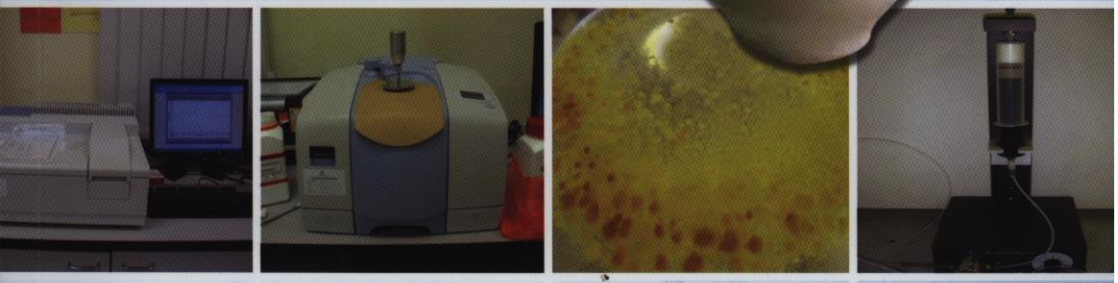
EXPERIMENTAL METHODS in MODERN BIOTECHNOLOGY

Volume 2



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Contents

Chapter 11

Extraction of Oil from Waste Source

Sarina Sulaiman

Introduction

Coconut oil was first extracted from the solid waste and characterised to investigate the oil content in the waste and the properties of the oil. In these studies, the waste from coconut industries is used as the feedstock. In Malaysia, about 78 thousand metric tons of coconut wastes were produced in 2010 of which majority are from coconut oil waste and being used as fertiliser or to feed the cows or left to decompose on the fields (Sulaiman, Abdul Aziz, & Aroua, 2013; Sulaiman, Abdul Aziz, & Kheireddine Aroua, 2013). Typically coconut may still contain 24 wt% of extractable oil content. Hexane and petroleum ethers were used as solvents for soxhlet extraction processes. Effect of solvents, temperature and reaction time were evaluated to determine the optimum conditions for the extraction process.

Extraction is a process where solute is transferred to another liquid (solvent). Extraction process involves contact of the solvent with the solid phase and separation or washing of the solute from the solid. Extraction of oil can be conducted using soxhlet extractor in industrial scale, solvent extraction and supercritical extraction. Soxhlet extractor is usually used because it is a simple and efficient way to determine the lipid or oil in the solid (Fernández, Ramos, Pérez, & Rodríguez, 2010). Oil or fat or wastes from solid material are extracted by repeated washing with solvent under reflux conditions. The oil recovery from the waste increases with the increase in the temperature (boiling point) of the solvent. The highest oil yield can be obtained from the soxhlet extractor. In this process n-hexane, petroleum ether, kerosene and even

diesel oil are utilised as solvents (Kojima, Du, Sato, & Park, 2004; Singh & Singh, 2010). N-hexane promotes and accelerates the mass transfer and diffusivity of oil within the seed. This is in agreement with the finding of (Shuit, Lee, Kamaruddin, & Yusup, 2010), where using methanol as solvent and 10% v/v of hexane as cosolvent is capable to extract more than 90% of oil.

There are few operating conditions involved in extraction process. These effects are particle size, temperature, type of solvent and solid to solvent ratio. The rate of extraction increases with the decrease in the size of particles. The smaller the size, the greater the interfacial area and pore diffusion between the solid and liquid. This is because the distance of the solute with solid for the diffusion to occur is smaller. Smaller particle size allows better mass transfer between oil and solvent (Kwiatkowski & Cheryan, 2002; Nagy & and Simándi, 2008).

Temperature plays an important role in the extraction process. Extraction temperature should be chosen with consideration of solubility, solvent diffusivity and solvent- vapour pressure. The increase in temperature increases the oil yield during extraction process (Meziane & Kadi, 2008). This is supported by Meziane and Kadi (2008) that the rise in temperature increases the solubility and diffusion of the oil while decreasing the viscosity. The mass transfer coefficient of the extraction process also increases with temperature, thus, affecting the diffusion.

The solvent for extraction process must be chosen based on several factors. It should have high saturation limit and selectivity for the solute to be extracted, low toxicity, low density, ease and economic recovery and low viscosity. Methanol is used as reactant and extractant in situ process, but it is a poor solvent for oil extraction. Introducing good solvent such as hexane, petroleum ether and chloroform could lead to a higher oil yield (Li, Xiaoling Miao, Rongxiu Li, & Zhong, 2011).

Solid to solvent ratio is another parameter that affects the performance of the extraction process. Increasing solid to solvent ratio increases the oil yield up to a certain point before the yield reach equilibrium as oil in the particle has been almost thoroughly extracted. At lower solid to solvent ratio, the oil extraction process maybe restricted because of lower solubility limit of oil in solvent. Kwiatkowski et al. (2002) reported that when extraction time and temperature are held