CHAPTER I
INTRODUCTION

Pectin is a high-value functional food ingredient which is widely used as a gelling agent and stabilizer. It consists of complex polysaccharides located in the cell walls and the middle lamellae of plants. The dominant structural feature of pectin is a linear $1\rightarrow 4$-linked chain of poly-α-D-galacturonic acid with varying degrees of esterification of carboxylic groups. Its gelling properties are primarily dependent on the degree of esterification and the molecular weight of the polysaccharides (1). Thus, sources of raw material and the extraction process of pectin can influence the properties and structure of pectin. Normally, commercial pectin is extracted from citrus peels and apple pomace with a multiple-stage physical-chemical process. In Thailand, pectin is imported from abroad at a value of more than 200 million baht per year (2). Alternatively, other sources of pectin have been investigated with special attention to agricultural raw materials which can be locally produced.

Okra plant, *Abelmoschus esculentus* (L.) Moench, is originally an African plant and is now grown in many areas of the world including the Middle East, the southern part of USA and Asia. In Thailand, okra is easily cultivated and widespread making its price inexpensive. Okra pods are consumed as a vegetable including blanched okra with chili paste. Moreover, immature okra is used in traditional medicine as a diuretic agent (3) and for treatment of dental disease (4) and as a dietary meal to prevent gastric irritations. Several benefits of okra are linked to the mucilage content. Interestingly, okra contains clear water soluble mucilage. Okra mucilage, commonly called okra gum, is mainly water soluble polysaccharides. It has a slimy appearance when extracted with water and can provide viscosity to a solution. In many areas of West Africa, okra mucilage is used as a thickening agent for soups and stews in home cooking (5). Furthermore, the okra polysaccharide was firstly found as an acidic polysaccharide consisting of galactose (Gal), rhamnose (Rham) and galacturonic acid (GalA) (6). Deters *et al*. (7) confirmed the findings as mentioned by

Lengsfeld *et al*. (8) that okra polysaccharide consisted of the sugars; Rham, GalA, Gal, glucose and glucuronic acid (GlcA). Besides, okra extract obtained by using hot buffer extraction was shown to be rich in Gal, Rham and GalA at a ratio of 1.3:1:1.3. The degree of acetylation was relatively high (DA = 58) while the degree of methyl esterification was relatively low (DM = 24) (9). The sequential extraction of okra cell wall material showed that okra contained different types of polysaccharides, that is, pectin, xyloglucans, xylans and cellulose (10). Thus, okra also has a potential for use as a source of pectin for commercial preparation.

The production of pectin consists of extraction, purification and drying. The use of a suitable method for pectin extraction is important in order to maximize its yield and quality. The yield and quality also depends on extraction operation condition such as the temperature, the extraction time, the pH and the type of extraction solvent. Levigne *et al*. (11) demonstrated that extractive conditions (pH, temperature, time and acid) affected the feature of extracted pectins. The viscosity of okra mucilage decreased markedly with high extraction temperature (12). The extraction of pectin from orange peels with water-base solution by El-Nawawi and Shehata (13) revealed that extending the extraction period resulted in an initial increase in pectin yield. However, when extraction period was further extended, the yield of pectin decreased. Moreover, the extraction by using distilled water as a solvent showed the greater yield than ethanol and EDTA. Besides condition of extraction, sources, cultivating location and many other environmental factors also influence the composition, structure, and physiological properties of pectin.

The key quality characteristics of pectin normally compose of its chemical composition, structure and molecular weight, properties that will determine its functionality (14). Subsequently, the application in food products should also be tested. Constantino *et al*., (15) showed that okra polysaccharide could be used as egg white substitute. It also acted as a fat substitute in chocolate bar cookies (16) and in chocolate frozen dairy dessert (17). Thus, the possibility to apply okra pectin in food has been investigated. However, the research and development is still limited.

The current study was undertaken to prepare okra gum from okra pod using water extraction to minimize the use of other organic solvents in the production of food ingredient. The extraction condition would be optimized by varying the temperature and the period of extraction to obtain good yield and gelling property. The resulted okra gum would be characterized in terms of the chemical composition and functional properties. The application in food products would also be studied. Furthermore, okra pectin would be prepared from okra gum by ethanol precipitation and investigated in the same manner described for okra gum for comparison.