strategies including utilising traditional food and herbs. In this investigation, we describe the anti-diabetic potential of six selected Malaysian seaweed species against recognised pharmacological targets. Specifically, we measured their ability to inhibit α-glucosidase and dipeptidyl-peptidase-4 (DPP-4) and also their ability to stimulate incretin hormone secretion in vitro. Crude water extracts of *Halimeda macroloba*, *Padina sulcata*, *Sargassum binderi* and *Turbinaria conoides* possessed potent inhibitory activities against α-glucosidase and DPP-4. The highest inhibitory activity against α-glucosidase was found in water extracts of the green seaweed species *H. macroloba* with an IC_{50} value of 6.388 mg mL^{-1}. Crude water extracts of the brown seaweeds studied namely *P. sulcata*, *S. binderi* and *T. conoides*, exhibited potent DPP-4 inhibition compared with the green seaweed *H. macroloba*. The brown seaweed also stimulates secretion of glucose-dependent insulinotrophic polypeptide (GIP) and glucagon-like peptide-1 (GLP-1) from pGIP neo STC-1 cells in vitro. *H. macroloba* stimulated GLP-1 secretion but not secretion of GIP.

Keywords α-glucosidase · Algae · Biotechnology · Diabetes · DPP-4 · GIP · GLP · Seaweed

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Introduction

Diabetes mellitus is a chronic metabolic disease affecting an estimated 382 million adults globally, and this figure is projected to increase to approximately 592 million cases in 2035. Type 2 diabetes mellitus (T2DM) accounts for approximately 90 % cases of diabetes and is quickly becoming a global epidemic of the twenty-first century (International Diabetes Federation 2013). In Malaysia alone, an estimated 2.6 million adults are living with diabetes (Feisul 2013).

T2DM is defined by a failure of the body to effectively control blood glucose levels, and this is due to impaired insulin secretion accompanied in many cases by the development of insulin resistance. Postprandial hyperglycaemia is a key feature of T2DM (Arnfred et al. 1988; Sheu et al. 2011) and effectively managing postprandial hyperglycaemia is an important aspect of diabetes care (Sheu et al. 2011). One treatment strategy includes the inhibition of sugar hydrolases such as α-glucosidase and α-amylase. This avoids large 'spikes' in blood glucose levels after a meal, thus minimising periods of hyperglycaemia for the patient. The enzyme α-glucosidase is widely distributed in various organisms with differing substrate specificities (Kimura et al. 2004). Its inhibitors can be categorised into three types, as follows: polyhydroxylated N-substituted heterocyclic compounds, polyhydroxylated cycloalkenes and oligomers of pseudosugars. The inhibition of α-glucosidase has become a subject of interest for many studies in diabetes control.