## **UNIVERSITI TEKNOLOGI MARA**

# Correlating Solubility of Piperine Extraction Using Empirical Models

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This report is submitted in partial fulfillment of the requirements needed for the award of **Bachelor of Engineering (Hons.) Chemical** 

**Faculty of Chemical Engineering** 

JULY 2017

### ABSTRACT

Bioactive compound, which known as piperine was extracted from Malabar black pepper at temperature of 313, 323 and 333 K and operating pressure of 200, 250 and 300 bar in supercritical carbon dioxide (SCCO<sub>2</sub>). The experimental data was obtained from literature to be analyzed by using Microsoft Excel 2013 software with the application of four empirical correlation models which are Chrastil's model (CH), Del Valle and Aguilera's model (DVA), Kumar and Johnston model (K-J) and Sung and Shim model (S-S) to estimate the solubility data. The comparison of the data was discussed, from the correlated results, the AARD (%) values of CH, DVA, K-J and S-S are 6.9928%, 6.9897 %, 5.7786 % and 5.6075 % with SD of 2.448, 2.447, 2.023 and 1.963. Based on the results obtained, S-S model performed better among the four models and proved the effect of temperature and pressure on the solubility of piperine in SCCO<sub>2</sub> with the minimum AARD (%) value that indicates the satisfactory correlation results which have been achieved for each empirical models which has the highest number of parameters present and containing temperature effects, thus, increased the accuracy of the correlation models was employed to predict the solubility of piperine in SCCO<sub>2</sub>. The thermodynamic properties, total enthalpy,  $\Delta H$  of the solid solute was obtained which was equivalent to -2867.27 J/mol and can be applied in designing extractor and comparison between SCFs based on diffusion rate of piperine.

Keywords: Empirical correlation, piperine, solubility, supercritical carbon dioxide

## ACKNOWLEDGEMENT

I would like to express the deepest appreciation to my supervisor Miss Sitinoor Adeib binti Idris, who has shown the attitude and the substance of a genius. She continually and persuasively conveyed a spirit of adventure in regard to research and scholarship, and an excitement in regard to teaching. Without her supervision and constant help this dissertation would not have been possible.

In addition, I would like to express my gratitude to all the lecturers for the guidance and encouragement. I would like to thank my friends who have helped me throughout encouragement and insightful comments.

Last but not least, I would like to thank my parents for their unconditional support, both financially and emotionally throughout my degree. In particular, the patience and understanding shown by my parents is greatly appreciated.

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### **CHAPTER ONE**

### INTRODUCTION

#### 1.1 RESEARCH BACKGROUND

Black pepper is also known as *Piper nigrum L*. is an aromatic plant that belongs to Piperaceae family and has been nicknamed as '*Black Gold*' and the '*King is Spices*' which is one of the most used spices in the world due to its flavor and pungency (Charles, 2012; May Lin, Siew Ping, Saptoro, & Freddie, 2013). It is one of the oldest spices that account for almost 35% of all the spices traded annually on the international market (Charles, 2012). Major countries of producing black pepper are India, Indonesia, Malaysia and Brazil. It is also cultivated in Vietnam, China, Sri Lanka, Mexico, Madagascar, Singapore, Myanmar, Thailand, Cambodia, Laos, New Guinea and West Africa (Charles, 2012; Lim, 2012). Black pepper is widely known as a valuable spice and prized for its content in alkaloids, essential oil and terpenes respectively. It has been found to be used in many industries, for instance food industries, pharmacological industries, perfumery, cosmetics and home remedies as its components extract possess multiple applications in these industries (Goswami & Meghwal, 2012; Lim, 2012).

Black pepper is derived from the dried unripe berries and it gives peppercorn or well known as black pepper. The processing into black pepper is depending on the harvest time and the processing. Black pepper is universally used as a taste and flavor enhancing food agent. It is found that black pepper has been effectively used in medical field worldwide and act as one of the most important constituents (Charles, 2012; Goswami & Meghwal, 2012). This is because of its beneficial influence in antioxidant, anticancer, gastrointestinal, anti-inflammatory, antidiabetic, antipyretic, and antihypertensive, improves digestion and promotes intestinal health (Lim, 2012; nutrition-and-you). Black pepper contains oil yield in range of 1% to 4% (Charles, 2012). From the extraction, it has been found that the oil contains phellandrene, linalool, limonene, pinene, caryophyllenene, sabinene and careen as the major constituents