

CHAPTER 1

INTRODUCTION

1.1 Background

Prevalence of lactose intolerance in the world is high, with 75% of the human population being intolerant to ingested dietary lactose (Silanikove, Leitner, & Merin, 2015). Lactose, the main carbohydrate in milk, is a sugar component that is found in all milk produced by mammals, hence it is often called as “milk sugar” (Adams, 2018). Lactose is broken down into two simple sugars: glucose and galactose, with the help of the enzyme lactase that is present in the lining of the small intestine. However, insufficient lactase production can lead to a condition called lactose intolerance, also known as lactase deficiency. It occurs when lactose cannot be digested properly, meaning that it cannot be broken down into its monosaccharides due to low amount or absence of lactase enzyme in the intestine. When lactase is low or absent, the undigested lactose passes through the intestine to the colon carrying extra fluid along with it. Lactic acid fermentation will then occur, producing fatty acids and gasses which can cause symptoms such as diarrhea, bloating, gas, flatulence, or abdominal cramps. This is due to the lactic acid which acts as an irritant and laxative (Szilagyi, Barr, Bedder, Hatcher, & Bell, 2016; Watson, Collier & Preedy, 2017). Lactose intolerance is more common in adults because as humans grow older, the lactase production gradually decreases as the diet also becomes more varied (Szilagyi et al., 2016).

The importance of milk in human diet cannot be denied, as it provides almost all the essential nutrients needed by the human body. Since lactose intolerant people cannot consume dairy milk, many food manufacturers are currently developing lactose-free milk as an alternative for lactose intolerant people. Thereby, they can still enjoy the benefits of milk without experiencing adverse effects. Current technologies used to produce lactose-free milk include membrane filtration (e.g. ultrafiltration, microfiltration) and enzymatic hydrolysis of lactose using lactase enzyme. Unfortunately, these methods cannot completely remove the lactose. Also, use of immobilized

enzyme requires more time, equipment, and work. Hence, lactose-free milk using soymilk as the “milk” based is believed to be a good solution because it is much simpler and does not involve such complex techniques. Nevertheless, use of soymilk has its own drawbacks with regards to the nutritional content and sensory properties.

As one of the nutrient contained in milk, protein is an important macronutrient needed for human growth. There are many types of protein powder commonly used in food production. The two categories of protein include animal-based protein (e.g. casein, whey) and plant-based protein (e.g. soy, pea, rice, oat, etc.). Casein and whey are the two proteins found and often used in milk products. Unfortunately, both casein and whey contain lactose (Chandan, Kilara, & Shah, 2008). This means that animal-based protein may not be suitable for those with lactose intolerance. Meanwhile, plant-based protein contains no lactose, which is more suitable to be consumed by those who are lactose intolerant (Weller, 2017).

Protein quality, which is defined by its amino acid composition and digestibility, is one of the determining factor of protein selection. Generally, animal-based protein provides a more complete source of amino acid that are often lacking in plant-based protein (Yadav, Bansal, Jaiswal, & Singh, 2017). Past investigations in human, although limited, showed that the ileal digestibility of plant protein is slightly lower than those reported in animal protein (e.g. animal proteins have a mean digestibility of 95% while plant proteins only 89-92%) (Mariotti, 2017). However, the differences between the quality of plant protein and animal protein are not that significant. Moreover, the use of plant protein is well established in western countries because it is regarded as source of dietary fiber and antioxidants, low in cholesterol, and lactose-free (Sethi, Tyagi, & Anurag, 2016).

Although plant proteins possess many benefits, a study by Yadav, Bansal, Jaiswal, & Singh (2017) revealed several problems regarding the use of plant-based substitutes, which are related with the overall acceptability (sensory properties) of the products. Based on acceptability, plant-based protein often possess a “beany” off-flavor and also chalky mouthfeel due to insoluble

particles, which makes it less tasty and less preferred compared to regular milk made from animal-based protein (Yadav et al., 2017). The aim of this study is to develop lactose-free milk fortified with plant-based protein, with comparable nutritional quality and sensorial properties (primarily taste) to that of dairy milk, in hope of making it acceptable and as appealing as dairy milk.

1.2 Objectives

The main objectives of this study is to develop lactose-free milk fortified with plant-based protein, with similar nutritional quality and acceptability to dairy milk. The sub-objectives are:

- To make a non-dairy milk by using plant-based protein as the primary protein source
- To assess the sensory characteristics and acceptability of the lactose-free milk, compared to dairy milk
- To assess the nutrient composition of the lactose-free milk, compared to dairy milk

1.3 Benefits of the Study

a. For public consumers

The development of lactose-free milk is hoped to provide an alternative to the regular milk which has high lactose content. This way, people with lactose intolerance can also enjoy milk without experiencing the adverse health effect (symptoms) associated with consumption of lactose. In addition, the lactose-free milk product is also a great choice for vegetarian consumers, because it is made from plant-based ingredients (dairy-free).

b. For food industries

This study is expected to provide a new reference method in developing lactose-free milk, by using plant proteins as an alternative primary protein source to the normally used animal-based proteins, which still contains lactose.

c. For other researchers

The outcome of this study is expected to increase the knowledge of other researchers related with the use of plant proteins for formulating milk products, especially for lactose-free milk. Also, this study is hoped to motivate other researchers to further look into and develop the result of this study so that they can optimize the use of plant proteins in product formulations.