CHAPTER 1

Introduction

Papaya (*Carica papaya L.*) is a plant in Caricaceae family (Rojsanga et al., 2014). Papaya is one of the major economic crops in Thailand (Subhadrabandhu and Nontaswatsri, 1997). The fruit is a popular commodity for consumer both locally and abroad. Papaya was ranked in the top 5 nutritionally beneficial fruits (with guava, watermelon, grapefruit and kiwifruit) among 38 common fruits based on nutritional scores and the percentage of Recommended Daily Allowance for pro-vitamin A, ascorbic acid, potassium, folate and fibre (Ikram et al., 2015). The luscious taste of the fruit has assisted its fast growing market. It is consumed fresh and widely used in food industry for the production of jams, liquors, ice creams and beverages (Kelebek et al., 2015). In Thailand, papaya can be grown in every region of the country. The major growing areas are Chumphon, Nakhon Pathom, Samut Sakorn, Chiang Mai and Ratchaburi provinces (Khurnpoon et al., 2010). The plant of papaya has productivity throughout the year. Khurnpoon et al. (2010) stated that the Northeast of Thailand had a papaya plantation for 16,509 rai and yielded up to 1,262.347 tonnes. According to Food and Agriculture Organisation (FAO, 2014), in 2011 and 2012 Thailand produced papayas for 212,000 and 215,000 metric tonnes, respectively. In Thailand, the green fruit of papaya is widely used in Thai cuisine, particularly in the famous papaya salad (Chaiwut et al., 2010). However during fruit ripening, softness of the papaya flesh fruit increases rapidly that causes deterioration, presence of microbial growth and shortening the fruit shelf life (Fuggate et al., 2010; Phothiset and Charoenrein, 2011). The yellow and red flesh of papaya fruit contained high water content (Nunes, 2008). The presence of water has a direct influence on the quality and durability of food, which affects many physicochemical and biological changes. One method of food preservations to preserve food is removal of water from fruit by drying. The reduction of moisture content in the fruit can help to safely store the fruit over an extended period of time. In addition, dried

food products also present low storage area and transportation compared to the fresh ones (Fernandes et al., 2006).

Development of food products that can promote health and well-being beyond providing basic nutrition is on the rise (Alzamora et al., 2005). This was partly due to a better awareness of consumers, causing a demand of probiotic functional food products to be rapidly increased (Tripathi and Giri, 2014). Probiotic food products are reported to provide several health benefits, including maintaining a good balance and composition of intestinal flora and an increase in the resistance against pathogen invasion (Argyri et al., 2013; Tripathi and Giri, 2014). At the moment, the most common probiotic microorganisms used and marketed in commercial food products belong to the genera *Lactobacillus* and *Bifidobacterium* (Martins et al., 2013). These microorganisms have been supplemented in various dairy products, including yoghurt, cheese, ice cream, butter and mouse. However, fruit, vegetable and cereal products can also be used as a vehicle to deliver probiotic microorganisms, since these food products can be incorporated with the good microorganisms and may provide prebiotic fibers (Martins et al., 2013). These authors had listed some fruit and vegetables products that have been studied to be a carrier of probiotic microorganisms, which included apple, olive, soybean, yam and cabbage. Up to now, there is scarce information that reports about the incorporation of probiotic in papaya fruit pieces.

Vacuum impregnation is considered as a promising technology to facilitate the impregnation of different solution into fruit and vegetable tissues (Panarese et al., 2013). The process is a part of food preparation techniques that can modify food composition and properties of food (Schulze et al., 2014). Applying the vacuum impregnation will lead to a substitution of air in food sample structures by an impregnation solution that can help to increase the rate of water-related weight loss and solid gain and control the quantities of a solution in the porous structure of the sample (Moreno et al., 2012). The fruit and vegetable tissues with different pore size and pore geometry will have different transport properties during vacuum impregnation (Panarese et al., 2013). The advantage of the process will include prevention discolouration of fruit pieces from enzymatic browning and oxidative browning without using antioxidants due to removal of oxygen from fruit pore. The method can also be

used to improve fruit quality by adding functional food ingredients, such as firming agents (Zhao and Xie, 2004).

Drying is an effective food preservation method to eliminate large amount of water from food materials and to slow down the growth of spoilage microorganisms, such as mould, yeast and bacteria. It can also inhibit enzymatic reaction or slow down other reaction in both chemical and biochemical reactions involving water that can cause food spoilage (Orikasa et al., 2014). Drying process is applying heat under controlled conditions in order to improve the quality and durability of foodstuffs (Cheenkachorn et al., 2012; Crowley and O'Mahony, 2016; Yousefi et al., 2013). Hot air drying is a traditional method with low cost procedure. The method is widely used for food dehydration by utilising some kinds of driers (Yousefi et al., 2013). On the other hand, vacuum drying is an alternative drying method, which is suitable for products that are sensitive to heat (Laopoolkit and Suwannaporn, 2011). The characteristics of the last drying method are low drying temperature, high drying rate and can help maintaining food qualities (Šumić et al., 2013). Different drying methods can be appropriately used for different food products. There are various advantages and disadvantages for each drying technique (Huang et al., 2016; Udomkun et al., 2015a). So, drying technique should be fit with food materials to make sure that the nutritional quality of food material is retained (Crowley and O'Mahony, 2016). In addition, when comparing fresh food with dried food it was found that dried food has light weight, small volume together with easy and low cost to manage and transport (Fernandes et al., 2006). Dried product creating a new product, which is an alternative choice for more consumer.

This study was aimed to investigate the effects of papaya raw materials, calcium solution, vacuum impregnation condition and drying conditions on the physicochemical properties of partially dried papaya. The final papaya product would also be supplemented with a lactic acid bacterium to increase its functional property and the survival of the bacterium in the papaya products at different storage temperatures would be investigated.

Purposes of the study

1. To study the maturity stages and fruit sizes of papaya on the physicochemical of vacuum impregnated papaya.
2. To investigate the vacuum impregnation conditions (impregnation solution ratio, vacuum time and relaxation times) on the physicochemical of vacuum impregnated papaya.
3. To examine different drying methods and drying temperatures to develop partially dried papaya.
4. To determine the effect of calcium solutions on intermediate moisture papaya texture.
5. To understand the survival of a probiotic bacterium in partially dried papaya during storage at different temperatures.