CHAPTER 1

INTRODUCTION

1.1 Background information

The potential world market for plant proteins and health foods has stimulated considerable research into potential products from soybean material (highest content beans may contain up to 40% protein). Soy foods are a good source of essential fatty acids and contain no cholesterol and are low in saturated fats (Liu, 1999). Other valuable components also found in soybean include phospholipids, vitamins, and minerals. Furthermore, soybeans contain many minor substances, some of which such as trypsin inhibitors, phytates and oligosaccharides are known to be biologically active. Others, such as isoflavones are also being recognised for their powerful ability to inhibit cancer cells, lower cholesterol, and inhibit bone resorption (Messina, 1999). In 1999, the United States FDA approved the use of a soy protein health claim, which stated that consumption of 25 g of soy protein a day as part of a diet low in saturated fat and cholesterol may reduce the risk of heart disease (U.S. FDA, 1999).

Tofu is soft, custard like food product made from soybeans. It is an important source of protein in the cuisines of China, Japan, Korea, and Southeast Asia and becoming an increasingly important international product outside these traditional markets (Prestamo and Fontecha, 2007). Its consumption in the West has increased rapidly since the 1970s, mainly as a vegetarian alternative to meat and cheese or as a novel food in itself (Berk, 1992). Tofu can be served not only with soy sauce and spices without further cooking, but also as an ingredient in an entire range of dishes. Tofu's naturally bland flavour means that it can be used in the national cuisines of many countries worldwide (Fukushima, 1981). In addition, it also acts as a prebiotic product, inducing an increase in the lactic acid bacteria in the tract of rats fed with tofu (Prestamo *et al*., 2002).

Since high pressure technology in food processing was introduced in late 1800s, the use of this technology has steadily increased. Knorr *et al*. (2006) reported that during the past decade and at present there have been some 82 industrial installations using high pressure processing. These at present having an annual production of more than 100,000 tons.

The main advantages of high pressure processing when compared with thermal processing are reported to include; (1) Better retention of the functional and nutritional qualities of ingredients in processed products. This improved food quality is usually attributed to the fact that pressure alters most of large size molecules leaving smaller molecules unaffected (Estrada-Giron *et al*., 2005; Hereman and Smeller, 1998; Master *et al*., 2004), therefore high pressure can be used to produce many materials that appear to be 'fresh' products. (2) High pressure treatment offers homogeneity of treatment at every point in the product due to the fact the applied pressure is instantaneously and uniformly distributed within the high pressure chamber, therefore, processing time is not a function of size or shape of the product (Estrada-Giron *et al*., 2005). (3) There are significant energy savings in comparison to thermal stabilization techniques, because once the desired pressure is reached, it can be maintained without the need for any further energy input (Estrada-Giron *et al*., 2005; Messens *et al*., 1997) while a heat treatment would require continuous energy input throughout the process. (4) High pressure processing can inactivate vegetative and spore forms of microorganism if the applied pressure is high enough. This type of processing has the potential to address the requirements for 'minimally' preserved foods (Gould, 2001). (5) There is essentially no environmental pollution associated with the process (Gomes, 1997). In addition, this technology also offers advantages that may be used to develop new foods with novel textural attributes (Estrada-Giron *et al*., 2005; Hereman and Smeller, 1998).

High pressure can affect protein conformation and can lead to protein denaturation, aggregation or gelation, depending on the protein system under consideration, the applied pressure, the solution conditions, and the magnitude and duration of the applied pressure treatment (Galazka *et al*., 2000). Pressure brings about modifications to soymilk components, particularly the proteins, which can subsequently lead to an altered structure with the possibility of producing novel or improved soy products. Heat has already proved to be useful process for the enhancement of the properties of soymilk proteins. However, heat and pressure have rather different effects on the structure, interactions, and properties of soymilk proteins.

There have been many reports on the effects of high pressure on soy proteins in an aqueous system. Most of them dealt with a pure protein systems such as isolated soy protein or the purified 7S and 11S component proteins (Apichartsrangkoon, 2002; Apichartsrangkoon, 2003; Dumoulin *et al*., 1998; Molina *et al*., 2001; Molina *et al*., 2002; Molina and Ledward, 2003; Torrezan *et al*., 2007; Zhang *et al*., 2003). However, there are very few studies which have examined complex full fat soymilk.

This research centered on investigations which studied the application of high pressure as an alternative technique to produce novel soybean gel food systems. Consequently tofu gels were prepared from full fat soymilk and their viscoelastic properties, microstructure and chemical changes were investigated.

1.2 Research objectives

1. To determine the rheological characteristics of modified tofu made using a high pressure treatment method.
2. To examine the microstructure of tofu made using high pressure treatment.
3. Determination of the extent of any chemical modifications occurring in the soymilk and tofu caused by high pressure treatment (i.e. surface hydrophobicity, trypsin inhibitor activity, etc).

1.3 Research locations

The experiments were mainly conducted at Department of Food Science and Technology, Chiang Mai University, Chiang Mai, Thailand and the School of Food Biosciences, The University of Reading, in the United Kingdom. Confocal scanning laser microscopy was conducted at School of Animal and Microbial Science, The

University of Reading. Scanning electron microscopy was conducted at Electron Microscopy Research and Service Centre, Chiang Mai University.