CHAPTER 1

INTRODUCTION

1.1. Background of Research

Indonesian dairy consumption continues to grow rapidly as milk and its derived products have been long considered as the essential commodities to meet nutritional requirement of human being. Priyanti & Soedjana (2015) stated that the steady growth in human population (1.45% per year) would trigger the national milk consumption to expand by 10% on an annual basis. The increased in consumer's income as well as improved nutrition awareness also contribute in rising demand of fresh high value dairy products in Indonesia. However, domestic output fails to meet both industry and consumer demand of high quality and high quantity bulk milk due to some logistical challenges in transporting those highly perishable goods (Walker, 2018). Furthermore, the lack of technology advancement limits Indonesian industries' productivity to manufacture milk with great nutritional, organoleptic properties as well as good stability. These obstacles drive the needs in exploring and establishing new techniques to limit imported goods while developing local milk production in Indonesia.

The majority of dairy industries depend on heat treatment to transform raw fresh milk into a safe consumable product through the reduction of both spoilage and pathogenic microbial population, inactivation of detrimental enzymes, and minimization of chemical reactions. The most common method applied in industries is pasteurization treatment. Despite being successfully effective in inactivating microorganisms, most spores and heat resistant bacteria are able to survive these treatments, limiting the shelf life of pasteurized milk. Since milk quality is an essential aspect in dairy industry, various non-thermal treatments for extending milk shelf life have been researched and investigated.

Studies showed that the cold plasma technology has a good prospective in milk and dairy production (Gurol *et al.*, 2012; Kim *et al.*, 2015; Patra *et al.*, 2017). Patra *et al.* (2017) stated that the recent increase of awareness and interest in the application of cold plasma technology in

milk and dairy industry is due to its superior action against spoilage microorganisms, especially *Escherichia coli* (Gurol *et al.*, 2012; Kim *et al.*, 2015), *Salmonella typhimurium* and *Listeria monocytogenes* (Song *et al.*, 2009). Coutinho *et al.* (2018) reported that more optimum or higher quality milk can be obtained by implementing cold plasma technology in combination with the subsequent heat treatment, such as HTST pasteurization (high temperature short time). Moreover, Hoffmann *et al*. (1996) also noted that thermal process is essential to meet standard acceptable limit of milk quality.

Cold plasma technology with argon gas has successfully produced ESL milk with good sensory characteristics. However, since argon is used, there are concerns regarding the projected cost of treatment for scaling up this technology in food industry. Therefore, the effectivity of nitrogen in substituting the cost-intensive noble gas is investigated in this project. Besides having propitious market opportunities, this research will provide significant outcome to the advancement of Indonesian dairy industries, including valuable information regarding novel dairy technology and expanding market niche in dairy industry through the development of new variety of milk; hence, this topic is considered to be worth investigating.

1.2. Problem Formulation

The research problems are formulated as follows:

- What are the impacts of applying cold nitrogen gas plasma technology to the shelf life quality of raw and HTST milk?
- What is the most effective period of cold nitrogen gas plasma treatment to enhance the shelf life stability of raw and HTST milk?

1.3. Objectives of Research

The objectives of this research are:

- To evaluate the effect of cold nitrogen gas plasma technology to the shelf life quality of raw and HTST milk.

- To determine the most effective period of cold nitrogen gas plasma treatment to achieve the optimum shelf life stability of raw and HTST milk.

1.4. Scope of Research

The scope of work of this research includes comparing the shelf life stability test between cold plasma, HTST, and cold plasma HTST milk; which samples are obtained from Tunghai Dairy Farm. Shelf life of milk samples is estimated based on their color, pH, titratable acidity, and microbial load changes over 10 weeks of storage at 4^{O}C. Color is determined using colorimeter, pH meter is used to monitor pH transformation, titration with 0.1 NaOH is done to evaluate the TA, while microbial load is quantified using PCA (plate count agar) and BHI (brain heart infusion) agar with pour-plate technique. Statistical analysis is performed using one-way ANOVA with XL-STAT program (version 7, 2018, Addinsoft Inc, USA).

1.5. Organization of Thesis

The organization of this thesis is as follows. Chapter 1 introduces the underlying problem which currently faced by Indonesian dairy industry, basic principles and the potential application of plasma technology in dairy industry, as well as the objectives and scopes of this research. Chapter 2 summarizes existing literatures regarding the topic of interest, including profile of Indonesian dairy industry, definition and type of milk, processing of milk, the significance of cold plasma in dairy industry, and further explains each procedure done to generate and analyze the milk samples. Chapter 3 describes every material, equipment, and methodology conducted in this research. Chapter 4 and 5 provide a complete analysis and discussion of the research findings which should answer the problems posed in the introduction. In the last chapter, chapter 6, the key findings of the research are highlighted and conclusions along with recommendation for further studies are presented.