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Marine-derived bioactive compounds with anti-obesity effect: A review

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ABSTRACT

The incidence of obesity, caused by an imbalance between energy intake and expenditure, has dramatically risen in recent years. Obesity is becoming a worldwide burden to public health. In many epidemic studies a lower prevalence of obesity-related diseases is observed in seafood-consuming population, suggesting a beneficial role of marine foods against obesity. It is believed that some functional ingredients in marine foods account for their anti-obesity effect. In this review, the cause and mechanism of obesity are first discussed in order to better understand how functional compounds can alleviate obesity. In addition, a series of anti-obesity components derived from marine origin, especially edible sources, are summarised, including lipids, polysaccharides, phlorotannins, carotenoids and others, with an emphasis on their efficacy and mechanism of action. Due to their anti-obesity effect, these marine-derived compounds might be excellent sources in the development of functional food against obesity.

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1. Introduction

The prevalence of obesity, caused by an imbalance between energy intake and expenditure, has dramatically risen in the past decades (Ogden, Carroll, Kit, & Flegal, 2014; Racette, Deusinger, & Deusinger, 2003). Obesity has become a great threat to global human health. The most common standard for estimating a person as overweight or obese is body mass index (BMI), which is calculated by dividing body weight in kg with square of height in metres. Regardless of sex, overweight is defined with BMI ranging from 25.0 to 29.9, and obesity is described by a BMI of 30.0 or higher. In the world, more than 1 billion people are overweight, and at least 400 million of them are defined as obese according to a recent WHO report of 2009. Obesity currently affects approximately 33% of population in the US and 25% in the UK (Rodgers, Tschöp, & Wilding, 2012). In addition, in some developing countries, obesity also constitutes a heavy burden to public health.

Obesity is a chronic disease and also a major risk factor for developing hyperlipidaemia (Charlton, 2009), hypertension (Rahmouni, Correia, Haynes, & Mark, 2005), type 2 diabetes (Tobias et al., 2014), cardiovascular diseases (Hubert, Feinleib, McNamara, & Castelli, 1983; Lavie, McAuley, Church, Milani, & Blair, 2014) and certain cancers (Hursting, Nunez, Varticovski, & Vinson, 2007; Vucenic & Stains, 2012). Obesity is positively related with increase in growing mortality, impaired life quality and huge expenditure on healthcare system. Indeed, obesity and related disorders cost over 100 billion dollars in the US and 2 trillion dollars annually at a global scale (Daniels, 2006).

Losing weight can reverse the harmful effect on health, and also improve or prevent obesity-related diseases. There are numerous options for the prevention and treatment of obesity. In general, current strategies include dietary intervention, physical activity, pharmacological therapy, and stomach surgery, either

alone or in combination. Most guidelines for obesity treatment are based on BMI. Lifestyle modifications such as low-calorie diet and increased exercise are recommended for individuals with BMI of 25–26.9; medication is recommended for individuals with BMI, as well as those with BMI of 27–29.9, plus one obesity-related disorder (i.e. diabetes, hypertension); bariatric surgery is suggested for extremely obese subjects (BMI > 40) (Fabricatore & Wadden, 2003; Gearhardt et al., 2012). Unfortunately, these above strategies have only shown limited success, although pursued for more than several years. As lifestyle modification is difficult to persist in, and drugs and surgical procedures are frequently accompanied by many kinds of side-effect and complication, nutritional and dietary factors should be developed as an alternative option of obesity treatment and prevention. In fact, growing correlation between diet and several chronic morbidities has suggested remarkable potentials of food for improving human health (Plaza, Cifuentes, & Ibáñez, 2008). As a consequence, a huge interest has been aroused among food industry and consumers in these products that can promote human health, especially on obesity control.

Seafood consumption is encouraged and accepted around the world as lower incidence of metabolic related disorders was observed in seafood consumption populations (Nakajima, 2010; Vázquez et al., 2014). Seafood is a good source of nutrients like proteins, vitamins and minerals, and contains huge varieties of health-promoting compounds as well. These compounds may explain the beneficial effects of marine foods in a large part, in addition to their micronutrients and macronutrients.

2. Overview of marine diversity

About 70% of the earth surface is covered by ocean, with more than 1 million multicellular organisms and 1 billion unicellular

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