CHAPTER I

INTRODUCTION

1.1 Background

Lawsone (2-hydroxy- 1,4- naphthoquinone) is a known naphthoquinone dye that is derived from Henna plant (*Lawsonia inermis*). Naphthoquinones which are commonly found in the form of botanical extracts have been used as dye and ornaments since ancient time, far earlier than the isolation and identification in modern era. But in the recent time, studies have found that naphthoquinones are therapeutic potential including have effects on wound healing, anti-inflammatory, antifertility, insecticidal, antimicrobial properties, and even anticancer properties. The functionality of naphthoquinone shifts from its original purpose as dye toward medicinal benefits (Qiu *et al*., 2018).

As the active compound in the henna leaves, lawsone is found to be able to act as antibacterial and antifungal, anti-inflammatory, antipyretic and analgesic, anticancer and cytotoxic Antioxidant plays an important role in delaying oxidative reaction due to the imbalance between free radical production and antioxidant presence (de Oliveira *et al*., 2017).

Lately, researchers have been studied the modification process of lawsone to increase the functional properties such as anti-leishmanicial activity, anti-cancer, antibacterial. The synthesis process of lawsone with aromatic aldehydes resulted in a structural compound with greater phenolic compounds which characterized the

presence of antioxidants. The results attract the attention of researchers to do further research regarding modification of lawsone. One of the modification processes of lawsone was done by synthesizing lawsone with aromatic aldehyde to form a dimer structure (de Araújo *et al*., 2014).

1.2 Research Problem

Lawsone has been used as natural dying agent with various functional properties such as antioxidant, anti-inflammatory, antifertility, insecticidal, antimicrobial properties, and anticancer properties. The antioxidant properties can be characterized by the presence of phenolic compound of lawsone. Previous study found that lawsone could be made into dimer structure, which was expected to have greater antioxidant activity due to the additional phenolic compounds, by synthesizing the lawsone with aromatic aldehyde with the presence of β-alanine. However, the utilization of β-alanine was not economically efficient to be utilized as catalyst thus the glutamic acid could be used as the substitute catalyst since both β-alanine and glutamic acid are amino acids that are commonly used as catalyst. Glutamic acid could be made from monosodium glutamate that are commercially available in the market. Therefore, in this research the lawsone would be synthesized with aromatic aldehydes which are benzaldehyde, salicylaldehyde, and cinnamaldehyde by the presence of glutamic acid as catalyst. Then, the modified lawsone products' antioxidant activities would be evaluated.

1.3 Objectives

1.3.1 General Objectives

The general objective of this research was to modify the structure of lawsone into dimer and to study the antioxidant activities of modified lawsone.

1.3.2 Specific Objectives

The specific objectives of this research were:

1. To determine effect of different amount of catalyst (glutamic acid) on the yield of modified lawsone products.
2. To determine effect of different types of aromatic aldehydes (benzaldehyde, cinnamaldehyde, and salicylaldehyde) on antioxidant activities of modified lawsone products and to compare with the commercial lawsone.
3. To measure the presence and structure of modified lawsone products including mass spectrums by using GC/MS, and to identify functional groups of modified products through FTIR-spectroscopy.