Chapter 2
Functional Food Innovation for the Treatment of Metabolic Syndrome

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ABSTRACT

Metabolic syndrome (MetS) is a metabolic disorder characterized by central obesity, insulin resistance, hypertension, and hyperlipidemia. MetS is associated with an increase in reactive oxygen species (ROS), triggered by oxidative stress. Oxidative stress occurs when the number of free radicals in the body exceeds its ability to neutralize them, causing cells, tissues, or organs damage, and triggering type 2 diabetes mellitus (DM) and coronary heart disease. One of the ways to manage of MetS is through functional food. Various studies have shown that functional foods contain bioactive components such as dietary fibers (beta-glucans, pectin, inulin), phytosterols, oleic acid, polyunsaturated fatty acids, antioxidant vitamins, phytochemicals such as flavonoids, and bioactive peptides. In addition, functional food processing uses state-of-the-art technology that generates heat through internal transmission energy and does not use high-temperature technology. This minimizes the deterioration of sensory characteristics, nutrients, and functional foods.

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INTRODUCTION

Metabolic syndrome (MetS) is a multiple risk factor for cardiovascular disease and develops through several interrelated factors between obesity as a factor causing insulin resistance which is associated with other cardiovascular risks, namely hypertension and dyslipidemia (Boden-Albala et al., 2008; Kurl et al., 2006). The results showed that more than 1 billion people in the world were identified as having MetS caused by central obesity (Saklayen, 2018). The prevalence of MetS in Indonesia is quite high, based on the 2007 Riskesdas data, at 5.2%, mainly caused by hypertension and central obesity (Soewondo et al., 2010). Various epidemiological studies have proven that metabolic syndrome increases the risk of cardiovascular disease almost twice as much as the non-metabolic syndrome population with obesity and insulin resistance (DeFronzo et al., 2004).

Mechanisms causing Metabolic syndrome (MetS), insulin resistance, and central (visceral) obesity due to the accumulation of fat cells, will increase free fatty acids from lipolysis, decrease insulin sensitivity, and increase gluconeogenesis resulting in increased glucose production and insulin extraction, causing hyperinsulinemia. Fat cells also secrete angiotensin, TNF, resistin, and leptin associated with a decrease in insulin resistance by inhibiting tyrosine kinase activity at insulin receptors and reducing the expression of glucose transporter-4 (GLUT-4) in fat and muscle cells (Kershaw & Flier, 2004). Meanwhile, adiponectin can reduce insulin resistance; its levels are decreased in metabolic syndrome (Weyer et al., 2001). Insulin resistance and hyperinsulinemia cause metabolic changes, resulting in hypertension, dyslipidemia, increased inflammatory, and coagulation responses through endothelial dysfunction and oxidative stress. Insulin resistance is getting worse over time, and insulin secretion eventually decreases, resulting in hyperglycemia and manifestations of type 2 diabetes (Gibson & Williams, 2000).

Intervention through lifestyle changes and physical activity to reduce insulin sensitivity or diabetes mellitus is a key factor in the success of metabolic syndrome treatment, namely by regulating food intake and functional food and physical activity so that weight loss is ideal (Tuomilehto et al., 2001). Various studies have shown that functional foods can play a role as prevention and as a therapy for MetS because it has various effective bioactive components such as dietary fibers (beta-glucans, pectin, and inulin), phytosterols, oleic acid, polyunsaturated fatty acids, antioxidant vitamins, phytochemicals such as flavonoids, and bioactive peptides. The content of these bioactive substances can be found in fruits and vegetables such as soybeans, pomegranates, cranberries, onions, tomatoes, grapes, wheat, nuts, fish, olive oil, tea, plant extracts, and fortified foods. Antioxidants contained in isoflavones can bind to endogenous receptors and are cardioprotective as antioxidants that can neutralize