CHAPTER I

INTRODUCTION

Traditional Thai rice wine is widely produced by fermentation of mixing cooked glutinous rice with Thai traditional starter (Luk-Pang) for about 14 days. The starter consists of mold, yeast, bacteria, rice flour, and Thai herbs. The fermented liquor will be collected after removal of large suspended solid by filtering through cheesecloth, and then heating prior to bottling to inactivate microorganisms and prolong shelf life. Typical characteristics of Thai rice wine are turbid liquid, slightly sweet, and short shelf life of 7 days at 5 ^{O}C. The final product still contains microorganisms and fine particles such as starch, cellulose and protein, resulting in off flavor, sedimentation, explosion of bottle, and short shelf life.

In order to prolong the shelf-life of Thai rice wine, the microorganisms have to be eliminated. Moreover, heating to stop activities of microorganisms should be avoided for maintain the flavor of products. Microfiltration using 0.10-0.45 μm membrane pore size will eliminate both living microorganisms and suspended solids. Microfiltration is widely used for stabilization and sterilization of wine and beer offer an attractive alternative process as cold-sterilization of traditional Thai rice wine. This process can be used for removing suspended solids and microorganisms without applying heat treatment resulting in retention of aroma and flavor compounds. Therefore, microfiltration was selected for improving the stability and quality of Thai rice wine, including prolonged shelf life. However, successful application of microfiltration may be hindered by membrane fouling, which reduced the permeate flux and filtration performance.

The filtration performance (in terms of permeate flux) are affected by operating conditions, membrane characteristics, and feed characteristics (Baker, *et al.*, 1985; Padilla-Zakour and McLellan, 1993; Bowen and Jenner, 1995; Baker, 2000; Gan *et al.*, 2001; Fillaudeau and Carrere, 2002; Urkiaga, *et al.*, 2002). The operating conditions are transmembrane pressure (ΔP), crossflow velocity, and stirring speed. An increase in the ΔP and crossflow velocity resulted in permeate flux increasing (Redkar and Davis, 1993; Shimizu, Shimodera, and Watanabe, 1993; Vyas, Bennett, and Marshall, 2000a).

The membrane characteristics are chemical properties (hydrophilicity and hydrophobicity), membrane pore size, and membrane morphology (membrane porosity and membrane pore structure). Membrane pore size was reported as one of important parameters, which affected the permeate flux and permeate characteristics (Girard and Fukumoto, 1999; Gan *et al.*, 2001; De Brujin, Venegas, and Borquez, 2002). Burrell and Reed (1994) have concluded that large pore size membranes increased permeate flux and permeate turbidity. Carneiro *et al.* (2002) and De Brujin, Venegas and Borquez (2003) found that the permeate qualities and permeate flux were successful improved when using a suitable membrane.

The feed characteristics such as constituents, suspended solid size and size distribution, and suspended solid concentration, affected the permeate flux and permeate characteristics (Belfort, Davis, and Zydney, 1994; Bowen and Jenner; 1995; Gehlert, Luque, and Belfort, 1998; Guell, Czekaj, and Davis, 1999; Vernhet and Moutounet, 2002). The filtration performance was governed by colloids and small particles, which plugged the pores of the membrane leading to a reduction in permeate flux (Kawakatzu, Nakao, and Kimura, 1993; Vernhet, Cartalade, and Moutiunet, 2003). Noordman *et al.* (2003) has reported that increasing the average particle size in the feed leaded to an increase in permeate flux. Increasing the particle concentration caused a decreased permeate flux (Vyas, Bennett, and Marshall, 2000b; Vladisavljevic, Vukosavljevic, and Bukvic, 2003). The pretreatments of feed prior to filtration such as prefiltration and centrifugation were used to minimize fouling and membrane resistance due to reducing the suspended solids contents in feed (Huang and Morrissey, 1998; Krstic, Markov, and Tekic, 2001; Fillaudeau and Carrere, 2002).

Cake filtration theory is widely used to describe membrane fouling. Basically, the permeate flux is determined by the combined resistance of membrane and the cake layer. The cake layer increases proportionally to the specific cake resistance which is a measure of the 'filterability' of the feed suspension and its dependence on pressure, which determines how quickly a filtration can be performed. In the most dead-end filtration process, the resistance of cake layer is dominant (Lodege, Judd, and Smith, 2004; Foley, 2006). Therefore, the microfiltration performance can be evaluated in terms of the specific cake resistance which correlated with the permeate volume and dry cake mass.

To date, the application of microfiltration in producing Thai rice wine has never been investigated. This research aims to provide a scientific knowledge for manufacturing superior quality Thai rice wine. In this research, the scientific bases to be studied were effects of feed characteristics (size and size distribution and concentration of suspended solids), operating conditions (ΔP and stirring speed) and membrane characteristic (membrane pore size) on microfiltration performance in terms of permeate flux and specific cake resistance (α) as well as permeate characteristics. In order to alter feed characteristics, three different separation methods were used for reduction of suspended solids in feed prior to microfiltration.

Objectives

The objectives of this study were

1. To determine effects of solid-liquid separation methods on microfiltration performance and characteristics of rice wine and microfiltered rice wine.

2. To determine effects of membrane pore size, ΔP, and stirring speed on microfiltration performance and microfiltered rice wine characteristics.

3. To determine effects of size, size distribution, and concentration of suspended solids on microfiltration performance.