CHAPTER 1

Introduction

1.1 Statement and significant of the study

Food waste, an organic solid waste which is usually discarded from various sources including canteen, restaurants, commercial kitchens and cafeterias (Yan et al., 2011). The amount of food waste has been predicted to increase in the next 25 years due to economic and population growth, mainly in the Asian countries. For example, the annual amount of food waste in Asian countries would increase from 278 to 416 million tons from year 2005 to 2025 (Uçkun Kiran et al., 2014). Food waste are usually landfilled or incinerated which can produce many environmental problems (Hong and Yoon, 2011) especially emission of greenhouse gases e.g. methane (CH_4) and carbon dioxide (CO_2) (Moon et al., 2009). The major component of the food waste is starch, which could be either hydrolyzed to fermentable sugars (Matsakas et al., 2014; Wang et al., 2012) or directly used as a carbon source for growth, lipids and carotenoids productions by various types of oleaginous microorganisms (Schneider et al., 2013; Tanimura et al., 2014).

Oleaginous yeasts are single cell oil which can fast synthesized and accumulated lipids in their cell more than 20% (w/w) (Donot et al., 2014). The typical genera of yeasts which have been considered as oleaginous are *Sporidiobolus*, *Rhodosporidium*, *Rhodotorula*, *Yarrowia*, *Trichosporon*, *Cryptococcus*, *Candida* and *Lipomyces* (Patel et al., 2016). They can store lipids in the form of triacylglycerol (TAG) and lesser amounts of sphingolipids, phospholipids, sterols and free fatty acid in their cell (Subramaniam et al., 2010). The major fatty acids in most of the yeast strains were oleic acid (C18:1), palmitic acid (C16:0), stearic acid (C18:0), linoleic acid (C18:2) and myristic acid (C14:0) (Sitepu et al., 2013). Lipids derived from oleaginous yeast, known as microbial lipids, have fatty acid compositions similar to vegetable oil which can use as the third generation of biodiesel feedstock and other oleochemicals (soaps, detergents, rubber and food additives and cosmetic industries) (Sitepu et al., 2014). The third generation of biodiesel feedstock is based on improvements in the production of microbial-derived biomass which is not food competitors, better environmental performance and particularly in terms of lower greenhouse gas emissions (Gambelli et al., 2017). Moreover, the production of microbial lipids has many advantages more than vegetable oils such as shorter culture period, easy to harvest and no need of agricultural land (Xu et al., 2012). Some oleaginous yeasts can accumulate both of lipids and carotenoids in their cell such as *Rhodosporidium* sp*., Rhodotorula* sp*., Sporidiobolus* sp. and *Sporobolomyces* sp. (Wang et al., 2012). Carotenoids have some advantages such as provitamin A function, anticancer activity, natural food colorants, ingredients in cosmetics and nutritional supplements (Cardoso et al., 2016). The lipids and carotenoids yields, depend on strain, species, culture medium conditions and physical conditions e.g. pH, agitation rate, light intensity and temperature (El-Banna et al., 2012).

There are many types of carbon sources that have been used for growth and lipogenesis of oleaginous yeasts, e.g., glucose (Lin et al., 2011; Wiebe et al., 2012), sugarcane (Tsigie et al., 2011) crude glycerol (Saenge et al., 2011b; Xu et al., 2012), molasses (Cheirsilp et al., 2011; Karatay and Dönmez, 2010), starch hydrolysate (Wang et al., 2012), lignocellulose hydrolysate (Patel et al., 2016). However, there are few reports of amylolytic oleaginous yeast and mold that capable to use starch based raw material as a sole carbon source. For example, Muniraj et al. (2013) reported that amylolytic oleaginous *Aspergillus oryzae* produced lipids and lipids content of 3.5 g/L and 40% (w/w), respectively, when potato processing wastewater was used as carbon source. While, *Rhodotorula glutinis* produced 4.55 g/L of lipids and 35% (w/w) of lipids content in the medium containing corn starch wastewater (Xue et al., 2010). Moreover, Chi et al. (2011) revealed that *Yarrowia lipolytica* produced lipids and lipids content of 0.03 g/L and 11.5% (w/w), when food waste and municipal wastewater were used as carbon source. Whereas, *Cryptococcus terricala* exhibited high lipids content of 61.96% (w/w) or 3.02 g/L of lipids when it was cultivated in starch medium through consolidated bioprocessing (Tanimura et al., 2014).

The utilization of cheap carbon source for lipids and carotenoids productions by oleaginous red yeast can contribute to the minimization of production costs. Exploring a low-cost carbon sources for high productivity of lipids and carotenoids is being interesting. Hence, this study demonstrates screening and isolation of amylolytic oleaginous red yeast from flowers and leaves samples collected from Doi-Inthanon National Park and Faculty of Agro-Industry, Chiang Mai University as well as the culture collection of the Thailand Institute of Scientific and Technological Research (TISTR) and the Division of Biotechnology, Faculty of Agro-Industry, Chiang Mai University. The newly amylolytic oleaginous red yeast (*Sporidiobolus pararoseus* KX709872) has ability to utilize rice residue from food waste as an alternative low cost carbon source for high value metabolite production of lipids and carotenoids. Moreover, the optimizations by the statistic designs approach are employed to enhance the production of the lipids and carotenoids by strain KX709872.

1.2 The objectives of this study

1.2.1 To screen and isolate oleaginous yeast for lipids and carotenoids production using rice residue from food waste as a carbon source.

1.2.2 To study the optimal condition for lipids and carotenoids production by selected oleaginous yeast strain using rice residue from food waste as a carbon source through the statistic experiment design.

1.2.3 To study the up-scale production of lipids and carotenoids in a stirred tank bioreactor using the optimal conditions.