CHAPTER I
INTRODUCTION

1.1 Background

In food industry, fruit peels are generally left unutilized and considered as waste. Nevertheless, they contain hidden potential in the form of bioactive ingredients, varying from antimicrobial substances to different phytonutrients. With the increase in fruit-based products, there is an immediate need to utilize fruit peel for its beneficial compounds, while at one time reducing environmental pollution.

Among horticultural commodities, rambutan (*Nephelium lappaceum* L.) is a native fruit of Indonesia which has gained popularity across ASEAN countries and largely contributes to the income source of Indonesian farmers (Prihatman, 2000). The peeled, deseeded fruit is valuable for both direct consumption and processed products as canned and freeze-dried fruits, or made into jam, jellies, syrup, and sweets. As a result, new studies emerge to develop beneficial uses from the seeds and peels. The woody seeds have been studied as a source of natural fat for manufacturing candies, soaps, fuels, and other industrial purposes (Sirisompong *et al.*, 2011; Solis-Fuentes *et al.*, 2010; Patamapongse and Showler, 1969).

Rambutan peels have also been subjected to assessment of antioxidant, anti-microbial and anti-hyperglycemic properties (Palanisamy *et al.*, 2011; Mohamed *et al.*, 1994). More recent studies showed that rambutan peels have an inhibitory effects toward fermentation processes, specifically in cider and cassava *tapai* (Benardo, 2012; Suhartaty, 2014; Manuella, 2014; Jonatan, 2014; Astria, 2014). A

study conducted by Benardo (2012) found that several compounds in rambutan peel contribute to the lower alcohol content in the making of cider, approximately 3% after 21-day fermentation period; lower than pomegranate peel cider made with the same treatments and methods conducted by Parlina (2012). Further research was carried out by Suhartaty (2014) who utilized rambutan peel as fermentation inhibitor in apple cider, where the ethanolic and ethyl acetic extracts of rambutan peel were able to produce low, controlled alcohol content of cider (approximately 1%) as compared to control (approximately 10%) after 21 days. Jonatan (2014) also concluded that both extracts of rambutan peel produced lower alcohol content of cassava tapai (approximately 3%) as compared to control (approximately 7%) after 6 days. In both studies, the ethyl acetic of rambutan peel showed higher inhibitory effect by producing lower, even no alcohol when applied in the same concentration as the ethanolic one.

Palm sap is a sweet liquid derived from the bark or flower of sugar palm tree (*Arenga pinnata* Merr.). Most of the collected palm sap is used as the main ingredient of moulded brown sugar, which is essential to Indonesian cooking. As an alternative to cane sugar, brown sugar has a relatively high demand in comparison to its productivity. Based on the report by Yusuf *et al*. (2012) the production of palm sugar is approximately 6,686 tonnes per year in Jawa Barat only. In 2003, the area of sugar palm tree plantation was recorded as 59,388 ha, from which 33,181 tonnes of sugar were produced (Ditjenbun, 2010); while Pontoh (2012) observed that each hectare of the plantation can produce up to 25 tons of sugar per year.

The sap is rich in nutritional components, especially sugar, thus easily become a favorable media for microbial growth, including fermentative yeasts and bacteria. Therefore, palm sap will quickly be spoiled due to natural fermentation after harvest and become unsuitable for sugar production after 3 hours (Faesal, 1988). This high perishability of palm sap has driven farmers and researchers to find the suitable preservative agent. Examples of such preservatives include candlenut, coconut oil, castor oil/seed (Marsigit, 2005), cashew apple leaves, bark of *Schleichera oleosa* or *kayu kesambi*, sodium benzoate, limestone (Muzaifa *et al.*, 2012), and jackfruit bark (Lubis, 2013). Nonetheless, rambutan peel has not yet been applied to palm sap to act as fermentation inhibitor as mentioned in the studies above. It is commonly known among farmers that longer storage time of palm sap will be beneficial; therefore, it is desirable to delay its fermentation where no significant chemical reactions occur. The problem regarding the short shelf life of raw palm sap may potentially be overcome by the utilization of rambutan peel to delay the natural fermentation and increase the productivity of palm sugar industry.

1.2. Research Problem

The productivity of palm sugar industry depends on the supply of fresh palm sap which contains high amount of sucrose and minimum concentration of acid and alcohol. However, the highly nutritive composition of palm sap induces natural fermentation to occur within approximately 4 hours, leading to a need of preservative agent which suppresses fermentation process. It is also well-known that prolonged storage of palm sap will be beneficial for farmers, by inhibiting the fermentation where chemical reactions change the properties of palm sap. It has been proven that ethyl acetic extract of rambutan peel can inhibit alcoholic

fermentation in cider and cassava *tapai* (Suhartaty, 2014; Jonatan, 2014), but the application in palm sap and its effect has not been studied. Therefore, this research was conducted to study the effect and effective concentration of rambutan peel made into several forms (reduced-size, dried, or semi-dried), and its ethyl acetic extract in inhibiting fermentation process of palm sap as the main ingredient for palm sugar.

1.3 Objectives

1.3.1 General Objectives

The general objective of this research was to utilize rambutan peel and its extract to inhibit the fermentation process of palm sap.

1.3.2 Specific Objectives

The specific objectives of this research were:

1) a) To preliminarily assess the suitable concentration of the reduced-size and dried rambutan peels in inhibiting alcoholic fermentation for sugar production.
   b) To search for the alternative forms of rambutan peels, should all or either one mentioned in point 1 a) did not work.
2) To determine the effect of the addition of semi-dried or ethyl acetic extract of rambutan peel (as the alternative form) on the physicochemical changes of palm sap.
3) To produce palm sugar from the sap treated with certain concentrations of semi-dried and extract of rambutan peel.