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Anti-Diabetic Activities of Phlorotannins from A Brown Seaweed Eisenia Arborea

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Abstract

The primary objective of the research proposal is to study the wholesome effect of constituents isolated from *Eisenia arborea* as antidiabetic's agents. In the first year of the proposal, extraction, fractionation of *E. arborea* was carried out with methanol, chloroform and ethyl acetate. These fractions and phloroglucinol isolated were found to possess α-glycosidase and α-amylase inhibition and cytotoxic effects experimentally. It was also proved by *in silico* studies that phloroglucinol bound to important catalytic residues of α-glycosidase and α-amylase enzymes. In the second year of the research, few other phlorotannin compounds (E1 and E2) were isolated and their role on glucose uptake in C_2C_{12} cells was also studied. Studies are underway to characterize the compounds by NMR and LC-MS. Since in most of the instances seaweeds are consumed as a whole or as supplement, the activity is due to synergistic action of multiple components present in the extract. In order to support our hypothesis, network pharmacology approach through *in silico* methods was carried out to show the multiple activities of different phlorotannins present in the brown macroalgae.

Keywords: Seaweeds; Eisenia arborea; Antidiabetic; Phlorotannin

Introduction

A great variety of seaweeds that exist in Portuguese archipelago have the potential of higher nutritional value and possibility of using it to prevent and combat diseases. Foraging and consumption of edible seaweeds have once again regained glory among many countries of the world and global harvesting of seaweeds for use as food products is estimated to value over 3.6 million dollars annually. It is therefore, important to regain the importance of seaweed cultivation by imparting their use in production of value added products (alginate), introduction into culinary (food and fodder) and exploiting for pharmaceutical uses (health and cosmetic sector). One or two of these activities could be clubbed together and maneuvered to gain both scientific and commercial success. In view of this the current proposal aims to exploit the anti-diabetic potential of edible seaweeds. Type II diabetes mellitus (T2DM) is mainly due to unhealthy diet, sedentary lifestyle, as well as rise of obesity in the population. Nutritional and lifestyle interventions could be used in the diabetes management. Seaweeds have been used as food traditionally in Portugal such as *Fucus spiralis, Laurencia viridis, Palmaria palmate, Saccharina latissima, Ulva rigida, Pyropia leucosticta* and many other species. Seaweeds are rich in non-starch polysaccharides (dietary fiber), protein, minerals and vitamins. Also they have low lipid content and provide few calories thus, having a positive effect on glycemic control. Numerous biological mechanisms have been attributed to the role of seaweeds in diabetes control including prolonged gastric clearance rate, inhibition of enzymes such as α-glycosidase, α-amylase and inhibition at varied gene expression checkpoints. The proposal aims to understand the biochemical composition of edible seaweeds, the role of pharmacologically important polyphones, dietary fibers, fatty acids and metabolites on Type 2 diabetes. The seaweeds that would be selected for the study include *Fucus spiralis, Laurencia viridis, Palmaria palmate, Saccharina latissima, Ulva rigida, Pyropia leucosticta* and those of importance in Portuguese cuisine. A plethora of *in vitro* assays have been designed, including biochemical composition of edible seaweeds, solvent extraction of seaweeds and checking their role on glucose uptake potential on cell lines, inhibition of α-glucosidase and α-amylase enzymes and determination of the molecular mechanisms through gene expression studies. Isolation of pharmacologically important metabolite will be attempted from the highly active extracts. The importance of the study include understanding the nutritional profile, anti-diabetic potential and molecular mechanism of edible seaweeds which is of both societal and scientific importance.

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