CHAPTER 1

INTRODUCTION

1.1 Introduction

The relation between Islam and Science cannot be separated because both have their own responsibilities towards human civilization. Science exists from the curiosity of human about their environment and Islam lead human towards prosperity in this world and hereafter. Quran is a guide for Muslim. Everything that Allah created has their own purposes and we should study the other things that Allah left for us to think of. According to hadith At-Tirmidziyy, Abu Hurairah (May Allah be pleased with him) reported: The Messenger of Allah (peace be upon him) said, "The world, with all that it contains, is accursed except for the remembrance of Allah that which pleases Allah; and the religious scholars and seekers of knowledge." This hadith is related to knowledge where it emphasizes that acquisition of knowledge is compulsory.

Thus, this study was proposed to dig further knowledge about dates fruit as the dates palm is the most regularly cited plant which is mentioned 21 times in Holy Quran and 300 times in the Hadith of the Prophet Muhammad (Al-Yahyai & Manickavasagan, 2012). According to Al-Yahyai & Manickavasagan, (2012), besides Islam, dates palm is acclaimed in Judaism and Christian faiths as well. One of the examples verse that mentioned palm trees in Quran is Surah Mukminun verse 19.

"And We brought forth for you thereby gardens of palm trees and grapevines in which for you are abundant fruits and from which you eat."

[Quran, Mukminun 23:19]

Dates fruit from dates palm (*Phoenix dactylifera* L.) is known as a species in Arecaceae family can be used as a nutritious food and play positive roles for human nutritional and health needs (Assirey, 2015) and is considered as excellent food ingredient (Ahmed et al., 2013). Dates fruit have been reported to give abundant of beneficial health effects on human body (Alfaro-Viquez et al., 2018). Ajwa dates fruit also known in Malay as "kurma nabi" has been selected for this study. The main purpose of this study is to investigate the beneficial effects of dates flesh on human body by exploring the changes of urinary metabolites before and after the consumption of Ajwa dates fruit.

In order to explore the beneficial effect of dates flesh on human body, firstly, we must identify the chemical composition of dates flesh. In extraction, the crucial part is choosing the right extraction solvent and extraction method. Two techniques of extraction method commonly used to extract the chemical compounds in fruits are modern technique such as supercritical fluid extraction (SFE) and conventional method such as liquid-liquid extraction (LLE). The preparation of Ajwa dates fruits in this study for analysis has been based on LLE method, which has been selected due to cost effective (Kumari et al., 2016) and its compatibility with majority of analytical instruments (Nugbienyo et al., 2017). Besides, according to some researchers, it is also known that the yield of chemical compounds extraction depends on the type of solvents with varying polarities (Kchaou et al., 2013), extraction time and temperature

(Gironi & Piemonte, 2011), the ratio of sample-to-solvent as well as on the chemical composition and physical characteristics of the sample (Handa et al., 2016).

Regarding the solvent system used during extraction, a group of compounds which soluble in that solvent will be extracted from plant materials. Nawaz et al (2015) reported that the yield of extraction significantly affected by solvent polarity. Each organic solvent has its own polarity index in which has been arranged in order of increasing of polarity index based on the degree of interaction with polar test solute (Collins et al., 2017). However, it is difficult to recommend a suitable solvent extraction for extracting individual plant materials due to various chemical compounds contained in plant and their different solubility in different solvents (Truong et al., 2019). Therefore, the advantages of three mixture design in extracting the chemical compounds in Ajwa dates fruits were explored.

To investigate the benefit of Ajwa flesh on human body, a study on metabolites changes in human urine after consumption of Ajwa dates or *kurma Nabi* was performed. There are few challenges faced for metabolomics in human nutrition. The first is to identify the entire chemical in biofluid related to human nutrition metabolites. The second challenge was related to the large data set of commonly used instruments for metabolomics study which is Nuclear Magnetic Resonance (NMR) and Mass Spectrometry (MS). ^{1}H-NMR spectrum simultaneously displays hundreds peak of metabolites which analysed at the same time (Duarte et al., 2014; Gu et al., 2007), meanwhile mass spectroscopic metabolomics technique provides data with high sensitivity and selectivity. For instance, Liquid Chromatography Mass Spectrometry (LCMS) could be benefited from lower detection limits and improved MS data quality due to reduced background noise (Naz et al., 2014) and Niu et al

(2014) stated that Gas Chromatography Mass Spectrometry (GC-MS) gives high resolution chromatographic separation and wide applicability through derivatization. Finally, which is the main problem in metabolomics is lacking of standardize method, especially for global metabolomics analysis. Consequently, combination of MS and NMR techniques will give more details information for metabolomics research combined with the statistical analysis such as Principal Components Analysis (PCA).

