

Review

Marine Organisms with Anti-Diabetes Properties

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Abstract: Diabetes is a chronic degenerative metabolic disease with high morbidity and mortality rates caused by its complications. In recent years, there has been a growing interest in looking for new bioactive compounds to treat this disease, including metabolites of marine origin. Several aquatic organisms have been screened to evaluate their possible anti-diabetes activities, such as bacteria, microalgae, macroalgae, seagrasses, sponges, corals, sea anemones, fish, salmon skin, a shark fusion protein as well as fish and shellfish wastes. Both in vitro and in vivo screenings have been used to test anti-hyperglycemic and anti-diabetic activities of marine organisms. This review summarizes recent discoveries in anti-diabetes properties of several marine organisms as well as marine wastes, existing patents and possible future research directions in this field.

Keywords: marine organisms; metabolic disorder; diabetes; microalgae; marine biotechnology; drug discovery

1. Introduction

Metabolic disorders (i.e., any of the diseases or disorders that disrupt normal metabolism) are common pathologies, and especially diabetes [1]. In 2013, it was estimated that over 382 million people throughout the world have diabetes and this number is expected to increase up to 500 million in 2030 [2] when it is expected that this disease will be the 7th leading cause of death [3]. Diabetes is usually caused by the interaction of genetic and environmental factors and is characterized by a lack of insulin secretion (relative and absolute) and insulin resistance, always leading to metabolism disorders of fat, protein and carbohydrate [4]. Insulin is a peptide hormone produced by beta cells of the pancreatic islets [2]. It has two essential functions without which the body would cease to function: (1) insulin stimulates glucose uptake and lipid synthesis; and (2) insulin inhibits the breakdown of lipids, proteins and glycogen, and also inhibits the glucose pathway (gluconeogenesis) [5–7]. Many people affected by diabetes will eventually have a series of diabetic complications like nephropathy, neuropathy, retinopathy, diabetic foot, ketoacidosis, and even increased risk of cardiovascular diseases and hypertension [4]. There are two types of diabetes, type-1 and type-2 (Figure 1), and also what is termed gestational diabetes that affects females during pregnancy. In type-1 diabetes, the beta cells are destroyed due to an autoimmune response and there is no insulin production [8]. What starts the autoimmune destruction is unknown, and may be due to a combination of genetic and environmental factors [9]. Type-1 diabetes is also referred to as insulin-dependent diabetes because patients need to take insulin injections for the rest of their life. In type-2 diabetes, the body does not produce enough insulin for proper functioning or the cells do not react to insulin (insulin resistance). In this case, patients can control the pathology by following a low calorie diet and exercising, even if they may need to take daily insulin injections or tablets. Type-2 diabetes is often associated to obesity and is related to eating high calorie diet and having a sedentary lifestyle. The occurrence of type-2 diabetes is more common, covering 90%–95% of all diabetes cases [10].