CHAPTER 1

INTRODUCTION

1.1 Background of the Study

Essential oils are complex mixtures of volatile compounds produced by living organisms and isolated by physical means only (pressing and distillation) from a whole plant or plant part of known taxonomic origin (Franz, & Novak, 2015). Essential oils are sourced not only from flowers, but from barks, seeds, peels, roots, buds and various parts of plants. They can be extracted by several extraction methods, for example distillation, solvent extraction, solvent free microwave extraction, expression and so on (Tongnuanchan, & Benjakul, 2014; Schmidt, 2015). In general, essential oils mainly contain of terpenes (monoterpenes and sesquerpitenes), aromatic compounds (aldehyde, alcohol, phenol, methoxy derivative, and so on), and terpenoids (isoprenoids) (Bakkali et al. 2008; Mohamed et al., 2010).

Strobilanthes Crispus (Acanthaceae) plant is native to countries from Madagascar to Indonesia (Sunarto, 1977). *Strobilanthes Crispus* is a bush-like plant. S.Crispus is known as pecah beling (Malay) and Black Faced General (Mandarin). Traditionally, *S. Crispus* is used to treat diabetes and cancer, prevent lysis, as laxative and diuretic agent (Sunarto, 1977; Perry and Metzger, 1980). *S. Crispus* is also famous among the public because of its good biological activities. There are studies proven that *S. Crispus* has properties, such as anticancer activity, anti-diabetic, wound healing properties, antimicrobial activities, antioxidant and anti-ulcerogenic (Nurraihana, & Norfarizan-Hanoon, 2013). According Asmah et. al. (2006), by using hydrodistillation method, the essential oil of *S. Crispus* fresh leaves did not give any cytotoxic value against all the cell lines tested. However, the study showed *S. Crispus* essential oil has higher antioxidant activity compared to α-tocopherol (standard) but lower than *L. inermes*.

The methods to obtain essential oil from medicinal plant, including *S. Crispus,* are distillation (hydrodistillation, steam distillation and hydrodifussion), solvent extraction (solvent, supercritical carbon dioxide and subcritical water) and solvent-free microwave (Tongnuanchan, & Benjakul, 2014). The quality of essential oil mainly depends on their constituents. Extraction method is one of main factors that determine the quality of essential oil (Tongnuanchan, & Benjakul, 2014). Inappropriate extraction procedure can destroy and alter chemical signature of essential oil (Tongnuanchan, & Benjakul, 2014). According to Okoh & Afolayan (2011), steam distillation can lead to susceptible chemical changes on monoterpenes compound. Besides that, the essential oil extracted through solvent extraction contains solvent residues that pollute the fragrances. The removal of its solvent causes losses of more volatile compounds.

In this research, the extraction methods that have been choosen are hydrodistialltion (HD) and microwave-assisted hydrodistillation (MAHD). According to Tongnuanchan & Benjakul (2014), HD is often used to isolate nonwater-soluble natural products with high boiling point. This method protects the oils extracted to a certain degree because the surrounding water acts as a barrier to prevent it from overheating. In the other hand, MAHD is an advanced method of HD, which use microwave oven in the extraction process. MAHD have been used by several researchers to isolate essential oils from rosemary (Karakaya, et al., 2014), *Cinnamomum iners Reinw* (Phutdhawong et al., 2007), thyme (Golmakani, & Rezaei, 2008), mango flowers (Wang et al., 2010), lemongrass (Ranitha et al., 2014) and ginger (Abdurahman et al., 2013). Essential oils extracted by HD and MAHD have the same chemical composition but the differences between HD and MAHD are the effectiveness of extraction (Wang et al., 2010). Microwave-assisted hydrodistillation shorten extraction time, improve extraction yield, save energy consumption and it is an environmental friendly method. (Golmakani and Rezaei, 2008).

1.2 Motivation

The use of essential oils together with their therapeutic properties is an ancient tradition. In ancient, essential oils have been used for cosmetic purposes, as well as for their spiritually and emotionally uplifting properties. In recent years, there are growing interest in alternative therapies and the therapeutic use of natural products, especially those derived from plants (Schwartsmann, et al., 2002). Therefore, application of essential oils which are extracted from natural plant gains growing attention in pharmaceutical and food industry. The world's total production of essential oils is estimated at about 100,000 – 110,000 tons (Gill et.al., 2014) . Besides, essential oils are famous with its biological activity, antioxidant, antibacterial and antifungal properties too.

There are many methods used to extract essential oils, such as distillation, solvent extraction, solvent free extraction, expression and so on (Tongnuanchan & Benjakul, 2014; Baser & Buchbauer, 2010). Among of the methods, hydrodistillation has become the standard method of essential oil extraction from plant material. However, oil extraction by using hydrodistillation need long extraction time and it is energy wasting method (Golmakani, & Rezaei, 2008). Recent, green and sustainable extraction methods of natural products is currently a hot research topic in the multidisciplinary area of applied chemistry, biology and technology. Therefore, an advanced hydrodistillation technique is developed which is known as microwave-assisted hydrodistillation. This technique saves energy and times, as well as increases the yield of essential oil (Golmakani, & Rezaei, 2008).

1.3 Problem Statement

Nowadays, essential oil of *S. Crispus* is still not available in the commercialized market now. *S. Crispus* leaves are commercialized as a healthy drinking tea in the health-food market. *S. Crispus* tea is the most common products that we can find in the market now. Besides that, *S. Crispus* are also available in the form of raw crude powder, as capsule and as an addictive mixed with coffee. *S. Crispus* have been proven showing several biological activities, such as anticancer, antidiabetic, antimicrobial, wound healing properties and so on. But, there is still a wide gap in looking for S. Crispus biological activities.Earlier studies on *S. Crispus* leaves were mostly focused on chemical