

# CHAPTER 1

## INTRODUCTION

The immune system plays an essential role in the body to fight against invasion of pathogen. One of the many ways of the body to defend itself from the invasion of pathogen is the secretion of cytokines, for example interleukin (IL)-6 and tumor necrosis factor (TNF)- $\alpha$ , by innate immune cells. There are numerous diseases associated with the immune system and those diseases often have the potential to endanger the life of patients. One of the many ways to prevent these diseases from occurring is to improve the body's immune system.

Improving the body's immune system can be done by maintaining a healthy diet such as consuming functional foods. Functional foods are foods that can offer health benefits beyond its basic nutritional function ("Scientific Concepts of Functional Foods in Europe Consensus Document," 1999). The basic nutritional function of food is to provide sufficient nutrients to meet the metabolic requirements of an individual.

One type of food that is included as functional food is fermented food. Fermented foods are foods that have been added with substances, such as salt, yeast, mold, and lactic acid bacteria (LAB) to start the fermentation process. Although, initially, LAB in fermented foods were meant for fermentation process, several studies revealed that some LAB in fermented foods have the potential to be probiotics that can improve gut health. Moreover, the fermentation process itself produces metabolites that also have the potential to offer diverse health benefits.

There are various types of fermented foods worldwide. In Indonesia, especially with the vast variety of cultures, fermented foods were made using different methods and ingredients from each culture. Some popular examples of Indonesian fermented food are tofu and tempeh which are made from soybeans.

In the process of tofu making, soy beans are ground which then produce a by-product; commonly known as soymeal. This by-product can be further processed into a fermented food, with a relatively lower price compared to tofu and tempeh, which is called oncom. Oncom is a traditional fermented food originated from West Java and usually consumed as it is or used as an ingredient to make other types of dish. This particular food is a good alternative source of protein for those who are included as lower to middle-income people.

According to Surono (2016), tofu by-products still contains high nutrient value and might contain similar proteins to tofu and soy. Soy proteins have been evaluated to offer several health benefits such as cholesterol-lowering effect and attenuates bone loss of the spine (Chao, 2008). Moreover, soy contains isoflavones genistein and daidzein which have been evaluated to improve lipid metabolism and produce antidiabetic effect (Mezei et al., 2003), to exhibit antiproliferative effects on the growth of human breast cancer cells (Vissac-Sabatier, Bignon, & Bernard-Gallon, 2009), and to inhibit prostate cancer proliferation and cell-cycle arrest (Adjakly et al., 2013). The genistein isoflavone can also be found abundantly in oncom extract (Mustarichie, Levita, Moektiwardoyo, & Musfiroh, 2011) indicating that the health benefits offered by soy may also be offered by oncom.

However, the consumption of oncom is still lower compared to that of other soy-based products: tofu and tempeh. Throughout 2002-2012, the consumption of oncom was 0.296 kg/capita/year meanwhile tofu and tempeh was 7.28 and 7.61 kg/capita/year, respectively (Indonesia Agricultural Data Center and Information System, 2014). By exploring more health benefits that oncom may offer and introduce them to people, it is expected that the consumption of oncom will increase.

There are a lot of studies done exploring the properties and benefits of oncom, among them are the chemical components, antioxidant and antimutagenicity of oncom (Matsuo, 2006) and the usage of red oncom powder as a growth medium for bacteria (Nur et al., 2015). Despite the numerous studies on this particular food, none of them focused on the potential of oncom in improving health especially in

improving the body's immune system. Thus, this study was conducted to evaluate the immunostimulatory effect of oncom water extract (OWE) on the body's innate immune system by *in vitro* method. The production of TNF- $\alpha$  and IL-6 cytokines by mouse macrophage-like RAW 264.7 cell line and mouse peritoneal macrophages were evaluated as the indicator of the immunostimulatory effect. In addition, this study was also conducted to identify the bioactive substance contained in OWE that is accountable for the immunostimulatory effect.