CHAPTER I

INTRODUCTION

Indonesia is an agricultural country that has many agricultural products especially food crop. Most of the agricultural crops that produced are cereals such as rice, corn, and tubers. Cereal plants are widely used as a source of carbohydrates for the body. Carbohydrates included in the polysaccharide sugar group, that are play an important role in making up an organism, and possess many pharmacological effect, such as antitumor, antivirus, antioxidant, immunomodulatory, neuroprotective, gastroprotective, and hepatoprotective activities (Cantu-Jungles *et al*., 2014). Moreover polysaccharides are commonly used in various food processing, including the sources of food nutrients, food additives, and source of biologically active molecules (Persin *et al*., 2010). Polysaccharides can be divided into three types according to their sources: animal polysaccharides, plant polysaccharides and microorganism polysaccharides. Plant polysaccharides can be easily found in cell wall of plant (Pauly and Keegstra, 2010).

Polysaccharides are commonly used in various foods processing, including the sources of food nutrients, food additives, and source of biologically active molecules (Persin *et al*., 2010). Polysaccharides are also found as a main resource to produce rare sugar D-sorbose through the enzymatic reaction using D-tagatose 3-epimerase (Granstrom *et al*., 2004).

D-sorbose is known as reactive reducing sugar to react with amino acids to generate MRPs. D-sorbose quickly binds amino acids and forming glycation reaction. Glycation reaction was produced negative and positive impact for the body and food processing. The negative impact caused to health such as degenerative diseases like cardiovascular, coronary heart and kidney failure (Zang *et al*., 2009). To avoid all the negative impacts, it can be prevented by a controlled heating treatment. The appropriate heating treatment would generate MRPs with positive impact to health and food product. The controlled heating treatment can be determined through the formation of color and the antioxidant value of during heating process.

Maillard reaction was non-enzymatic browning reaction between reducing sugar and amino acids. This complex reaction usually forming an antioxidant compounds known as Maillard Reaction Products (MRPs) which contribute markedly to the aroma, taste and color, and antioxidant of foods (Manzocco *et al*., 2001). During heating process, the glycation reaction may be appeared initially by the Maillard reaction between amino groups and carbonyl group of reducing sugar. Maillard reaction was depended on several factors such as amino acids, reducing sugar, pH condition, and heating time (Laroque *et al*., 2008).

Threonine is a group of amino acids that able to easily react with the carbonyl group of reducing sugar to form MRPs. The thermal degradation of threonine was relatively complex, however the beginning of heating process leads to the formation of Amadori compounds that may be exhibited antioxidant effect and provided a distinctive aroma-color of the final product (Shu, 1999).

D-sorbose was a reducing sugar that obtained from the fermentation of D-tagatose. D-tagatose has an epimerase chain C-3 which is able to accelerate the formation of aldehyde compound (Fox, 1997). C-3 is open chain and play important role of Maillard reaction to attached with amino group and form MRPs such as antioxidant and aldehyde compounds. The previous research reported that protein glycated with Sorbose and all rare sugar exhibited a higher antioxidant and MRPs than protein glycated with alimentary sugar which were easily found in nature (Sun *et al*., 2014). Maillard reaction may-occur in alkaline conditions and the optimum length of heating time (Ajandouz *et al*., 2001) with the minimum temperature below 60℃ (Alvarenga *et al*., 2014).

The objective of this research was to analyze the formation of intermediate compounds of Maillard reaction from D-sorbose and threonine in low temperature. According to Alvarenga *et al*. (2014) reported that with temperature below 60℃ Amadori product may be generated on initial stages and would accumulated during heating treatment. This research using low temperature to avoid the formation of the carcinogenic compound as a negative impact. According to Labuza *et al*. (1998) reported that mutagenic compound was found on brownest food, because too high temperature may be generated acrylamide products. This research investigated based on the intensity of the brown, color development, spectrum measurement, ABTS antioxidant activity, and the correlation between the intensity of the brown and scavenging activity of MRPs formed during the heating process.