CHAPTER

6

EXTRACTION FOR RAMBUTAN PEEL

Nursyarfariena Kamal, Raihanah Roslan, and
Muhammad Syafiq Hazwan Ruslan

6.1 INTRODUCTION

This chapter introduces rambutan, or scientifically known as *Nephelium lappaceum*, from the Sapindaceae family as the potential natural resource of antioxidants for rubber industries. Rambutan trees grow in warm climate regions such as Malaysia, Thailand, Mexico, and India. Its fruit has edible, white, and juicy flesh. The fruit peel turns into bright red when ripe, sometimes with yellow or orange hues. It is not edible in its raw form. The fruit is covered by a round pericarp with soft, thorn-like hairs, comprising approximately 46% to 65% of the fruit weight. The fruit peel contains an abundance of compounds, consisting of four main types of phenolic compounds such as corilagin, ellagic acid, gallic acid, and the dominant geraniin. It also contains anthocyanins which are natural pigments. Hence, the extract of rambutan peel could be used as natural colorants for industrial application.

Rambutan has been one of the most popular local fruits, accounting for nearly 9% of all local fruit production. Its cultivation spans approximately 15,995.71 hectares, yielding an annual production of around 37,215.01 metric tons (Abu Dardak, 2019). ASEAN nations, including Malaysia, have engaged in a cross-border trade of tropical fruits to meet high domestic demand. According to the ASEAN Secretariat, Malaysia imported local fruits worth about RM383,160.00 in 2018, while exports to foreign nations were about RM409,329.71. The fruits are usually eaten fresh or made into products such as canned or dried fruits. As the fruit demand increases, waste generated from the processing becomes abundant and indirectly contributes to the environmental problems. Somehow, rambutan peel has a bright potential to turn it into antioxidants for the application of rubber industries.

Raw rubber is highly susceptible to oxidation when exposed to light, heat, and ozone over extended periods. Rubber industries employ synthetic antioxidants like N1-(4-methylpentan-2-yl)-N4-phenylbenzene -1,4diamine (6PPD) and poly(1,2-dihydro-2,2,4-trimethyl-quinoline) (TMQ) in gloves, tires, and other products to prevent rapid oxidization. The added antioxidant may quench the chain reaction of free radicals. Hence, antioxidants are important to keep rubber from degrading, improving its flexibility, strengthening the material, and extending its shelf life. However, the excessive use of synthetic antioxidants may contaminate the environment. The chemical hazards are harmful and may cause eye irritation, organ damage, and allergic skin reactions. The threshold limit value of 6PPD is as low as 2 ppm. Therefore, there is a high demand for producing natural antioxidants from plant-based materials as alternatives to conventional synthetic antioxidants.

Extraction plays a major role in the effort to recover value-added or antioxidative compounds from rambutan peels. Even though the setup of conventional extraction techniques such as maceration and soxhlet extraction is simple, and the cost is also durable, the energy consumption and extraction time of the conventional techniques are relatively high. The technique of maceration may take up to hours or days to complete extraction. Often, a large volume of solvent is required for extraction. The high-volume usage of solvent contributes to a significant cost of operation. Therefore, microwave-assisted extraction (MAE) and ultrasound-assisted extraction (UAE) have been the methods of choice recently. Specifically, solvent-free microwave extraction (SFME) is accepted as a reliable method to extract bioactive compounds from natural resources. SFME enhances the efficiency of extraction and reduces the energy consumption and extraction time in the absence of solvents. This technique has widely been applied to extract essential oil from aromatic herbs. It integrates microwave heating and dry distillation at atmospheric pressure without adding any solvent or water for extraction. Therefore, SFME can be considered as green technology. Its extraction efficiency strongly depends on microwave energy. More importantly, the extraction efficiency is definitely higher than hydro-distillation which requires longer extraction time. A large volume of solvent is also required to distillate volatile compounds during distillation.

Solvent-free microwave extraction (SFME) highly depends on the original water content inside the sample matrices. The requirement of using SFME is that the sample must have at least 70% to 80% moisture content. The in-situ water will absorb microwave radiation and undergo localized molecular superheating. This leads to a sudden increment of pressure and surface tension, thus resulting the rupture of the cell wall. The vaporized water escapes from the sample matrices along with compounds to the condenser and is collected in the flask at the end of the setup.

6.2 OPERATING VARIABLES AND RESPONSES

This section discusses the process of SFME for rambutan peels. Fresh rambutan peel can be washed and rinsed to remove dirt prior to extraction. The peel is cut into small pieces and stored in a freezer to prevent oxidation before analysis.

A preliminary study on the moisture content of rambutan peel can be conducted before optimization. The moisture content is gravimetrically analyzed by drying the cut rambutan peels in an oven at 105 °C for 3 hours. The weight difference of the sample before and after drying can be used to determine the moisture content. It is important to ensure enough moisture in the sample matrix for solvent-free extraction.

Consequently, two critical operating variables, such as extraction time and microwave power, are carefully monitored to prevent samples from burning during extraction. Both fresh and frozen rambutan peels can be placed in different round-bottom flasks and radiated using