PCA is one of chemometrics technique used as a tool for exploratory analysis which designed to reduce complexity of data sets and rearranges the data to exploit linear structure. PCA is also a well-defined as a technique using mathematically procedures as on orthogonal linear transformation from original data. The transformation of new data must have correlation between the new variable that called as Principal Components (PCs).

1.2 Problem Statement

Dates or *Phoenix dactylifera L* is one of the fruits consumed by Prophet Muhammad (peace be upon him) and known to benefit human health and metabolism as they are highly nutritious (Assirey, 2015) and rich in phytochemical compounds (Baliga et al., 2011). As well as other raw plants, dates flesh consist of chemical compounds with varying polarities from polar to nonpolar (Thouri et al., 2017), thus different polarity of solvent extraction is required in order to extract the compounds (Kumari et al., 2017; Nawaz et al., 2015). Nevertheless, some studies reported on the effects of combination of water and polar organic solvents (Thouri et al., 2017) and aqueous extract (El-Sharnouby et al., 2014) on dates flesh extraction. Therefore, in this study, by following the three mixture design concept, we used three organic

solvents with different polarities as the solvent extraction. Meanwhile, we know that consumption of dates flesh may have significant effect on the human metabolic system (Assirey, 2015; Gibney et al., 2005). Previous study showed the effect of dates flesh on diseases (Khan et al., 2017), as a potential cardioprotective agent (Alhaider et al., 2017) and in pregnancy (Al-Kuran et al., 2011). However, there are only few established journals reported on the effect of consuming dates fruits on the healthy human metabolic system. Hence, this study was done to investigate the role of Ajwa flesh on volunteers which are considered as healthy human as they have no history of exposure to severe diseases.

1.3 Significance of Study

Dates fruit are known as one of barakah fruits as they were mentioned multiple times in Al-Quran. Dates fruit also known to be a good supplement for human because this fruits have large amount of dietary fiber and contains carbohydrates with high energy content. Most of previous studies had focused on the beneficial effects of dates fruit on human with disease history, and the results showed the good effects of dates fruit on particular diseases. However, consumers with no history of chronic disease are always afraid to consume dates fruit due to high content of glucose. Therefore, this study will focus on the effect of Ajwa dates fruit on healthy volunteers which has no history of any chronic diseases.

1.4 Objectives

This study embarks on the following objectives:

1. To identify the chemical compounds in dates flesh using FTIR, GC-MS and LC-QToF-MS.
2. To measure the profiles of human urine post consumption of dates flesh using ^{1}H-NMR, GC-MS and LC-QToF-MS.
3. To evaluate the changes in human urine metabolites post consumption of Ajwa dates using Chemometrics technique (Principal Components Analysis).
4. To identify the metabolic pathway involved in human body from ^{1}H-NMR results.

1.5 Scope of Study

Chemical compounds in Ajwa dates flesh were extracted using three mixture design and were identified using GC-MS. To get more details on chemical compounds in Ajwa dates flesh, identification using LC-QToF-MS was done. Furthermore, ten different varieties of dates fruit were selected to profile the fingerprint of dates flesh using FTIR. On metabolomic part, the study was conducted on 10 healthy volunteers with no record of chronic diseases that consist of five males and five females aged between 20 to 25 years old. All volunteers were given detail information throughout the experiments to ensure they understand every detail on what they can or cannot do (including to follow the control diets) and the need to consume seven Ajwa dates flesh according to the information given as in Appendix 8. Throughout the experiments, urine samples were collected from all volunteers on Day 1 (one day before consumption of Ajwa dates flesh) and Day 2 (0, 4, 8, 12 hours) until Day 4 (24, 36, 48 and 60 hours) after consumption of Ajwa dates flesh. Metabolites changes in urine

samples were studied using ^{1}H-NMR, GC-MS and LC-QToF-MS to get further information on the effect of Ajwa flesh consumption in human body. All data obtained were evaluated using Unscrambler X 10.3 (CAMO, Norway) software.